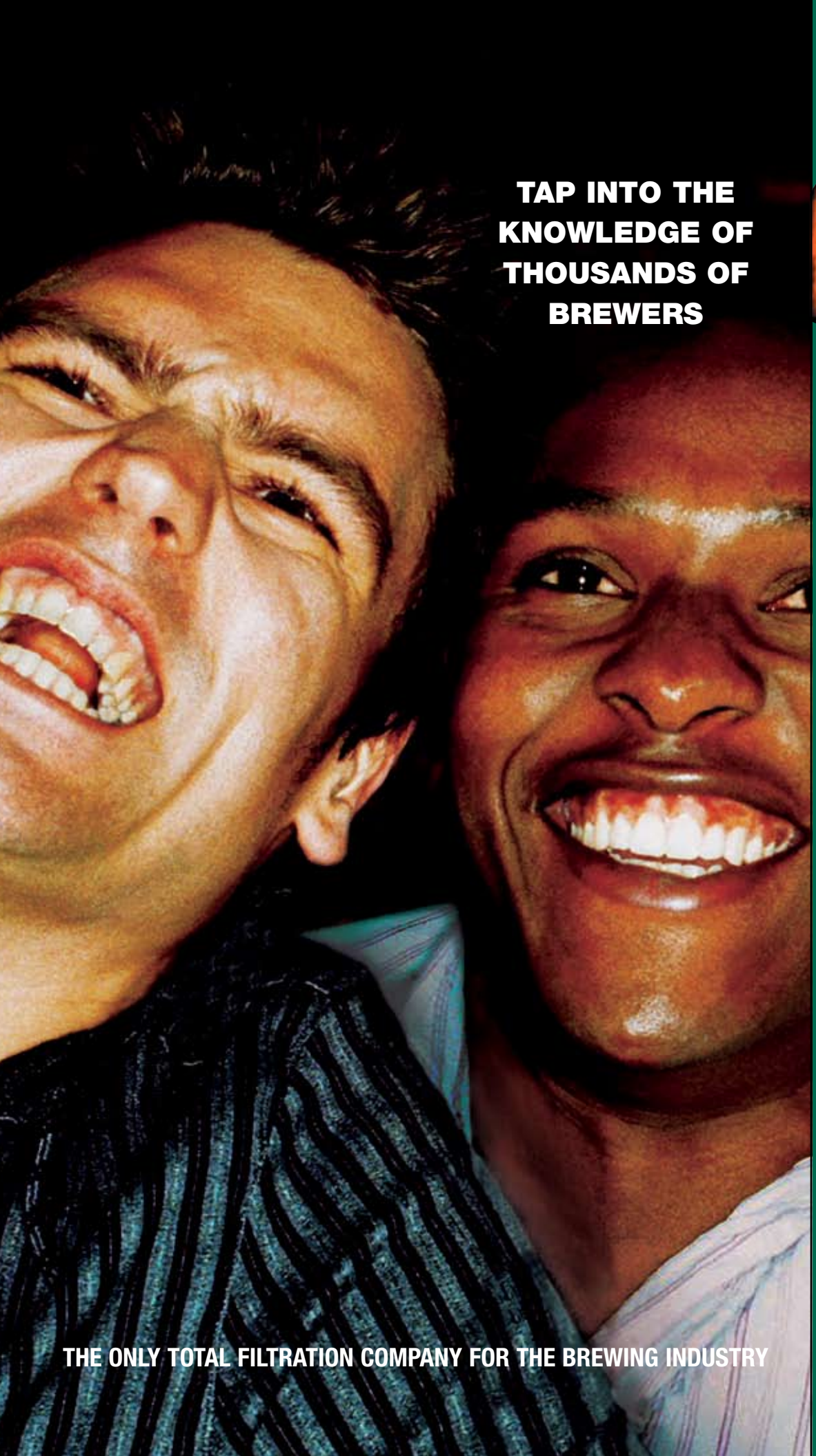
Program Book

World Grains Summit: Foods and Beverages

Co-hosted by AACC International and the Master Brewers Association of the Americas

September 17-20, 2006
Moscone Convention Center
San Francisco, California U.S.A.



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Bringing You a World of Innovation!

Greetings from the Program Planning Committee.

Perry K.W. Ng
AACC International Co-Chair, Program Planning Team

Ray Klimovitz
MBAA Co-Chair, Program Planning Team

Congratulations! You're about to become part of something truly unique and precedent-setting.

The World Grains Summit is an opportunity unlike any other. As members of the program planning committee, we understood that such an event required nothing short of an outstanding program. And that is exactly what we set out to achieve, turning our traditional approach to program planning upside down and inside out. We believe the results are as inspiring and full of potential as the World Grains Summit itself.

Premiering at the Summit are "Track Sessions," each designed around major global grain-based products and each featuring significant topics of interest by industry leaders and experts from around the globe. There's more to the technical program as well, including a new and unique presentation format for poster presenters (all have three-minute oral presentations on Monday afternoon).

What you'll see, learn and hear at the Summit is international state-of-the-art information. This is indeed a global event, organized by a team of professionals from around the world. As co-chairs we cannot thank our fellow committee members enough for their time, energy, and expertise.

So go out and make history! Don't miss a beat. Take in everything this premier event has to offer. We feel honored to have helped make it possible.

Cheers!

Perry K.W. Ng
AACC International Co-Chair, Program Planning Team
Michigan State University, Michigan, U.S.A.

Ray Klimovitz
MBAA Co-Chair, Program Planning Team
Klimovitz Brewing Consultants, Inc., Wisconsin, U.S.A.

2006 World Grains Summit: Foods and Beverages
September 17-20
San Francisco, CA

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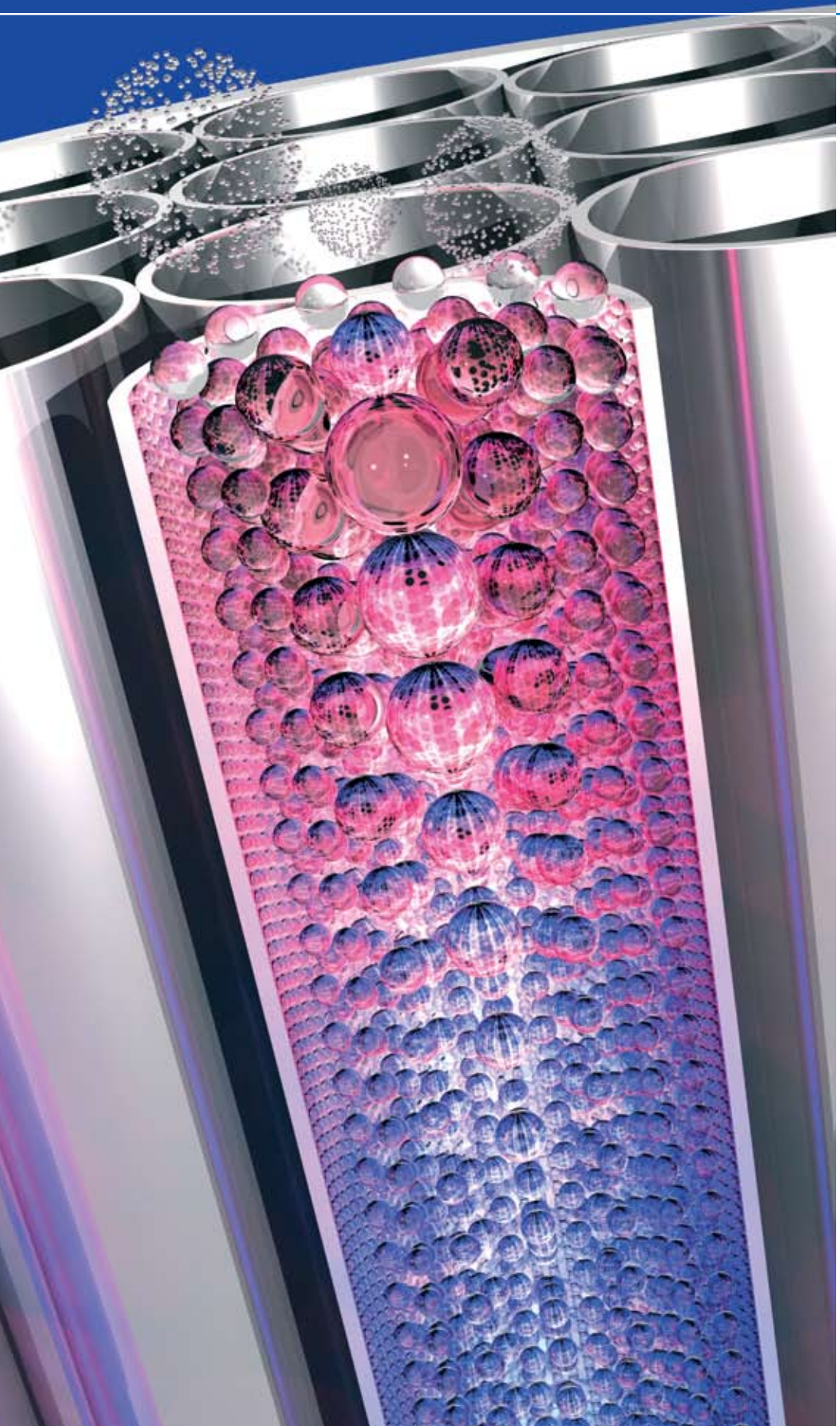

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Hop acid isomerisation

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Excellent homogeneity for uniform heat treatment

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Better brewhouse utilisation

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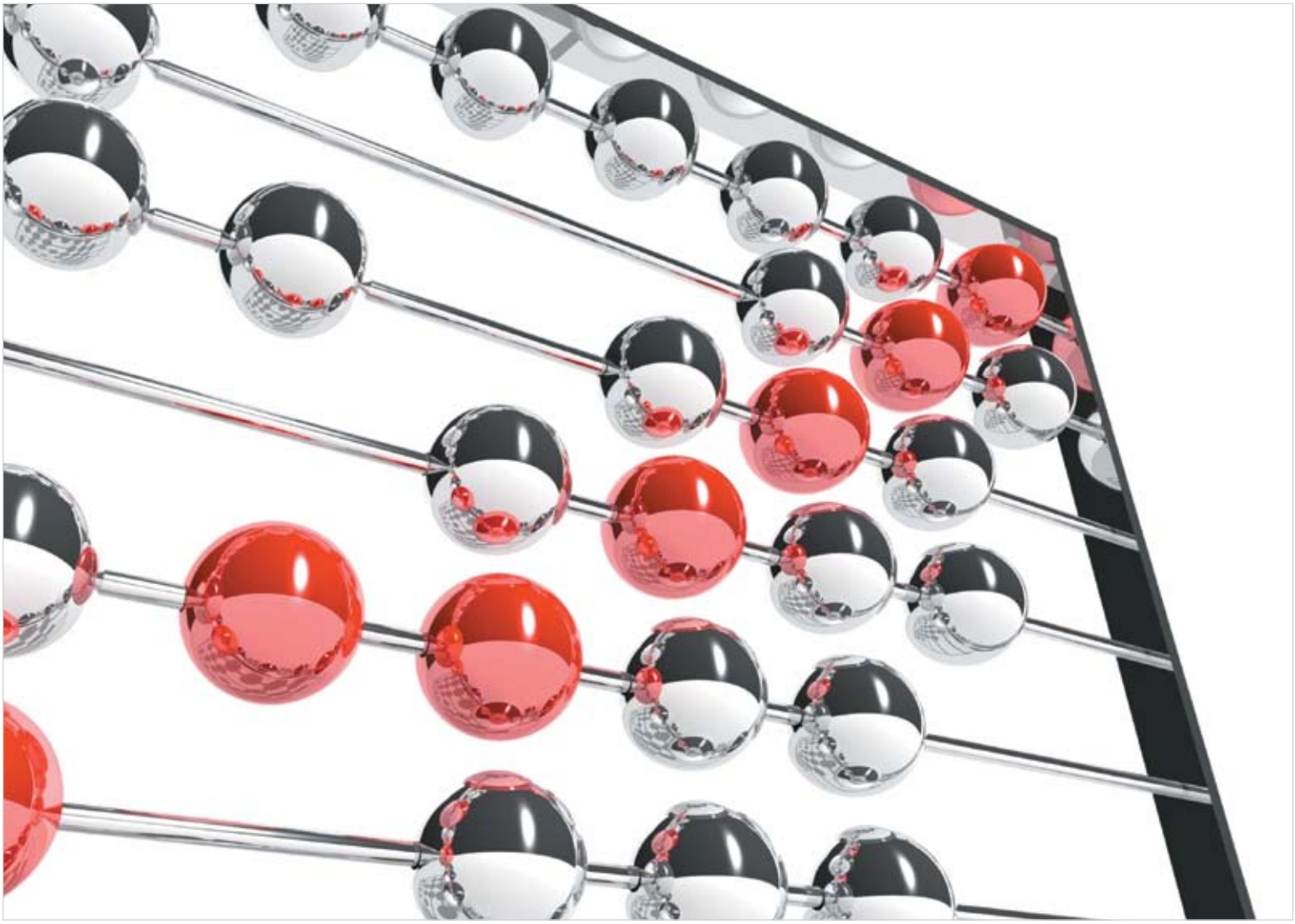

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Our company principles:
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This is how we realize your complete new brewery.
Wherever it may be.

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AACC International has been the leading source of scientific and technical information to the grain-based food industry for more than 90 years. Food industry professionals rely on AACC International for the latest research developments and industry trends through its publications, including Cereal Chemistry *and* Cereal Foods World®, *as well as books on grain and food science. Other programs and membership opportunities, including an international check sample and proficiency testing service, analytical sanitation certification, regional sections and subject matter divisions, provide additional professional development opportunities and technical support for the grain-based foods community.*

Master Brewers Association of the Americas was formed in 1887 with the purpose of promoting, advancing, and improving the professional interest of brew and malt house production and technical personnel. Today, MBAA is a dynamic, global community working to advance the brewing, fermentation, and allied industries by advocating the exchange of knowledge; creating, assembling, interpreting, and disseminating credible and beneficial information; developing world-class education offerings; and providing valuable personal and professional development opportunities

A Global Partnership!

AACC International and MBAA Welcome You to the First-Ever World Grains Summit

Jaime Jurado
MBAA President

Stuart Craig
AACC International President

We are proud, pleased, and excited to co-host the first-ever World Grains Summit: Foods and Beverages—a unique and rare opportunity to explore grain-based science and technology from a whole new perspective!

For the first time, professionals from throughout the grain-based food and beverage communities are gathered together to exchange ideas, share information and insights, and hear the latest developments in grain-based science and technology.

This is fertile ground, a field of possibilities, where the cross-pollination of ideas and information is just waiting to happen. Let it happen to you!

Take advantage of the many opportunities to learn, grow, and connect with colleagues while you are here at this unique, first-time event. The cutting-edge programming is the result of months of work by respected colleagues from around the world and throughout the grain-based food and beverage industries. It starts with a series of product session tracks designed to let you zero in on the latest science and technology impacting your work. But it doesn't stop there.

The technical program features more than 250 posters, plenary sessions featuring industry experts, an opening keynote by popular business strategist Stan Slap, a rare opportunity to focus on your professional development through the Summit's Professional Development Track, plus a closing address by Phil Lempert, consumer trend tracker, author, and food trends expert for NBC's Today Show.

And more—including networking, sightseeing, and special events to keep you engaged, informed, and inspired like never before.

Enjoy!

Jaime Jurado
MBAA President

Stuart Craig
AACC International President

General Information

Registration

Exhibit Hall C, Moscone Convention Center

Sunday, September 17	General Registration	4:00 – 6:30 p.m.
Monday, September 18	General Registration	7:30 a.m. – 7:00 p.m.
Tuesday, September 19	General Registration	7:30 a.m. – 4:00 p.m.

Lobby Area, Moscone Convention Center

Wednesday, September 20	General Registration	7:30 a.m. – 1:00 p.m.

Exhibits

Exhibit Hall C, Moscone Convention Center

Sunday, September 17	Exhibitor Set-up and Registration	9:00 a.m. – 2:00 p.m.
	Grand Opening Exhibition and Gala	4:00 – 6:30 p.m.
Monday, September 18	Exhibits and Lunch	12:00 – 2:00 p.m.
Tuesday, September 19	Exhibits and Lunch	12:00 – 2:00 p.m.
	Exhibit Take-down	2:00 – 6:00 p.m.

Posters

Exhibit Hall C, Moscone Convention Center

Monday, September 18	Poster Set-up	7:00 – 10:00 a.m.
	Poster Viewing	10:00 a.m. – 7:00 p.m.
	Beer and Poster Presentations by Authors	4:45 – 6:30 p.m.
Tuesday, September 19	Poster Viewing	8:00 a.m. – 2:00 p.m.
	Authors Present	12:00 – 2:00 p.m.
	Poster Take-down	2:00 – 3:30 p.m.

Marketplace

Exhibit Hall C, Moscone Convention Center

Sunday, September 17	4:00 – 6:30 p.m.
Monday, September 18	12:00 – 2:00 p.m.
Tuesday, September 19	12:00 – 2:00 p.m.

Lobby Area, Moscone Convention Center

Monday, September 18	3:00 – 5:00 p.m.
Tuesday, September 19	9:00 – 11:00 a.m.
Wednesday, September 20	9:00 a.m. – 2:00 p.m.

Silent Auction, ***organized by the AACC International Student Division***
Exhibit Hall C, Moscone Convention Center

Sunday, September 17	4:00 – 6:30 p.m.
Monday, September 18	12:00 – 2:00 p.m.
Tuesday, September 19	12:00 – 1:30 p.m.

Offsite Venues

Carbohydrate Division Dinner
A. Sabella's Restaurant
2766 Taylor Street, Third Floor
San Francisco, California
415.771.6775

Cereals&Europe Special Event
Boudin's Bakery
Fisherman's Wharf
160 Jefferson Street
San Francisco, California
415.928.1849

Protein Division Social and Dinner
Empress of China
838 Grant Avenue
San Francisco, California
415.434.1345

Open Meeting Rooms

A room will be available at the Parc 55 and the Moscone Convention Center for groups of 20 people or less. Sign up at the registration desk.

Sunday, September 17	1:00 – 6:00 p.m.	Parc 55
Monday, September 18	7:00 a.m. – 5:00 p.m.	Parc 55 and Convention Center
Tuesday, September 19	7:00 a.m. – 5:00 p.m.	Parc 55 and Convention Center
Wednesday, September 20	7:00 a.m. – 5:00 p.m.	Parc 55 and Convention Center

Stay Connected While in San Francisco

World Grains Summit provides an Internet Café and Internet access in the Exhibit Hall for attendee use during the meeting. *Internet Café sponsored in part by AcquiData, Inc.*

Media Information

Members of the media seeking news releases and other Summit information should contact headquarters staff at the registration desk.

Photo Release

Photographs will be taken throughout the World Grains Summit for use in promotional materials. By virtue of your attendance, you agree to AACC International's and MBAA's use of your likeness in promotional materials.

Appropriate Attire

Meeting attire is business casual.

Smoke-Free Environment

The Moscone Convention Center is a non-smoking facility.

Medical Emergencies

Medical emergencies should be communicated to the headquarters staff as soon as possible.

Renaissance Parc 55

House Doctor - Dr. Savage
Call the Hotel Operator for assistance contacting the doctor.
Direct line: 415.981.1102

Moscone Convention Center

An EMT will be available during the main meeting hours.

The nearest hospital is:

St Francis Hospital
900 Hyde St.
415.353.6300
Corner of Hyde St. and Pine St. approx. 8 blocks from the Parc 55

Safety Tips

- Do not travel alone—stay in groups and travel in well lit areas.
- Remove name badges when outside the hotel and convention center unless you are participating in a World Grains Summit event.
- Do not give your room number out to anyone you do not know and avoid giving out your room number in conversations where strangers may hear you talking.
- Bolt your hotel room door and only open when you know who is on the other side. (Note: Hotel personnel wear uniforms and have an identification badge. If in doubt, call hotel security to verify an employee's identity.)
- Do not leave your door ajar if you are going down the hall for ice. Someone may enter when you are not looking.
- Know where the stairs are located in case of fire (do not use evaluators). Also count the number of doors to the nearest exit in case you can not see in a smoke-filled hallway.
- Valuables, airline tickets, and money should be kept in a hotel safety deposit box or in a room safe, if available.

Procedures In Case of Fire

In case of fire:

- Try to leave the hotel as quickly as possible. If you can not, stay in your room and call the operator or security to let them know you are in your room.
- Put your hand on the room door to see if it is hot before opening it. If it is, do not open quickly. Open it just a crack to see what is on the other side and be prepared to slam it quickly if necessary.
- If you leave your room, take your room key with you! Shut your room door to keep smoke out. You may have to return if the exit is blocked. Remember the way back to your room as you go to the exit in case you need to return.
- If necessary, drop to your knees to avoid smoke. Tie a wet towel around your nose and mouth to act as a smoke filter. Fold it into a triangle and put the corner in your mouth.
- Do not take the elevator when you smell smoke or if you know that there is a fire in the building.

Procedures for Earthquakes

The greatest threat during an earthquake is falling debris. Earthquakes are unpredictable and strike without warning.

If you are in the hotel during an earthquake:
The safest place during an earthquake is inside of the hotel. Should you feel an earthquake stay in the area you are in. Move away from any windows. Move slowly to the corner of a room and away from anything that might fall from overhead, such as light fixtures, chandeliers etc. You may seek cover under a desk or table. Wait till all of the quake movement has stopped. Then proceed down to the lobby or second floor if you are nervous about staying in the building. Hotel staff will guide you from there to a safe location. The public address system will also be used to give guests instructions.

- Do not use elevators after an earthquake until hotel staff advises it is safe to do so.
- Move slowly down any stairwells. Look ahead to make sure the stairs are okay to walk down.
- Do not run outside during an earthquake. That is the most dangerous place to be. Debris and broken glass may come down from buildings all around the hotel during an earthquake. Stay inside the hotel during an earthquake unless there is eminent danger.

If you are in the Convention Center during an earthquake:

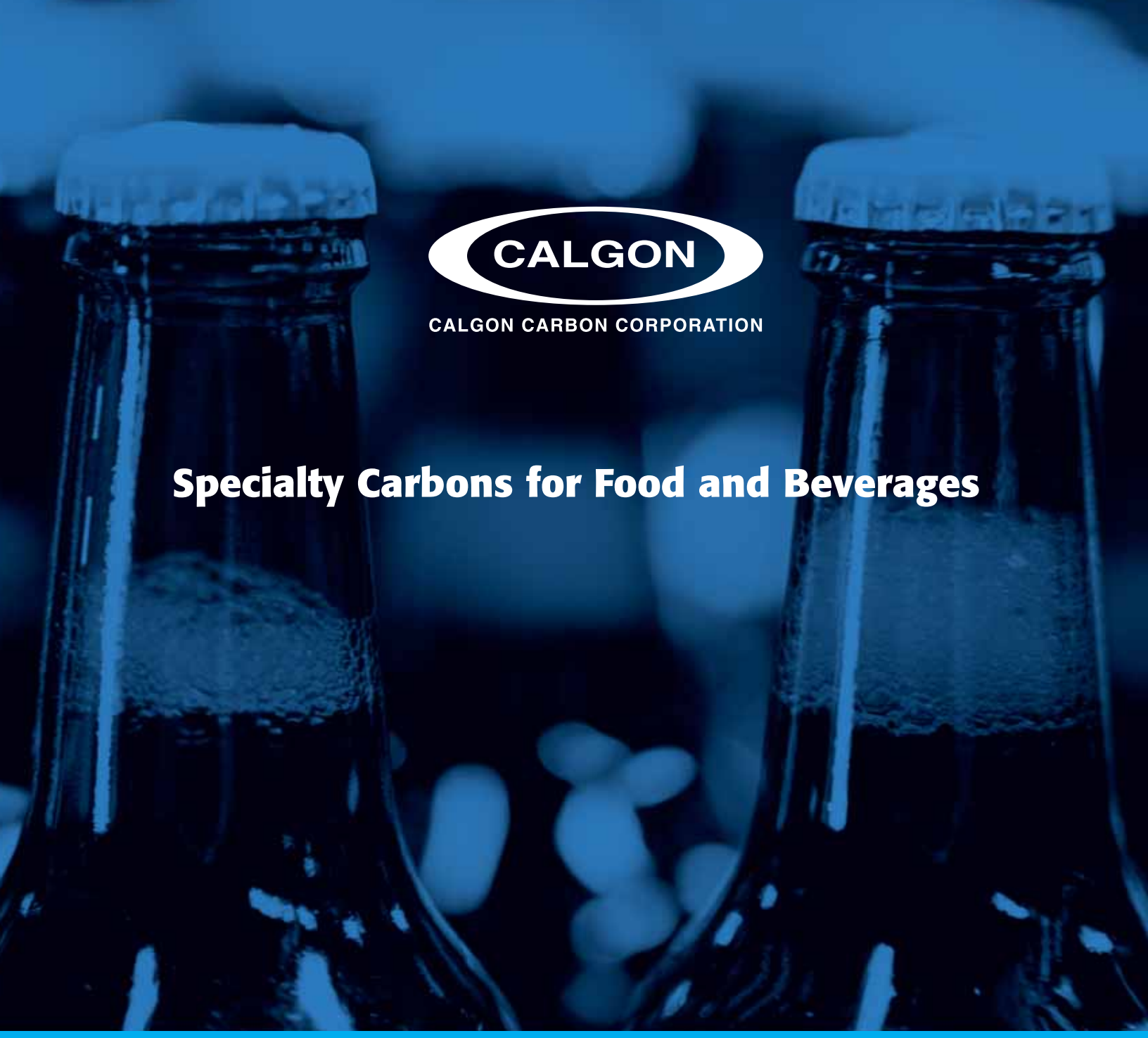
- Remain inside the building.
- Seek immediate shelter under a heavy desk or table, or brace yourself inside a doorframe or against an inside wall. If shaking causes the desk or table to move, be sure to move with it.
- Get at least 15 feet away from all windows.
- Expect to hear noise from broken glass, creaking walls, and falling objects; don't be surprised if the power goes off or alarms start ringing.

If you are in one of the Exhibit Halls:

- Move to open areas in the exhibit hall—take cover and protect yourself and others.
- Public address system announcements will give further instructions.

If you are outdoors during an earthquake:

- Move away from buildings and utility poles.
- Watch for falling glass, electrical wires, poles, or other debris.



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Networking Opportunities/Social Program

For additional social events check the program schedule for division, section, and alumni activities.

Sunday, September 17

Meeting Orientation

2:00 – 3:00 p.m. • Barcelona II, Parc 55

All meeting attendees are invited to this special session to learn how to make the most of the meeting. Leaders from both AACC International and MBAA as well as staff will be on hand to explain meeting events and answer your questions.

Exhibitor Welcome

3:00 – 3:45 p.m. • Exhibit Hall C/Exhibitor Lounge

Long-time and first-time exhibitors, please join experienced exhibitors and staff for a quick, entertaining, and informative overview of all the ways to benefit from the World Grains Summit. Beverages and a snack will get you off to an energetic start at the first exhibit session that immediately follows.

Grand Opening Exhibition and Gala with Ribbon-Cutting Ceremony

4:00 p.m. Ribbon–Cutting Ceremony
4:00 – 6:30 p.m. • Exhibit Hall C

Join the festivities as Stuart Craig, AACC International President, and Jaime Jurado, MBAA President, cut the ribbon to open the World Grains Summit: Foods and Beverages and the Exhibition. Then enter the exhibit hall and greet old friends, make new acquaintances, and visit with over 250 leading suppliers during this casual and festive event. Mingle and dine as you add to your industry knowledge.
Gala sponsored in part by QUALISOY.
Please Note: The Gala is scheduled early this year to allow time for attendees to dine at the many exceptional San Francisco restaurants.

Mentoring Kick-Off Event

6:30 – 8:00 p.m. • Barcelona II, Parc 55

This event is for those who have signed up to participate in AACC International's mentoring program. All mentors and protégés are invited to attend this kick-off event. Learn more about the benefits of our mentor program and meet your partner for the year.

Bierstube/Hospitality Suite

Sunday, Monday, Tuesday, and Wednesday

Visit with friends and colleagues while enjoying a variety of complimentary beers from around the world contributed to the meeting by MBAA brewery members. The Bierstube will be open during exhibition hours in Exhibit Hall C and the Hospitality Suite will be open evenings at the Renaissance Parc 55 Hotel. Check the program for times and location.

Monday, September 18

Beer and Poster Session Presentations

4:45 – 6:30 p.m. • Exhibit Hall C

Extend your knowledge in a variety of areas at this years expanded poster viewing and author presentations. From 4:45 p.m. to approximately 6:30 p.m. each author, grouped in their poster category, will present a short three-minute presentation of their research. Complimentary beer will be provided in the Bierstube.

Tuesday, September 19

Young Professionals Event

4:30 – 6:00 p.m. • Barcelona I, Parc 55

Get to know your fellow meeting attendees in a relaxing atmosphere during the Young Professionals Event. Anyone 35 and younger and those who would like to network with this group are encouraged to attend. Complimentary light appetizers and beverages provided. Sponsored by the Joseph Warthesen Young Professionals Symposia Fund.

International Member Forum (IMF)

This meeting is open to anyone interested and meets only once a year during the Annual Meeting. The Forum's mandate is to seek ideas and comments from members outside the United States and provide input and feedback to the International Executive Council (IEC) on how to improve member service. Activities and plans of the international sections will also be reported to the IMF. Pre-registration is not required. Join us to provide ideas or just listen.

Tuesday, September 19
5:00 – 6:00 p.m.
DaVinci Room, Parc 55

International Member Forum (IMF)
5:00 – 6:00 p.m. • DaVinci Room, Parc 55

The Forum's mandate is to seek ideas and comments from AACC International members outside the United States and provide input and feedback to the International Executive Council (IEC) on how to improve member service. Activities and plans of the international sections will also be reported to the IMF.

MBAA Installation of Officers and Awards Dinner
6:00 – 9:00 p.m. • Ballroom, Parc 55

MBAA members are invited to celebrate the awardees and officers of MBAA at this sit-down dinner. Following dinner, the AfterGlow Party will provide a relaxing night's blend of desserts, cocktails, and networking in the Ballroom Atrium area. *AfterGlow is sponsored, in part, by International Malting Company.*

Wednesday, September 20

ICC Luncheon *(followed by the General Assembly)*
12:00 – 2:00 p.m. • Room 232, Convention Center

Upcoming ICC events, the new ICC 7-language *Dictionary* and ICC's growing role in international projects will be highlighted at the ICC Luncheon. The recently established ICC Academy will honor its fellows. This is a great opportunity to meet new colleagues and get reacquainted with old friends from the global cereal family. *Pre-registration is required for the luncheon.*

Wild Crush: A Wine Affair – Closing Event
Featuring California wine tasting, food, and silent wine auction
7:00 – 9:30 p.m. • Barcelona II, Parc 55

Enjoy an elegant evening of wine tasting, dining, and a silent wine auction to benefit the AACC International Bill Doty Memorial Fund. After three full days of innovative program content, take this last evening to sit back and relax with friends while you sample a variety of California wines and dine on a selection of heavy reception style foods selected to complement the wines. Best of all this evening experience is only steps away from your hotel room.

Throughout the evening there will be opportunities to place bids on the wines tasted in addition to a variety of California wines at the Silent Auction. *Pre-registration is required.*

Tours

Sonoma: Birthplace of California Winemaking

Sunday, September 17 • 9:00 a.m. – 3:00 p.m.
Buses depart promptly at 9:00 a.m. from the white zone in front of the Parc 55 Hotel, on Cyril Magnin Street.

The day begins with a visit to one of Sonoma's several world-renowned wineries. A tour of the winemaking facilities will precede a stop in the tasting room, with samplings of some of the winery's fine varietals. Next, a stop at Viansa, a gracious Tuscan-style villa perched atop a hillside in Sonoma. After the private tour and tasting, a lavish picnic luncheon, featuring fresh local ingredients prepared with an Italian flair, will be served. The picnic will be held on the winery's lawns, surrounded by olive trees, grape arbors, and spectacular views of the Sonoma Valley. *Pre-registration is closed for this tour.*

San Francisco Highlights at Night

Monday, September 18, 2006 • 6:30 – 11:00 p.m.
Buses depart promptly at 6:30 p.m. from the white zone in front of the Parc 55 Hotel, on Cyril Magnin Street.

Travel by some of San Francisco's most legendary landmarks, including the majestic Golden Gate Bridge spanning the entrance to San Francisco Bay; *Painted Ladies*—vividly restored Victorian homes; cafés and boutiques of San Francisco's most prestigious neighborhoods; Bohemian Italian North Beach; panoramic views from Twin Peaks; the awe-inspiring Pacific Ocean and the Cliff House perched high above the waves; and bustling Fisherman's Wharf with its steaming crab cauldrons, colorful fishing boats, and seafood restaurants overlooking the Bay. Dinner will be on your own in the Fisherman's Wharf area. *Pre-registration is required. Check at the registration desk for tickets*.

San Francisco Brewery Pub Crawl

Monday, September 18, 2006 • 7:00 – 11:00 p.m.
Buses depart promptly at 7:00 p.m. from the white zone in front of the Parc 55 Hotel, on Cyril Magnin Street.

Join the Northern California District of MBAA for a tour of San Francisco's breweries. Stops may include San Francisco Brewing, Gordon Biersch, Thirsty Bear, Twenty First Amendment, Magnolia, Eldo's, and Beach Chalet. The cost includes guided transportation to/from the various pubs. All drinks and food are on your own. *Pre-registration is required. Check at the registration desk for tickets*.


Photo by Phillip H. Coblentz

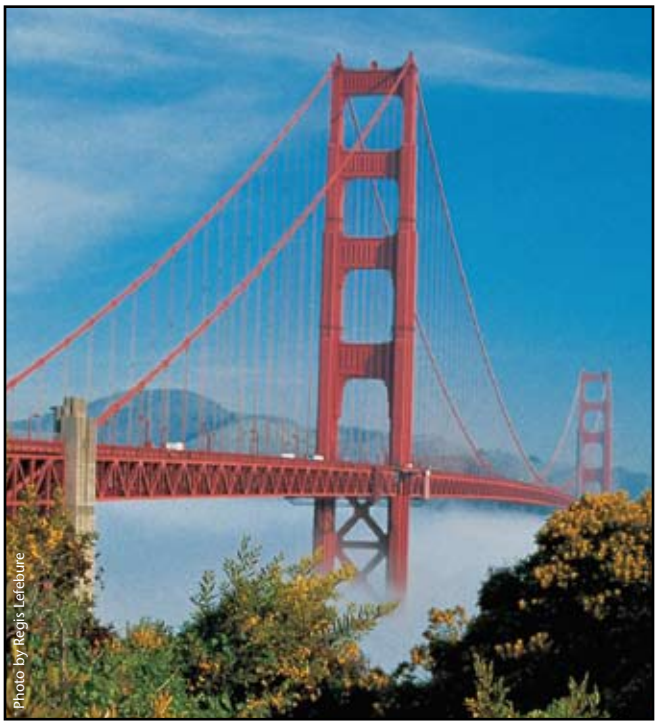
Photo by Regis Lefebure

Hollywood by the Bay: A Star-Struck City Tour

Tuesday, September 19, 2006 • 6:30 – 11:30 p.m.
Buses depart promptly at 6:30 p.m. from the white zone in front of the Parc 55 Hotel, on Cyril Magnin Street.

From *The Jazz Singer* to *The Wedding Planner*, *The Maltese Falcon* to *Dirty Harry*, *Vertigo* to *High Anxiety*, *The Graduate* to *Mrs. Doubtfire*, *Birdman of Alcatraz* to *The Rock*, San Francisco is one of the most filmed cities in the world, from the earliest silent films to this summer's blockbuster hits. As the motorcoach winds through the picturesque parts of San Francisco, the Golden Gate Bridge will come into view as scenes are described from blockbusters such as *Superman* and *A View to a Kill*. From *The Towering Inferno* to *The Presidio*, discover the places immortalized in films and television. A beautifully colored movie map, marking each San Francisco location and detailing the scenes from which it takes place, will be provided. A stop on the tour will be made so there will be time to dine on your own. *Pre-registration is required. Check at the registration desk for tickets*.

Guest Program

The World Grains Summit Guest Program features a complimentary continental breakfast and San Francisco Orientation for all guests of summit attendees on Monday morning.

San Francisco Orientation

Monday, September 18 • 8:30 – 10:00 a.m.
Barcelona I, Parc 55

Attend the orientation presented by a local guide and learn how to make the most out of your stay in San Francisco. Breakfast will begin at 8:00 a.m. with presentation at 8:30 a.m. This event is complimentary for guests. *Pre-registration is required*.

Guest Tour Package

Pre-registration is required.
If minimum number of participants in this package is not met, participants will be notified and full refunds will be given.

A full guest program package is offered that includes the following:

Grand Opening Exhibition and Gala

Sunday, September 17 • 4:00 – 6:30 p.m.
Exhibit Hall C

Visit with over 250 of the industry's leading suppliers during this casual and festive event. Mingle, dine on light appetizers, visit the Bierstube, and get the latest information.

Chinatown Discovery – A Walking Excursion

Monday, September 18 • 10:30 a.m. – 3:00 p.m.
Tour departs promptly at 10:30 a.m. Meet in the front lobby area of the Parc 55 Hotel and wear comfortable shoes.

Discover exotic Chinatown on foot! Enter into the "city-within-the-city." Grant Avenue, the bustling, exotic main street of Chinatown, features shops specializing in everything from rare jade, ivory, and silk, to Godzilla toys. Visit an authentic fortune cookie factory and a Chinese temple where clouds of incense waft from upper windows. Meander down streets where herbal shops, offering jars of ginseng root alternate with Chinese groceries whose windows display smoked ducks. Aromas from Chinatown restaurants combine with the sounds of Chinese dialects complete the illusion of a visit to Hong Kong. At the end of the walk, there will be time to stop and enjoy lunch on your own at one of the many restaurants passed along the way.

Magical Marin

Tuesday, September 19 • 10:00 a.m. – 3:30 p.m.
Buses depart promptly at 10:00 a.m. from the white zone in front of the Parc 55 Hotel, on Cyril Magnin Street.

Cross the magnificent Golden Gate Bridge into fabled Marin County with its astonishingly varied land and seascapes. Driving along the slopes of Mount Tamalpais, the winding mountain road leads to Muir Woods National Monument. The redwoods located here have a biological ancestry dating back well over a million years. There will be time to wander among these ancient trees and come away with a sense of the immense grandeur and spans of time encompassed by this noble forest. The next stop is Sausalito, a Riviera-like bayside village with its winding wooded streets, eclectic houseboats, unique boutiques, and art galleries. There will be ample time to explore the shops and galleries or simply stroll along the waterfront before enjoying lunch on your own.

SAVE on the Best Books in Food and Beverage Science during the meeting!

MBAA and AACC International Books are available at 2 locations

Marketplace: Exhibit Hall C

Sunday, Sept 17 .....4:00 –6:30 p.m.
Monday, Sept 18 .....Noon–2:00 p.m.
Tuesday, Sept 19.....Noon–2:00 p.m.

Lobby of Convention Center South

Monday, Sept 18 .....3:00–5:00 p.m.
Tuesday, Sept 19.....9:00 –11:00 a.m.
Wednesday, Sept 20 ....9:00 a.m –2:00 p.m.

AACC INTERNATIONAL PRESS

WGS AD #7

Program


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and Drink,
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Program Highlights

Pre-Summit Workshops

Sunday, September 17
Beer Tasting 101
2:00–3:30 p.m. • Ballroom I, Parc 55

The title says it all! Learn from a professional brew master how to really taste beer. This workshop will lead you through the world of beer tasting, the basics of beer making, and the physiology of taste. Then, apply what you've learned during the actual tasting of our favorite beverage—BEER!

Malt Analysis: Today and Tomorrow

12:00 - 4:00 p.m. • Barcelona I, Parc 55

Malt analysis allows you to understand the relationship between each batch of malt and how it will affect your brew. Learn how to read malt analysis sheets and discuss what the future holds for malt analysis and the paradigm of matching malt specifications to brewhouse performance.

Opening General Session

Monday, September 18
8:00 – 9:15 a.m. • Esplanade Ballroom, Convention Center
Coffee sponsored by Pizzey's Milling USA

Kick off the meeting program at the Opening General Session featuring the dynamic Stan Slap. Enter the world of strategic planning and problem solving with his thought provoking presentation, *Bury My Heart at Conference Room B*. Take an engaging look at emotional commitment as the ultimate trigger for discretionary effort. It's the kind of commitment that solves unsolvable problems, creates energy when all energy has seemingly been expended, and ignites emotional commitment in others—employees, teams, and customers. How to get it? Stan provides the ways!

Stan Slap is the consultant of choice to many of today's biggest, smartest, and fastest companies. He is an expert in persuasive communication to customer and employee cultures—the two logic-free groups that decide the success of any business!

Student Product Development Competition

Monday, September 18
10:00 a.m. – 1:00 p.m. • Room 236, Convention Center

The Student Division Product Development Competition is a student-run competition sponsored by industry members. Aimed at bringing together students and professionals via an exciting and challenging venture, students form teams to develop a new product containing at least one major grain ingredient. Meeting attendees are invited to stop in and check out the end product.

Beer and Poster Session Presentations

Monday, September 18
4:45 – 6:30 p.m. • Exhibit Hall C, Convention Center

Extend your knowledge in a variety of areas at this year's expanded poster viewing and author presentations. From 4:45 p.m. to approximately 6:30 p.m. each author, grouped in their poster category, will present a short three-minute presentation of their research. Complimentary beer will be provided in the Bierstube.

Plenary Sessions

Tuesday, September 19
8:00 – 9:15 a.m. • See program schedule for rooms
Coffee sponsored by NORIT HOFFMANS/NORIT SUDMO, NutraCea, and Perten Instruments Inc.

Choose from four concurrent Plenary Sessions, presented by industry experts, covering current issues affecting the food and beverage industries: What's New on the Label, Biotechnology – 10 Years in Review, Leading Breakthrough Innovation, and How the "Here's to Beer" Campaign is Elevating and Enhancing the Image of Beer.

Biotechnology – 10 Years in Review
Presenter: Clive James, Chair, ISAAA Board of Directors, Grand Cayman, Cayman Islands

In the early 1990s, many were skeptical that genetically modified (GM) crops, now often referred to as biotech crops, could deliver improved crops and make an impact at the farm level. 2005 was the 10th Anniversary of the commercialization of biotech crops globally. Despite the continuing public acceptance debate in Europe, the early promises of biotech crops have met expectations in both industrial and developing countries. The global adoption and impact of biotech crops during the first decade of commercialization is reviewed. Their future prospects during the 2nd decade of commercialization, 2006-2015 will be discussed, including their contribution to global food, feed and fiber security, a safer environment and a more sustainable agriculture.

How the "Here's to Beer" Campaign is Elevating and Enhancing the Image of Beer
Presenter: Tom Shipley, Director, Global Industry Development, Anheuser-Busch, St. Louis, MO

Anheuser-Busch has been the market share leader in the U.S. domestic beer industry since 1957. Today, the company brews the world's largest-selling beers, Budweiser and Bud Light, and commands nearly 50 percent share of U.S. beer sales. Beer is America's alcohol beverage of choice, accounting for 57 percent of all alcohol beverage servings – more than wine and hard liquor combined. However, over the past five years, beer has lost share to wine and hard liquor. An overview of the current state of the U.S. domestic beer industry will be provided, as well as insights into the "Here's To Beer" campaign, the industry wide effort to elevate the image of beer spearheaded by Anheuser-Busch.

continued

Leading Breakthrough Innovation
Presenter: Bob Eckert, Senior Partner, New & Improved, LLC, Paul Smiths, NY

The word "innovation" is being used more frequently today than ever in history. Few people have a deep understanding of what it takes to sustain ongoing innovative output. The single most powerful innovation impactor happens to be the behavior and thinking patterns of leaders up and down the hierarchy. By studying those leaders who foster innovation around them and who are themselves innovative, we now know what it takes to live "The Way Of The Innovation Leader".

This plenary will lay out the key qualities of the innovation leader and describe a path to improving those qualities in both yourself and those around you. We'll learn some of the most robust "tools" and apply them immediately in the Plenary Session and at the Summit.

What's New on the Label
Presenter: John Masschelin, U.S. Treasury Dept., Tax & Trade Bureau, Walnut Creek, CA

Market pressures, product evolution, consumer action lobbyists, and regulatory initiatives are rapidly changing the marketplace for the brewing industry. Much of the information that is required for labeling now must come from the analytical laboratory and the requirements are growing. This presentation will discuss some of the regulatory history behind the malt beverage nutrition label and the history of the cooperative efforts to meet past regulatory requirements. It will also outline the current methodology used to assess compliance and enumerate a number of the analytical and regulatory challenges that new product lines have and will present. Modern analytical science is needed to get ahead of the curve and address these challenges.

Closing General Session

Wednesday, September 20
10:45 a.m. – 12:00 p.m. • Esplanade Ballroom, Convention Center

What better way to close a World Summit than to take a look to the future with Keynote Speaker Phil Lempert, consumer trend tracker, author and food trends expert for NBC's Today Show. With his presentation "Food for Thought: A Look into the Future of the Grain-based Food & Beverage Industry," Phil will explore future consumer trends and their impact on the grains-based food and beverage industry. He will discuss the changing consumer–demographic, psychographic shifts and impact on the grains industry; the changing retail environment; and the emerging trends – a combination of "what shoppers want" and the top trends broken down into 5/10/20/30 year opportunities. The future is today! You can be part of it during this provocative presentation. Lempert is the most visible and respected expert in his field. He is an author, syndicated columnist, WOR Radio Network talk show host, and food trends editor for NBC's Today Show. He is also the founder and editor of two industry newsletters and creator of SupermarketGuru.com, an online trend watcher for the food industries.

AACC International Short Course

Grain Morphology: A Basis for Understanding Whole-Grain Cereals
Thursday, September 21 – Friday, September 22
8:00 a.m. – 5:00 p.m. Thursday and 8:00 a.m. – 5:00 p.m. Friday • Ballroom II, Parc 55

Through micrographs, this course demonstrates the range of tissue types that make up cereal grains. The composition of these tissues and the way they relate to whole-grain nutrition and product processing and quality will be covered, in addition to the importance of grain endosperm softness and its ramifications for product production and quality. An extensive course booklet has been prepared summarizing knowledge on grain structure and composition, with emphasis on the similarities and differences between each of the cereal grains.

The course is suitable for grain graduate students, product development specialists, and technical marketers, and any member of the grain industry who needs a fuller appreciation of the structure of grains and of how this structure is altered by traditional grain processing technologies. *Pre-registration is required.*

Your Support Speaks Volumes!

Visit the Student Division Silent Auction to bid on one or many of the items up for auction. Proceeds benefit the AACC International Foundation.

Located in Marketplace

Sunday, September 17	4:00 – 6:30 p.m.
Monday, September 18	12:00 – 2:00 p.m.
Tuesday, September 19	12:00 – 1:30 p.m.

Bidding closes at 1:30 p.m. on Tuesday.

The auction may be silent, but your generosity will be heard!

AACC INTERNATIONAL
Student Division

INGREDIENTS FOR FOOD & BEVERAGE

Mitsubishi International Food Ingredients

ACIDULANTS
Adipic Acid, Citric Acid, Fumaric Acid, Lactic Acid, Malic Acid, Phosphoric Acid, Sodium Citrate, Tartaric Acid
Supplier: Mitsubishi* • ADM • Bartek Ingredients • Fuso/PMP • Innophos • Invista • Purac America • Prayon • Tate & Lyle

ANTICAKING AGENTS
Microcrystalline Cellulose, Modified Food Starch, Stearates, Tricalcium Phosphate
Supplier: Innophos • Prayon

ANTIMICROBIAL AGENTS
Benzoates, Lactates, Natural Antimicrobial Agents, Nitrates, Nitrites, Parabens, Propionates, Sorbates
Supplier: Mitsubishi* • Clariant • DSM • Macco Organiques • Purac America

NATURAL ANTI-MICROBIAL
Lysozyme "inovapure"
Supplier: Neova Technologies

ANTIFOAMING AGENTS
Full Range of Dow Corning™ Anti-foam Products
Supplier: Dow Corning

ANTIOXIDANTS
Ascorbates, Chelating Agents/EDTA, Erythorbates, Rosemary Extract, Variety of Chemical and Natural Antioxidants
Supplier: Mitsubishi* • BASF

BULKING AGENTS
Crystalline Maltitol (Lesys & Amalty), Glycerin, Mannitol, Polydextrose, Sorbitol, Polyethylene Glycol (PEGs), Full Range of Fibers
Supplier: Mitsubishi* • Mitsubishi/Towa • Acid Chem • BASF • Roquette America

COLORS
Caramel Color, Titanium Dioxide
Supplier: DD Williamson • Sethness

DILUENTS / HUMECTANTS
Ethanol, Glycerin, Isopropyl Alcohol, Propylene Glycol, Sorbitol
Supplier: Mitsubishi* • Acid Chem • BASF • Roquette America • Shell Chemicals

EMULSIFIERS / SPECIALTY FATS AND OILS
Fatty Acids, Lecithin, Monoglycerides, Mono & Diglycerides, Polysorbates, Propylene Glycol Esters, Calcium/Sodium Stearyl Lactylates, Sorbitan Esters, Trans-free Fats and Oils
Supplier: Riken Vitamin • ADM • BASF • Loders Croklaan

FLAVORS / FLAVOR ENHANCERS
Encapsulated Ingredients, Maltol/Ethyl Maltol, MSG, Nucleotides, Ribotide, I+G, Yeast Extracts, Disodium Succinate, Vanillin/Ethyl Vanillin, Dry Flavor Powders
Supplier: Mitsubishi* • Takeda Kirin • AC Humko • Balchem

HYDROCOLLOIDS / TEXTURIZERS
Agar, Carboxymethyl Cellulose, Carrageenan, Gelatin, Guar Gum, Gum Arabic, Gum Tragacanth, Locust Bean Gum, Hydroxypropyl Methylcellulose, Lactose, Methylcellulose, Microcrystalline Cellulose, Xanthan Gum, Gum Blends
Supplier: ADM • Alfred L. Wolff • Innophos • Shin Etsu • Vyse Gelatin • Deosen • Zibo Unitech
JVM Specialty Ingredients • AEP Colloids

NUTRITIONAL INGREDIENTS & SPECIALTIES
Ascorbic Acid, Carnosine/Anserine Chromium Picolinate, Chondroitin, Creatine, Enzymes, Folic Acid, Fibers & Proteins, GABA, Glutathione, Glucosamine, Lipoic Acid, Minerals, Mulberry Extract, Probiotics, Specialty Chelates, Taurine, Vitamins, Yakon Leaf, Yeast Specialties, Various Nutritional Plant Extracts
Supplier: Mitsubishi* • AMT Labs • DSM

OXYGEN ABSORBER
"Ageless"
Supplier: Mitsubishi Gas Chemical (www.mitsubishiageless.com)

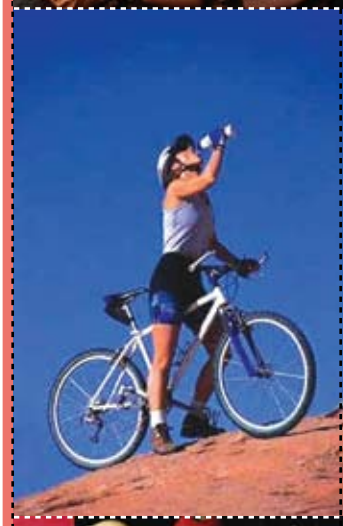
PHOSPHATES
Full-Range of Food Phosphates
Supplier: Innophos • Prayon

SPECIALTY PROTEINS
Egg Replacers, Fat Replacers, Nonfat Dry Milk, Dairy Proteins, Whipping Proteins
Supplier: All American Dairy • Parmalat

SWEETENERS / POLYOLS / SACCHARIDES
Crystalline Maltitol (Lesys & Amalty), Acesulfame K, Aspartame, Corn Syrup Solids, Dextrose, Fructose, Lactose, Maltodextrin, Sodium Saccharin, Full Range of Polyols/Sugar Alcohols
Supplier: *Mitsubishi • ADM • Grain Processing • Kerry • Mitsubishi/Towa • Roquette America • Tate & Lyle

**** Mitsubishi International Food Ingredients Branded Products***

› ask US about MALTITOL



NEED MORE INFORMATION ABOUT INGREDIENTS FOR FOOD AND BEVERAGE?

Phone: 800-628-3092
Fax: 614-798-8339

Mitsubishi International Food Ingredients
5080 Tuttle Crossing Blvd., Suite 400
Dublin, Ohio 43016

www.mifiusa.com

Mitsubishi International Food Ingredients

Schedule at a Glance

Monday September 18

Morning

Registration
7:30 a.m. – 7:00 p.m. • Hall C

Opening General Session with Keynote Speaker Stan Slap
8:00 – 9:15 a.m. • Esplanade Ballroom

Software for Brewers
9:30 a.m. – 12:00 p.m. • 234

Beer and Other Beverages Track Session
9:30 a.m. – 12:00 p.m. • 206

Breads Track Session
9:30 a.m. – 12:00 p.m. • 304

Breakfast Foods Track Session
9:30 a.m. – 12:00 p.m. • 300

Grain Exchange Track Session
9:30 a.m. – 12:00 p.m. • 220

Pasta/Noodles Track Session
9:30 a.m. – 12:00 p.m. • 303

Professional Development Track Session
9:30 a.m. – 12:00 p.m. • 270

Sweet/Salty Foods Track Session
9:30 a.m. – 12:00 p.m. • 256

Posters on View
10:00 a.m. – 7:00 p.m. • Hall C

Tuesday September 19

Morning

Technical Committee Meetings
7:00 – 8:00 a.m.
- Bread Baking Methods – Medici, Parc 55
- Methods for Grain and Flour Testing – Tuscany, Parc 55

Technical Committee Meetings
7:00 – 8:30 a.m.
- Near Infrared Analysis – Dante, Parc 55
- Pasta Products Analysis – Sienna I, Parc 55
- Rice Milling and Quality – Sienna II, Parc 55

Registration
7:30 a.m. – 4:00 p.m. • Hall C

Plenary Session – Biotechnology 10 Years in Review
8:00 – 9:15 a.m. • 256

Plenary Session – How the "Here's to Beer" Campaign is Elevating and Enhancing the Image of Beer
8:00 – 9:15 a.m. •206

Plenary Session – Leading Breakthrough Innovation
8:00 – 9:15 a.m. • Espanade Ballroom

Plenary Session – What's New on the Label
8:00 – 9:15 a.m. • 301

Posters Available for Viewing
8:00 a.m. – 2:00 p.m. • Hall C

Beer and Other Beverages Track Session
9:30 a.m. – 12:00 p.m. • 206

Breads Track Session
9:30 a.m. – 12:00 p.m. • 304

Breakfast Foods Track Session
9:30 a.m. – 12:00 p.m. • 300

Grain Exchange Track Session
9:30 a.m. – 12:00 p.m. • 220

Pasta/Noodles Track Session
9:30 a.m. – 12:00 p.m. • 303

Professional Development Track
9:30 a.m. – 12:00 p.m. • 270

Sweet/Salty Foods Track Session
9:30 a.m. – 12:00 p.m. • 256

Whole Grains Forum
11:00 a.m. – 12:00 p.m. •236

Wednesday September 20

Morning

Technical Committee Meetings
7:00 – 8:30 a.m.
- Barley and Barley Products – Dante, Parc 55
- Biotechnology Methods – Rubens, Parc 55
- Chemical Leavening Agents – Medici, Parc 55

Registration
7:30 a.m. – 1:00 p.m. • Foyer Area

Beer and Other Beverages Track Session
8:00 – 10:30 a.m. • 206

Breads Track Session
8:00 – 10:30 a.m. • 304

Breakfast Foods Track Session
8:00 – 10:30 a.m. • 300

Grain Exchange Track Session
8:00 – 10:30 a.m. • 220

Pasta/Noodles Track Session
8:00 – 10:30 a.m. • 303

Professional Development Track Session
8:00 – 10:30 a.m. • 270

Sweet/Salty Foods Track Session
8:00 – 10:30 a.m. • 256

Closing General Session with Keynote Speaker Phil Lempert
10:45 a.m. – 12:00 p.m. • Esplanade Ballroom

Afternoon

Sunday September 17

MBAA Short Course – Malt Analysis: Today and Tomorrow*
12:00 – 4:00 p.m. • Barcelona I, Parc 55

Meeting Orientation
2:00 – 3:00 p.m. • Barcelona II, Parc 55

MBAA Short Course – Beer Tasting 101*
2:00 – 3:30 p.m. • Ballroom I, Parc 55

Registration Open
4:00 – 6:30 p.m. • Hall C

Grand Opening Exhibition Gala and Ribbon Cutting
4:00 – 6:30 p.m. • Hall C

Hospitality Room Open
6:30 – 11:00 p.m. • Corintia, Parc 55

Monday September 18

Exhibits and Lunch
12:00 – 2:00 p.m. • Hall C
Lunch from 12:00 – 1:30 p.m.

Beer and Other Beverages Track Session
2:00 – 4:30 p.m. • 206

Breads Track Session
2:00 – 4:30 p.m. • 304

Breakfast Foods Track Session
2:00 – 4:30 p.m. • 300

Grain Exchange Track Session
2:00 – 4:30 p.m. • 220

Pasta/Noodles Track Session
2:00 – 4:30 p.m. • 303

Professional Development Track Session
2:00 – 4:30 p.m. • 270

Sweet/Salty Foods Track Session
2:00 – 4:30 p.m. • 256

Technical Committee Meetings
4:30 – 6:00 p.m.
- Dietary Fiber and Starch – 228
- Oat Products –230

Beer and Poster Presentations Session
4:45 – 6:30 p.m. • Hall C

Hospitality Room Open
8:00 – 11:00 p.m. • Corintia, Parc 55

Tuesday September 19

Exhibits and Lunch
12:00 – 2:00 p.m. • Hall C
Lunch Served 12:00 – 1:30 p.m.

Poster Authors Present
12:00 – 2:00 p.m. • Hall C

Beer and Other Beverages Track Session
2:00 – 4.30 p.m. • 206

Breads Track Session
2:00 – 4:30 p.m. • 304

Breakfast Foods Track Session
2:00 – 4:30 p.m. • 300

Grain Exchange Track Session
2:00 – 4.30 p.m. • 220

Pasta/Noodles Track Session
2:00 – 4.30 p.m. • 303

Professional Development Track
2:00 – 4:30 p.m. • 270

Sweet/Salty Foods Track Session
2:00 – 4:30 p.m. • 256

Technical Committee Meetings
4:30 – 6:30 p.m.
- Physical Testing Methods – Cervantes, Parc 55
- Pulse and Legume – Verona, Parc 55
- Soft Wheat Flour – Rubens, Parc 55
- Statistical Advisory – Tuscany, Parc 55
- Vitamin, Mineral, and Lipid Analysis – Sienna II, Parc 55

MBAA Installation of Officers Social and Dinner
6:00 – 9:00 p.m. • Ballroom, Parc 55

Hospitality Room Open
8:00 – 11:00 p.m. • Corintia, Parc 55

Wednesday September 20

Beer and Other Beverages Individual Track Session
2:00 – 4:30 p.m. • 206

Breads Track Session
2:00 – 4:30 p.m. • 304

Breakfast Foods Track Session

2:00 – 4:30 p.m. • 300

Grain Exchange Track Session
2:00 – 4:30 p.m. • 220

Pasta/Noodles Track Session
2:00 – 4:30 p.m. • 303

Professional Development Track
2:00 – 4:30 p.m. • 270

Sweet/Salty Foods Track Session
2:00 – 4:30 p.m. • 256

Wild Crush: A Wine Affair - Closing Party*
7:00 – 9:30 p.m. • Barcelona II, Parc 55

Hospitality Room Open
8:00 – 11:00 p.m. • Corintia, Parc 55

** Indicates ticketed events; check Registration Desk for availability.*

World Grains Summit Track Schedule

Session Tracks

Monday, Tuesday, and Wednesday

New at the World Grains Summit! Tracks provide a user-friendly system to select the sessions that best meet your needs! Each track offers technical presentations and symposia featuring invited speakers from around the globe. Topics within tracks will address processing and raw materials, nutritional aspects, analytical aspects and functional properties, and safety and quality. Stay with one track or cross tracks, this flexible system allows you to create a meeting program that offers you the type of presentations that address your specific needs and areas. Tracks are:

- Beer and Other Beverages
- Breads
- Breakfast Foods
- Grain Exchange
- Pasta/Noodles
- Professional Development
- Sweet/Salty Foods

Twenty-five symposia and over 100 oral presentations that cover the broad spectrum of grain-based food and beverage sciences, from analytical methodology in grain evaluation to the production are included in the tracks.

Session Descriptions

Please refer to the pages listed for symposia and technical session descriptions.

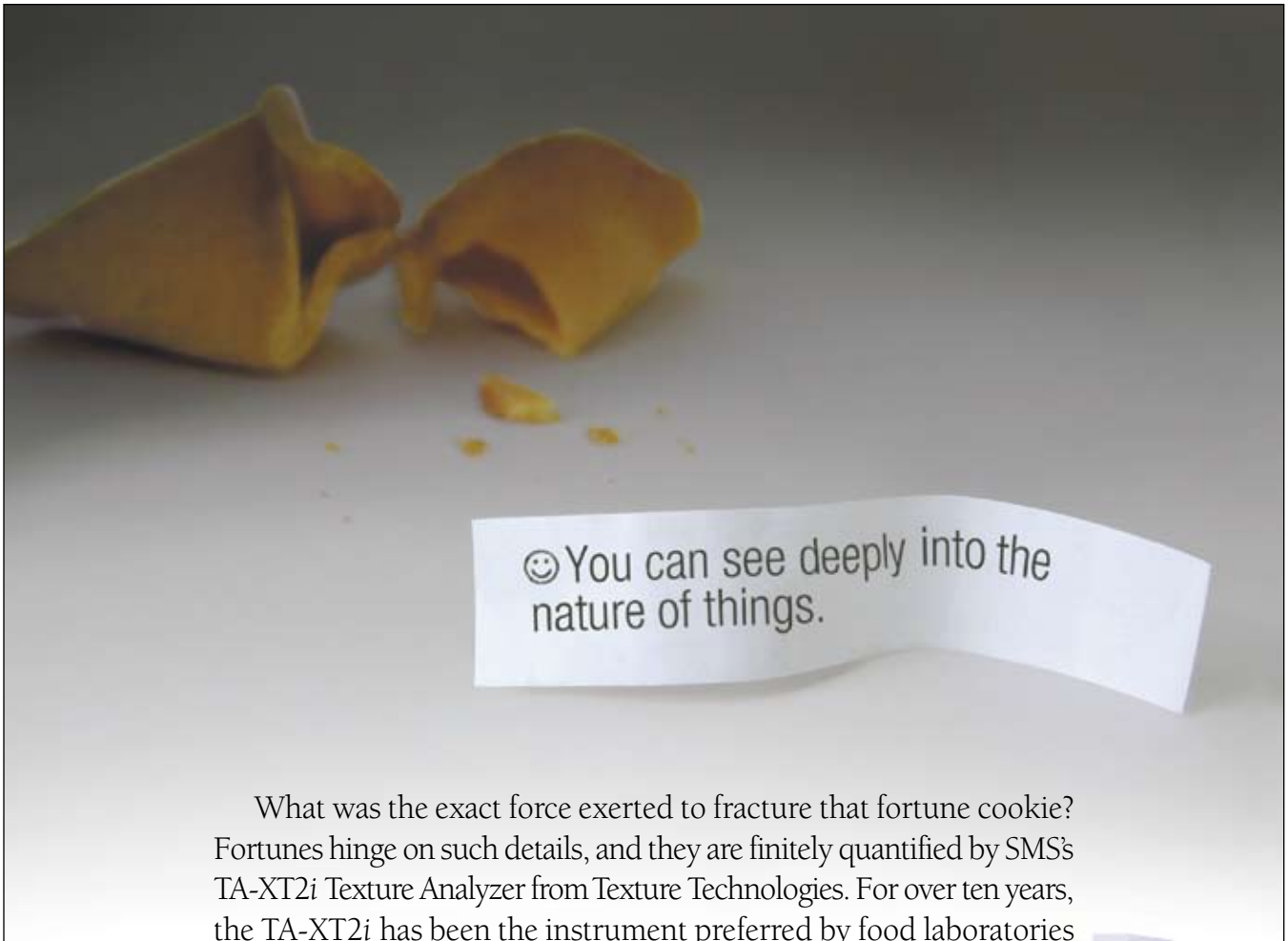
	BEER AND OTHER BEVERAGES TRACK *Room 206*	BREADS TRACK *Room 304*
SUNDAY, SEPTEMBER 17		
4:00 – 6:30 p.m.		
MONDAY, SEPTEMBER 18		
8:00 – 9:15 a.m.		
9:30 a.m. – 12:00 p.m.	Technical Session – Health and Nutrition Aspects Special Session – Software for Brewers *(Room 234)*	Technical Session – Analytical Aspects and Functional Properties
12:00 – 2:00 p.m.		
2:00 – 4:30 p.m.	Technical Session – Processing and Raw Materials	Applications of Science and Technology to Bread Making Around the World
4:45 – 6:30 p.m.		
TUESDAY, SEPTEMBER 19		
8:00 – 9:15 a.m.		
9:30 a.m. – 12:00 p.m.	Technical Session – Fermentation	Technical Session – Processing and Raw Materials
12:00 – 2:00 p.m.		
2:00 – 4:30 p.m.	Technical Session – Filtration and Stabilization	Flour Fortification
WEDNESDAY, SEPTEMBER 20		
8:00 – 10:30 a.m.	Technical Session – Beer General	Molecular Basis for Dough Development
10:45 a.m. – 12:00 p.m.		
12:00 – 2:00 p.m.		
2:00 – 4:30 p.m.	Technical Session – Beer General	Carbohydrate - Protein Interaction in Baked Products
Evening		

BREAKFAST FOODS TRACK *Room 300*	GRAIN EXCHANGE TRACK *Room 220*	PASTA/NOODLES TRACK *Room 303*	PROFESSIONAL DEVELOPMENT TRACK *Room 270*	SWEET/SALTY FOODS TRACK *Room 256*
Grand Opening Exhibition and Gala				

Opening General Session featuring Stan Slap				
Formulation and Processing to Enhance the Nutritional Benefits of Breakfast Foods	International Wheat Quality Grading Systems: A Comparison	Traditional and New Pasta and Noodle Products from Around the World	Help! I Need to Get Organized!	Water Activity: The More Important Water Analysis
Exhibition/ Posters/ Lunch				
Use of Whole Grains in Breakfast Foods: Challenges and Benefits	Technical Session – Processing and Raw Materials	Technical Session – Processing and Raw Materials	Food Science — Oh, the Places You'll Go!	Technical Session – Health and Nutritional Aspects
Beer and Poster Presentations				

Plenary Sessions				
Production and Measurement of Finished Product Quality	Ten Years of Biotechnology	Pasta: An Industry Perspective on Processing and Future Research Priorities	Leadership and Management Skills	Health Issues and Snacks
Exhibition/ Posters/ Lunch				
Technical Session – Processing and Raw Materials	Technical Session – Biotechnology	Noodles: From Raw Materials to Finished Products to Consumers	Mustering Expertise and Maximizing Impact	Have Your Whole Grain Cake and Eat It Too: Challenges of Delivering Texture in Food Systems

Technical Session – Analytical Aspects and Functional Properties	International Efforts to Guarantee Food Safety and Traceability	Technical Session – Analytical Aspects and Functional Properties	Leadership and Management Skills	The Next Generation of Sweet and Salty Snacks – Global Products
Closing General Session featuring Phil Lempert				
Division Meetings and Lunches				
Technical Session – Health, Nutrition, and Chemical Aspects	Recent Advances Non-Wheat Grain Quality	Noodles and Pasta: What is Quality and How Can It Be Measured?		Technical Session – Analytical Aspects and Functional Properties
Wild Crush: A Wine Affair — Closing Event				



What was the exact force exerted to fracture that fortune cookie? Fortunes hinge on such details, and they are finitely quantified by SMS's TA-XT2*i* Texture Analyzer from Texture Technologies. For over ten years, the TA-XT2*i* has been the instrument preferred by food laboratories around the world. Preferred for its precision, ease of use, phenomenal software, unequaled range of applications & fixtures and its cost. Preferred because Texture Technologies' steadfast support and training, as well as free software upgrades come with each instrument.

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The TA-XT2*i* Texture Analyzer and *Texture Expert Exceed* software are designed & manufactured by Stable Micro Systems, Goldalming, U.K.

Daily Program Schedule

All meetings take place at the Moscone Convention Center South unless noted in the program. The Convention Center uses numbers (ie. 206) to identify many of the meeting rooms.

Friday, September 15

1:00 – 3:00 p.m.	AACC Intl. Finance Committee Meeting	DaVinci II, Parc 55
3:00 – 5:00 p.m.	AACC Intl. Board of Directors Meeting	DaVinci II, Parc 55

Saturday, September 16

8:00 a.m. – 5:00 p.m.	AACC Intl. Board of Directors Meeting	DaVinci II, Parc 55
9:00 a.m. – 12:00 p.m.	MBAA Executive Committee Meeting	Michelangelo, Parc 55
12:00 – 1:00 p.m.	AACC Intl. Board of Directors Lunch	DaVinci I, Parc 55
1:00 – 5:00 p.m.	MBAA Board of Governor's Meeting	Barcelona I, Parc 55
5:00 – 11:00 p.m.	Hospitality Room	Corintia, Parc 55

Sunday, September 17

8:00 – 9:00 a.m.	MBAA Technical Committee Meeting	DaVinci II, Parc 55
8:00 – 10:00 a.m.	AACC Intl. Check Sample Committee Meeting	Medici, Parc 55
8:00 – 10:00 a.m.	AACC Intl. Publications Task Force Meeting	Michelangelo, Parc 55
8:00 – 10:00 a.m.	MBAA Education Committee Meeting	Dante, Parc 55
9:00 a.m. – 3:00 p.m.	Tour - Sonoma: Birthplace of California Winemaking*	
9:00 a.m. – 1:00 p.m.	AACC Intl. - International Executive Council	Milan, Parc 55
9:00 a.m. – 2:00 p.m.	Exhibitor Set-Up and Registration	Exhibit Hall C
10:00 – 11:30 a.m.	AACC Intl. Online Products Committee Meeting	Rubens, Parc 55
10:00 a.m. – 12:00 p.m.	2007, 2008, 2009 AACC Intl. Technical Program Development Team Leaders Planning Meeting	DaVinci II, Parc 55
12:00 – 1:30 p.m.	AACC Intl. Cereal Chemistry Editorial Board Luncheon	Sienna, Parc 55
12:00 – 1:30 p.m.	AACC Intl. Approved Methods Committee Meeting	DaVinci I, Parc 55
12:00 – 4:00 p.m.	MBAA Workshop – Malt Analysis, Today and Tomorrow*	Barcelona I, Parc 55
1:00 – 1:30 p.m.	Technical Moderators Orientation Meeting	Cervantes, Parc 55
1:00 – 6:00 p.m.	Room Available for Small Meetings	*Check at registration desk, Parc 55*
1:30 – 2:00 p.m.	Poster Leaders Orientation Meeting	Cervantes, Parc 55
1:30 – 2:30 p.m.	AACC Intl. Journals Committee Meeting	Medici, Parc 55
1:30 – 3:30 p.m.	AACC Intl. Board of Directors Meeting with Committee Leaders	Ballroom II, Parc 55
2:00 – 3:00 p.m.	Meeting Orientation	Barcelona II, Parc 55
2:00 – 3:00 p.m.	AACC Intl. Milling & Baking Division Advisory Board Meeting	Rubens, Parc 55
2:00 – 3:30 p.m.	MBAA Workshop - Beer Tasting 101*	Ballroom I, Parc 55
2:30 – 3:30 p.m.	AACC Intl. Student Division Executive Committee and University Representative Meeting	DaVinci II, Parc 55
2:30 – 4:00 p.m.	AACC Intl. Book Committee Meeting	Dante, Parc 55
2:30 – 4:00 p.m.	AACC Intl. Awards Committee Meeting	Tuscany, Parc 55
3:00 – 3:45 p.m.	Exhibitor Welcome	Exhibit Hall C
3:00 – 4:00 p.m.	AACC Intl. Milling & Baking Division Executive Committee Meeting	Rubens, Parc 55
3:00 – 4:00 p.m.	MBAA District Officers Orientation	Barcelona II, Parc 55
4:00 – 6:30 p.m.	Registration Open	Exhibit Hall C
4:00 p.m.	Ribbon Cutting Ceremony	Entrance to Hall C
4:00 – 6:30 p.m.	Grand Opening Exhibition and Gala	Exhibit Hall C
4:00 – 6:30 p.m.	Marketplace and Silent Auction Open	Exhibit Hall C
6:30 – 8:00 p.m.	AACC Intl. Mentoring Event	Barcelona II, Parc 55
6:30 – 11:00 p.m.	Hospitality Room	Corintia, Parc 55

** indicates ticket required*

Monday, September 18

See Track Schedule, page 22, for specific symposia and technical session titles.

7:00 – 7:45 a.m.	Beer and Other Beverages Speaker and Poster Presenters Breakfast	228
7:00 – 10:00 a.m.	Poster Set-up by authors	Exhibit Hall C
7:30 a.m. – 7:00 p.m.	Registration	Exhibit Hall C
7:00 a.m. – 5:00 p.m.	Room Available for Small Meetings, Parc 55	*Check at registration desk*
7:00 a.m. – 5:00 p.m.	Room Available for Small Meetings, Convention Center	*Check at registration desk*
8:00 – 9:15 a.m.	Opening General Session – with Keynote Speaker Stan Slap	Esplanade Ballroom
8:30 – 10:00 a.m.	Guest Breakfast and San Francisco Orientation Program*	Barcelona I, Parc 55
9:30 a.m. – 12:00 p.m.	Beer and Other Beverages Track Session	206
9:30 a.m. – 12:00 p.m.	Breads Track Session	304
9:30 a.m. – 12:00 p.m.	Breakfast Foods Track Session	300
9:30 a.m. – 12:00 p.m.	Grain Exchange Track Session	220
9:30 a.m. – 12:00 p.m.	Pasta/Noodles Track Session	303
9:30 a.m. – 12:00 p.m.	Professional Development Track Session	270
9:30 a.m. – 12:00 p.m.	Sweet/Salty Foods Track Session	256
9:30 a.m. – 12:00 p.m.	Software for Brewers	234
9:45 – 11:00 a.m.	AACC Intl. Corporate Member Coffee Break, *by invitation*	228
10:00 a.m. – 1:00 p.m.	AACC Intl. Student Product Development Competition Presentations *(open to all attendees)*	236
10:00 a.m. – 7:00 p.m.	Posters Available for Viewing	Exhibit Hall C
12:00 – 2:00 p.m.	Exhibits and Lunch *Lunch from 12:00 – 1:30 p.m.*	Exhibit Hall C
12:00 – 2:00 p.m.	Marketplace	Exhibit Hall C
12:00 – 2:00 p.m.	Silent Auction Open	Exhibit Hall C
1:00 – 2:00 p.m.	AACC Intl. Education Division Meeting	Sienna, Parc 55
1:00 – 5:00 p.m.	AACC Intl. Student Product Development Competition Posters	Exhibit Hall C
2:00 – 4:30 p.m.	Beer and Other Beverages Track Session	206
2:00 – 4:30 p.m.	Breads Track Session	304
2:00 – 4:30 p.m.	Breakfast Foods Track Session	300
2:00 – 4:30 p.m.	Grain Exchange Track Session	220
2:00 – 4:30 p.m.	Pasta/Noodles Track Session	303
2:00 – 4:30 p.m.	Professional Development Track Session	270
2:00 – 4:30 p.m.	Sweet/Salty Foods Track Session	256
3:00 – 4:30 p.m.	AACC Intl. Student Division Business Meeting	DaVinci I, Parc 55
3:00 – 5:00 p.m.	AACC Intl./MBAA Bookstore	Lobby Area
4:30 – 6:00 pm.	Technical Committee Meetings	
	• Dietary Fiber and Starch	228
	• Oat Products	230
4:45 – 6:30 p.m.	Beer and Poster Presentations Session *Authors Presenting Posters*	Exhibit Hall C
5:00 – 6:00 p.m.	AACC Intl. Thomas Burr Osborne Medal Committee and Applied Research Award Meeting	Medici, Parc 55
5:00 – 6:30 p.m.	AACC Intl. Carbohydrate Division Executive Committee Meeting	Dante, Parc 55
5:30 – 6:15 p.m.	AACC Intl. Cereals&Europe Business Meeting	Sienna, Parc 55
6:30 – 11:00 p.m.	Tour – San Francisco Highlights*	
7:00 – 11:00 p.m.	Tour – San Francisco Brewpub Pub Crawl*	
7:00 – 11:00 p.m.	Student Division Dinner and Social*	Offsite
8:00 – 11:00 p.m.	Cereals&Europe Special Event*	Boudin's Bakery
8:00 – 11:00 p.m.	Hospitality Room Open	Corintia, Parc 55

** indicates ticket required*

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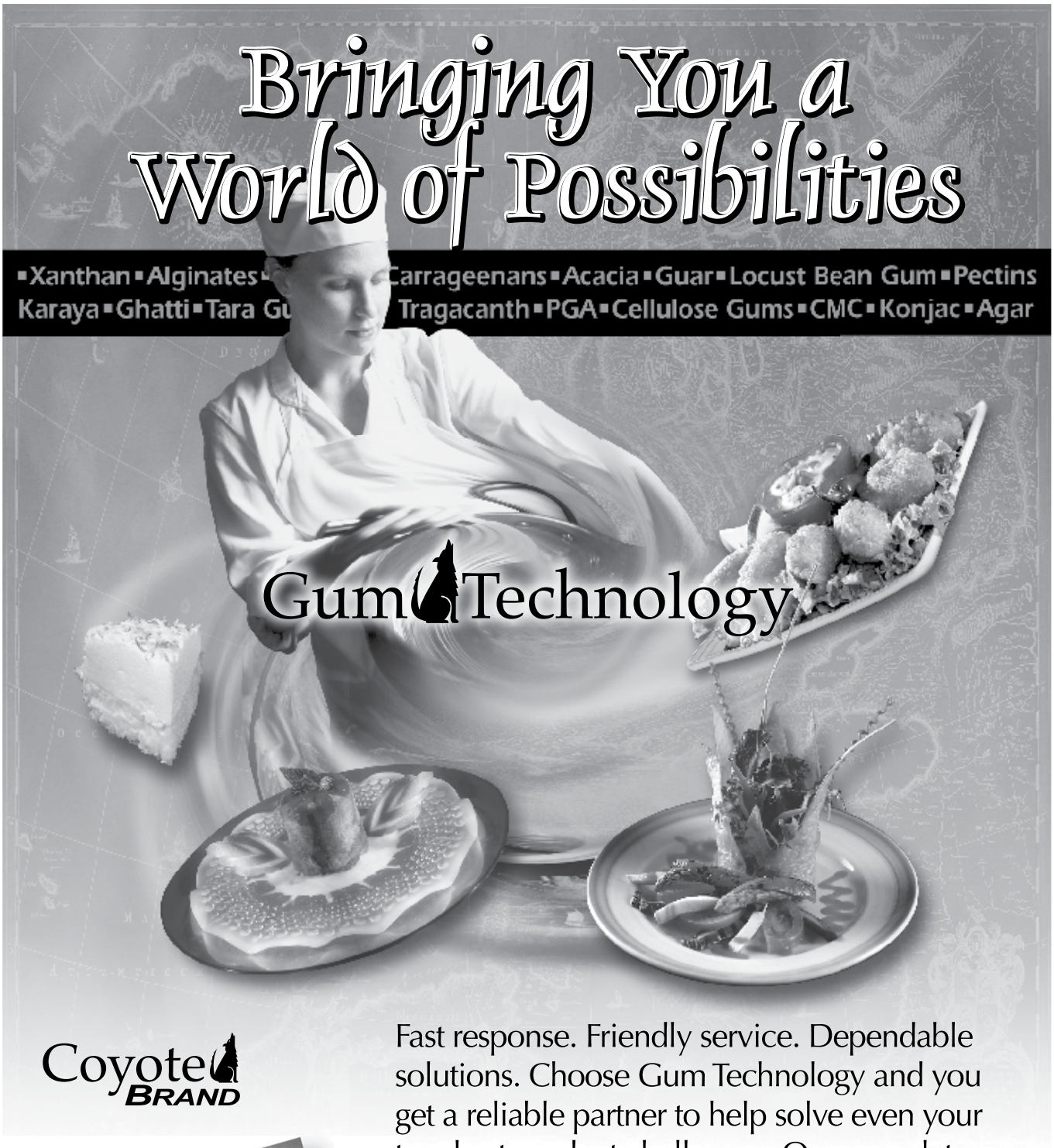

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MBAA Special Session – Monday Morning

Beer and Other Beverages: Software for Brewers

Organizer: Jaime Jurado, The Gambrinus Company, San Antonio, TX, USA
Moderator: Jaime Jurado, The Gambrinus Company, San Antonio, TX, USA
Sponsor: MBAA

This session will demonstrate the power of two software suites and the underpinning basis of each. Master Brewers' Toolbox, built by Jim Hackbarth, is based on MicroSoft Access software and provides a platform to calculate and store all brewing related material formulas, processing parameters, and product specifications. Master Brewers' Toolbox will be available for purchase during the Summit at the Marketplace. PLS_Toolbox is a collection of essential and advanced chemometric routines, with the tools to explore data and build predictive models. Neal Gallagher will present an overview of the suite, followed by examples of data analysis from the world of brewing.

9:30 a.m.—S-1
Chemometrics for brewing applications using PLS_Toolbox. N. GALLAGHER (1). (1) Eigenvector Research, Inc., Manson, WA, USA
10:30 a.m.—S-2
Master Brewers' Toolbox: A unique brewing software suite from the MBAA. J. HACKBARTH (1). (1) The Gambrinus Co., San Antonio, TX, USA

Symposia – Monday Morning

Breakfast Foods: Formulation and Processing to Enhance Nutritional Benefits of Breakfast Foods

Organizer: Talwinder Kahlon, USDA-ARS, WRRC, Albany, CA, USA
Moderator: Talwinder Kahlon, USDA-ARS, WRRC, Albany, CA, USA
Sponsor: Nutrition Division

Breakfast food manufacturers are always looking for ways to enhance the nutritional appeal of their products: What functional ingredients can be added? How can the extruder or other processes be run to minimize any negative effect on the nutritional content of the finished product? Presentations in this symposium will review the latest research and trends in fiber and fiber sources, reducing glycemic index, the benefit of antioxidants, and other nutritional opportunities for breakfast foods. Methodology of reducing the negative impact of processing on the nutritional content of finished products will also be discussed.

9:30 a.m.—S-3
Glycemic index: From clinical tool to commercial opportunities for breakfast cereals. A. ALLDRICK (1). (1) Campden & Chorleywood Food RA, Gloucestershire, UK
9:50 a.m.—S-4
Relative healthful potential of breakfast cereals and cereal fractions. T. KAHLON (1). (1) USDA ARS, Albany, CA, USA
10:10 a.m.—S-5
New cereal foods for improved human health. D. TOPPING (1). (1) CSIRO, Adelaide, South Australia
10:50 a.m.—S-6
Breakfast and satiety—How does breakfast affect food consumption habits? M. E. CAMIRE (1). (1) University of Maine, Orono, ME, USA
11:10 a.m.—S-7
Barley and rye for flavor and nutritional enhancement of breakfast foods. E. A. ARNDT (1). (1) ConAgra, Omaha, NE, USA
11:30 a.m.
Panel discussion: Questions and answers

Grain Exchange: International Wheat Quality Grading Systems: A Comparison

Organizers: András Salgó, Budapest University of Technology and Econo, Budapest, Hungary; Robert Cracknell, Crackers Consulting, Mount Eliza, Victoria, Australia
Moderator: Jim Dexter, Canadian Grain Commission, Winnipeg, MB, Canada

All wheat producers like to categorize their wheat into consistent parcels of predictable composition and performance to improve its marketability. Established exporters have perfected this approach so it highlights the strong points of each particular type, and they complement this with a descriptive name that tells the buyer the hardness of the grain, its seed coat color, protein content, and where it was grown. Buyers on the other hand, particularly those in Europe, now have to contend with supplies from a wide range of sources, some of which are new on the scene. Speakers will compare some of these new wheat types and comment on those from established exporters.

9:30 a.m.—S-8
Introduction, outline, and comparison of the grading systems employed by the major southern hemisphere wheat exporters, Australia and Argentina. R. L. CRACKNELL (1), T. Watts (2). (1) Crackers Consulting, Melbourne, Australia; (2) AWB Limited, Melbourne, Australia
10:10 a.m.—S-9
The wheat grading and classification systems employed by the United States and Canada, and an update on hard white wheat development. J. E. DEXTER (1), G. L. Lookhart (2). (1) Canadian Grain Commission, Winnipeg, MB, Canada; (2) Manhattan, KS
10:30 a.m.—S-10
Evolution of wheat quality and grain grading in Kazakhstan. A. I. MORGOUNOV (1), A. I. Abugalieva (2). (1) International Maize and Wheat Improvement Centre (CIMMYT), Almaty, Kazakhstan; (2) Kazakh Research Institute of Agriculture, Almaty, Kazakhstan
10:50 a.m.—S-11
A comparison of the wheat classification systems in central Europe and other European countries, with those in use in the U.S. and Canada. S. TÖMÖSKÖZI (1), A. Salgó (1). (1) Budapest University of Technology and Economics, Budapest, Hungary
11:10 a.m.—S-12
Milling and baking industries, UK. S. P. CAUVAIN. BakeTran, High Wycombe, UK
11:30 a.m.
Discussion: J. E. DEXTER (1), R. L. CRACKNELL (2). (1) Canadian Grain Commission, Winnipeg, MB, Canada; (2) Crackers Consulting, Melbourne, Australia

Pasta/Noodles: Traditional and New Pasta and Noodle Products from Around the World

Organizer: David Hahn, New World Pasta, Harrisburg, PA, USA
Moderator: David Hahn, New World Pasta, Harrisburg, PA, USA

An overview of the many different pasta and noodle products available to consumers around the world will be presented. Traditional and new applications (frozen, fried, microwaveable, etc.) for these products will be discussed with reference to industrial trends and products and implications for raw material requirements and nutritional impact.

9:30 a.m.—S-13
Effects of semolina composition and processing conditions on couscous quality. B. CUQ (1), J. Abecassis (1). (1) INRA, Montpellier, France
9:50 a.m.—S-14
New pasta products trends and innovations in North America. D. HAHN (1). (1) New World Pasta Co., Harrisburg, PA, USA
10:10 a.m.—S-15
Refrigerated products: New product trends and innovations. C. ANDERSON (1). (1) Monterey Gourmet Foods, Salinas, CA, USA
10:30 a.m.—S-16
Overview of pasta products in Europe and America. M. G. D'EGIDIO (1). (1) Instituto Spermentale Cerealicoltura, Roma, Italy
10:50 a.m.—S-17
Wheat noodle products in Asia. B. X. FU (1). (1) Canadian International Grains Institute, Winnipeg, MB, Canada
11:10 a.m.—S-18
Wheat noodle products in Latin America. G. HOU (1). (1) Wheat Marketing Center, Portland, OR, USA

Professional Development: Help! I Need to Get Organized!

Tired of wasting valuable time hunting for things? Can't find time to get everything done? Drowning in paperwork and emails? If so, this workshop is for you. Rhonda Elliott, Professional Organizer, will share simple, yet effective ways you can get and stay organized. Do more with less stress!

9:30 a.m. – 12:00 p.m.
Help! I need to get organized. R. ELLIOTT (1). (1) Organized by Design, Pleasanton, CA, USA

Sweet/Salty Foods: Water Activity: The More Important Water Analysis

Organizer: Brady Carter, Decagon Devices, Pullman, WA, USA
Moderators: Brady Carter, Decagon Devices, Pullman, WA, USA; Art Bettge, USDA ARS, Pullman, WA, USA
Financial Sponsor: Decagon Devices, Pullman, WA, USA

This symposium will cover a description of water activity, why it is important for sweet and salty cereal foods, and how it differs from moisture content. The influence of water activity on glass transition and molecular mobility will be addressed in detail. The impact of water activity on product shelf life will also be discussed, specifically its influence on the texture, moisture migration, reaction rate, and microbial spoilage of sweet and salty cereal foods. Finally, water activity measurement techniques will be discussed, with a special

emphasis on the new concept of measuring water activity using NIR.

9:30 a.m.—S-19
Water and solids mobility in foods: An overview. S. SCHMIDT (1). (1) University of Illinois, Urbana, IL, USA
9:50 a.m.—S-20
What is water activity? A. FONTANA (1). (1) Decagon Devices, Pullman, WA, USA
10:10 a.m.—S-21
Modeling the boundaries of *Staphylococcus aureus* growth for risk assessment and product development purposes. C. STEWART (1). (1) National Center for Food Safety & Technology, Summit-Argo, IL, USA
10:50 a.m.—S-22
Practical applications of water activity in foods. K. KOU (1). (1) General Mills, Minneapolis, MN, USA
11:10 a.m.—S-23
Methods for water activity measurement. B. CARTER (1). (1) Decagon, Devices, Pullman, WA, USA
11:30 a.m.—S-24
Fast water activity analysis of food and feed products using a diode-array based near-infrared spectrometer. W. SHADOW (1). (1) Perten Instruments, Bountiful, UT, USA

Technical Sessions – Monday Morning

Beer and Other Beverages: Health and Nutritional Aspects, Part I

Moderator: Karl Ockert, BridgePort Brewing Co., Portland, OR, USA

9:30 a.m.—O-1
The upcoming crisis in grains. M. LYONS (1), B. Hoskins (2). (1) Heriot Watt University/Alltech, Dunboyne, Ireland; (2) Heriot Watt University/Alltech, Lexington, KY, USA
9:50 a.m.—O-2
Functional drinks based on malted buckwheat, sorghum and triticale. S. KREISZ (1), M. Zarnkow (1), W. Back (1). (1) Institute of Brewing Technology I, Technische Universität München-Weihenstephan, Freising, Germany
10:10 a.m.—O-3
Nutritional properties of oat-based beverages as affected by processing and storage. H. ZHANG (1), G. Önning (1), R. Öste (2). (1) Biomedical Nutrition, Lund University; (2) Food Chemistry and Applied Nutrition, Lund University
10:30 a.m.
Break

Beer and Other Beverages: Health and Nutritional Aspects, Part II

Moderator: Inge Russell, Alltech, Inc., London, ON, Canada

10:50 a.m.—O-4
Pulque fortification with iron, zinc and selenium. L. TOVAR (1), M. Olivos (1), L. Campos-Villegas (1). (1) CIIEMAD/IPN, Mexico City, Mexico
11:10 a.m.—O-5
Malting and brewing with buckwheat. B. D. SCHEHL (1), H. H. Wijngaard (1), B. P. Nic Phiarais (1), E. K. Arendt (1). (1) Department of Food and Nutritional Sciences, National University of Ireland, University College Cork, Cork, Ireland
11:30 a.m.—O-6
Optimization of the mashing procedure for malted proso millet. M. Zarnkow (2), M. KEβLER (2), F. Burberg (2), E. Arendt (1), W. Back (2), S. Kreisz (2). (1) Department of Food Science and Technology, University College Cork, Cork, Ireland; (2) Lehrstuhl für Technologie der Brauerei I, Technische Universität München, München, Germany
11:50 a.m.
Question-and-answer session

Breads: Analytical Aspects and Functional Properties

Moderators: Peter Koehler, German Research Center of Food Chemistry and Hans-Dieter-Belitz-Institute for Cereal Grain Research, Garching, Germany; Baninder Sroan, Kansas State University, Manhattan, KS, USA

9:30 a.m.—O-7
Effect of bread structure and chemistry on moisture diffusion. A. H. BARRETT (2), U. Sajjad (2), G. Kaletunc (1). (1) The Ohio State University, Department of Food, Agricultural and Biological Engineering, Columbus, OH, USA; (2) US Army Natick Soldier Center, Combat Feeding Directorate, Natick, MA, USA
9:50 a.m.—O-8
Impact of TGase on the ultrastructure, fundamental rheological and baking characteristics of batters and breads made from different gluten free flours. S. RENZETTI (1), E. K. Arendt (1). (1) Food Technology, Food and Nutritional Sciences Department, UCC, Cork, Ireland
10:10 a.m.—O-9
Influence of the fatty acid on the baking activity of phospholipids. B. Fischer (1), P. KOEHLER (1). (1) German Research Center of Food Chemistry and Hans-Dieter-Belitz-Institute for Cereal Grain Research, Garching, Germany
10:30 a.m.—O-10
Role of liquid lamellae in gas cell stability in bread making. B. S. SROAN (1), F. MacRitchie (1). (1) Kansas State University, Department of Grain Science and Industry, Manhattan, KS, USA
10:50 a.m.—O-11
Crystalline changes in wheat starch during the bread-making process: Starch crystallinity in the bread crust. C. PRIMO-MARTÍN (3), N. H. Van Nieuwenhuijzen (1), R. J. Hamer (2), T. Van Vliet (1). (1) Wageningen Centre for Food Sciences and Wageningen University, Wageningen, The Netherlands; (2) Wageningen Centre for Food Sciences, Wageningen, and TNO Quality of Life, Zeist, The Netherlands; (3) Wageningen Centre for Food Sciences, Wageningen, The Netherlands
11:10 a.m.—O-12
Ultrasonic characterization of bread crumb: Application of the Biot-Allard model for porous structures. B. LAGRAIN (2), L. Boeckx (1), E. Wilderjans (2), W. Lauriks (1), J. A. Delcour (2). (1) Laboratory of Acoustics and Thermal Physics, K.U.Leuven, Leuven, Belgium; (2) Laboratory of Food Chemistry, K.U.Leuven, Leuven, Belgium
11:30 a.m.—O-13
Rapid prediction of dough extensibility using near infrared analysis. R. E. DEMPSTER (1). (1) AIB International

Symposia – Monday Afternoon

Breads: Applications of Science and Technology to Breadmaking Around the World

Organizers: Stanley Cauvain, BakeTran, High Wycombe, UK; Weining Huang, Southern Yangtze University, Wuxi, Jiangsu, China

Moderators: Stanley Cauvain, BakeTran, High Wycombe, UK; Weining Huang, Southern Yangtze University, Wuxi, Jiangsu, China

Most bread products are based on the gluten-forming properties of wheat flour, and a wide diversity of product forms and production methods have been developed. This diversity is based on historical experiences, with traditional methods being adapted through trial and error to meet modern production demands. This seminar will show how the application of underpinning science and technology is used to understand the contribution of raw materials and processing methods in the optimization of product quality for a range of bread forms. Presentations will show that while the underpinning cereal science may be global, its application requires a sound knowledge of local products and their associated manufacturing and consumer bases for bakers to remain successful.

2:00 p.m.—S-25
Rye bread—The impact of raw materials and proecssing on bread quality. M. G. LINDHAUER (1). (1) Federal Research Centre for Nutrition and Food Institute for Cereal Potato and Starch Technology, Detmold, Germany
2:20 p.m.—S-26
Improving bread quality with mechanical dough development. S. P. CAUVAIN (1), L. S. Young (1). (1) BakeTran, High Wycombe, UK
2:40 p.m.—S-27
Making bread in 21st century America. T. KUK (1). (1) American Society of Baking, Sonoma, CA, USA
3:00 p.m.—S-28
Making of Chinese steamed bread containing almond flour/skin flour. W. HUANG (1). (1) Southern Yangtze University, Wuxi, Jiangsu, People's Republic of China
3:20 p.m.—S-29
Evolution and future of bread in Spain. J. ALAVA (1). (1) La Familia SA, Valencia, Spain
3:40 p.m.—S-30
New Zealand: New products and processes for the future. A. WILSON (1), K. Sutton (1), M. Morgenstern (1). (1) Crop & Food Research Ltd., Lincoln, New Zealand
4:00 p.m.—S-31
Exploring the link between the cell structure and eating properties in sandwich bread using C-cell and texture analysis. R. CABRERA (1). (1) Frank Roberts & Sons Ltd., Northwich, Cheshire, UK

Breakfast Foods: Use of Whole Grains in Breakfast Foods: Challenges and Benefits

Organizer: Julie Jones, College of St. Catherine, St Paul, MN, USA
Moderator: Julie Jones, College of St. Catherine, St Paul, MN, USA

The incorporation of whole grains into breakfast cereals has become common, but issues and challenges remain. This symposium will review the benefits of whole grains and recent work linking whole grains to improved health and disease prevention. The use of alternative whole grains and their unique benefits will also be discussed. Inclusion of whole grains in a product leads to challenges in formulation and in the processing of breakfast foods to produce a desirable product. The final product must still be appealing to the consumer to assure repeat sales.

2:00 p.m.—S-32
Breakfast. Still the most important meal of the day? A discussion of the many benefits of grain-based foods on well being and disease prevention. J. ADAMS (1). (1) Grain Foods Foundation, Ridgway, CO, USA
2:20 p.m.—S-33
Latest research on whole grains and their importance in formulating breakfast foods. J. JONES (1). (1) College of St Catherine, St. Paul, MN, USA
2:40 p.m.—S-34
Oat soluble fiber: A unique part of the benefits of a whole grain. J. J. SMITH (1). (1) Quaker Oats, Barrington, IL, USA
3:00 p.m.—S-35
Making all cereals whole grain: The General Mills story. K. L. Wiemer (1), C. GOOD (1). (1) General Mills, Minneapolis, MN
3:20 p.m.—S-36
Barley and rye – new potential for healthy breakfast cereals. A. KAUKOVIRTA-NORJA (1), K. -H. Liukkonen (1), K. Katina (1), K. Poutanen (1). (1) VTT Technical Research Centre of Finland, Finland

Professional Development: Food Science – Oh the Places You'll Go!

Organizer: William Atwell, Cargill, Inc., Minnetonka, MN, USA
Moderator: William Atwell, Cargill, Inc., Minnetonka, MN, USA
Sponsor: AACC Intl. Professional Development Panel

This symposium will include presentations by accomplished people in the grains-based industry who all started with cereal science or food science, or related degrees. The point will be that food science can lead to a variety of exciting careers. The format includes presentations by professional speakers, a speaker panel to field questions from the audience, and a concluding summary.

2:00 p.m.—S-37
Introduction: The easiest symposium I ever organized. W. ATWELL (1). (1) Cargill, Inc., Minnetonka, MN, USA
2:20 p.m.—S-38
It's important to have a plan? S. SHELLHAASS (1). (1) General Mills Inc., Minneapolis, MN, USA
2:40 p.m.—S-39
A random walk through science. J. FAUBION (1). (1) Kansas State University, Manhattan, KS, USA
3:00 p.m.—S-40
From research to food ingredient sales: Is the grass really greener? E. KNIGHT (1). (1). McCormick & Co., Inc., St Louis Park, MN, USA
3:20 p.m.—S-41
My career in the USDA. A. BETSCHART (1). (1) USDA ARS, Washington, DC, USA
3:40 p.m.—S-42
Food science is a tool, use it! V. CARLSON (1). (1) Van Carlson & Co., St. Paul, MN, USA
4:00 p.m.—S-43
The misguided missle: Finding your niche. L. MARQUART (1). (1). University of Minnesota, St. Paul, MN
4:20 p.m.
Panel discussion

Technical Sessions – Monday Afternoon

Beer and Other Beverages: Raw Materials and Processing, Part I

Moderator: George Reisch, Anheuser-Busch Inc., Wildwood, MO, USA

2:00 p.m.—O-14
Boulevard Brewing Company: Brewing up success in Kansas City. K. Wasmuht (2), J. MCDONALD (1). (1) Boulevard Brewing Co., Kansas City, MO, USA; (2) Krones AG Steinecker Plant, Freising, Germany
2:20 p.m.—O-15
Practical experiences of mash filtration on thin bed filters from brews with all kinds of raw materials. R. BRAEKELEIRS (1). (1) Meura SA, Peruwelz, Belgium
2:40 p.m.—O-16
Advantages of whole grain conditioning (WGC) for milling with roller mills (RM) and lautering with a lauter tun (LT). H. MENGER (2), U. Keller (1). (1) Bühler AG, Uzwil, Switzerland; (2) Ziemann Ludwigsburg GmbH, Ludwigsburg, Germany
3:00 p.m.
Break

Beer and Other Beverages: Raw Materials and Processing, Part II

Moderator: Jeff Biegert, New Belgium Brewing Co., Ft. Collins, CO, USA

3:20 p.m.—O-17
Influence of milling and particle sizes on mash conversion and filtration process. J. VOIGT (2), S. Gruener (1). (1) Adalbert-Raps-Zentrum, Freising Weihenstephan, Germany; (2) Technical University Munich Weihenstephan, Freising, Germany
3:40 p.m.—O-18
Jetstar, a novel internal boiler concept for wort preparation. T. M. BUEHLER (1). (1) Huppmann AG, Kitzingen, Germany
4:00 p.m.—O-19
External thermosyphon wort boiling – New plants in USA, Australia, and UK and their impact on flavour stability. J. M. ANDREWS (1), P. Dowd (1). (1) Briggs of Burton plc, Burton on Trent, UK
4:20 p.m.
Question-and-answer session

Grain Exchange: Processing and Raw Materials

Moderators: Michaela Miedl, Heriot-Watt University, Edinburgh, UK; Yi Xiang Xu, University of Nebraska, Lincoln, NE, USA

2:00 p.m.—O-20
Effects of eggshell powder as nucleating agent on the structure, morphology and functional properties of normal corn starch foams. Y. XU (1), M. A. Hanna (1). (1) Industrial Agricultural Products Center, University of Nebraska, Lincoln, NE, USA
2:20 p.m.—O-21
Tensile properties of compounded and injection molded corn gluten meal. J. W. LAWTON (1). (1) USDA-ARS-NCAUR, Peoria, IL, USA
2:40 p.m.—O-22
Use of extrusion for synthesis of starch-nanoclay composites for biodegradable packaging films. X. TANG (1), S. Alavi (1). (1) Kansas State University, Manhattan, KS, USA
3:00 p.m.—O-23
Bioethanol production from wheat employing a low temperature process. M. MIEDL (3), S. Cornfine (3), K. A. Leiper (2), M. Shepherd (1), G. G. Stewart (3). (1) Green Spirit Fuels plc, Templecombe, Somerset, UK; (2) North British Distillery Co. Ltd., Edinburgh, UK; (3) The International Centre for Brewing and Distilling, Heriot-Watt University, Edinburgh, UK
3:20 p.m.—O-24
Ozonation: A non-chemical alternative for control of stored product pests and molds in food grains. C. A. CAMPABADAL (1), D. Maier (1), R. Hulasare (1), C. P. Woloshuk (1), L. Mason (1). (1) Purdue University, West Lafayette, IN, USA
3:40 p.m.—O-25
Powder form grain extracts – A new spray process to generate powders from viscous liquids. S. GRUENER (1), F. Otto (2), J. Voigt (3). (1) Adalbert-Raps-Zentrum, Freising, Germany; (2) Adalbert-Raps-Zentrum, TU Muenchen, Freising, Germany; (3) Lehrstuhl Maschinen- & Apparatekunde, Tu Muenchen, Freising, Germany
4:00 p.m.—O-26
Milled rice quality and property variation due to environmental conditions. R. C. BAUTISTA (1), T. J. Siebenmorgen (1). (1) University of Arkansas

Pasta/Noodles: Processing and Raw Materials

Moderators: Phil Williams, PDK Projects, Inc., Nanaimo, BC, Canada; Larisa Cato, AWB Ltd., Melbourne, VIC, Australia

2:00 p.m.—O-27
Processing and assessment of ramen noodles: Evaluation of APH, AH and APW wheat grades for the quality attributes of ramen noodles. L. CATO (1). (1) AWB Ltd., Melbourne, VIC, Australia
2:20 p.m.—O-28
Spaghetti with plantain starch addition: Cooking characteristics and sensory evaluation. R. G. HERNANDEZ-NAVA (1), L. A. Bello-Perez (1), J. Berrios (2), J. Pan (2). (1) CEPROBI-IPN, Yautepec, Morelos, Mexico; (2) U.S. Department of Agriculture, WRRC, Albany, CA
2:40 p.m.—O-29
Fortification of white salted noodles with pulse flours. J. HAN (2), R. T. Tyler (2), L. J. Malcolmson (1). (1) Canadian International Grains Institute, Winnipeg, MB, Canada; (2) University of Saskatchewan, Saskatoon, SK, Canada
3:00 p.m.—O-30
Effective moisture diffusivity of durum wheat pasta according to drying temperature and relative humidity. S. VILLENEUVE (1), P. Gélinas (1). (1) Food Research and Development Centre, Agriculture and Agri-Food Canada, Saint-Hyacinthe, QC, Canada
3:20 p.m.—O-31
A preliminary study of applying FT-NIR spectroscopy to predict semolina and pasta quality. M. PAGANI (2), N. Sinelli (2), M. Mariotti (2), M. Riva (2), M. D'Egidio (1). (1) C.R.A. - Experimental Institute for Cereal Crops, Rome, Italy; (2) DiSTAM (Department of Food Science and Microbiology), University of Milan, Milan, Italy
3:40 p.m.—O-32
Water uptake of durum wheat endosperm in pasta manufacturing. A. KRATZER (2), S. Handschin (2), D. Gross (1), B. Conde-petit (2), F. Escher (2). (1) Bruker Biospin GmbH, Rheinstetten, Germany; (2) Institute of Food Science and Nutrition, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland

4:00 p.m.—O-33
When a white wheat becomes red! P. C. WILLIAMS (1). (1) PDK Projects, Inc., Nanaimo, BC, Canada

Sweet/Salty Foods: Health and Nutritional Aspects

Moderators: Elsayed Abdel-Aal, AAFC, Guelph, ON, Canada; Wallace Yokoyama, USDA-ARS, Albany, CA, USA

2:00 p.m.—O-34
Effects of baking and storage on lutein in whole wheat cookie and muffin products naturally high or fortified with lutein. E. M. ABDEL-AAL (1), J. Young (1), I. D. Rabalski (1). (1) AAFC, Food Research Program, Guelph, ON, Canada

2:20 p.m.—O-35
Reduction of plasma and liver cholesterol in hamsters by extruded legumes. W. H. YOKOYAMA (1), J. De J. Berrios (1). (1) USDA, ARS, Western Regional Research Center

2:40 p.m.—O-36
Rice amylopectin fine structure is related to lower rapidly digestible starch. M. BENMOUSSA (1), K. A. Moldenhauer (2), B. R. Hamaker (1). (1) Purdue University, West Lafayette, IN, USA; (2) University of Arkansas, Stuttgart, AR, USA

3:00 p.m.—O-37
Processing and storage effects on texture, microstructure and functionality of beta-glucan in oat bran muffins. S. M. TOSH (1), P. J. Wood (1), T. M. Wolever (2). (1) Agriculture and Agri-Food Canada, Guelph, ON, Canada; (2) University of Toronto

3:20 p.m.—O-38
Modification of molecular weight and solubility of beta glucan in oat bran muffins, and effect on the glycemic response. Y. BRUMMER (1), P. Wood (1), S. Tosh (1), X. Lan-Pidhainy (2), T. Wolever (2). (1) Agriculture and Agri-Food Canada, Guelph, ON, Canada; (2) University of Toronto, Department of Nutritional Sciences, Toronto, ON, Canada

3:40 p.m.—O-39
Anti-cancer effects of rice bran peptide hydrolysates on cultured human cancer cell lines. A. KANNAN (1), N. Hettiarachchy (1). (1) University of Arkansas, Fayetteville, AR

4:00 p.m.—O-40
Technical and nutritional benefits of acacia gum in bakery and cereal based products. S. BARAY (1). (1) Colloides Naturels Inc., Bridgewater, NJ, USA

Tuesday, September 19

See Track Schedule, page 22, for specific symposia and technical session titles.

7:00 – 7:45 a.m.	Beer and Other Beverages Speaker Breakfast	228
7:00 – 8:00 a.m.	Cincinnati Section Meeting and Breakfast	Veranda Restaurant, Parc 55
7:00 – 8:00 a.m.	AACC Intl. Past Presidents Breakfast	Michelangelo, Parc 55
7:00 – 8:00 a.m.	Technical Committee Meetings	
	• Bread Making Methods	Medici, Parc 55
	• Methods for Grain and Flour Testing	Tuscany, Parc 55
7:00 – 8:30 a.m.	Technical Committee Meetings	
	• Infrared Analysis	Dante, Parc 55
	• Pasta Products Anaysis	Sienna I, Parc 55
	• Rice Milling and Quality	Sienna II, Parc 55
7:00 a.m. – 5:00 p.m.	Room Available for Small Meetings, Parc 55	*Check at registration desk*
7:00 a.m. – 5:00 p.m.	Room Available for Small Meetings, Convention Center	*Check at registration desk*
7:30 – 9:00 a.m.	AACC Intl. Exhibitor Advisory Committee Meeting	Rubens, Parc 55
7:30 a.m. – 4:00 p.m.	Registration	Exhibit Hall C
8:00 – 9:15 a.m.	Plenary Session: Biotechnology – 10 Years in Review	256
8:00 – 9:15 a.m.	Plenary Session: Leading Breakthrough Innovation	Esplanade Ballroom
8:00 – 9:15 a.m.	Plenary Session: How the "Here's to Beer" Campaign is Elevating and Enhancing the Image of Beer	206
8:00 – 9:15 a.m.	Plenary Session: What's New on the Label	303
8:00 a.m. – 2:00 p.m.	Posters Available for Viewing *Authors Present 12:00 – 2:00 p.m.*	Exhibit Hall C
9:00 – 11:00 a.m.	AACC Intl./MBAA Bookstore	Lobby Area
9:30 – 11:00 a.m.	AACC Intl. Foundation Board Meeting	214
9:30 a.m. – 12:00 p.m.	AACC Intl. Working Group: Baking and Baked Products	230
9:30 a.m. – 12:00 p.m.	Beer and Other Beverages Track Session	206
9:30 a.m. – 12:00 p.m.	Breads Track Session	304
9:30 a.m. – 12:00 p.m.	Breakfast Foods Track Session	300
9:30 a.m. – 12:00 p.m.	Grain Exchange Track Session	220
9:30 a.m. – 12:00 p.m.	Pasta/Noodles Track Session	303
9:30 a.m. – 12:00 p.m.	Professional Development Track Session	270
9:30 a.m. – 12:00 p.m.	Sweet/Salty Foods Track Session	256
11:00 a.m. – 12:00 p.m.	Whole Grains Forum	236
12:00 – 1:30 p.m.	Silent Auction *Bidding closes at 1:30 p.m.*	Exhibit Hall C
12:00 – 2:00 p.m.	Exhibits and Lunch *Lunch from 12:00 – 1:30 p.m.*	Exhibit Hall C
12:00 – 2:00 p.m.	Marketplace Open	Exhibit Hall C
12:00 – 2:00 p.m.	Poster Authors Present	Exhibit Hall C
2:00 – 3:30 p.m.	Poster Take-Down	Exhibit Hall C
2:00 – 4:30 p.m.	Beer and Other Beverages Track Session	206
2:00 – 4:30 p.m.	Breads Track Session	304
2:00 – 4:30 p.m.	Breakfast Foods Track Session	300
2:00 – 4:30 p.m.	Grain Exchange Track Session	220
2:00 – 4:30 p.m.	Pasta/Noodles Track Session	303
2:00 – 4:30 p.m.	Professional Development Track Session	270
2:00 – 4:30 p.m.	Sweet/Salty Foods Track Session	256
2:00 – 6:00 p.m.	Exhibit Take Down	Exhibit Hall C
3:30 – 4:30 p.m.	Young Professionals Committee Meeting	228
4:30 – 5:30 p.m.	AACC Intl. Carbohydrate Division Meeting	236
4:45 – 6:00 p.m.	Iowa State University and Friends Reception*	Medici, Parc 55
4:30 – 6:00 p.m.	AACC Intl. Publications Panel Meeting	214
4:30 – 6:00 p.m.	Technical Committee Meetings:	
	• Physical Testing Methods	Cervantes, Parc 55
	• Pulse and Legumes	Verona, Parc 55
	• Soft Wheat Flour	Rubens, Parc 55
	• Statistical Advisory	Tuscany, Parc 55
	• Vitamin, Mineral, and Lipid Analysis	Sienna II, Parc 55
4:30 – 6:00 p.m.	Young Professionals Event*	Barcelona I, Parc 55
4:30 – 6:30 p.m.	ICC Executive Committee Meeting	230

4:30 – 6:30 p.m.	2007, 2008, 2009 AACC Intl. Technical Program Planning Meeting	232
5:00 – 6:00 p.m.	AACC Intl. International Member Forum Meeting	DaVinci I, Parc 55
5:15 – 8:00 p.m	AACC Intl. Biotechnology Division Meeting and Dinner*	DaVinci II, Parc 55
5:30 – 6:30 p.m.	AACC Intl. Protein Division Business Meeting	Raphael, Parc 55
6:00 – 9:00 p.m.	MBAA Installation of Officers Social and Dinner*	Ballroom, Parc 55
6:30 – 9:30 p.m.	Carbohydrate Division Dinner *	A. Sabella's Restaurant
6:30 – 10:00 p.m.	Protein Division Social and Dinner*	Empress of China Restaurant
6:30 – 11:00 p.m.	Tour – Hollywood by the Bay*	
6:45 – 8:00 p.m.	ICC Technical Committee Meeting	230
8:00 – 11:00 p.m.	Hospitality Room Open	Corintia, Parc 55
9:00 – 11:00 p.m.	MBAA AfterGlow Party	Ballroom Atrium, Parc 55

** indicates ticket required*

Symposia – Tuesday Morning

Breakfast Foods: Production and Measurement of Finished Product Quality

Organizer: Brad Strahm, The XIM Group, LLC, Sabetha, KS, USA
Moderator: Brad Strahm, The XIM Group, LLC, Sabetha, KS, USA

This symposium will discuss the present and future state of in-plant quality control for breakfast cereal producers. The primary focus will be on present and future approaches to at-line and in-line quality measurement and control. Quality parameters such as bulk density, color, size, shape, starch gelatinization, and proximate analysis will be discussed.

9:30 a.m.—S-44
Opportunities and challenges for on-line quality monitoring and control in the breakfast cereal industry. B. STRAHM (1). (1) The XIM Group, LLC, Sabetha, KS, USA
9:50 a.m.—S-45
Using a high-speed diode array based near-infrared spectrometer in a breakfast cereal plant. W. SHADOW (1), D. Honigs (1), G. Nilsson (1). (1) Perten Instruments, Inc., Bountiful, UT, USA
10:10 a.m.—S-46
On-line bulk density measurement technologies. B. MARLOW (1). (1) III Sigma Company, Lawrence, KS, USA
10:30 a.m.—S-47
Plant-wide quality control strategies utilizing existing data. V. SPAULDING (1). (1) Strategic Planning, Finance, and Implementation, LLC, Marshfield, WI, USA
11:10 a.m.—S-48
Technologies for on-line product fingerprinting for process control and feed-back. R. ABERLE (1). (1) The XIM Group, LLC, Sabetha, KS, USA

Grain Exchange: Ten Years of Biotechnology

Organizers: Mike Giroux, Montana State University, Plant Sciences, Bozeman, MT, USA; Randal Giroux, Cargill, Wayzata, MN, USA
Moderators: Randal Giroux, Cargill, Wayzata, MN, USA; Anne Bridges, Minneapolis, MN, USA
Sponsor: Biotechnology Division

This year marks the 10th year since biotech crops were first commercialized. The rapid adoption of biotechnology and its wide implementation are remarkable. In 2005 approved biotech crops occupied over 220 million acres and were grown in over 20 countries. The speakers in this symposium will examine what the current trends are in the use of biotech crops and what will be possible in the future.

9:30 a.m.—S-49
10 Years of biotechnology. C. JAMES (1). (1) ISAAA, Grand Cayman, Cayman Islands
10:30 a.m.—S-50
10 Years of corn biotechnology. D. GROTHAUS (1). (1) Envirologix, Portland, ME, USA
11:10 a.m.—S-51
A glimpse into the next generation of biotech crops and food products. J. GARRETT (1). (1) Monsanto, St. Louis, MO, USA
11:50 a.m.
Discussion. R. GIROUX (1). (1) Cargill, Central Research, Wayzata, MN, USA

Pasta/Noodles: Pasta: An Industry Perspective on Processing and Future Research Priorities

Organizer: Roberto Ranieri, Barilla, Parma, Italy
Moderator: Roberto Ranieri, Barilla, Parma, Italy

Quality from an industrial perspective will be discussed, from the raw material through primary and secondary processing to the final pasta product. The goal of this symposium is to identify future research priorities in areas including breeding, chemistry and technology, and end-product quality.

9:30 a.m.—S-52
Genetic enhancement of durum wheat to meet new food safety standards. J. CLARKE (1). (1) Agriculture and Agri-Food Canada, Swift Current, SK, Canada
9:50 a.m.—S-53
Durum breeding to meet the requirements of the Italian durum wheat/pasta production chain. E. DE AMBROGIO (1). (1) Produttori Sementi Bologna, Argelato, Italy
10:10 a.m.—S-54
Efficient reduction of contaminants in durum wheat processing. D. RONEY (1). (1) Buhler Milling, Plymouth, MN, USA
10:30 a.m.—S-55
Grain safety assurance: A grain exporting country's perspective. T. W. NOWICKI (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada
10:50 a.m.—S-56
Innovative approaches on pasta process research to improve end product characteristics. C. M. POLLINI (1). (1) Pavan, Galliera Veneta, Italy

11:10 a.m.—S-57
Mycotoxins in durum wheat/pasta production chain: an overview of recent researches. M. PASCALE (1), R. Ranieri (2), M. Silvestri (2), A. Visconti (1). (1) Institute of Sciences of Food Production, Bari, Italy; (2) Barilla G. & R. Fratelli SpA, Parma, Italy
11:30 a.m.—S-58
Knowledge management systems from durum wheat to pasta products. B. CUQ (1), R. Thomopoulos (1), J. Abecassis (1). INRA Montpellier, France

Professional Development: Leadership and Management Skills Seminar, Part I

Organizers: Gil Sanchez, Sierra Nevada Brewing Co., Chico, CA, USA; Lars Larson, Trumer Brauerei, Berkeley, CA, USA; Terence Sullivan, Sierra Nevada Brewing Co., Cellar, Chico, CA, USA; Jeff Hiris, Anheuser-Busch, Fairfield, CA
Moderator: Terence Sullivan, Sierra Nevada Brewing Co., Cellar, Chico, CA, USA
Sponsor: MBAA District Northern California

The success of any company relies heavily on the caliber and leadership of its management and how resources are used to further the company's business in a highly competitive industry. This track will focus on a broad spectrum of key managerial skills, practices, and concepts, such as leadership, strategic planning, implementing change, assembling a winning team, goal setting, and project management. These disciplines will be examined and shared by a group of speakers accomplished and experienced in their fields of expertise.

9:35 a.m.—S-59
Leadership versus management. S. HUFFMAN (1). (1) Mead O'Brien, Inc., St. Louis, MO, USA (to be presented by B. Seabaugh, Midwest Valve & Controls Inc., St. Louis, MO, USA)
10:20 a.m.—S-60
Strategic management: taking time to consider your company's direction. C. BEROS (1). (1) Alderwood Capital LLC, San Francisco, CA, USA
11:05 a.m.—S-61
Building high performance teams. H. JOHNSON (1). (1) Leadership One, Sacramento, CA, USA

Sweet/Salty Foods: Health Issues and Snacks

Organizer: Hannu Salovaara, University of Helsinki, Helsinki, Finland
Moderator: John J. Smith, PepsiCo/Quaker Oats, Barrington, IL, USA

Snacking forms an essential but nutritionally controversial role in our diet. According to several studies snacking plays a role in obesity, whereas other studies suggest snacking could help in weight control. How should a snack be designed to be compatible with sensible nutrition and still be attractive? This symposium examines physiological issues associated with snacking. Problems and solutions related to snack design will be discussed, including alternative sweeteners, snack foods for appetite control, use of trans-fat, and cereal-based alternatives to dairy snacks.

9:30 a.m.—S-62
Snacking in modern life-style. B. BURTON-FREEMAN (1), N. Keim. (1) University of California, Davis, CA, USA
9:50 a.m.—S-63
Strategies for developing snack foods that enhance satiety and decrease subsequent intakes. R. W. WELCH (1), S. A. Moorhead (1), P. A. Irvine (1), M. B. E. Livingstone (1). (1) University of Ulster, Coleraine, UK
10:10 a.m.—S-64
Controlling hunger and energy intake with a reduced-calorie snack. S. A. S. CRAIG (1). (1) Danisco USA Inc., Ardsley, NY, USA
10:30 a.m.—S-65
Sensible snacking: A way to increase consumption of whole grains and fiber. J. J. SMITH (1). (1) Quaker Oats, Barrington, IL, USA
10:50 a.m.—S-66
Snack food composition and quantity in the regulation of food intake. G. H. ANDERSON (1). (1) University of Toronto, Toronto, ON, Canada
11:10 a.m.—S-67
Cereal beta-glucans in snack and diary products. R. G. FULCHER (1). (1) University of Manitoba, Winnipeg, MB, Canada
11:30 a.m.—S-68
Cereal-based alternatives to dairy snacks of yogurt-type. H. SALOVAARA (1). (1) University of Helsinki, Helsinki, Finland
11:50 a.m.—S-69
Probiotics and cereals—Synbiotic functions, current applications and future development. P. BENGTSSON (1), G. Önning (1). (1) Probi AB, Lund, Sweden

Technical Sessions – Tuesday Morning

Beer and Other Beverages: Fermentation, Part I

Moderator: Alex Speers, Dalhousie University, Halifax, NS, Canada

9:30 a.m.—O-41
Studies on the uptake and metabolism of wort sugars during brewing fermentations. G. G. STEWART (1). (1) The International Centre for Brewing and Distilling
9:50 a.m.—O-42
Aeration during yeast propagation – A key to control fermentation. C. TENGE (1), S. Schoenenberg (1). (1) TUM-Weihenstephan, Freising, Germany
10:10 a.m.—O-43
Low carbohydrate beer production: Issues with sticky yeast beds. E. J. SAMP (1), L. Sillberman (2). (1) Coors Brewing Company, Golden CO; (2) Gusmer Enterprises, Inc.
10:30 a.m.
Break

Beer and Other Beverages: Fermentation, Part II

Moderator: Scott Jennings, Sierra Nevada Brewing Co., Chico, CA, USA

10:50 a.m.—O-44
Modeling ale fermentation parameters: Predicting and improving process control for fermentation and creation of criteria for yeast harvesting. P. F. BOUCKAERT (1), J. C. Biegert (1), W. B. Hepp (1), J. K. Trujillo (1). (1) New Belgium Brewing Co, Inc., Fort Collins, CO, USA
11:10 a.m.—O-45
Revolutionary new technology for measuring dissolved oxygen. R. JOHNSON (2), M. Buis (1), F. Verkoelen (1). (1) Haffmans BV, Venlo, The Netherlands; (2) Haffmans North America, Rockford, IL, USA
11:30 a.m.—O-46
Effect of hops on production of hydrogen sulfide during beer fermentation. S. T. Moon (1), J. Lee (1), S. K. PARK (1). (1) Kyung Hee University, Department of Food Science and Technology, Yongin-Si, Kyungki-Do, South Korea
11:50 a.m.
Question-and-answer session

Breads: Processing and Raw Materials

Moderator: Carla Mejia, Purdue University, West Lafayette, IN, USA; Robin Connelly, University of Wisconsin, Madison, WI, USA

9:30 a.m.—O-47
Application of whole waxy wheat for breadmaking and role of enzymes as improvers. P. V. HUNG (2), T. Maeda (1), N. Morita (2). (1) Department of Life and Health Sciences, Hyogo University of Teacher Education, Hyogo, Japan; (2) Laboratory of Food Chemistry, Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Osaka, Japan
9:50 a.m.—O-48
High temperatures during wheat grain development increase expression of non-gluten protein genes that may be important in quality. S. B. ALTENBACH (1), K. M. Kothari (1), C. K. Tanaka (1), W. J. Hurkman (1). (1) USDA-ARS Western Regional Research Center, Albany, CA, USA
10:10 a.m.—O-49
Effect of the addition of high molecular weight glutenin on the secondary structure and viscoelastic properties of polymers of maize zein. C. D. MEJIA (1), D. C. Gonzalez (1), L. J. Mauer (1), O. H. Campanella (1), B. R. Hamaker (1). (1) Department of Food Science, Purdue University, West Lafayette, IN, USA
10:30 a.m.—O-50
Slow-tight binding inhibition of TL-XI, a thaumatin-like xylanase inhibitor, from wheat. E. FIERENS (1), S. Rombouts (2), K. Gebruers (1), C. M. Courtin (1), H. Goesaert (1), K. Brijs (1), G. Volckaert (2), S. Van Campenhout (2), J. A. Delcour (1). (1) Laboratory of Food Chemistry, KU Leuven, Leuven, Belgium; (2) Laboratory of Gene Technology, KU Leuven, Leuven, Belgium
10:50 a.m.—O-51
Comparison of the flow and mixing patterns in laboratory flour testing mixers using numerical simulation. R. K. CONNELLY (2), J. B. Jordan (2), J. L. Kokini (1). (1) Rutgers, The State University of New Jersey; (2) University of Wisconsin-Madison
11:10 a.m.—O-52
Effects of laccase and xylanase on the chemical and rheological properties of oat and wheat doughs. L. H. FLANDER (2), X. Rouau (1), M. Morel (1), T. Seppänen-Laakso (2), K. Kruus (2), J. Buchert (2), K. Autio (2). (1) UMR IATE, INRA-ENSAM-UMII-CIRAD, Montpellier, France; (2) VTT, Espoo, Finland
11:30 a.m.—O-53
Influence of genotype and environment on wheat gluten proteins and breadmaking quality predicted by small-scale analytical methods. H. Naeem (1), H. D. SAPIRSTEIN (1). (1) University of Manitoba, Department of Food Science, Winnipeg, MB, Canada

Symposia – Tuesday Afternoon

Breads: Flour Fortification

Organizers: Jeff Gwirtz, JAG Services, Manhattan, KS, USA; and Jon Faubion, Kansas State University, Manhattan, KS, USA
Moderators: Jeff Gwirtz, JAG Services, Manhattan, KS, USA; and Jon Faubion, Kansas State University, Manhattan, KS, US

Long considered a "settled issue," flour fortification is again a hot topic internationally. This session will feature internationally recognized authorities addressing the topic's key issues. Speakers will present global perspectives related to fortification and address (in detail) two fortificants of particular concern, iron and folic acid. Finally, the session will deal with problems of high relevance to processors and producers of cereal foods—process control/setting limits and the impact of fortification on food product development.

2:00 p.m.—S-70
Bioavailability of elemental iron powders used for food fortification. L. TURNER (1). (1) SUSTAIN, Washington, DC, USA
2:20 p.m.—S-71
Folic acid impact and issues. G. OAKLEY (1). (1) Emory University, Atlanta, GA, USA
2:40 p.m.—S-72
Global vitamin and mineral deficiency perspectives. G. MABERLY (1). (1) Emory University, Atlanta, GA, USA
3:00 p.m.—S-73
Global consumption patterns for wheat and maize. K. BELL (1). (1) Emory University, Atlanta, GA, USA

3:20 p.m.—S-74
Setting the level of folic acid used to fortify flour. R. J. BERRY (1). (1) Centers for Disease Control, Atlanta, GA, USA
3:40 p.m.—S-75
Impact of food fortification on food product development. Speaker to be announced
4:00 p.m.—S-76
Process control for fortification. Q. JOHNSON (1). (1) Micronutrient Inititative/Quican Inc., Rockwood, ON, Canada

Pasta/Noodles: Noodles: From Raw Materials to Finished Products to Consumers

Organizer: Gary Hou, Wheat Marketing Center, Portland, OR, USA
Moderators: Gary Hou, Wheat Marketing Center, Portland, OR, USA; Robert Fesler, Horizon Milling, LLC, Ogden, UT, USA

Quality attributes, market development, and consumer acceptance of different noodle products will be discussed from the perspective of the noodle manufacturers and cereal chemists. The critical aspects of noodle processing will be overviewed and related to the functionality of raw material components (starch and protein) and final product quality.

2:00 p.m.—S-77
Asian noodle flour quality: From a miller's perspective. R. FESLER (1). (1) Horizon Milling, LLC, Ogden, UT, USA
2:20 p.m.—S-78
Association of wheat protein and starch with processing, cooking and textural properties of noodles. B. K. BAIK (1). (1) Washington State University, Pullman, WA, USA
2:40 p.m.—S-79
Recent studies on noodles in a Japanese flour mill. H. OKUSU (1). (1) Nippon Flour Mills, Atsugi, Kanagawa, Japan
3:00 p.m.—S-80
Laboratory-scale sheeting and lubricated squeezing flow behavior of Asian noodle doughs. A. S. ROSS (1), J. B. Ohm (1). (1) Oregon State University, Corvallis, OR, USA
3:20 p.m.—S-81
Polyphenol oxidases and discoloration of Asian noodles. C. F. MORRIS (1). (1) USDA ARS, Pullman, WA, USA
3:40 p.m.—S-82
Instant noodle quality: From a manufacturer's perspective. J. GONZALEZ (1). (1) El Pacayal, Palin Escuintla, Guatemala

Professional Development: Mustering Expertise and Maximizing Impact

Organizer: Jaime Jurado, The Gambrinus Co., San Antonio, TX, USA
Moderator: Jaime Jurado, The Gambrinus Co., San Antonio, TX, USA

To grow as managers, we need to develop new analytical tools and metrics for benchmarking by accessing the knowledge base of outside experts. This track addresses areas where brewing and grain professionals may not have ventured in the past, but more than likely will today and in the future: warehousing, maintenance management, and operations. An approach to world-class manufacturing is supported by metrics and a greater awareness of the beverages and cereal-based business world.

2:00 p.m.—S-83
Build your own "dashboard" for metrics in warehousing/transportation logistics. A. TALIAFERRO (1). (1) Deloitte Inc., Montreal, QC, Canada
2:40 p.m.—S-84
Software-driven metrics and KPIs for maintenance management. C. ANDERSON (1). (1) Dastastream (now Infor), San Francisco, CA
3:20 p.m.—S-85
Mustering expertise through outsourced maintenance management. S. WIGDOR (1). (1) Maintech, Malvern, PA
4:00 p.m.—S-86
Born to be wild—The brewing industry and the perils of transition. I. VERSTL (1). (1) Brauwelt International, Munich, Germany

Sweet/Salty Foods: Have Your Whole Grain Cake and Eat It Too: Challenges of Delivering Texture in Food Systems

Organizer: Marc Johnson, Texture Technologies Corp., South Hamilton, MA, USA
Moderator: Marc Johnson, Texture Technologies Corp., South Hamilton, MA, USA
Sponsor: Rheology Division

Texture is a critical element of many food products. As consumer preferences evolve, new challenges in delivering texture emerge. From yesterday's low-calorie cookie to today's whole-grain products, cereal technologists are continually challenged to deliver specific textural performance throughout products' shelf-life to match consumers' exacting expectations. Developing products with a winning texture requires the technologist to understand the basis of texture and its drivers. The symposium will present some model foods to highlight how specific textural properties can be designed into food products. The symposium will also discuss methods of texture measurement and the processes that companies should consider when designing products for textural characteristics. Throughout the product development cycle food technologists need to understand the nature of their textural targets as well as their tools for measuring progress toward those goals.

2:00 p.m.—S-87
A review of instrumental measurements of physical properties of cooked Asian wheat-flour noodles. A. S. ROSS (1). (1) Oregon State University, Corvallis, OR
2:20 p.m.—S-88
Designing whole grain foods for taste and texture. L. SKARRA (1). (1) Merlin Development, Plymouth, MN
2:40 p.m.—S-89
Considering mouthfeel, moistness and other factors when designing food products for texture. R. C. HOSENEY (1). (1) R & R Research Services, Manhattan, KS
3:00 p.m.—S-90
Texture of alkaline cooked corn masa products. H. ALMEIDA (1). (1) Kellogg Co., Battle Creek, MI
3:20 p.m.—S-91
Textural and sensory analysis of porous grain-based foods. A. BARRETT (1), A. Cardello (1). (1) US Army Natick Soldier Center, Natick, MA
3:40 p.m.
Discussion

Technical Sessions – Tuesday Afternoon

Beer and Other Beverages: Filtration and Stabilization, Part I

Moderator: Fred Havel, Molson Breweries, Richelieu, PQ, Canada

2:00 p.m.—O-54
Beer stabilization, comparison of alternative methods and practical application on candle filter. J. P. ZUBER (1), U. Gans (1). (1) FILTROX AG, St. Gallen, Switzerland
2:20 p.m.—O-55
Total filtration concept in breweries – Economical advantages in the right combination of separator, cross flow filtration and cold sterile filtration. D. Weber (2), A. MODROK (1), F. Hoel (1). (1) Alfa Laval Corporate AB, Brussels, Belgium; (2) Sartorius Food & Beverage GmbH, Goettingen, Germany
2:40 p.m.—O-56
Water recovery and reuse in malting and brewing – Membrane bioreactor. D. MEIJER (1). (1) Norit Membrane Technology BV, Enschede, Netherlands
3:00 p.m.
Break

Beer and Other Beverages: Filtration and Stabilization, Part II

Moderator: Jack Ehmann, Gusmer Enterprises, Grasonville, MD, USA

3:20 p.m.—O-57
Increasing production, product flexibility, and product quality before the filler. R. KOUKOL (1), M. Plutshack (2). (1) Centec GmbH, Frankfurt, Germany; (2) Centec LLC, Germantown, WI, USA
3:40 p.m.—O-58
Instant inline verification of the hygienic condition of process and dispensing lines using recently developed European technology. P. THONHAUSER (1). (1) Thonhauser USA Inc., Cincinnati, OH
4:00 p.m.—O-59
DE free filtration: Current state of the art. J. SNYDER (1). (1) Norit Process Technologies, Rockford, IL, USA
4:20 p.m.
Question-and-answer session

Breakfast Foods: Processing and Raw Materials

Moderators: Beth Arndt, ConAgra Foods Inc., Omaha, NE, USA; Helene Chanvrier, Food Science Australia, North Ryde, NSW, Australia

2:00 p.m.—O-65
Micro-heterogeneity and micro-rheological properties of high-viscosity oat beta-glucan solutions. J. XU (2), T. Chang (1), G. E. Inglett (2), S. Kim (2), Y. Tseng (1), D. Wirtz (1). (1) The Johns Hopkins University; (2) USDA, Peoria, IL USA
2:20 p.m.—O-66
Processing of novel wheat varieties: Textural and nutritional attributes challenges. H. CHANVRIER (1), B. Anthony (2), A. Htoon (1), Z. Li (3), M. Morell (3), S. Jay (1), D. Topping (2). (1) CSIRO – Food Futures National Research Flagship and Food Science Australia, North Ryde, NSW, Australia; (2) CSIRO – Food Futures National Research Flagship, North Ryde, NSW, and Human Nutrition, Adelaide, SA, Australia; (3) CSIRO – Food Futures National Research Flagship, North Ryde, NSW, and Plant Industry, Canberra, ACT, Australia

2:40 p.m.—O-67
Yellow pigments in wheat species: Determination and influence of processing. S. SIEBENHANDL (2), H. Grausgruber (1), G. Zweytick (2), F. Eticha (1), T. Pundy (2), C. Gast (2), E. Berghofer (2). (1) University of Natural Resources and Applied Life Sciences, Department of Applied Plant Sciences and Plant Biotechnology, Vienna, Austria; (2) University of Natural Resources and Applied Life Sciences, Department of Food Science and Technology, Vienna, Austria

3:00 p.m.—O-68
Effect of screw speed and feed moisture on the residence time distribution of legume formulation in a twin screw extruder. R. T. PATIL (1), J. Berrios (2), J. Tang (3), B. Swanson (3), J. Pan (2). (1) Central Institute of Agricultural Engineering, Bhopal, India; (2) USDA-ARS, WRRC, Albany, CA, USA; (4) WSU, Pullman, WA, USA

3:20 p.m.—O-69
Application of spectroscopic methods to reveal changes in food ingredients as a result of extrusion. C. A. LENDON (2), J. A. Engleson (2), B. Atwell (2), D. L. Elmore (1), S. A. Smith (1), A. R. Muroski (1), M. Porter (2), B. Aimutis (2), S. Baier (2). (1) Cargill, Memphis, TN, USA; (2) Cargill, Wayzata, MN, USA

3:40 p.m.—O-70
Measurement of mechanical properties of co-extruded dual phase products. L. Samuel (1), H. DOGAN (1), J. L. Kokini (1). (1) Rutgers University, New Brunswick, NJ, USA

Grain Exchange: Biotechnology

Moderators: Mike Giroux, Montana State University, Bozeman, MT, USA; Brian Beecher, USDA ARS, Pullman, WA, USA

2:00 p.m.—S-43a
Bruce Wasserman Young Investigator Award Lecture: Enzymatic processing of corn for food, feed, and fuel. D. JOHNSTON (1). USDA, Wyndmoore, PA

2:40 p.m.—O-60
Genetic and quality analyses of transgenic durum wheats expressing genes encoding high-molecular-weight glutenin subunits Dx5 and Dy10. A. E. BLECHL (3), A. Gadaleta (4), A. Blanco (4), S. Nguyen (3), J. W. Lin (3), J. S. Quick (2), S. Huang (1). (1) California Wheat Commission, Woodland, CA, USA; (2) Colorado State University, Fort Collins, CO, USA; (3) USDA Agricultural Research Service, Albany, CA, USA; (4) University of Bari, Bari, Italy

3:00 p.m.—O-61
Role of chain terminators in the varying UPP values of near-isogenic wheat lines. R. JONNALA (1), F. MacRitchie (1), L. Domenico (2). (1) Kansas State University, Manhattan, KS, USA; (2) University of Tuscia, Viterbo, Italy

3:20 p.m.—O-62
Identification of genomic regions associated with pre-harvest sprouting resistance in bread wheat (*Triticum aestivum* L.). R. SINGH (1), M. Matus-cadiz (1), M. Baga (1), P. Hucl (1), R. N. Chibbar (1). (1) Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK, Canada

3:40 p.m.—O-63
Characterization of thioredoxin h isoforms from wheat showing differential expression in seeds. R. CAZALIS (1), P. Pulido (2), J. Perez Ruiz (2), F. Cejudo (2). (1) ESA Purpan, Toulouse, France; (2) Instituto de Bioquímica Vegetal y Fotosíntesis, Sevilla, Spain

4:00 p.m.—O-64
Grain softness in wheat requires cooperative binding of puroindoline A and B to starch. H. W. WANJUGI (1), J. M. Martin (1), M. J. Giroux (1). (1) Montana State University, Bozeman

Wednesday, September 20

See Track Schedule, page 22, for specific symposia and technical session titles.

7:00 – 7:45 a.m.	Beer and Other Beverages Speaker Breakfast	228
7:00 – 8:00 a.m.	ICC Meeting	214
7:00 – 8:00 a.m.	Technical Committee Meetings:	
	• Barley and Barley Products	Dante, Parc 55
	• Biotechnology Methods	Rubens, Parc 55
	• Chemical Leavening Agents	Medici, Parc 55
7:00 a.m. – 5:00 p.m.	Room Available for Small Meetings, Parc 55	*Check at registration desk*
7:00 a.m. – 5:00 p.m.	Room Available for Small Meetings, Convention Center	*Check at registration desk*
7:30 – 9:30 a.m.	AACC Intl. Scientific Advisory Panel	DaVinci I, Parc 55
7:30 a.m. – 1:00 p.m.	Registration	Lobby Area
8:00 – 10:30 a.m.	Beer and Other Beverages Track Session	206
8:00 – 10:30 a.m.	Breads Track Session	304
8:00 – 10:30 a.m.	Breakfast Foods Track Session	300
8:00 – 10:30 a.m.	Grain Exchange Track Session	220
8:00 – 10:30 a.m.	Pasta/Noodles Track Session	303
8:00 – 10:30 a.m.	Professional Development Track Session	270
8:00 – 10:30 a.m.	Sweet/Salty Foods Track Session	256
9:00 – 10:30 a.m.	AACC Intl. Corporate Development Committee Meeting	214
9:00 a.m. – 2:00 p.m.	AACC Intl./MBAA Bookstore	Lobby Area
9:30 – 10:30 a.m.	AACC Intl. Nominating Committee Meeting	232
10:45 a.m. – 12:00 p.m.	Closing General Session with Keynote Speaker Phil Lempert	Esplanade Ballroom
12:00 – 1:00 p.m.	Engineering and Processing Division Meeting and Luncheon*	230
12:00 – 1:30 p.m.	Rheology Division Meeting and Luncheon*	228
12:00 – 2:00 p.m.	ICC Luncheon and General Assembly*	232
12:00 – 2:30 p.m.	AACC Intl. Rice Division Meeting and Luncheon*	238
12:15 – 1:45 p.m.	Milling & Baking Division Meeting and Luncheon*	Barcelona II, Parc 55
1:00 – 2:30 p.m.	AACC Intl. Professional Development Panel Meeting	Michelangelo, Parc 55
1:00 – 3:00 p.m.	AACC Intl. Approved Methods Committee Meeting	DaVinci I, Parc 55
2:00 – 4:30 p.m.	Beer and Other Beverages Track Session	206
2:00 – 4:30 p.m.	Breads Track Session	304
2:00 – 4:30 p.m.	Breakfast Foods Track Session	300
2:00 – 4:30 p.m.	Grain Exchange Track Session	220
2:00 – 4:30 p.m.	Pasta/Noodles Track Session	303
2:00 – 4:30 p.m.	Professional Development Track Session	270
2:00 – 4:30 p.m.	Sweet/Salty Foods Track Session	256
7:00 – 9:30 p.m.	Wild Crush: A Wine Affair - Closing Party*	Barcelona II, Parc 55
8:00 – 11:00 p.m.	Hospitality Room Open	Corintia, Parc 55

** indicates ticket required*

Symposia – Wednesday Morning

Breads: Molecular Basis for Dough Development

Organizer: Seok-Ho Park, USDA-ARS-GMPRC, Manhattan, KS, USA

Moderator: George L. Lookhart, Manhattan, KS, USA

This session will provide in-depth information on recent research progress and new theories concerning molecular and microscopic development of dough. The most distinguished speakers in the areas of protein chemistry, rheology, and cell wall materials will present and discuss hot topics, including structural origin of gluten and its development mechanism, gas cell size distribution and stability, suiting gluten protein composition to processing needs, and effects of nonstorage protein constituents like starch, nonstarch polysaccharide, and lipids on dough development. This will be an exciting session where you can find answers on the most critical phenomena of dough development.

8:00 a.m.—S-92
Linear and no-linear viscoelastic properties of wheat flour doughs and progress in identifying their structural origins. J. L. KOKINI (1). (1) Rutgers University, New Brunswick, NJ, USA

8:20 a.m.—S-93
The molecular basis of dough rheology-some answers some questions. P. S. BELTON (1). (1) University of East Anglia, Norwich, UK

8:40 a.m.—S-94
Formation of viscoelastic properties and gas cell structure in dough development. F. MacRITCHIE (1). (1) Kansas State University, Manhattan, KS, USA

9:00 a.m.—S-95
Molecular balance: Suiting gluten-protein composition to processing needs. C. W. WRIGLEY (1), F. Bekes (2), W. Bushuk (3). (1) Food Science Australia and Wheat CRC, North Ryde (Sydney), NSW, Australia; (2) CSIRO Plant Industry, Canberra, ACT, Australia; (3) University of Manitoba, Winnipeg, MB Canada

9:20 a.m.—S-96
Glutenin particles, their relevance and their relation to protein storage vacuoles from immature wheat endosperm. R. J. HAMER (1). (1) Wageningen Centre for Food Sciences, Wageningen, Netherlands; Wageningen UR, Food Chemistry

group, Wageningen, Netherlands; and TNO Quality of Life, Zeist, Netherlands
9:40 a.m.—S-97
Dough development: Not only a matter of gluten formation. J. A. DELCOUR (1). (1) Katholieke Universiteit Leuven, Heverlee, Leuven, Belgium
10:00 a.m.
Question-and-answer period

Grain Exchange: International Efforts to Guarantee Food Safety and Traceability

Organizer: Roland Ernest Poms, ICC - International Association for Cereal Science and Technology, Vienna, Austria
Moderators: Concha Collar, IATA-CSIC, Paterna, Spain; Stanley Cauvain, BakeTran, High Wycombe Bucks, UK

Food safety and traceability are hot topics for consumers, legislators, manufacturers, and retailers. Guaranteeing food safety poses analytical and economic challenges. Contaminants such as mycotoxins are facing the trend toward lower acceptable maximum limits. In many countries legislation requires labeling of food allergens. Microbial contamination is a growing concern, with the trend toward prolonged freshness of cereal-based products. The concurrent demand for traceability has a great impact on logistics and the use of raw materials. These issues are drivers for implementing process control as well as process innovations and the development of rapid, sensitive, and economical analytical methods.

8:00 a.m.—S-98
Traceability models, systems and standards used for reducing systematic information loss in food chain. P. OLSEN (1). (1) Norwegian Institute of Fisheries and Aquaculture, Tromso, Norway
8:20 a.m.—S-99
Worldwide mycotoxin regulations and analytical challenges. A. FELLINGER (1). (1) R-Biopharm, Vienna, Austria
8:40 a.m.—S-100
Food allergens: Legislation, analytical challenges and economic impact. R. E. POMS (1). (1) ICC - International Association for Cereal Science and Technology, Vienna, Austria
9:00 a.m.—S-101
A decade of biotech crops/foods: Legislation, analytical reqirements and the resulting economic impacts. R. W. GIROUX (1). (1) Cargill Inc., Wayzata, MN, USA
9:20 a.m.—S-102
Microbial safety, legal requirements and new opportunities for developing fresh products with a long shelf life. J. W. VAN DER KAMP (1), J. Kastelein (1), R. Montijn (1), J. van der Vossen (1). (1) TNO, Quality of Life, Zeist, Netherlands
9:40 a.m.—S-103
International standards for food safety assessment. M. G. LINDHAUER (1). (1) Federal Research Centre for Nutrition and Food, Detmold, Germany
10:00 a.m.—S-104
Sampling practices in the global market. L. FREESE (1). (1) USDA, Kansas City, MO, USA
10:20 a.m.
Discussion: Food safety and traceability—International efforts challenged. A. BRIDGES (1). (1) Malvern, VIC, Australia

Professional Development: Leadership and Management Skills Seminar, Part II

Organizers: Gil Sanchez, Sierra Nevada Brewing Co., Chico, CA, USA; Lars Larson, Trumer Brauerei, Berkeley, CA, USA; Terence Sullivan, Sierra Nevada Brewing Co., Cellar, Chico, CA, USA; Jeff Hiris Anheuser-Busch, Fairfield, CA
Moderator: Lars Larson, Trumer Brauerei, Berkeley, CA, USA
Sponsor: MBAA District Northern California

The success of any company relies heavily on the caliber and leadership of its management and how resources are used to further the company's business in a highly competitive industry. This track will focus on a broad spectrum of key managerial skills, practices, and concepts, such as leadership, strategic planning, implementing change, assembling a winning team, goal setting, and project management. These disciplines will be examined and shared by a group of speakers accomplished and experienced in their fields of expertise.

8:05 a.m.—S-107
Project management—Case study: building a new brewhouse in an operating brewery. J. HIRIS (1). (1) Anheuser-Busch Inc., Fairfield, CA, USA
8:50 a.m.—S-105
Operational excellence and goal setting. R. LEWIS (1). (1) McKinsey Corp., Los Angeles, CA, USA
9:35 a.m.—S-106
Managing change. B. BALES (1). (1) Sierra Nevada Brewing Co., Chico, CA, USA

Sweet/Salty Foods: The Next Generation of Sweet and Salty Snacks – Global Products

Organizer: Diane Gannon, Kraft Foods, Toledo, OH, USA
Moderator: Diane Gannon, Kraft Foods, Toledo, OH, USA

Today's consumer demands extend beyond our native country's borders. Through ease of communication, the Internet, study-abroad programs available at universities across the globe, free-trade agreements, and global food companies participating in the food markets, the variety of snack foods available across the globe is immense! This symposium will also address alternative/specialty grain ingredients, grain quality characteristics, formulations, and processes used for international snacks. Alternative sourcing of raw materials beyond wheat flour, their application, their challenges, and success stories will also be presented. A global presentation of sweet and salty snacks will draw the curtain on the show of products available to consumers around the world. Marketing trends and new consumer demands will be presented, and labeling claims and issues surrounding new claims will be discussed. Join the presenters for a look at what's happening in snacking!

8:00 a.m.—S-108
Global new product trends within sweet and salty snacks. C. BRINNEHL (1). (1) Mintel Market Analysts, Chicago, IL
8:40 a.m.—S-109
Challenges of formulating sweet and salty snack products with whole wheat flour. L. SLADE (1). (1) Nabisco, Hanover, NJ (to be presented by D. Gannon, Kraft Foods, Toledo, OH, USA, and L. Haynes, Kraft Foods, East Hanover, NJ, USA)
9:20 a.m.—S-110
New "novel grain" product labeling. T. VOLPE (1). (1) Diagnostics, Kinnelon, NJ

10:00 a.m.—S-111
New developments in whole grain corn products. W. DUENSING (1). (1) Bunge Milling, Danville, IL, USA

Technical Sessions – Wednesday Morning

Beer and Other Beverages: Beer General, Part I

Moderator: John Mallett, Bell's Brewery Inc., Kalamazoo, MI

8:00 a.m.—O-71
Assessment and reduction of beer soluble iron in new kegs. J. I. MELLEM (1), H. R. Hight (1), G. W. Sanchez (1), K. R. Grossman (1). (1) Sierra Nevada Brewing Co., Chico, CA
8:20 a.m.—O-72
Could beer components reduce the absorption of dietary cholesterol? Ligand docking studies with cholesterol analogues from barley and yeast. R. F. SHARPE (1), S. Walker (1), J. Brauer (1), M. Junquera (1), R. Muller (1). (1) Brewing Research International, Nutfield, UK
8:40 a.m.—O-73
Reduced iso-alpha acids' impact on beer flavor and appearance: Considerations when replacing iso-alpha acids in beer. T. H. SHELLHAMMER (1), A. N. Fritsch (1), T. Kunimune (1). (1) Oregon State University, Corvallis, OR, USA
9:00 a.m.
Break

Beer and Other Beverages: Beer General, Part II

Moderator: Graham Stewart, International Center for Brewing and Distilling, Riccarton, Edinburgh, Scotland

9:20 a.m.—O-74
Possibilities for state of the art production management using the Widmer Brewing Co. as an example. M. S. LUTZ (1). (1) Brewmaxx, Herzogenaurach, Germany
9:40 a.m.—O-91
If you don't measure it, you can't manage it. P. ANDERSON (1). (1) JohnsonDiversey/Nalco Alliance, Cincinnati, OH
10:00 a.m.—O-75
Insights on producing and co-packing special products in a brewery environment. R. KLIMOVITZ (1). (1) Master Brewers Association of the Americas
O-76 will be presented at 2:00 p.m. during the session Beer and Other Beverages: Beer General, Part IV
10:20 a.m.
Question-and-answer session

Breakfast Foods: Analytical Aspects and Functional Properties

Moderators: Ton Van Vliet, Wageningen Centre for Food Sciences, Wageningen, Netherlands; Pierre Gelinas, Agric- and Agri-Food Canada, Saint-Hyacinthe, QC, Canada

8:00 a.m.—O-77
Molecular weight distribution of (1-3)(1-4)-beta-glucan and pasting property of the flour from oat lines with high and typical amounts of beta-glucan. N. YAO (2), J. Jannink (1), P. J. White (2). (1) Department of Agronomy, Iowa State University, Ames, IA, USA; (2) Department of Food Science and Human Nutrition, Iowa State University, Ames, IA, USA
8:20 a.m.—O-78
New GPC method for methylcellulose and hydroxypropyl methylcellulose food gums as soluble dietary fiber in foods. R. G. Harfmann (1), M. TUROWSKI (1), J. R. Conklin (1), B. K. Deshmukh (1), S. K. Lynch (1). (1) The Dow Chemical Company, Midland, MI, USA
8:40 a.m.—O-79
Gluten contamination of cereal foods in Canada. P. GÉLINAS (1), C. M. McKinnon (1), M. Mena (2), E. Méndez (2). (1) Food Research and Development Centre, Agriculture and Agri-Food Canada, Saint-Hyacinthe, QC, Canada; (2) Unitad de Gluten, Centro Nacional de Biotecnología, CSIC, Cantoblanco, Madrid, Spain
9:00 a.m.—O-80
Psychophysical markers for crispness and influence of phase behavior and structure. H. DOGAN (1), J. L. Kokini (1). (1) Rutgers University
9:20 a.m.—O-81
Oat phenolics: Purification and structural elucidation of new avenanthramides from oat kernels. F. COLLINS (1), N. Fillion (1). (1) Agriculture and Agrifood Canada
9:40 a.m.—O-82
Acoustic emission, fracture behaviour and morphology of dry cellular crispy foods. T. VAN VLIET (1), H. Luyten (1), W. Lichtendonk (1). (1) Wageningen Centre for Food Sciences, Wageningen, Netherlands
10:00 a.m.—O-83
Functional properties of modified wheat proteins and their applications for encapsulating oils. L. DAY (1), M. Xu (2), L. Sanguansri (1). (1) Food Science Australia, Werribee, VIC, Australia; (2) Institute of Land and Food Resources, Gilbert Chandler Campus, University of Melbourne, Werribee, VIC, Australia

Pasta/Noodles: Analytical Aspects and Functional Properties

Moderators: Stephen Delwiche, USDA-ARS, Beltsville, MD, USA; Hicran Koc, Kansas State University, Manhattan, KS, USA

8:00 a.m.—O-84
Optical properties of mold-damaged free-falling single kernel wheat at the millisecond level. S. R. DELWICHE (1). (1) USDA-ARS
8:20 a.m.—O-85
Nondestructive testing for sprout resistance in wheat via chemical imaging with InGaAs focal plane array spectroscopy. H. KOC (1), V. W. Smail (1), D. L. Wetzel (1). (1) Microbeam Molecular Spectroscopy Lab., Grain Science Department, Kansas State University, Manhattan, KS, USA
8:40 a.m.—O-86
An ongoing quality control program for an NIR-based service and research laboratory. M. SURYAATMADJA (1), C. R. Hurburgh (1). (1) Iowa State University, Ames, IA, USA
9:00 a.m.—O-87
Wheat aleurone fraction purity via diamond internal reflection infrared spectroscopy. D. L. Wetzel (2), E. S. Bonwell (2), S. FRAZER (1), S. Ellis (1). (1) Horizon Milling, Wayzata, MN, USA; (2) Kansas State University, Grain Science Department, Microbeam Molecular Spectroscopy Laboratory, Manhattan, KS, USA
9:20 a.m.—O-88
Solvent free technology used in the production of natural oat bran concentrate. J. ZEIHER (1). (1) GTC Nutrition
9:40 a.m.—O-89
Prediction of small scale wheat quality assay and end use behavior using solvent retention capacity test. F. ANJUM (1), I. Pasha (1). (1) Institute of Food Science & Technology, University of Agriculture, Faisalabad, Pakistan

10:00 a.m.—O-90
Synchrotron infrared microspectroscopy determines secondary protein structure of wheat endosperm in situ relative to protein quality. D. L. WETZEL (1), T. Fisher (1), V. W. Smail (1), H. Koc (1), E. S. Bonwell (1). (1) Microbeam Molecular Spectroscopy Laboratory, Grain Science Department, Kansas State University, Manhattan, KS, USA

Symposia – Wednesday Afternoon

Breads: Carbohydrate-Protein Interactions in Bakery Products

Organizers: Clodualdo Maningat, MGP Ingredients, Inc., Atchison, KS, USA; Peter Weegels, Unilever Research & Development, Vlaardingen, Netherlands
Moderators: Clodualdo Maningat, MGP Ingredients, Inc., Atchison, KS, USA; Peter Weegels, Unilever Research & Development, Vlaardingen, Netherlands
Sponsors: Carbohydrate Division, Protein Division

A better understanding of ingredient interactions during dough or batter processing, baking, and finished product storage is critical in achieving baked products with desirable qualities. Carbohydrates and proteins, whether endogenous to wheat flour or added as ingredients in the formulation, constitute the major components in baked products. This symposium will specifically highlight the interactions of carbohydrates and proteins during the transformation of doughs or batters into finished baked products. The different physical, chemical, rheological, biochemical, and nutritional aspects of carbohydrate/protein interactions that dictate the structural, textural, and sensory properties of baked products will be examined.

2:00 p.m.—S-112
Proteomic identification of proteins associated with starch and their potential impact in baked product quality. F. M. DUPONT (1), W. H. Vensel (1), W. J. Hurkman (1), D. D. Kasarda (1). (1) USDA ARS, Albany, CA, USA
2:20 p.m.—S-113
A review of the plasticizing effect of low molecular weight carbohydrates on gluten matrix. V. HUANG (1). (1) General Mills, Inc., Minneapolis, MN, USA
2:40 p.m.—S-114
Puroindolines: Carbohydrate interactions. C. F. MORRIS (1), A. D. Bettge (1), G. E. King (2), M. J. Pitts (2), K. Pecka (3), P. Greenwell (2). (1) USDA ARS, Washington State University, Pullman, WA, USA (2) Washington State University, Pullman, WA, USA (3) University of Idaho, Moscow, ID, USA
3:00 p.m.—S-115
How large is the role of proteins and their interactions with starch in gluten-free bread? T. J. SCHOBER (1), S. R. Bean (1). (1) USDA ARS, Manhattan, KS, USA
3:20 p.m.—S-116
Partial restoration of gluten and starch viscoelasticity through optimized high-fiber blends. C. COLLAR (1), E. Santos (1), C. M. Rosell (1). (1) Institute of Agrochemistry and Food Technology, Valencia, Spain
3:40 p.m.—S-117
Interaction of arabinoxylan- and beta-glucan enriched barley fractions with gluten in wheat dough and baked products. M. IZYDORCZYK (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada

4:00 p.m.—S-118
The role of water partitioning over starch and protein phases during baking. P. A. M. Steeneken (1), C. DON (1), A. Jurgens (1). (1) TNO Quality of Life, Groningen & Zeist, Netherlands
4:20 p.m.—S-119
Impact of exogenous proteins on starch and gluten functionality in enzyme-supplemented doughs. C. M. ROSELL (1), C. Marco (1), A. Bonet (1). (1) Institute of Agrochemistry and Food Technology, Valencia, Spain

Grain Exchange: Recent Advances in Non-Wheat Grain Quality

Organizers: Scott Bean, USDA ARS, Manhattan, KS, USA; Tilman Schober, USDA ARS, Manhattan, KS, USA; Jeff Dahlberg, National Sorghum Producers, Lubbock, TX, USA
Moderators: Tilman Schober, USDA ARS, Manhattan, KS, USA; Jeff Dahlberg, National Sorghum Producers, Lubbock, TX, USA

Non-wheat grains are important for food, feed, and bio-industrial uses throughout the world. While grains, such as maize, sorghum, rice, and barley, share some quality characteristics with wheat, such as kernel hardness, they also have their own unique quality factors. These range from milling properties, protein digestibility, starch chemistry, phytochemical composition, kernel shape, etc. Understanding these quality factors is an important, and necessary, component in their utilization. This symposium will focus on recent research on better understanding the quality of non-wheat grains. Speakers will discuss how quality components of these grains influences their utilization and methods for determining these quality factors.

2:00 p.m.—S-120
Quality variations of rye and their impact on baking quality. K. AUTIO (1), L. Flander (1). (1) VIT Biotechnology, Espoo, Finland
2:20 p.m.—S-121
Barley grain quality requirements for fractionation-utilization. T. VASANTHAN (1). (1) University of Alberta, Edmonton, AB, Canada
2:40 p.m.—S-122
The physical basis of test weight in oats. D. DOEHLERT (1), M. S. McMullen (2). (1) USDA ARS, Fargo, ND, (2) North Dakota State University, Fargo, ND, USA
3:00 p.m.—S-123
Effect of corn quality on dry grind ethanol production. V. SINGH (1). (1) University of Illinois, Urbana, IL, USA
3:20 p.m.—S-124
Protein composition and grain hardness in sorghum. S. R. BEAN (1), B. P. Ioerger (1). (1) USDA-ARS, Manhattan, KS
3:40 p.m.—S-125
The African Biofortified Sorghum Project—Applying biotechnology to develop nutritionally improved sorghum for Africa. R. JUNG (1). (1) Pioneer Hi-Bred International, Johnston, IA, USA
4:00 p.m.
Discussion

Pasta/Noodles: What Is Quality and How Can It Be Measured?

Organizers: Brian Marchylo, Canadian Grain Commission, Winnipeg, MB, Canada; Gary Hou, Wheat Marketing Center, Portland, OR, USA
Moderator: Brian Marchylo, Canadian Grain Commission, Winnipeg, MB, Canada

Raw material quality requirements for pasta and noodles have evolved beyond strict consideration of grain composition (protein or moisture content) or intrinsic quality factors (protein or starch quality). Today's processors and consumers also connect cultivation methods, grain or food safety, nutrition, etc. to final product quality. This symposium will discuss the many faces of quality, with a focus on the means for measuring these factors

2:00 p.m.—S-126
Objective methodology to achieve quality goals in Asian noodles. D. W. HATCHER (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada
2:40 p.m.—S-127
Evaluation of test conditions in terms of sample size and compression degree in noodle texture measurement. S. J. LEE (1). (1) Dongguk University, Seoul, Korea
3:00 p.m.—S-128
Durum wheat, semolina and pasta–Defining and evaluating quality within a quality management system. L. SCHLICHTING (1), B. A. Marchylo (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada
3:20 p.m.—S-129
An approach to standardize the instrumental texture determination of cooked spaghetti firmness. M. J. SISSONS (1), L. Schlichting (2), N. E. Egan (1), W. Aarts (2), B. A. Marchylo (2). (1) New South Wales Agriculture, Tamworth, NSW, Australia; (2) Canadian Grain Commission, Winnipeg, MB, Canada
3:40 p.m.—S-130
Selenium and other minerals of nutritional importance in the Italian durum wheat and products. M. CARCEA (1), F. Cubadda (2). (1) INRAN, Roma, Italy; (2) ISS, Roma, Marina, Italy
4:00 p.m.
Discussion

Technical Sessions – Wednesday Afternoon

Beer and Other Beverages: Beer General, Part III

Moderator: Scott Helstad, Cargill Inc., Dayton, OH, USA

O-91 will be presented at 9:40 a.m. during the session Beer and Other Beverages: Beer General, Part II
2:00 p.m.—O-76
Beer as liquid bread: Overlapping science. C. W. BAMFORTH (1). (1) Department of Food Science and Technology, University of California, Davis, CA, USA
2:50 p.m.
Break
3:10 p.m.—O-92
Stratification in fermenters. D. KAPRAL (1). (1) Anheuser-Busch (retired)
4:10 p.m.
Question-and-answer session

Breakfast Foods: Health, Nutritional, and Chemical Aspects

Moderators: Yong-Cheng Shi, Kansas State University, Manhattan, KS, USA; Jose Berrios, USDA-ARS, WRRC, Albany, CA, USA

2:00 p.m.—O-93
Cys155 of 27 kDa maize gamma-zein is the key amino acid to improve its in vitro digestibility. S. LEE (1), B. Hamaker (1). (1) Purdue University, West Lafayette, IN, USA
2:20 p.m.—O-94
Enzymatic reduction of acrylamide formation using asparaginase from *Aspergillus oryzae*. B. A. KORNBRUST (1), M. A. Stringer (1), H. V. Hendriksen (1). (1) Novozymes A/S, Bagsvaerd, Denmark
2:40 p.m.—O-95
Alpha-D-glucans: Enhanced branching leads to reduced digestibility. Y. YAO (1), J. Shin (1), S. Simsek (1). (1) Purdue University, West Lafayette, IN, USA
3:00 p.m.—O-96
Annealing and gelatinization of waxy rice and wheat starches. Y. SHI (1). (1) Department of Grain Science and Industry, Kansas State University, Manhattan, KS
3:20 p.m.—O-97
Analysis of the degree of polymerization of arabinoxylans in complex cereal systems. C. M. COURTIN (1), J. A. Delcour (1). (1) KULeuven, Laboratory of Food Chemistry, Leuven, Belgium
3:40 p.m.—O-98
Reduction of oligosaccharides in raw and extruded dry beans flours by enzymatic treatment. J. J. BERRIOS (1). (1) USDA-ARS-WRRC, Albany, CA
4:00 p.m.—O-99
Go with the grain: Novel ingredients make whole grains easier to swallow. C. R. MITCHELL (1). (1) Creative Research Management, Stockton, CA

Sweet/Salty Foods: Analytical Aspects and Functional Properties

Moderators: Suthaya Phimphilai, Maejo University, Chiangmai, Thailand; Martin Whitworth, Campden & Chorleywood Food Research Association, Chipping Campden, UK

2:00 p.m.—O-100
Development of a maltogenic amylase for extended shelf-life of cakes and other sweet goods. T. SPENDLER (1). (1) Novozymes A/S, Bagsværd, Denmark
2:20 p.m.—O-101
Solvent retention capacity of mill streams in wheat. E. J. SOUZA (1), M. Kweon (1), L. Andrews (1). (1) USDA-ARS, Wooster, OH
2:40 p.m.—O-102
Objective measurement of baked and extruded product structure and appearance. M. B. WHITWORTH (1). (1) Campden & Chorleywood Food Research Association, Chipping Campden, UK
3:00 p.m.—O-103
Breeding wheat for cookies: Solvent retention capacity, wire cut, and sugar snap cookies. M. J. GUTTIERI (2), E. J. Souza (1), K. M. O'Brien (2), M. Kweon (1). (1) USDA-ARS, Wooster, OH; (2) University of Idaho, Aberdeen, ID
3:20 p.m.—O-104
Citrus fiber ingredients for adding strength to cracker products and moistness to baked products, including whole grain breads. B. LUNDBERG (1). (1) Fiberstar, Inc., Ellsworth, WI USA
3:40 p.m.—O-105
Effect of gamma-irradiation on the increase of energy density of cereal porridges. B. EUI-HONG (1), L. Ju-Woon (1), K. Jae-Hun (1), L. Seung-Taik (2), B. Myung-Woo (1). (1) Korea Atomic Energy Research Institute, Jeongeup, Chunbuk, Korea; (2) Korea University, Seoul, Korea
4:00 p.m.—O-106
Cassava starch modification for wheat based biscuits using ultraviolet radiation and a solar oven. S. PHIMPHILAI (2), K. Phimphilai (3), S. Chotineeranat (1), K. Sriroth (1). (1) Cassava and Starch Technology Research Unit, Kasetsart University, Bangkok, Thailand; (2) Department of Food Technology, Maejo University, Chiangmai, Thailand; (3) Department of Mechanical Engineering, Chiangmai University, Chiangmai, Thailand

Thursday, September 21

8:00 a.m. – 12:00 p.m.	AACC Intl. Board of Directors Meeting	Michelangelo, Parc 55
8:00 a.m. – 5:00 p.m.	Post-Summit Short Course – Grain Morphology: A Basis for Understanding Whole Grains Cereals	Ballroom II, Parc 55

Friday, September 22

8:00 a.m. – 5:00 p.m.	Post-Summit Short Course – Grain Morphology: A Basis for Understanding Whole Grains Cereals	Ballroom II, Parc 55

Oral Titles and Abstracts

Symposia listed on pages 47-74; Orals pages 75-102. Taking photographs of material projected during presentations or displayed materials is prohibited without the permission of the authors. Author index begins on page 233.

Information provided appears as submitted by the presenter.

Symposia

S-1
Chemometrics for brewing applications using PLS_Toolbox. N. GALLAGHER (1). (1) Eigenvector Research, Inc., Manson, WA, USA.

Recent advances in data analysis tools and software in the chemical process industries are finding utility in the brewing industry for applications in process monitoring and quality control. Potential applications in detection, classification, quantification, and pattern recognition are only limited by our imagination and the most successful applications arise when data acquisition, measurements, and data analysis objectives are integrated. This talk introduces some basic concepts behind multivariate analysis and then provides examples that demonstrates how advanced data analysis tools can be utilized in the brewing industry. The examples utilize the PLS_Toolbox chemometrics software package with a focus on results of the analysis rather than software implementation.

S-2
Master Brewers' Toolbox: A unique brewing software suite from the MBAA. J. HACKBARTH (1). (1) The Gambrinus Co., San Antonio, TX, USA.

'Master Brewer's Toolbox' represents integrated technical tools for the professional brewer, built on the MS Access platform. The heart of the concept is that it provides a simple method of documenting specifications and changes to specifications. The suite will calculate and store all brewing related material formulas, processing parameters and product specifications. Processing parameters are the physical constraints specified to be controlled during the process. The suite exploits a relational database and it's normalized tables. This normalization makes it extremely easy to add new plants, products, processes, parameters, and raw materials. Brews have been designed on the system from 30 L scale to 1000 bbl. Using the suite, output reports include specifications and tolerances as well as brewing process protocols and a bill of materials. The suite includes many features, including: Calculates raw materials forward from formulas and formulas backward from raw materials. Calculates brew house water, wort volumes and degrees Plato. Calculates brew house efficiency and hop utilization. Estimates hop utilization, mash RDF and finished color. Estimates strike temperatures and combined cooker and mash mixer temperatures. Calculates extract priming. Converts weights and volumes to any unit, English or Metric. Rounds results to any increment, i.e. 0.1 bbl, or 25 kg bag. Calculates the cost per bbl including raw materials, utilities, and losses. Displays fields to be selected from drop down lists. Provides a simple method of documenting instructions and changes to instructions. Calculates brewing analyses from any pair in the set (RDF, OG, RE, ALC, SPG, ABV, Calorie). Calculates both targets and tolerances for brewing analyses. Calculates BU and Color during processing, based on losses, additions, and dilutions. Calculates beer blends and analog dilutions. Corrects for priming. Calculates nutritional values. Tags revised specification records with an asterisk. Examples of its functionality will be presented to demonstrate its operation and its inputs/outputs. The suite is being launched for sale by the MBAA in this presentation (all proceeds benefit MBAA exclusively).

S-3
Glycemic index: From clinical tool to commercial opportunities for breakfast cereals. A. ALLDRICK (1). (1) Campden & Chorleywood Food RA, Gloucestershire, UK.

The GI can be described as the blood glucose raising potential of carbohydrate foods. It is measured by determining the incremental increase in blood glucose concentration accompanying consumption of a test meal over a set period of time and comparing it with an isoglucidic control meal, usually glucose and is expressed as a percentage of this. Consumption of low and medium GI foods has been associated with reducing the risk of, or ameliorating a number of the diseases associated with metabolic syndrome X and improved physiological status. Originally a clinical tool, GI has now become a commercial opportunity in a number of countries including Australia, South Africa and the United Kingdom, with products either carrying a certified GI value or an indication as to whether it is high medium or low. Given that GI can be modified by altering the susceptibility of starch to amylolytc breakdown and/or dietary fibre content, breakfast cereal technology is amenable to producing products with low to medium GI values. Routes to achieve this include processing to reduce starch digestibility such as starch retrogradation, addition of dietary fibres and use particular ingredients e.g. high amylose raw materials and whole grain products.

S-4
Relative healthful potential of breakfast cereals and cereal fractions. T. KAHLON (1). (1) USDA ARS, Albany, CA, USA.

Cholesterol lowering and cancer prevention potential of 15 ready-to-eat breakfast cereals (RTE) was evaluated by their relative in vitro bile acid binding. The RTE tested were extruded wheat bran, wheat bran flakes, shredded wheat, wheat barley flakes, wheat barley nuggets, wheat brown rice flakes, extruded oat bran, extruded oats, toasted oats, extruded rice, puffed rice, toasted rice, rice flakes, extruded corn and corn flakes. The relative in vitro bile acid binding on an equal dry matter (DM) basis considering cholestyramine as 100% bound, was lowest for corn flakes (2%) and highest for extruded wheat bran (13%). Mean relative bile acid binding values for single grain wheat, oat, rice and corn cereals were 9.4, 8.6, 2.8 and 2.1%, respectively. In order to maximize the

bile acid binding capacity of wheat bran (WB) by extrusion energy input. WB was extruded (E) at five (120, 177, 234, 291 and 358 Wh/kg) specific mechanical energy (SME) levels. The results demonstrate the relative health promoting potential of WBE-177 > WBE-120 > WB = WBE-234 = WBE-291 >WBE-358 as indicated by their bile acid binding ability on DM basis. Data suggest that extrusion of WB under the selected low SME input (WBE-177 and WBE-120) could result in breakfast cereal with enhanced healthful potential.

S-5

New cereal foods for improved human health. D. TOPPING (1). (1) CSIRO, Adelaide, SA, Australia.

Dietary change through altered purchasing practice is an effective means of risk reduction for important diet-related diseases such as constipation, diabetes, colo-rectal cancer and coronary heart disease. High fibre foods promote laxation and US fibre intakes are substantially below those needed for regularity. While the importance of fibre is recognised, starches which are digested less efficiently by human small intestinal enzymes may be even more important for human health. Slowing amylolysis gives a lower glycaemic index (GI) while limiting total small intestinal starch digestion allows a fraction to escape into the large bowel. This undigested starch (resistant starch, RS) is metabolised to short chain fatty acids (SCFA) by the colonic bacteria. SCFA promote bowel function and have the potential to lower risk of large bowel disease. Most current starchy foods have high GI and a high throughput screen has shown that many also have low RS. CSIRO is developing a range of high RS/low GI cereal cultivars for incorporation into popular consumer foods. One of these is a high RS, low GI, high beta-glucan barley (BARLEYmax™) with good processing characteristics. New wheat cultivars are currently under development using advanced breeding technologies to modify starch synthesis to lower GI and raise RS.

S-6

Breakfast and satiety—How does breakfast affect food consumption habits? M. E. CAMIRE (1). (1) University of Maine, Orono, ME, USA.

Dieting consumers are admonished to "eat a good breakfast," but does scientific research support this notion? Are whole-grain breakfast foods more satisfying? Are breakfast cereals better than baked goods? Consumers have many questions about breakfast, and researchers are racing to provide answers. By literally breaking the overnight fast, the early morning meal provides macronutrients and helps fill the stomach. The composition of the breakfast meal can influence satiety, leading to reduced calorie intake later in the day. Protein, fat, dietary fiber and complex carbohydrates all contribute to the appetite-suppressing effect of breakfast, yet an optimal satiating meal formulation eludes product development scientists. Experimental design of satiety studies can influence outcomes. Short-term effects do not necessarily carry over into longer periods. Measurement of appetite and satiety are still relatively subjective measures, and in reality, consumers do not stop during a meal and consider how full they feel. Lifestyles may not permit preparation of some types of breakfast foods, so opportunities exist for development of satisfying, yet easy to prepare, grain-based breakfasts. Recent research on breakfast, satiety and weight loss will be critically examined, and recommendations for future work will be made.

S-7

Barley and rye for flavor and nutritional enhancement of breakfast foods. E. A. ARNDT (1). (1) ConAgra, Omaha, NE, USA.

The 2005 USDA Dietary Guidelines for Americans recommends increased consumption of whole grains as part of an overall healthful diet. At least half of grain intake should be from whole grains. Research indicates that consuming a diet rich in whole-grain foods may help reduce the risk of heart disease, type 2 diabetes and certain cancers and may help with weight management. Per 2004 USDA ERS data, Americans consumed 10.4 servings of grain-based foods per day (16 g per serving). Wheat-based foods comprised more than 70% of the grains consumed. By comparison, barley and rye consumption was less than 0.5 g each. Barley and rye are nutrient-dense grains that contain fiber, protein, healthy lipids, vitamins, minerals and other phytonutrients. One barley variety, Prowashonupana, contains at least 30% dietary fiber, of which more than 40% is soluble fiber. Barley and rye can be used to enhance the flavor, texture, appearance and nutritional composition of a variety of traditional and non-traditional breakfast foods, including hot and ready-to-eat cereals, breads, tortillas, muffins, bars, vegetarian patties and smoothies. Data includes nutritional contributions for products formulated with different inclusion levels of barley and rye.

S-8

Introduction, outline, and comparison of the grading systems employed by the major Southern Hemisphere wheat exporters, Australia and Argentina. R. L. CRACKNELL (1), T. Watts (2). (1) Crackers Consulting, Melbourne, Australia; (2) AWB Limited, Melbourne, Australia.

The wheat grading and classification systems in both countries have very similar backgrounds, but over the years they have become markedly different, with Australia developing a complex quality-based system and Argentina tending to follow a more traditional regional approach, although this is currently undergoing some significant changes. Many decades ago, the Australian wheat industry adopted a "white grain only" policy and with the benefit of hindsight this was a master stroke. Whilst it brought with it the downside of high sprout damage susceptibility, Australia's generally hot and dry summer harvesting conditions minimised the likelihood of pre-harvest rain damage, thus providing a solid basis for the system employed today. The Australian Wheat Board, now AWB Limited, initially employed a "Fair Average Quality – FAQ" classification system whereby, provided basic physical grain quality standards were met, all deliveries in a geographical area would be binned together regardless of variety or protein content. Under the influence of seasonal and environmental conditions, this approach produced parcels of wheat which varied substantially in quality between regions and seasons. Over the years the system has evolved to one which categorises wheat into eight primary classifications based on variety and protein content. The system is driven primarily by the environmental conditions encountered in the main wheat growing regions and a conscious effort to utilize its potential and match it to the quality requirements of

specific end products. Argentina on the other hand has tended to persevere with an FAQ-type system where deliveries in clearly defined regions are binned together, characterized, and marketed on the basis of their overall performance. However the local flour millers have long since recognized the value of segregating individual varieties for particular purposes, and there are moves afoot to introduce such a system more widely. Details of the system and how it compares with Australian approach will be discussed.

S-9

The wheat grading and classification systems employed by the United States and Canada, and an update on hard white wheat development. J. E. DEXTER (1), G. L. Lookhart (2). (1) Canadian Grain Commission, Winnipeg, MB, Canada; (2) Manhattan, KS.

The wheat grading and classification systems employed by the US Federal Grain Inspection Service (FGIS) and the Canadian Grain Commission (CGC) are based on similar principles. Both systems use approved sampling procedures to obtain representative lots that are assigned grades on the basis of test weight and protein, and visual assessment of physical condition. In recent years FGIS and CGC have incorporated reference photographs of common causes of damage such as frost, sprout, black point (tip) and *Fusarium* (scab) to assist inspectors. Customers are increasingly requesting additional quality specifications. For example, the CGC has formed a working group to develop an operational plan for implementing falling number measurements into the Canadian wheat grading system. Grain safety is also becoming of increasing importance. The US and Canada are both endeavouring to develop high quality hard white (HW) wheat. Whole wheat products prepared from HW are preferred by some consumers over hard red (HR) whole wheat flour because of the milder taste and superior colour of HW products. White HW flour also has a colour advantage over white HR flour, and in particular, is preferred for some forms of Asian noodles because specks are less conspicuous. In the US, winter and spring HW varieties have been developed. Canada introduced the medium protein HW class Canada Prairie Spring White in 1990, and in 2004 the higher protein Canada Western Hard White Spring class was launched. To date the production of HW wheat in the US and Canada has lagged behind expectations because of the challenge of developing varieties that combine good agronomic performance with desirable quality. However, both the US and Canada remain committed to development of HW wheat, and the potential for HW wheat to become increasingly important in both the US and Canada remains strong.

S-10

Evolution of wheat quality and grain grading in Kazakhstan. A. I. MORGOUNOV (1), A. I. Abugalieva (2). (1) International Maize and Wheat Improvement Centre (CIMMYT), Almaty, Kazakhstan; (2) Kazakh Research Institute of Agriculture, Almaty, Kazakhstan.

The virgin lands of Northern Kazakhstan were brought into cultivation in the late 1950s to satisfy the growing needs of the Soviet Union in wheat grain. The area under wheat quickly grew from almost non-existent to 20 mln ha. After 1991 with the new country of Kazakhstan established the wheat area dropped to 10–11 mln ha due to low external demand. The crop cultivated in Northern Kazakhstan represents almost entirely high latitude short season spring bread wheat similar to Hard Red Spring Wheat types of USA and Canada. Precipitation varying from 250 to 400 mm a year remains a major abiotic limiting factor. Despite the fertile soil the average yield in the country has varied from 0.6 to 1.3 t/ha over the past 50 years. The domestic consumption of wheat is around 8 mln tonnes and, hence, three to five mln tonnes of wheat are exported annually either as grain or flour. The neighbouring countries of Central Asia (Tajikistan, Kyrgyzstan, Uzbekistan), Caucasus (Azerbaijan, Georgia) as well as Russia and in some years Ukraine represent the main traditional export markets. The new export opportunities are being explored in Afghanistan, Iran, Middle East (Jordan, Algeria) and Europe. The system of grain quality classification has been based on the approaches and parameters of the old system from the former USSR. At the elevator gate the grain is classified into five classes based primarily on moisture, vitreousness, gluten content and its quality and percentage of mixture. The main difference of the grain quality system in Kazakhstan and other grain exporters is that gluten content and quality as well as vitreousness are given relatively high weight. At the same time the parameters commonly used in other countries like grain hardness and Falling Number are not utilized. Kazakhstan sees its grain production potential in increasing the volume of grain and flour export though more aggressive marketing, lower production and transportation costs and, importantly, harmonization of the grain quality grading system.

S-11

A comparison of the wheat classification systems in central Europe and other European countries, with those in use in the U. S. and Canada. S. TÖMÖSKÖZI (1), A. Salgó (1). (1) Budapest University of Technology and Economics, Budapest, Hungary.

Different standardized procedures are used for determination of wheat and flour quality. The application of methods is mainly depending on the goals of classification (i.e. qualification for milling industry, baking processes, pasta production, etc.), but partly also on the historical and/or regional tradition. However, the global wheat market requires more and more knowledge about the coherencies between parameters obtained with different methods, the reliability and barriers of their adaptability and, maybe, the reasons of the relationships. Is it necessary to use more than twenty different methods for complex characterization of wheat quality? Or is it enough to ensure some classes of wheat with standard quality – and the technologies and the chemicals will solve the other problems? Is it possible to estimate some parameters from the others for simplifying the qualification procedures? How is changing the role of the chemical composition, nutritional and food safety aspects in the wheat qualification today? In the lecture, an overview will be given concerning different classification systems and their backgrounds in our region.

S-12

Milling and baking industries, UK. S. P. CAUVAIN (1). (1) BakeTran, High Wycombe, UK.

The choice of wheats in the UK to be used in the UK milling grist is influenced by three mains factors; the use of the

Chorleywood Bread Process and not-time doughs for the production of about 95% of bread, the quality of the UK harvest which in 'good' years may provide up to 70% of wheat usage and the rise of premium breads at the expense of the 'economy' loaf. Imported wheats continue to play a significant part in UK bread production but increasingly traceability in the grain chain is becoming as important as wheat quality.

S-13
Effects of semolina composition and processing conditions on couscous quality. B. CUQ (1) and J. Abecassis (1). (1) INRA, Montpellier, France.

Durum wheat is a very important crop in the Mediterranean basin as a basic ingredient in many dishes such as couscous. The industrial process for making couscous has been designed to reproduce traditional methods: mixing-agglomeration, detaching, sifting, steam cooking, drying, cooling, and packaging. The first part of the process, where the semolina particles are hydrated and agglomerates through mechanical mixing effects, is an essential step in bringing about interactions between particles leading to form couscous granules. The knowledge and the control of interactions between water and durum wheat semolina is considered as a one of the key factor in the overall process for making couscous. After the mixer, the moist agglomerates are discharged into the detacher to separate the entangled couscous granules and conveyed to a wet-sifting process to remove the oversized agglomerates and fine particles. Couscous then is steam cooked, dried, and graded into the desired granulations. The management of couscous processing is discussed in regard with the recycling circuits for the moist and cooked agglomerates and with the prior semolina hydration in premixing before mixing. Couscous is considered to be good quality when the particle size is uniform, there is no unusual odor, the texture is light and fluffy, and it should not be gummy or gritty. When rehydrated, it should be soft, unsticky, with a high water absorption capacity. Only few studies have focused on the mechanisms underlying couscous quality. Couscous quality is known to depend on the raw materials, the semolina particle size and chemical composition (quality and quantity of protein and lipids). The contribution of raw wheat characteristics on couscous quality has only been considered for cultivars, semolina particle size, and semolina composition. Durum wheat cultivars exhibiting strong mixing characteristics (strong gluten) had an advantage over cultivars that have weak mixing properties (weak gluten) for some quality parameters, particularly couscous yield and water absorption index.

S-14
New pasta product trends and innovations in North America. D. HAHN (1). (1) New World Pasta Co., Harrisburg, PA, USA.

Pasta product sales are rebounding from their low during the peak of Atkin's diet fad. Like all grain based products health will continue to drive new products and consumer interest. The release of the 2005 Dietary Guidelines for Americans and the new MyPyramid with the media attention on diet and healthy has sparked the consumer interest in more healthy products. Whole grain-high fiber products are currently the primary drivers of growth. This should continue as more research shows the important role of whole grains and fiber in health, lowering the risk of obesity and their positive effects on insulin sensitivity. The positive benefits of omega-3 fatty acids and their inclusion into new products are also revitalizing the pasta category. Organic pasta sales are also showing strong growth. The challenge for the industry is to produce good tasting high quality products to meet these emerging trends.

S-15
Refrigerated products: New product trends and innovations. C. ANDERSON (1). (1) Monterey Gourmet Foods, Salinas, CA, USA.

In today's world, consumers are looking for products, which are healthy, easy to prepare, nutritious and speak gourmet. This focus has enhanced the image of pasta and in particular, refrigerated pasta. Only a few years ago, the Atkins Diet severely impacted the pasta industry. Many dry and refrigerated pasta companies were forced out of business as consumers reduced their intake of carbohydrates in their diet. With the recent demise of the Atkins Diet this trend has been reversed and demand for pasta and pasta products is steadily increasing. Refrigerated pasta was developed to meet the needs of consumers who wanted fresh pasta with extended shelf life. Consumers are now recognizing that pasta is low in calories, low in fat, high in fiber and cholesterol free. Moreover, refrigerated pasta is perceived as fresh and fits the concept of being a gourmet food. With the incorporation of whole wheat, whole grain or flax seed, refrigerated pasta is being associated with promoting a strong cardiovascular system, lowered glycemic index and an overall asset contributing to a healthy lifestyle. Since 2003, refrigerated pasta sales have steadily increased. This trend, however, is not without its challenges as whole wheat, whole grain, flax seed and other exotic ingredients are incorporated into these products. Pasta is still one of the most popular meals eaten in America. Refrigerated pasta is now gaining market share and there are strong indications that this trend will continue for the foreseeable future.

S-16
Overview of pasta products in Europe and America. M. G. D'EGIDIO (1). (1) Instituto Spermentale Cerealicoltura, Roma, Italy.

Pasta products have been known to Mediterranean civilizations for many centuries and are still responding to actual requirements of nutrition and safety. Mediterranean diet for example promotes an high intake of cereals, rich in complex carbohydrates, proteins, vitamins and minerals coming from pasta itself. Pasta is now a very popular food obtained by a relatively simple process, available in a variety of shapes and eaten everywhere. Durum wheat is universally recognized as the preferred raw material for pasta products in view of the quantity and quality of its protein component which guarantee the best cooking quality, although common wheat can be also used to obtain a less satisfactory product. The properties of durum wheat required for a good quality pasta are related to milling performance (semolina milling quality) and to ability of semolina to give pasta with good appearance, resistance to breakage and cooking tolerance. In the traditional pasta-consuming countries (i.e. Italy), the textural characteristics of pasta products play an essential role in determining the consumer acceptance, while in other

countries factors such as colour or nutritional value are also implicated. During the last five years novel new pasta based-products have been released as more rich in terms of ingredient composition and more balanced from the nutritional point of view. An overview on the current trends in pasta product releasing in EU countries and in Northern America is presented, particularly as regard the new trends of products, the consumers requirements and the new developments of sector.

S-17

Wheat noodle products in Asia. B. X. Fu (1). (1) Canadian International Grains Institute, Winnipeg, MB, Canada.

Recent archaeological evidence suggests that deft skills existed in China to make long and thin noodles 4,000 years ago. Many premium noodle products are still produced by the traditional hand-stretching methods in China and Japan. Despite their ancient origins, noodles have undergone considerable evolution and migration, as the products become increasingly globalized. The modification and processing is necessary due to regional eating habits, taste preferences, change in lifestyle, and advances in technology. Developments in noodle processing technology, such as vacuum mixing, waved rollers and multi-layer sheeting, were based on the principles of gluten development in handmade noodles. The local uniqueness of formulations and processing has created many country-specific systems for noodle classification. There is a need to standardize noodle nomenclature. With the development of economy in Asia-Pacific, consumer expectations of noodle product quality are getting higher. High quality noodles should be bright in colour with very slow discoloration, have an adequate shelf life without visible microbiological deterioration or oxidative rancidity, and have appropriate flavour and textural characteristics which will vary according to noodle type and region. While the major raw material for wheat noodles is flour, there in fact many other ingredients which contribute to the quality of finished product. Raw materials with appropriate characteristics are judged from an understanding of their functionalities, the finished product, and process involved. Functionality of flour components and other key ingredients related to noodle quality will be discussed.

S-18

Wheat noodle products in Latin America. G. HOU (1). (1) Wheat Marketing Center, Portland, OR, USA.

Wheat noodles have been an traditional food in Asia, but in recent years they are gaining popularity in other parts of the World in recent years. In many Latin American countries, wheat noodles have become part of local foods. Instant ramen noodles and chaomein noodles are the two most popular noodles in Latin America. Instant ramen noodles are steamed and fried noodles. They are packed in either bags or cups along with noodle soup seasoning sachets. The cup type ramen is more popular than the bag type, because the cup noodles are more convenient to serve by simply adding hot water. Only a small portion of ramen noodles are produced locally, a majority of ramen noodles sold in Latin America are imported from the U. S. and Asia. Instant ramen noodle manufacturers in Latin America have mass production capability and the noodle production is highly automated. Chaomein noodles are mostly produced locally. They are steamed, air-dried or sun-dried noodles. The steaming time usually lasts about 30–60 minutes, and the drying time takes about 45 minutes to 6 hours depending on the equipment used. Many variations in formula, process, and finished product quality exist among different manufacturers in the region. Most Chaomein noodle manufacturers are small operations and the noodle production is often done in batches. Because firm bite noodles are preferred by the consumers in the region, the manufacturers often request wheat flours of high protein content, such as the flour blend of U. S. hard red spring and hard red winter wheat. However, flour quality standards for such noodle products remain to be developed. More collaboration between flour millers and noodle manufacturers is necessary to assure that the flour meets the needs of the noodle processors and maintain the quality consistency.

S-19

Water and solids mobility in foods: An overview. S. SCHMIDT (1). (1) University of Illinois, Urbana, IL, USA.

Water plays a profound role in the production, processing, microbial safety, chemical and physical stability, and sensory perception of food ingredients and systems. Thus, water in foods has been an essential focus of study in many fields of inquiry for numerous years – yet there is still much to discover, learn, and apply. Currently, there are three main water relations in foods research avenues or approaches – water activity, molecular water mobility, and the glass transition. Since the main topic of this symposium is water activity this presentation serves as a broad overview of the three water relations in foods avenues and as a springboard to the more detailed presentations to follow that focus more exclusively on water activity measurement methods and industrial applications. Thus, the objectives of this presentation are to: 1) discuss the fundamental principles and associated measurement methods underlying each of the three water relations in foods research approaches, 2) highlight the strengthens and limitations of each approach, and 3) explain how these approaches are not mutually exclusive, but rather can be used in concert to provide a composite, multi-level (at various distance and time scales) portrait of the water and solids dynamics (that is, mobility) that govern the stability and quality behavior of food systems.

S-20

What is water activity? A. FONTANA (1). (1) Decagon Devices, Pullman, WA, USA.

The single most important property of water in food systems is the water activity. The concept of water activity will be derived from fundamental thermodynamics and be defined as a measure of the energy status of the water in a system. The factors that control the water activity within a food will be discussed. Water activity is a measure of how tightly water is "bound" and related to the work required to remove water from the system. Water that is "bound" should not be thought of as totally immobilized. Microbial and chemical processes are related to this "bound" energy status in a fundamental way. Because water is present in varying energy states, analytical methods that attempt to measure total moisture in samples don't always agree or relate to safety and quality. A comparison of the differences between moisture content, an extensive variable that describes the total amount of water

present in a food, and water activity an intensive variable that describes the energy status, or escaping tendency of the water in a sample, will be presented with examples illustrating these differences.

S-21
Modeling the boundaries of *Staphylococcus aureus* growth for risk assessment and product development purposes. C. STEWART (1). (1) National Center for Food Safety & Technology, Summit-Argo, IL, USA.

Formulation of shelf-stable intermediate moisture products is a critical food safety issue, therefore knowing the precise boundary for the growth-no growth interface of Staphylococcus aureus is necessary for food safety risk assessment. This study was designed to examine the effects of various humectants and to produce growth boundary models as tools for risk assessment. The concepts of molecular mobility and the effect of various physical properties of humectants, such as glass transition temperature, membrane permeability and ionic vs. nonionic humectants on *S. aureus* growth were investigated. The effects of relative humidity (RH; 84–95% adjusted by sucrose plus fructose, glycerol or NaCl), initial pH (4.5–7.0 adjusted by HCl), and potassium sorbate (0 or 1000 ppm) on the growth of *S. aureus* were determined. Growth was monitored by turbidity over a 24-week period. The 1792 data points generated were analyzed by SAS LIFEREG procedures that showed all studied parameters significantly affected the growth responses of *S. aureus*. Differences were observed in the growth/no growth boundary when different humectants were used to achieve the desired RH values both in the absence or presence of potassium sorbate. Sucrose plus fructose was most inhibitory at neutral pH, while NaCl was most inhibitory at low pH. The addition of potassium sorbate greatly increased the no growth regions, particularly when pH was <6.0. The models will be presented and use in the assessment of product safety and shelf life will be demonstrated.

S-22
Practical applications of water activity in foods. K. KOU (1). (1) General Mills, Minneapolis, MN, USA.

Water, the most important component of most foods, profoundly affects food texture and quality, its microbial safety, as well as its nutritional status and digestibility. Much progress has been made in the study of water relations in foods in order to understand and thus predict such phenomena as food spoilage. Among the three main water relations in foods research approaches (i.e., water activity, molecular water mobility, and the glass transition), water activity is the most widely used measure of the availability of water in foods. Even though water activity is not a perfect predictor, it does correlate sufficiently well with physical changes, chemical reaction rates and rates of microbial growth to make it a useful indicator of product stability and microbial safety. Since the main topic of this symposium is water activity this presentation will focus on practical applications of water activity in foods and discuss some real-world examples of how water activity is used as an effective tool for assessing product safety and quality. Thus, the objectives of this presentation are to: 1) discuss the practical uses of water activity related to physical changes, chemical reaction rates, microbial safety, texture, caking and clumping in foods, and 2) discuss using water activity in combination with other moisture management strategies in foods research.

S-23
Methods for water activity measurement. B. CARTER (1). (1) Decagon, Devices, Pullman, WA, USA.

Water activity is an important indicator of food safety and quality. It is defined as the partial vapor pressure over a sample at a certain temperature divided by the saturated vapor pressure at the same temperature. The purpose of this discussion will be to review methods used to measure water activity accurately. There are predictive models that can be used to calculate the water activity of a product based on the relative concentration of its ingredients. However, these models are usually limited in accuracy due to interactions between product ingredients that cannot be accounted for by the model. Instead instrumentation is needed to accurately measure the water activity of complex food products. Several different water activity measurement methods are available, but those primarily in use today are the electric hygrometer, the chilled mirror hygrometer, and indirect measurement by NIR. Each of these methods have advantages and disadvantages that will be discussed. For all types of instruments, maintaining accuracy is of utmost importance. Critical to maintaining accuracy is to verify instrument performance using salt standards. In addition, since water activity is a temperature dependent measurement, fluctuations in temperature can affect instrument accuracy. Some instrumentation has built-in temperature control to buffer against temperature fluctuations. Sample preparation and treatment prior to testing can also impact accuracy. Since most product types can be measured accurately with very little sample preparation, minimal handling is preferable. However, if sample preparation is needed, it is vital that preparation steps are consistent for each water activity test.

S-24
Fast water activity analysis of food and feed products using a diode-array based near-infrared spectrometer. W. SHADOW (1). (1) Perten Instruments, Bountiful, UT, USA.

Water activity measurement is a useful tool in many food and feed based manufacturing processes. Instruments are available to accurately measure water activity in less than 5 minutes. However, even faster analysis time is needed for certain applications. High speed diode array based near-infrared spectrometers offer heretofore unavailable analysis opportunities. They can perform a water activity analysis in only 6 seconds with no sample preparation required. Measuring water activity by NIR requires a unique calibration curve for each product. Other constituents (moisture content, oil content, protein content, etc.) may be measure simultaneously with water activity if calibrations are available. Calibration and subsequent water activity measurements of various foods and grains will be presented.

S-25
Rye bread—The impact of raw materials and processing on bread quality. M. G. LINDHAUER (1). (1) Federal Research Centre for Nutrition and Food Institute for Cereal Potato and Starch Technology, Detmold, Germany.

Breadmaking from whole grain rye or rye flours has to overcome certain constraints. The one is that rye does not

contain proteins being able to form a three-dimensional network as basic structure of dough and final bread crumb. Secondly, rye contains higher amounts of non-starch polysaccharides subsumed under the term "pentosans". Pentosans are characterized by a high swelling and thus water binding capacity and by this they carry to a very high extent the burden of dough structure formation instead of the missing gluten. Furthermore, rye starch contributes to a higher extent to dough formation than in wheat processing. Rye starch gelatinates at lower temperatures, already, and is less resistant against enzymatic degradation. As a result it contributes significantly to water binding. Enzyme susceptibility, however, may turn out as a disadvantage when rye grains under unfavourable harvest conditions suffer from pre-harvest sprouting, i.e. the initiation of high activity of degrading enzymes, mainly alpha-amylase. Depending on the extent of pre-harvest-sprouting damage dough-preparation and breadmaking becomes more difficult or even impossible. To at least minimize this problem it can be shown rye breeding has effected remarkable success in resistance against pre-harvest sprouting. Sour-sough application has a very long tradition in rye bread baking. It not only improves solubility and thus water binding capacity of rye proteins and other constituents but also has a significant impact on final bread quality, shelf-life of products. In summary, rye processing has a long and successful tradition in Central, Northern and Eastern parts of Europe which is demonstrated by multifold tasty and with respect to nutrition physiology very healthy rye breads and other baking goods.

S-26
Improving bread quality with mechanical dough development. S. P. CAUVAIN (1), L. S. Young (1). (1) BakeTran, High Wycombe, UK.

Control of dough rheological properties are critical in the processing of bread dough. Failure to match dough qualities with equipment performance commonly leads to problems with final bread quality. Some examples of dough processing problems and their solutions will be presented.

S-27
Making bread in 21st century America. T. KUK (1). (1) American Society of Baking, Sonoma, CA, USA.

The environment for baking in the USA is changing in response to government and consumer pressures. In the 21st century American bakers will face the need to be more responsive and innovative than ever. This paper addresses some of the key issues and examines how changes in manufacturing technology are being used by bakers to meet the challenges of this century.

S-28
Making of Chinese steamed bread containing almond flour/skin flour. W. HUANG (1). (1) Southern Yangtze University, Wuxi, Jiangsu, People's Republic of China.

Steamed bread, leavened by steam, is one of the popular staple foods made from wheat flour in China. Chinese steamed breads are divided into two categories, that is, northern style and southern style. Currently, about 45 percent of wheat flour is processed into steamed bread in China, particularly in its Northern part. In general, Northern-style steamed bread has whiter and smoother surface, larger volume, finer and uniform structure, and more elastic and tough than southern-style steamed bread. Almonds produced in California are low in carbohydrates, rich in dietary fibers and proteins, and are a nut that benefits heart health as claimed by FDA. This paper resulted from a joint project between Southern Yangtze University and Almond Board of California. The objectives of this research were to formulate a new type of northern-style steamed bread that satisfies the qualified health claim criteria using American California almond flour or almond skin flour, as another key ingredient besides wheat flour, and to investigate their rheological, textural and sensory characteristics. Steamed breads were made from wheat and almond flour/almond skin flour based on a traditional Chinese formulation. The statistical design of Response Surface Methodology was used to optimize the formula of new type of steamed bread. Steamed bread products were evaluated for quantified textural attributes by a trained sensory panel, and descriptive profiles of textural attributes were obtained. Products were also tested by use of Texture Analyzer and by Minolta chroma meter. Flavor components of products were identified by using GC/MS spectrometry. Experimental data were analyzed using analysis of variance and principal components analysis. Relationships between sensory and instrumental analyses were identified with correlations. Results showed that steamed breads produced with the addition of California almond flour or almond skin flour have significantly different texture and sensory characteristics as compared to the traditional formulation.

S-29
Evolution and future of bread in Spain. J. ALAVA (1). (1) La Familia SA, Valencia, Spain.

The consumption of bread in Spain has a long history. There are many traditional bread varieties which are still produced in Spain and Spanish-speaking countries around the world. Small locally-based bakeries continue to provide a significant portion of the bread consumed in Spain but the industrial bakeries which developed some years ago continue to expand. The manufacture of sandwich and toast-style breads represents a significant part of the Spanish market and crustless bread a significant product type. This paper will examine the development of Spanish bread products and their potential for future development.

S-30
New Zealand: New products and processes for the future. A. WILSON (1), K. Sutton (1), M. Morgenstern (1). (1) Crop & Food Research Ltd., Lincoln, New Zealand.

The New Zealand baking industry has a long history of funding research to benefit the industry. Changes in Government funding have led to larger, more focused and longer term programs to support the industry. Two such programs will be presented as examples of how cooperative research can benefit not only the whole industry but the country as well. The 'Lifestyle Foods' program is aimed at the growing health and convenience driven market by developing products with proven health benefits. The 'Future Energy Efficiency' program targets reducing energy needs in anticipation of increased energy costs by challenging the way we do things to discover more energy efficient ways of bread manufacturing.

S-31
Exploring the link between the cell structure and eating properties in sandwich bread using C-cell and texture analysis. R. CABRERA (1). (1) Frank Roberts & Sons Ltd., Northwich, Cheshire, UK.

Sandwich bread is an important part of the UK bread market and is becoming increasingly important in the European market. The manufacturer strives to find a balance between the customer or sandwich market requirement to make a loaf as square as possible and consumers desire to have acceptable eating quality throughout refrigerated shelf life. Historically measurement of eating properties and bread characteristics has been very subjective using human perception. The use of analytical techniques such as C-Cell to measure internal structure of the crumb and bread shape along with Texture Analysis to measure softness and resilience can now produce and objective result. These techniques can be used in isolation to measure the properties of bread. This presentation will show the study that has been used to explore the link between bread structure versus eating properties using C-Cell and Texture Analysis.

S-32
Breakfast. Still the most important meal of the day? A discussion of the many benefits of grain-based foods on well being and disease prevention. J. ADAMS (1). (1) Grain Foods Foundation, Ridgway, CO, USA.

As long as each of us can remember, breakfast has been touted as the most important meal of the day. Is it true or just something our mothers told us? Skipping breakfast is highly prevalent throughout the U. S., in some populations more than others. The definition of breakfast also varies considerably among age groups and cultures. Dieters are often guilty of skipping breakfast – does it make them lose weight? On the other hand, are breakfast eaters slimmer, smarter and have overall healthier lifestyles? This presentation will address those issues by reporting the findings of numerous breakfast studies.

S-33
Latest research on whole grains and their importance in formulating breakfast foods. J. JONES (1). (1) College of St. Catherine, St. Paul, MN, USA.

New intervention and epidemiological studies continue to strengthen the case that whole grains reduce the risk for cancer, coronary disease, diabetes, hypertension and other disorders. Relating the findings of this research to health professionals and consumers is one challenge for the industry. Formulation of good-tasting, properly labeled whole grain breakfast foods is another. Still another is the challenge is identifying what components in the whole grain are involved with various health effects and making certain that these are not lost during processing and storage. Finally, there is the communication challenge of telling the consumer what is in the product in a fair and accurate way. This is accompanied by the need to change consumer behavior and to persuade consumers of the importance of including whole grain products as a regular part of their breakfast pattern. Breakfast is the ideal place to add a variety of the types of grain and a variety of whole grain foods, and the industry has an opportunity to offer an array of exciting products.

S-34
Oat soluble fiber: A unique part of the benefits of a whole grain. J. J. SMITH (1). (1) Quaker Oats, Barrington, IL, USA.

Contemporary society is plagued with a variety of chronic health conditions which can be ameliorated by diet, exercise, and stress reduction techniques. Current emphasis on diet has focused on the benefits of increased whole grain consumption. Oats offer an exceptional whole grain solution since they are relatively unique among members of the grass family because of their content of beta glucan, or soluble fiber. The presentation highlights this unique nature of oats by demonstrating how the health benefits of oats contribute as a whole grain to cholesterol reduction, diabetes management, blood pressure maintenance, and weight control.

S-35
Making all cereals whole grain: The General Mills story. K. L. Wiemer (1), C. GOOD (1). (1) General Mills, Minneapolis, MN.

General Mills is the single largest producer of whole grain foods in the country, and has had a significant impact on whole grain consumption among Americans over the past 80 years. With the creation of Wheaties in 1924, Cheerios in 1941, and Total in 1961, General Mills has made whole grains tastier, more accessible and convenient for more Americans than any other food company. We have also long placed an emphasis on whole grain foods as a way to improve public health. In March 1999, General Mills initiated the first authoritative health claim about the relationship between plant foods, specifically whole-grain foods and lower risk of heart disease and certain cancers. Most recently in Fall 2004, General Mills made a commitment to convert it's entire Big G cereal portfolio to include at least half a serving of whole grain in each bowl. This initiative single-handedly raised by more than 1.5 billion the number of whole grain servings per year for Americans—without additional calories. Currently, 9 out of 10 Americans do not eat the recommended 3 servings of whole grain each day. Innovation in the cereal aisle has helped create an easy, great tasting way for adults and children to get more whole grain in their diet. Furthermore, increased promotion of whole grains offers consumers ways to more readily identify whole-grain foods, learn about their health benefits and explore ways of increasing consumption This presentation will explore the steps leading up to the launch of our whole grain initiative, regulatory challenges faced along the way, it's impact on the marketplace and a glimpse at the future.

S-36
Barley and rye – New potential for healthy breakfast cereals. A. KAUKOVIRTA-NORJA (1), K.-H. Liukkonen (1), K. Katina (1), K. Poutanen (1). (1) VTT Technical Research Centre of Finland, Finland.

Barley and rye are important food crops in Northern Europe. The composition and health benefits of rye have actively been studied over a decade in Europe. The health benefits of rye are strongly linked to the dietary fibre complex, the main component of which are partially soluble arabinoxylans. The associated bioactive compounds include lignans, other phenolic compounds and vitamins. The health benefits of barley are clearly connected to its fibre component, beta-glucan. Barley contains similar amounts or even more beta-

glucans than oats. Barley beta-glucan has on average smaller molecular weight than oat beta-glucan and forms less viscous dispersions, but has been demonstrated to lower cholesterol levels. Both barley and rye are typically consumed as porridge flakes in the Nordic countries. A large selection of instant and other porridge flakes are available in supermarkets. A porridge flake mixture containing barley, rye, wheat and oat flakes is very popular in Finnish breakfast tables. Rye and barley flakes are both used in muesli mixtures. Furthermore, whole grain rye breads and barley flat breads are typical in breakfast tables as well as during other meals. Due to its high beta-glucan content barley has a great potential in novel type breakfast foods like drinks and yogurt-type products. The technological challenges in using whole grain barley are linked to flavour and often greyish colour. Also rye has a very strong, peculiar flavour and a dark colour. However, our recent studies have shown that with advanced milling techniques rye fractions with palatable flavour and lighter colour but high bioactivity can be produced. Furthermore, tailored malting process alone or in combination with subsequent fermentation can be used to produce rye ingredients with superior levels of bioactive compounds but improved sensory properties.

S-37
Introduction: The easiest symposium I ever organized. W. ATWELL (1). (1) Cargill, Inc., Minnetonka, MN, USA.

The major point to be made during this symposium is how many very fulfilling careers can be enjoyed starting with a food science or grain science degree. Our six very willing speakers will each discuss their career path to the illustrious positions they hold today. We intend to make this session a great deal of fun and hopefully inspiring for those just beginning their career journeys.

S-38
It's important to have a plan? S. SHELLHAASS (1). (1) General Mills Inc., Minneapolis, MN, USA.

Sheri Schellhaas has spent 25 years practicing in the field of Food Science. She always had a 5 year career plan…. She never met the objectives of a single plan. How can a career have been so satisfying when she never met a single 5 year career goal? Sheri will present her point of view on what constitutes a successful career…including the highlight and lowlights of her 25 year journey.

S-39
A random walk through science. J. FAUBION (1). (1) Kansas State University, Manhattan, KS, USA.

Some career paths, the author's for example, appear random when viewed from the outside. While that might actually be the case, its more likely that decisions are the result of training, self-awareness, council, and expectations. While it helps if the training is appropriate, the awareness is rational, the council wise and the expectations realistic, it isn't an absolute necessity. That idea, along with the concept of a time averaged life will be illustrated using the only career the author has a right to discuss, his own.

S-40
From research to food ingredient sales: Is the grass really greener? E. KNIGHT (1). (1) McCormick & Co., Inc., St. Louis Park, MN, USA.

Real life scenario of transitioning from product development to various sales opportunities. Sales from functional ingredients, i.e. emulsifiers, fats, oils, and modified food starches, to selling flavors. The pros and cons of food sales, and how the food industry has changed in the last 25 years. It takes real inner strength to develop as a successful sales representative.

S-41
My career in the USDA. A. BETSCHART (1). (1) USDA ARS, Washington, DC, USA.

Antoinette Betschart is the associate administrator for research operations and management in the Agricultural Research Service. From November 1997 until her selection for this position Betschart served as the area director of ARS's Pacific West Area, headquartered in Albany, Calif. She was director of ARS's Western Regional Research Center in Albany from 1991–97. From 1989–91 she was the research leader of the Cereal Products Research Unit at the Center. Betschart served as the research leader of the Center's Nutrients Research Unit from 1980–89. From 1974–80 she worked as the project leader of the Center's oilseed protein research project. She began her career with the agency as a research food technologist with the Center's Cereal Grains Laboratory in 1971.

S-42
Food science is a tool, use it! V. CARLSON (1). (1) Van Carlson & Co., St. Paul, MN, USA.

Whether you are an introvert, extrovert, analytical, entrepreneur or double "A1" personality you can succeed using your food science degree. Success has more to do with your personality (self awareness, interpersonal skills, drive, attitudes, ethics) than degree, however, food science gives you a "fundamental" understanding of how all job functions fit together to make the food industry work. If you have an attitude of continuous learning you can go wherever you desire in the food industry, as well as develop careers in the areas of pharmaceutical, biotechnology, chemical, marketing and food law just to name a few.

S-43
The misguided missile: Finding your niche. L. MARQUART (1). (1) University of Minnesota, St. Paul, MN.

Getting to know yourself—strengths, weaknesses, passions and a compatible working environment requires soul searching. Common themes often emerge as you assess and learn from past childhood, volunteer and work experiences.

S-43a
Enzymatic processing of corn for food, feed, and fuel. D. B. Johnston (1). (1) USDA ARS, Wyndmoore, PA.

Although the use of enzymes in grain processing is not a recent development, new processing strategies are demonstrating the potential to change the current industry standards. Enzymatic corn wet milling or E-Milling, is one of these processes. E-Milling reduces and potentially eliminates

the sulfur dioxide requirements of conventional corn wet milling. This process utilizes a protease to significantly reduce processing time, produces higher starch yields compared to the conventional wet milling process and could potentially be developed into an "Organic Certified" process. Using a similar strategy, an enzyme based dry grind process (fermentation process of whole corn kernels) for ethanol production has also been developed. The modified dry grind process allows co-products (germ for oil extraction and pericarp for gum or animal feed applications) to be recovered prior to fermentation. Removal of co-products prior to fermentation has many advantages over the existing dry grind process, including increases in fermentation capacity and compositional improvements for Distillers Dried Grains with Solubles (DDGS). The modified dry grind process (at the laboratory scale) has consistently shown improved fermentation rates and final co-product compositions. Other applications of enzymes are currently being investigated in our laboratory, particularly for use in the dry grind ethanol process. Results from the enzyme based processes will be presented, ranging from laboratory scale to pilot and plant scale trials. Process engineering and cost models for each process will also be shown and will include an overview of the economic outlook for each process.

S-44
Opportunities and challenges for on-line quality monitoring and control in the breakfast cereal industry. B. STRAHM (1). (1) The XIM Group, LLC, Sabetha, KS, USA.

Like most processing industries, the Breakfast Cereal industry contains opportunities for implementing on-line and at-line quality control technologies. Most food processes are largely based on art with an underlying science that is not completely understood. Breakfast cereal processing is no exception. Opportunities exist to take advantage of the underlying science and new technologies to transform the art of manufacturing breakfast cereals to involve a greater scientific basis with resulting benefits such as increased quality and cost savings. However, as with most transformations, there are challenges, which are both technological and social in nature. This presentation will review the opportunities for on-line and at-line quality control that exist for raw materials, processing, and products as well as the challenges the industry faces in implementing new and existing technologies to address those opportunities.

S-45
Using a high-speed diode array based near-infrared spectrometer in a breakfast cereal plant. W. SHADOW (1), D. Honigs (1), G. Nilsson (1). (1) Perten Instruments, Inc., Bountiful, UT, USA.

Advances in instrumentation offer many new analysis and control opportunities for breakfast cereal manufacturers. High speed diode array based near-infrared spectrometers provide for rapid analysis of parameters such as moisture, water activity, fiber, and sugar. Calibration, maintenance, and economic impacts of implementing at-line analysis systems will be discussed.

S-46
On-line bulk density measurement technologies. B. MARLOW (1). (1) III Sigma Company, Lawrence, KS, USA.

The ability to measure bulk density on line has significantly improved and expanded in the last 15 years. Before that time, the only methods were manual sampling and measurement, and on-line radiation. Today, because the industry has demanded more reliable and accurate measurements, there are many different technologies for measuring bulk density. The most common procedure is still the manual method. Automated systems using random pack, radiation, microwave and ultrasound are now available. Automation of bulk density measurement has become more important as demands for product and process control have increased. Bulk density control helps reduce packaging costs, and meet stricter customer demands for product quality and consistency. Automated methods are becoming the preferred procedures to accommodate feed back controls and general plant automation. Reproducible sampling and increased frequency of sampling are the primary benefits of automation. The increased frequency and repeatability has helped operators better understand processes and better understand sources of product variation. Another selection criterion to consider is whether the method is direct measurement of an inferred determination. Inferential or indirect measures like radiation, microwave and ultrasound correlate variations in the change of a wave pattern to bulk density. Direct measure on the other hand determines bulk density by actually weighing a known volume of sample. The specific choice of automated method depends on the product being measured. Some methods are more accurate then others for certain types of products. This may depend on particle size, flow characteristics or product composition.

S-47
Plant-wide quality control strategies utilizing existing data. V. SPAULDING (1). (1) Strategic Planning, Finance, and Implementation, LLC, Marshfield, WI, USA.

Many companies have invested hundreds of thousands of dollars in plant floor automation systems, with the understanding that they will improve their overall plant profitability. While certain plant profit levels have been achieved, most of the data generated is never transferred to the right person at the right time for proper action to be taken. Microsoft calls these data types "Actionable Data". This presentation will review how data is created on the plant floor and then utilized properly by various levels of management. A specific focus will be placed on how real-time data can be incorporated into a companies ERP system for real-time actual costing, inventory break-downs and shrink or the reconciliation of raw ingredients to finished products throughout the manufacturing process. Technology trends which provide us with the ability to transfer data from plant floor data architectures to top floor ERP systems.

S-48
Technologies for on-line product fingerprinting for process control and feed-back. R. ABERLE (1). (1) The XIM Group, LLC, Sabetha, KS, USA.

New developments in Near Infrared (NIR) and Ultrasonic sensing technologies allows the design of food processing systems including online instant verification of Quality

Assurance measures. These new developments allow NIR and Ultrasonic sensing devices to "see through" a flowable product, allowing measurements to be taken through an entire product stream, and not just from a product surface. These instruments provide online feedback of a continuous sampling of the production stream. The technologies provide measurement of nutrient and chemical composition (fat, fiber, protein, etc) and rheological properties (moisture and degree of starch gelatinization or cook). These measurements collectively are referred to as the product signature. Any change or disruption in product quality is detectable as a rheological change and/or product nutrient or chemical change (a change in the product signature). This product signature can be coupled with a control mechanism (human and/or machine) to detect variations and disruptions in product quality, and then implement a pre-defined decision matrix to correct or eliminate the quality deviation quickly and automatically. In such an environment, quality is no longer simply checked or verified, but rather, it is an ultimate result of a process that is understood, monitored, and controlled in an inline, real time manner. In this process, quality is both predicted and described by the system using its sensing and monitoring capabilities. These technologies have been tested in an extrusion processing environment. Data will be presented showing the usefulness of these sensors in producing a product signature.

S-49
10 Years of biotechnology. C. JAMES (1). (1) ISAAA, Grand Cayman, Cayman Islands.

In the early 1990s, many were skeptical that genetically modified (GM) crops, now often referred to as biotech crops, could deliver improved crops and make an impact at the farm level. 2005 was the 10th Anniversary of the commercialization of biotech crops globally. Despite the continuing public acceptance debate in Europe, the early promises of biotech crops have met expectations in both industrial and developing countries. The global adoption and impact of biotech crops during the first decade of commercialization is reviewed. Their future prospects during the 2nd decade of commercialization, 2006–2105 are discussed., including their contribution to global food, feed and fiber security, a safer environment and a more sustainable agriculture.

S-50
10 Years of corn biotechnology. D. GROTHAUS (1). (1) Envirologix, Portland, ME, USA.

Growers, grain handlers, processors, food companies and consumers have all been greatly impacted by the introduction of biotechnology derived maize products. Life science companies (technology providers) have invested heavily in the use of biotechnology with the goal of rapidly creating seed products with ever greater total economic value. To date, the benefits of biotechnology in maize have largely been generated through cost savings to the grower created by products with "input traits" such as insect and herbicide resistance. Growers have embraced the early offerings these products have been quickly integrated into agriculture in large volumes. This rapid acceptance by growers combined with regulatory constraints and strong consumer preferences have caused a number of complicated issues for all stakeholders downstream from the grower. Testing for trait purity and adventitious presence (AP) have been challenging in many ways and will continue to be a very important consideration in the future of biotechnology products. Additional biotechnology based approaches are currently being employed to create second and third generations of insect and herbicide resistance, yield enhancement and stability, nitrogen responsiveness, fungal disease resistance and drought resistance. In the future, biotechnology derived "output traits" which result in improvements to feed, processing and human nutrition and health are expected to benefit feed and food companies, processors and ultimately the consumer. The impact of biotechnology in rice will also be covered in this talk.

S-51
A glimpse into the next generation of biotech crops and food products. J. GARRETT (1). (1) Monsanto, St. Louis, MO, USA.

Experience with commercial ag biotech crops is over a decade old and has generated over a billion harvested acres. The next decade will bring even more improvements to corn, soybeans, canola, cotton and other crops in areas such as agronomic traits, processor benefits and consumer benefits. The technology platforms that will enable these improvements such as genomics, conventional breeding, molecular breeding, crop analytics and biotechnology will be highlighted and a glimpse into the resulting products will be described.

S-52
Genetic enhancement of durum wheat to meet new food safety standards. J. CLARKE (1). (1) Agriculture and Agri-Food Canada, Swift Current, SK, Canada.

Issues around food safety and biosecurity are playing an increasing role in durum wheat production, trade and processing. The factors amenable to mitigation by production management include mycotoxins from disease organisms such as Fusarium Head Blight (FHB), residues of pesticides on grain, and content of heavy metals such as cadmium. All of these latter factors can be influenced by genetics, and thus can be manipulated through breeding. Allowable limits of the FHB mycotoxin deoxynivalenol (DON) on raw grain vary widely in different countries, and have recently been tightened by the European Union. Resistance to FHB tends to be less in durum than in bread wheat, but resistance may be transferred to durum from bread wheat and its near relatives using conventional breeding techniques. Genetic resistance to other diseases, such as the rusts and leaf spotting organisms, reduces usage of fungicides for disease control, thus reducing chemical residues on harvested grain. Similarly, genetic resistance to insect pests such as Hessian fly, wheat stem sawfly, and wheat blossom midge reduce or eliminate application of insecticides and residues on grain. Recent imposition of limits on permissible concentration of the heavy metal cadmium in grain has prompted breeding of durum cultivars with low cadmium concentration. Such cultivars translocate approximately 50% as much cadmium to the grain as do conventional cultivars. Further genetic variability appears to be available to increase uptake of nutritionally desirable metals or to decrease that of other undesirable metals. Genetic enhancement of durum will play a pivotal role in food safety issues, as well as continuing to improve processing quality attributes for pasta.

S-53
Durum breeding to meet the requirements of the Italian durum wheat/pasta production chain. E. DE AMBROGIO (1). (1) Produttori Sementi Bologna, Argelato, Italy.

The Durum-Pasta production chain is very important for Italy, as world leader in pasta production and consumption. Durum breeders are requested to satisfy the demands of farmers, millers, pasta-makers and consumers. The seed company Società Produttori Sementi Bologna is part of a production chain involving Barilla, the world leader in pasta production. The targets of the breeding program are high yield and good adaptability for the farmers; high test weight and low ash content for the millers; high protein content, gluten strength and yellow index for the pasta-maker; high firmness and low stickiness for the consumer. The relative importance of the quality traits has been changing over time and new varieties have been released to meet these changing requirements. New requests concern an even higher quality, food safety in terms of low mycotoxin content and nutritional value. The ways followed to meet these new challenges will be outlined.

S-54
Efficient reduction of contaminants in durum wheat processing. D. RONEY (1). (1) Buhler Milling, Plymouth, MN, USA.

Mycotoxin contamination of grain depends on different factors such as grain variety, farming methods, rotation of crops, fungicides, climate and storage conditions. Mycotoxins are metabolic products of mold which endanger the health of humans and animals alike. Fungi producing mycotoxins are extremely resistant to acid and heat. Since the functional properties of semolina and flour begin to change at a temperature as low as 60°C (140°F), methods other than thermal treatment must be used in the grain processing industry to control mycotoxins. The extent of damage that mycotoxins cause to grain can vary. Some grain may merely be contaminated on the surface, whereas others may be partially or completely tainted. Therefore, different cleaning methods are required. The unique "Peeling" process allows the external contamination of the grain to be reduced by literally peeling off the outer pericarp of the kernel in strips. Since 2003 this process has been applied with great success around the world. Recently, another innovation in the field of grain processing has been introduced – the new GRAVOMAT High-Capacity Density Grader. The Gravomat has been specifically developed for the separation of shriveled and DON-contaminated kernels, which have a specific gravity different from that of sound kernels. The novel technology applied enables high-precision grading of the wheat into four fractions with different DON contamination degrees. Separation of the heavily contaminated wheat reduces the degree of contamination of the main stream of material. This slashes the DON content. In addition, the Gravomat High-Capacity Density Grader is highly suitable for the efficient removal of low-density and shriveled grains from durum, hard, and soft wheat. This cleaning process yields grain to produce semolina and coarse whole meal products of the highest purity. Both of these novel cutting-edge technologies contribute substantially to transforming wheat into safe, healthy, tasty and premium quality end products.

S-55
Grain safety assurance: A grain exporting country's perspective. T. W. NOVICKI (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada.

In recent years, world and grain industry trends with respect to the various aspects directly related to food safety have had significant impacts on how grain is bought and sold both domestically and internationally and steps taken by exporters to ensure dependability with respect to food safety issues and fitness for consumption. The ever increasing number of toxic substances, such as pesticide residues and mycotoxins, for which maximum limits in grains are being incorporated into legislation, the lowering of these limits and setting of very low default tolerances and introduction of strict inspection and testing requirements for control of undesirable substances in imported foods create concerns and challenges for grain exporters. Being able to demonstrate that shipments should be able to meet customer standards and the process of actually ensuring that they will do so, requires a concerted effort and major expenditures of resources. When problems occur, the hold and test protocols that are followed in some countries cause serious problems for future sales. Differences in test results between the exporter and authorities in destination countries may simply be due to differences in sampling procedures and test methods, sample-handling irregularities and other factors. For shipments to EU countries, exporters need to be mindful of the rapid alert system that they have in place. Provision of advance samples and pre-export checks are possibilities for facilitating trade, but establishing equivalency of inspection and sampling and analytical testing processes presents challenges. Laboratory issues such as application of measurement uncertainty can also present challenges for the exporter when dealing with authorities in other countries.

S-56
Innovative approaches on pasta process research to improve end product characteristics. C. M. POLLINI (1). (1) Pavan, Galliera Veneta, Italy.

In the last two decades many efforts were focused on pasta production processes in order to optimise final product quality level: conventional presses, twin-screw mixers, belt mixers, quite different types of dryers and drying diagrams, mathematical modelling of water absorption - desorption and so on. Everything dedicated to traditional, well known and worldwide diffused durum wheat dry pasta. The evolution of the markets and the higher consciousness of consumers brought to an increase of the request of new and particular products, like quick-cooking pastas, corn or rice pastas, protein enriched pastas and "functional" pastas with a lot of different nutraceutical agents. In order to preserve the final quality and the nutritional action of additives, researchers had to "reinterpret" technology and to modify traditional plants or to utilise new machineries. Particularly, for quick-cooking pastas and corn and rice pastas different types of steaming equipment were used; for enriched pasta very precise gravimetric dosers and very mild dough ripeners were utilised. In the lecture theoretical bases, principles of working and description of technological choices will be described.

S-57

Mycotoxins in durum wheat/pasta production chain: An overview of recent researches. M. PASCALE (1), R. Ranieri (2), M. Silvestri (2), A. Visconti (1). (1) Institute of Sciences of Food Production, Bari, Italy; (2) Barilla G. & R. Fratelli SpA, Parma, Italy.

Mycotoxins are toxic metabolites produced by various fungal species, mainly of the genera *Aspergillus*, *Fusarium* and *Penicillium*, that under favorable environmental conditions can infest crops in the field or foodstuffs during processing, transportation and storage. The development of rapid, sensitive and accurate methods for the determination of major mycotoxins and toxigenic fungi occurring in durum wheat/pasta production chain is essential in order to protect consumer health from the risk of mycotoxin exposure. Innovative analytical methods for the determination of deoxynivalenol (DON), ochratoxin A (OTA), T-2 and HT-2 toxins, and toxigenic *Fusarium* species in wheat and derivative products have been recently investigated in our laboratories. In particular, the following methods were developed: i) a fluorescence polarization immunoassay (FPIA) for rapid screening of DON in wheat, semolina and pasta; ii) an antibody-based electrochemical immunosensor for the determination of OTA in wheat; iii) a HPLC/immunoaffinity clean-up method with fluorescence detection (FD) for the simultaneous determination of T-2 and HT-2 toxins in wheat using 1-anthroylnitrile as labelling reagent; iv) a Surface Plasmon Resonance (SPR) method for the detection of *Fusarium culmorum* (DON producer) in durum wheat samples. Moreover, the fate of DON during durum wheat processing and spaghetti cooking was investigated showing a consistent reduction of toxin levels during each of the processing steps, from uncleaned durum wheat to cooked spaghetti.

S-58

Knowledge management systems from durum wheat to pasta products. B. CUQ (1), R. Thomopoulos (1), J. Abecassis (1). INRA Montpellier, France.

Knowledge management of durum wheat processing is based on a research project of global data integration and knowledge representation. This research program is consistent with the increase of food-related public organoleptic and health issues. The Nutrition and Food Security program of the World Health Organization encourages the development of inter-sectorial food and nutrition policies, on the basis of current scientific evidence. This project aims at bringing its contribution in the domain of cereal technology, and more specifically in durum wheat processing. The main goal of the research program is to structure and integrate in a computerized decision-making tool all the knowledge and expertise related to the process monitoring of durum wheat transformations and to the management of the overall quality of final products. This research project is built on two complementary actions. The first task is to identify and classify all the available scientific and technical knowledge about durum wheat processing. This task is organized around three complementary levels with the aim to integrate all the available knowledge: description of unit operations, effect of the process parameters on the quality of durum wheat-based food products, potential innovation for each unit operation involved in durum wheat transformations. The second task concerns the development of a specific computerized decision-making tool that can firstly integrate and compile all the knowledge concerning durum wheat processing and product quality. This system will be able to establish relationships between raw materials characteristics, process unit operations and final quality parameters of the durum wheat-based food products. The approach is based on the cooperation between two sources of information: Experimental data (acquisition conditions, observed results). These data gather a large amount of information that surpasses the knowledge of a given expert, without having its synthetic aspect; Expert knowledge, that describes mechanisms identified by experts as a result of their experience in the domain. Knowledge management will help several users (breeders, industrials, public institutions) to better control the overall quality of end products and to propose innovative actions.

S-59

Leadership versus management. S. HUFFMAN (1). (1) Mead O'Brien, Inc., St. Louis, MO, USA.

Some think the terms are synonymous. Others think they cannot coexist, especially if it involves more than one person. How can these two things benefit each other, and you?

S-60

Strategic management: Taking time to consider your company's direction. C. BEROS (1). (1) Alderwood Capital LLC, San Francisco, CA.

The presentation will focus on a discussion of strategic and long term management perspectives. It will emphasize the importance of making an organizational commitment to the process of identifying and evaluating critical strategic issues. Specific strategic issues to be addressed include the following. 1) Evaluating competitive position and industry trends. 2) Planning for ownership transitions and management succession. 3) The importance of financial forecasting and capital planning. 4) The impact of operating and business strategies on value maximization and realization alternatives. The discussion will include an overview of the disciplines and tools used to consider each of these issues and will feature examples highlighting various aspects of the subject topics drawn from the speaker's experience with corporate clients.

S-61

Building high performance teams. H. JOHNSON (1). (1) Leadership One, Sacramento, CA, USA.

Most managers work in groups – not teams. There are certain "plays", just like winning sports teams, that you need to know to create effective teamwork. This material addresses the key knowledge on how to achieve exceptional business results through team collaboration and execution.

S-62

Snacking in modern life-style. B. BURTON-FREEMAN (1), N. Keim (1). (1) University of California, Davis, CA, USA.

In humans, the daily intake of food is typically distributed over a certain number of meals and snacks. Although there is no formal definition for the term "snack", it is generally inferred that food consumed in the inter-meal interval and making up a relatively small portion of total daily energy intake constitutes snacking. Frequent snacking can make important contributions to the quality of the diet acutely

(daily) as well as chronically (long-term). Recent trends in snacking have challenged the benefit snacks may bring to the diet because the foods chosen are typically low quality foods; highly processed, energy-dense and nutrient-poor. Some investigators propose that snacking is a bad habit that drives up total energy intake and body weight and should be avoided to reduce the risk of consuming excess calories, gaining unwanted weight, and diluting (further) an already challenged healthy dietary food intake pattern. However, there is also evidence that frequent snackers are better at adjusting the energy content of their meals than individuals who do not snack but eat fewer larger meals. In addition, frequent feeding has been positively associated with beneficial physiological effects such as reduced blood cholesterol and improved glucose tolerance and appetite control. Effective snacking could improve diet quality by increasing the opportunity for consumption of valuable naturally nutrient-rich foods that in turn promote health and reduce risk for disease. Hence, it may not be the behavior of snacking that is detrimental to the diet, but rather the foods chosen for snacks that affects diet quality and health. Understanding the role of snacking in the diet will be to understand its potential attributes and detriments on health in modern life-style; and further, to devise standards for evaluating and grading foods for health-promoting qualities (eg. nutrient-density), motivating consumer education and dietary guidance.

S-63

Strategies for developing snack foods that enhance satiety and decrease subsequent intakes. R. W. WELCH (1), S. A. Moorhead (1), P. A. Irvine (1), M. B. E. Livingstone (1). (1) University of Ulster, Coleraine, UK.

Foodstuffs that yield greater satiety, compared to other foods with similar nutrient profiles, have the potential to restrict energy intakes, and may help to prevent or alleviate over-consumption. Thus the identification of foodstuff characteristics or ingredients that yield enhanced satiety and decrease subsequent intakes may assist the development of snack foods that are seen as more healthy. We have evaluated three potential strategies: (1) increasing dissolved gas in a drink, (2) increasing the proportion of the gas phase in solid foods and (3) using novel fat ingredients. Effects of dissolved gas were evaluated in a study with men and women, who drank preloads with varying levels of carbonation, 10 minutes before a lunch meal. Results showed that increasing the level of carbonation led to significantly increased satiety and decreased lunch intakes by over 10%. Effects of varying the proportion of gas in solid foods were evaluated using two ready-to-eat whole-grain cereals that differed in bulk volume. The cereals were eaten as part of breakfast, and results showed that the cereal with the greater bulk volume led to significantly higher satiety until lunch when food intakes were lower by ca. 30%. The effects of a novel fat ingredient were evaluated in a series of studies that compared yogurts that contained either milk-fat, or a novel fat emulsion. These studies, conducted with lean, overweight and obese men and women showed that, compared to the yogurt with milk-fat, the yogurt with the novel fat emulsion significantly increased satiety and led to decreases in intakes of 10–34%, that could persist for over 24 hours. Further longer-term studies are needed to evaluate the persistence of all these effects. However, the results suggest there are a number of strategies that can be used, possibly in combination, to produce foodstuffs that yield enhanced satiety.

S-64

Controlling hunger and energy intake with a reduced-calorie snack. S. A. S. CRAIG (1). (1) Danisco USA Inc., Ardsley, NY, USA.

Are reduced-calorie (RC) foods less satiating, leading to compensation by eating more later? Or can intake of a RC snack contribute to lower calorie intake over the long term? Clinical studies were conducted to investigate the following hypothesis: RC snacks containing polydextrose and/or xylitol are at least as satiating as the full-calorie (FC) control. The snacks were eaten prior to an ad libidum meal. The RC snacks (containing polydextrose and/or xylitol) were found to be more satiating than the FC snacks. There was a reduced caloric intake at the ad libidum meal of between 5 and 25% in the studies. In addition, ingestion of these RC snacks led to equal or greater subjective feelings of fullness compared to the FC control. These studies show that RC snacks can be equally satiating to FC snacks, and can even be more satiating.

S-65

Sensible snacking: A way to increase consumption of whole grains and fiber. J. J. SMITH (1). (1) Quaker Oats, Barrington, IL, USA.

Healthy and sensible snacking is one habit consumers can develop to control food cravings and simultaneously promote desired weight management. There are many approaches available to food scientists in the development of healthy snack products including reduced serving sizes, targeted sugar levels, addition of moderate amounts of healthy fats and oils, and the manipulation of protein, whole grain and fiber content. This presentation will focus on whole grain and fiber ingredients that may be employed to deliver healthy and organoleptically pleasing snacks.

S-66

Snack food composition and quantity in the regulation of food intake. G. H. ANDERSON (1). (1) University of Toronto, Toronto, ON, Canada.

The regulation of food intake is under a complex system of environmental and physiologic inputs. This presentation will focus on the composition, quantity and timing of snack foods required to avoid "energy creep" and to contribute to the overall goal of maintaining energy balance. Because the physiologic regulation of food intake is quantitatively imprecise in the short-term it has been hypothesized that high energy dense snack foods consumed between meals lead to a net increase in energy consumed during the day. The hypothesis will be discussed with reference to the effects of components in snack foods on the biomarkers of satiety and the composition and structure required to invoke physiologic systems.

S-67

Cereal beta-glucans in snack and dairy products. R. G. FULCHER (1). (1) University of Manitoba, Winnipeg, MB, Canada.

Epidemiological studies continue to show that diets high in fiber and low in saturated fat and cholesterol are associated with a reduced risk of diabetes, digestive disorders, heart disease, as well as certain types of cancer. In the past few years, several clinical studies have been carried out with oat

and barley, two cereals that contain elevated levels of mixed-linkage beta-glucans, much of which is soluble. The polymers appear to slow glucose absorption in the upper intestine, they have been implicated in cholesterol reduction, and they are also able to stimulate immune responses in mammalian cells. Although the mechanisms by which these important cereal polymers exert their effects is somewhat unclear, it has been shown that diets fortified with oat or barley beta-glucans reduce post-prandial glucose response quite markedly. The high viscosities of the polymers in the gut, as well as their potential for interacting with intestinal mucosa, are potential mechanisms by which glycemic responses are reduced. It has also become clear that highly purified beta-glucans are also able to stimulate cytokine secretion in mammalian cells, an observation that suggests specific interaction between beta -glucans and cell membrane receptors. Cereal beta-glucans have also been implicated for many years as important components of cholesterol-lowering foods such as oat- and barley-based breakfast and dairy products. In order to facilitate dietary delivery of beta-glucans in acceptable foods, it is imperative that we also explore the utility of glucan-enriched products suitable for regular consumption. Beta-glucans are especially suited to manufacture of snack and other types of RTE foods, including dairy products.

S-68
Cereal-based alternatives to dairy snacks of yogurt-type. H. SALOVAARA (1). (1) University of Helsinki, Helsinki, Finland.

Consumer interest in dairy alternatives, such as soybean-based 'milks' and 'yogurts' has been increasing steadily in recent years. Cereal-based dairy alternatives to milk also exist, such as the 'rice milk' and 'oat milk', and the technology for making oat bran-based yogurt is also available. Compared to milk and soybean cereals offer different profile and properties in terms of health promotion, including dietary fibre, such as beta-glucan. Oatmeal and oat bran in particular are interesting raw materials, because of their mild basic flavour and their health promoting properties allowing health claims on glycemic index and cholesterol based on the soluble beta-glucan fibre. The physiological effects of oat beta-glucan are probably dependant on its ability to increase lumen viscosity. This property is favoured by proper hydration of the beta-glucan in excess water under heat (cooking) in the absence of beta-glucan hydrolysing enzymes. Gelatinised starch has a major role in this type of colloidal cereal food system, which can be made to have different consistencies, such as in spoonable or drinkable yogurt. Fermentation is an expected process in such an aqueous colloidal cereal system and microbial starters known in yogurt industry can be used. When suitable probiotic strains of lactic acid bacteria or bifidobacteria are applied, additional health promoting arguments are available. The paper discusses the potential of such technology and products in particular from the point of view of maintaining the physiological benefits of the viscous oat fibre in colloidal cereal snacks of yogurt-type.

S-69
Probiotics and cereals—Synbiotic functions, current applications and future development. P. BENGTSSON (1), G. Önning (1). (1) Probi AB, Lund, Sweden.

Among the most commonly used and commercially available probiotics are lactic acid bacteria. There is evidence that some strains of *Lactobacillus* spp. reduce the presence of potential pathogenic bacteria in the intestinal flora, improve the condition of the intestine, the immune defense and the metabolism. Cereals are rich in dietary fibers that can function as prebiotics, i.e. beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon. A combination of probiotics and prebiotics (synbiotics) could probably be used to increase the persistence of probiotics within the gastrointestinal tract, facilitate the recolonisation of the colon following the depletion of the microflora after an illness or antibiotic treatment. Cereals are also rich in phenolic compounds. Some bacteria like *L. plantarum*. can possess enzymatic activity towards polyphenols and are also able to metabolise phenolic acids. For example possesses *L. plantarum* DSM 9843 tannases and in studies it has been shown that this probiotic bacteria can act in synergy with dietary fibers and polyphenols and reduce the lipid peroxidation. This can be of importance to keep the intestine in a healthy status and also for improving a diseased intestine. Today probiotics are mostly included in dairy based and liquid foods. One interesting future development could be cereal foods like flakes and bars that are supplemented with a probiotic bacteria. However, the stability of the probiotic strain during storage in such products can be a problem. Special techniques are probably needed to improve the stability and to ensure that the probiotic strain reach the consumers intestine in a living form and at a sufficient concentration to give a health effect.

S-70
Bioavailability of elemental iron powders used for food fortification. L. TURNER (1). (1) SUSTAIN, Washington, DC, USA.

Abstract not available

S-71
Folic acid impact and issues. G. OAKLEY (1). (1) Emory University, Atlanta, GA, USA.

Abstract not available

S-72
Global vitamin and mineral deficiency perspectives. G. MABERLY (1). (1) Emory University, Atlanta, GA, USA.

Abstract not available

S-73
Global consumption patterns for wheat and maize. K. BELL (1). (1) Emory University, Atlanta, GA, USA.

Abstract not available

S-74
Setting the level of folic acid used to fortify flour. R. J. BERRY (1). (1) Centers for Disease Control, Atlanta, GA, USA.

Abstract not available

S-75
Impact of food fortification on food product development. Speaker to be announced.

Abstract not available

S-76
Process control for fortification. Q. JOHNSON (1). (1) Micronutrient Inititative/Quican Inc., Rockwood, ON, Canada.

Abstract not available

S-77
Asian noodle flour quality: From a miller's perspective. R. FESLER (1). (1) Horizon Milling, LLC, Ogden, UT, USA.

How to produce a good quality Asian noodle flour? The United States flour market uses all the available grown wheat's to make various Asian Noodle flours. HRW, SWW, SRW, NS, DNS, HWW and Buckwheat, each can be used by itself and some are flour blends of each to make specific noodle products. Cost effective wheat transportation, storage and wheat of flour blending at the milling facilities provide the initial step in noodle flour production consistency. Each Asian culture has brought their own noodle characteristic from their respective homeland to United States customer culture. The Ramen-Instant noodle growth has increased the overall quality of noodle products throughout our flour milling industry. Instant noodles were developed to 'feed the people' at low cost. These noodle consumers grow up, looking for better quality noodle products at restaurants, grocery store shelves or at specialty Asian stores. Commercial flour milling production of Asian noodle flour for the USA market may fall into five basic categories. 1) Hard Red Winter (HRW) milled 100% to produce 11 to 12 flour protein; 2) A blend of HRW and SRW or SWW with a 10.5 to 12 flour protein; 3) A blend of HRW with NS or DNS with a 11.5 to 13 flour protein; 4) any of the wheat or flour blends with specific ash content requirements and 5) The consistency of HWW in milling quality to produce consistent ash, protein and Farinograph attributes.

S-78
Association of wheat protein and starch with processing, cooking and textural properties of noodles. B. K. BAIK (1). (1) Washington State University, Pullman, WA, USA.

Starch and protein largely control the processing and product quality of Asian noodles. Identification of starch and protein characteristics suitable for noodles is crucial for breeding noodle wheat variety as well as improvement of noodle processing and product quality. Using wheat flours of various starch functionality and protein content and quality, we have investigated the roles of starch and protein in making noodles. Water absorption for making noodles exhibited negative relationships with flour protein content, SDS sedimentation volume and starch amylose content. An increase in wheat flour protein content generally improved noodle dough mixing and sheeting quality, and reduced fat absorption of instant fried noodles. Instant fried noodles prepared from wheat flours with reduced starch amylose content were higher in fat content than those prepared from wheat flours of wild type starch. Cooking time of noodles was positively related to flour protein content and starch amylose content. Cooking time of noodles was shortest in wheat flour of waxy starch endosperm, longer in those of reduced starch amylose content and longest in those of wild type starch. Protein content and SDS sedimentation volume of flour as well as starch amylose content were positively related with firmness of cooked noodles. Increase in cohesiveness of noodles was also noted as starch amylose content of flour decreased. Wheat flours of waxy endosperm starch and 17.8% protein produced softer noodles than soft wheat flour of regular starch and 10.5% protein. Hardness of noodles prepared from flour blends of normal and waxy wheat decreased as the proportion of waxy wheat flour increased, even though protein content of the flour blends increased. To establish a quality profile of noodle wheat cultivars, the interactive effects of starch and protein components on processing and product quality need to be identified and considered.

S-79
Recent studies on noodles in a Japanese flour mill. H. OKUSU (1). (1) Nippon Flour Mills, Atsugi, Kanagawa, Japan.

The importance of noodles in the diets of Asia-Pacific has justified a great deal of attention from major wheat producing and exporting countries. Most research on noodles has been focused on the biochemical basis of noodle color, color stability, and cooked noodle texture. Such knowledge would benefit breeders for developing new cultivars with improved noodle making quality. As a major supplier of noodle flours in Japan, Nippon Flour Mills has also conducted extensive research on noodles but with somewhat different approach. In our Mills, raw material selection, adjustment of milling process, noodle formulation and processing methods are considered as a whole package in order to produce high quality noodle flours effectively and cost-wisely. It is important for us to understand the changing needs and demands of markets and customers. This presentation will review the current demands and future trends on noodle quality in Japan. Research work conducted in our Mills to improve noodle appearance, texture, shelf life, and safety will be discussed. Wheat quality is the key linkage among wheat suppliers, flour millers, noodle manufacturers, and consumers.

S-80
Laboratory-scale sheeting and lubricated squeezing flow behavior of Asian noodle doughs. A. S. ROSS (1), J. B. Ohm (1). (1) Oregon State University, Corvallis, OR, USA.

Salt and alkaline noodle doughs were made from flours of 2 wheat varieties with contrasting dough attributes. Water addition was fixed at 34% and doughs were either rested for 45 min after compounding or processed without resting. Doughs were compounded through a 5 mm roll gap then reduced in thickness through gaps of 3.5, 2.45, 1.7, and 1.2 mm. Lubricated squeezing flow (LSF) rheometry with stress relaxation was performed on doughs between each roll pass. Dimensions of sheeted doughs were altered by flour source, formulation, and presence or absence of resting. Doughs from the weaker variety were significantly (all significance at $P < 0.01$) thinner across all treatments. Rested doughs were thinner than unrested doughs, but only at the first reduction pass. Differences in dough length were small and contingent on the treatment factors being compared. Proportional die-swell (PDS) after passing the roller nip was significantly higher for the stronger doughs across all treatments, and was significantly lower for rested doughs at the first reduction. However, PDS of rested doughs tended to equal or exceed that of unrested doughs in the final reduction pass. Alkaline doughs had significantly higher PDS, except for unrested doughs of the stronger variety where alkaline doughs had

lower PDS. The LSF method allowed the observation of relaxation times (RT) for the doughs (time at constant strain for stress to decay to 1/e of peak stress). RT decreased with each roll pass in all treatments. This was most pronounced in the stronger doughs. RTs were somewhat shorter for the rested doughs in the first 2 or 3 reduction passes but equaled RT for the unrested doughs in the later reductions. RT was longer for alkaline doughs in all comparisons of salt and alkaline doughs with one exception. Other LSF factors are still being analyzed at the time of writing.

S-81
Polyphenol oxidases and discoloration of Asian noodles. C. MORRIS (1). (1) USDA ARS, Pullman, WA, USA.

Color is a key consumer quality aspect of Asian noodles. Darkening of noodle products is undesirable and has been associated with the enzyme polyphenol oxidase (PPO). We developed a quick (60 min) robust whole-seed assay to measure PPO levels of wheat grain lots and breeding lines. The method, AACC International Approved Method 22-85, uses the diphenolic substrate L-DOPA at 10 mM. Among a range of wheat cultivars, activity levels of PPO were approximately 1.7–2.4 fold higher when using L-DOPA compared to using a monophenol substrate such as tyrosine. In addition, ratios of soluble (leached from kernels) to insoluble PPO were about 0.2 when using L-DOPA, whereas no soluble PPO activity was detected using tyrosine. However, monophenolase activity could be activated in kernel leachate with micromolar levels of diphenol. Most kernel PPO is associated with bran, and in highly homogenized bran only ca. 5% of total PPO activity was soluble. Method 22-85 accounted for only about 1–2% of total kernel PPO. Tropolone and salicylhydroxamic acid (SHAM) at 1 micromolar reduced wheat L-DOPA PPO activity by 50%. In alkaline noodle doughs, tropolone (0 to 316 ug/g) reduced noodle darkening (delta L* 24 h) from 11 to 6 in the high PPO cultivar Klasic, but had little effect in the low PPO cultivar ID377s. In a retrospective study of over 500 samples from the USDA Western Wheat Quality Lab, whole-kernel L-DOPA PPO and delta L* were correlated at r = 0.64, whereas ash (r = 0.00) and protein (r = 0.14) were not well correlated with delta L*. The least squares regression intercept indicated a "zero" PPO activity associated with a delta L* of 4.4. Results suggest that the complete elimination of PPO activity from seeds would not completely eliminate wheat product discoloration. In summary, PPO is a major factor associated with noodle discoloration. Approved Method 22-85 is a useful tool to characterize grain lots and cultivars for PPO activity and noodle darkening even though Method 22-85 measures only a small fraction of total kernel PPO.

S-82
Instant noodle quality: From a manufacturer's perspective. J. GONZALEZ (1). (1) El Pacayal, Palin Escuintla, Guatemala.

Because of its favorable flavor, affordable price, and convenience to prepare, the instant Cup Ramen Soup noodles have turned in past years into a most popular noodle product in Central America. In Guatemala, there are approximately 72 million units a year, which is equivalent to 5,000 metric tons, with an approximate annual growth of 8%. It is a US $20 million business. According to the latest studies, the estimated consumption per capita in Guatemala is about two noodle soups per month. 80% of these noodles are produced by three domestic manufacturers, and the remaining 20% are imported from the United States and Asia. The main brands include Koka, Samyang, Campbells, and Laki Man. The most common packages of ramen noodles in Central American market are: 70 grams for the cup noodles and 85 grams for the pillow-type bag noodles. But a larger packaging containing multi noodle cakes for family consumption is also available in the market. Chicken, shrimp, and meat are the most common flavors accepted by the consumers. However, new flavors such as spicy shrimp, sweet corn, tomato flavor, and others are gradually added on the market to meet the consumers' changing taste. The raw materials (flour, water, additives, and frying oil) used in the manufacture of ramen noodles must be subjected to rigorous inspections to guarantee the satisfaction and safety of the customers. The process is in appliance to the HACCP system and each critical control point is established. The finished products are inspected and evaluated using the pre-defined methods to assure the consistency and quality requirements.

S-83
Build your own "dashboard" for metrics in warehousing/ transportation logistics. A. TALIAFERRO (1). (1) Deloitte, Montreal, QC, Canada.

Your supply chain for your finished product—if you can't measure it, how can you improve it? This seminar will present a "dashboard" of indicators you should be using to determine your effectiveness and the expected ranges for each. The dashboard can then be used to judge year-to-year performance or to benchmark your operations in the increasingly competitive beverage industry. Developing a dashboard is a first step to reducing distribution costs for your product.

S-84
Software-driven metrics and KPIs for maintenance management. C. ANDERSON (1). (1) Dastastream (now Infor), San Francisco, CA.

Maintenance management in the brewery is a vital function, which breweries are increasingly focusing on optimizing. A world-class maintenance department can be developed, where metrics for performance as well as an efficient system to input and extract key data are parameters to be considered. Use of dashboard tools to benchmark staff and the department, as well as plant hardware provide world-class asset management. Application of dashboards built from a powerful software suite support thorough analyses of maintenance processes and systems in the brewery.

S-85
Mustering expertise through outsourced maintenance management. S. WIGDOR (1). (1) Maintech, Malvern, PA.

Outsourcing has long been touted as a cost-saving measure for corporate support services. The problem with some outsourcing initiatives is that they start with the wrong answer: they ask outsourcing providers to quote a price on replicating the existing service approach. But, who says that the existing approach is best? What is it you are trying to accomplish by outsourcing? While the typical response is "we want to save money," often a brewery may not have defined objectives and the answer. After reviewing the benefits, the answers change to: 1) trust (core competence), 2), reliability,

3) risk management, 4) work processes, 5) customer satisfaction. These items may become costs savings when outsourcing maintenance and its management.

S-86
Born to be wild—The brewing industry and the perils of transition. I. VERSTL (1). (1) Brauwelt International, Munich, Germany.

A brewer, reading the morning paper, to his wife: "Mergers, acquisitions, divestitures, restructuring, outsourcing, maximized shareholder value! Refresh my memory…what business am I in?" Sounds familiar? This presentation will argue that while the brewing industry consolidates on a global scale, brewers had better start to think like MBAs in order to understand that many of the intra-organisational battles that are being fought over the age-old question "human capital or labor costs", are actually just a symptom of the industry's gradual and often painful transformation from being technology-driven to finance-driven.

S-87
A review of instrumental measurements of physical properties of cooked Asian wheat-flour noodles. A. S. ROSS (1). (1) Oregon State University, Corvallis, OR.

The textural characteristics of cooked Asian noodles are subtle. To test them by sensory analysis and reliably make comparisons between samples generally requires long experience and intensive training. Instrumental texture tests on noodles can be used to monitor accurately differences in noodle textures resulting from the use of different flours, processes, or formulations. However, accuracy depends on paying attention to critical aspects of sample preparation. Large deformation uniaxial tests are the most prevalent type, and compressive tests are more common than tensile tests. These tests can measure noodle hardness dependably, but can also highlight other attributes of noodle texture such as surface firmness, aspects of elasticity, and surface characteristics. The paper focuses its review on instrumental determinations of cooked noodle physical properties other than hardness, such as elasticity. In addition to the "traditional" texture tests, some laboratories use dynamic rheometry to address cooked noodle physical properties related to compositional changes in flour and the technique shows promise for investigating structure/function relationships in cooked noodles. However, unlike large deformation "texture" tests, dynamic oscillating rheometry does not always match sensory perceptions of noodle texture. This seems to result from the scale of the deformations applied, which are commonly much smaller than the deformations required for rupture. Combining information from small and large deformation tests shows promise as a way of in highlighting differences in the contributions to cooked noodle texture from protein and starch.

S-88
Designing whole grain foods for taste and texture. L. SKARRA (1). (1) Merlin Development, Plymouth, MN.

FDA health claims provide a means to guide food consumption towards more healthy eating patterns. However, each claim's wording provides developers with specific challenges to meet the letter and spirit of the claim. Beyond merely meeting the claim's compositional requirements, a successful food product is one which will meet real consumer needs and drive sustained repeat sales in the marketplace and must meet a significant collection of additional requirements. These include great taste and texture, consistent performance under all conditions of consumer use, appropriate cost, fit with manufacturing limitations, etc. The specific wording of the whole grain claim results in significant challenges to deliver whole grain foods, and meeting the 51% whole grain requirement often means dilution of normal protein and lipid contents in the food. Delivery of the expected quality and functionality in the face of that dilution requires a broad range of "tools". Specific examples of the problem and strategies for solutions will be presented.

S-89
Considering mouthfeel, moistness and other factors when designing food products for texture. R. C. HOSENEY (1). (1) R & R Research Services, Manhattan, KS.

The measurement of food texture is not as simple as it first appears. The common approach of taking our sample to the texture analyzer and assuming if we squeeze it hard enough it will give us the answer we want rarely works. It usually takes a lot of thought and perhaps preliminary experiments to determine what measurements are needed. An example is the measurement of stickiness. Do we want to measure surface adhesion, if so, adhesion to what type of surface? Care must be taken that the surface does not dry, as this would change the adhesion force. Mouthfeel and moistness are 2 additional properties that are often important but difficult to measure. Mouthfeel is very complex and affected by such things as viscosity and shear thinning of the material. Moistness appears at first light to be simple. Moisture is relatively easy to measure. However, moistness generally relates better to the amount and type of fat in the system rather than the water content. Other factors discussed will be the change in the texture of cookies with age (time after baking) and the effect of environment on the texture of crackers.

S-90
Texture of alkaline cooked corn masa products. H. ALMEIDA (1). (1) Kellogg Co., Battle Creek, MI.

Alkaline cooked corn masa products include mainly table tortillas and chips. Desirable tortillas are flexible, soft and shelf stable. Tortilla texture vary with grain cooking conditions, masa properties, baking conditions, puffing extent and moisture content. Desirable chips are crispy and crunchy. Chip texture is defined by masa properties, thickness, baking conditions, moisture content prior to frying and frying conditions. Texture of tortillas, chips and their intermediate products has been measured subjectively and more recently with instrumental procedures. Retention of cooked corn hulls with higher pH provides for additional flexibility and softness of fresh and reheated tortillas. Optimum cooking of corn to absorb lime and partially digest the hulls helps also. Glycerin and CMC provide softness to both fresh and stored tortillas. Thin chips, baked to minimal moisture, allowed to temper for moisture equilibration prior to frying and fried at high temperature for a short time develop a highly porous microstructure that delivers a crispy texture. Thick chips, baked to a high moisture, fried without tempering at lower temperatures for longer times develop a non-uniform more-continuous solid microstructure that are perceived as

undesirably hard and crunchy. Optimal formulation and process combined with sensitive techniques are required for effective texture quality control that delivers appropriate, improved food for targeted consumers.

S-91

Textural and sensory analysis of porous grain-based foods. A. BARRETT (1), A. Cardello (1). (1) US Army Natick Soldier Center, Natick, MA.

The physical structure, particularly cellularity, of snack and baked products is what lends these foods their characteristic texture. In brittle snack foods (i.e., extruded products), the incremental fracturing of the structure is the physical process responsible for sensory "crunchiness"; cell size and cell wall thickness, for a given chemical composition, largely determine the frequency and magnitude of fractures occurring during either mastication or mechanical compression. In moist systems (i.e., baked products), physical attributes such as density and plasticization level determine mechanical resistance properties and sensory texture. Mechanical and sensory analysis methodologies, mathematical techniques for treatment of data, and the relationships between instrumental and sensory measurements will be discussed, as well as effects of specific treatments/ingredients on texture.

S-92

Linear and no-linear viscoelastic properties of wheat flour doughs and progress in identifying their structural origins. J. L. KOKINI (1). (1) Rutgers University, New Brunswick, NJ, USA.

This presentation will focus on the state of the current knowledge in understanding the molecular origins of the viscoelasticity of wheat flour dough and its protein components. The presentation will show how wheat proteins are amorphous polymers with a distinct glass transition followed by a rubbery region and free flowing region. Work with a pressure Rheometer has also enabled us to characterize crosslink formation in several proteins. Based on understanding of phase behavior and molecular conformation it is possible to predict the rheology of cereal proteins and the resulting dough. For example in the glassy region glasslike flow models predict the behavior of the relaxation modulus as a function of time; the rubber elasticity theory predicts the rubberlike behavior and constitutive models such as the Wagner model predict entangle polymer flow behavior in wheat polymers. Crosslink models, which derive from extension of the rubberlike theory, enable prediction of the changes in flow behaviors because of crosslinking. The knowledge base will be covered with clear examples of how these ideas relate to the processing and quality of wheat flour doughs.

S-93

The molecular basis of dough rheology – Some answers some questions. P. S. BELTON (1). (1) University of East Anglia, Norwich, UK.

It is generally recognised that the principle determinants of dough rheology are the high molecular weight subunits. The loop and train model of dough rheology is based upon the idea that the subunits contain extendable regions called loops which on extension interact with other subunits to form less extensible trains. Recent measurements of the behaviour of gluten and model peptides have supported this model. Whilst the model correctly predicts the dependence of dough rheology on water content, factors affecting hydrogen bonding, glutamine derivatisation and some additives, many questions remain to be answered. The theory does not adequately explain the role of the other protein components nor does it explain in detail the dependence of dough rheology on subunit type, although some indicators are becoming apparent. Another feature which is still problematic is the role of hydration kinetics in the mixing process. In the talk an attempt will be made to provide answers where they exist and to point to areas where further work is required.

S-94

Formation of viscoelastic properties and gas cell structure in dough development. F. MACRITCHIE (1), Kansas State University, Manhattan, KS, USA.

During development of bread dough, two main changes occur that have an important influence on the final product quality. These are the formation of the viscoelastic properties that enable subsequent dough expansion and the creation of a gas cell structure. In the early stages of mixing, photomicrography of differentially stained dough components show discrete lumps of gluten protein. This transforms to a continuous protein network as the dough is developed, providing the viscoelastic properties that are required for expansion of the dough. Simultaneously, during the later stage of mixing, dough density decreases, reflecting the incorporation of air cells. The concentration and size distribution of the air cells depend on the rheological properties of the dough and the nature of the proteins and lipids that are present to act as stabilizers. Both dough rheological properties as well as gas cell size distribution and stability undergo some change in subsequent processing but the properties set up during mixing largely determine the final quality.

S-95

Molecular balance: Suiting gluten-protein composition to processing needs. C. W. WRIGLEY (1), F. Bekes (2), W. Bushuk (3). (1) Food Science Australia and Wheat CRC, North Ryde, Sydney, NSW, Australia; (2) CSIRO Plant Industry, Canberra, ACT, Australia; (3) University of Manitoba, Winnipeg, MB, Canada.

The unique rheological properties of wheat dough make it suitable for a great diversity of food uses. Most popular of these is bread manufacture, but this, along with the many other uses, has specific requirements with respect to processing needs, e.g., stronger, weaker or medium strength; very extensible or tough; rapid or slow achievement of peak strength. The diverse types of dough quality needed for various products require different balances of properties such as dough strength and extensibility. Such variations in dough consistency are determined by balances at several molecular and supermolecular levels. These include the gliadin: glutenin balance, the size distributions for the many gluten-protein chains, and balanced contributions of HMW and LMW glutenin subunits. In particular, genetic differences in glutenin-subunit composition are valuable in designing new wheats with specific genetic potentials. Subunit 7 is a recent example of the distinct contributions of glutenin subunits; its presence in the genotype as either the normal or the over-expressed type makes a great difference to dough-quality

potential. As we are now learning the "rules" by which these various balances operate to determine dough quality, we can devise predictive methods to evaluate dough quality at the genetic level (for use in breeding) and after harvest, when growth environment has made its contribution.

S-96
Glutenin particles, their relevance and their relation to protein storage vacuoles from immature wheat endosperm.
R. J. HAMER (1). (1) Wageningen Centre for Food Sciences, Wageningen, Netherlands; Wageningen UR, Food Chemistry group, Wageningen, Netherlands; and TNO Quality of Life, Zeist, Netherlands.

It is generally accepted that the fraction of very large glutenin protein aggregates play a key role in determining wheat functional properties such as dough mixing requirements and gas holding properties (related to affect loaf volume). We recently published our observation that glutenin protein aggregates from wheat flour, isolated using a combination of a detergent (SDS) and centrifugation, consist of spherical particles (3–70 micrometer diameter). We hypothesized that such particles originate from the protein bodies as present in immature wheat grain. In this presentation we will review work underpinning the relevance of the glutenin particle concept as a key to understanding wheat flour technological properties. We will show how the properties of glutenin particles are affected both by variations in HMWGS and LMWGS composition and by growing conditions. We will demonstrate how such variations translate not only into glutenin particle properties, but in turn also into technological properties like dough mixing requirements. We also performed a series of experiments in which we have compared glutenin particles (isolated from flour/mature endosperm) with protein bodies isolated from immature wheat endosperm. The gluten proteins as present in protein bodies and glutenin particles were compared in terms of composition, level of polymerisation after sonication, and level of aggregation as observed using CSLM. Our results lend further support to the proposed relation between protein bodies and glutenin particles. We will discuss the importance of this relation with respect to controlling the technological role of glutenin protein.

S-97
Dough development: Not only a matter of gluten formation.
J. A. DELCOUR (1). (1) Katholieke Universiteit Leuven, Heverlee, Leuven, Belgium.

Amongst the flour products which can be made from cereal grains, that from wheat is unique in that, when mixed in the presence of water, it leads to the formation of a visco-elastic dough. Significant research has been carried out on the mechanism whereby the wheat storage proteins glutenin and gliadin lead to the formation of what has been referred to as gluten formation. However, not only the properties of the wheat storage proteins are responsible for the properties of wheat flour based doughs. The present lecture therefore focuses and/or speculates on the direct or indirect impact of wheat flour dough ingredients on dough properties. In doing so, it will mainly deal with the starch and nonstarch polysaccharide constituents as well as with lipids.

S-98
Traceability models, systems and standards used for reducing systematic information loss in food chain.
P. OLSEN (1). (1) Norwegian Institute of Fisheries and Aquaculture, Tromso, Norway.

Traceability has to do with the systematic recording and retrieval of data related to origin, processes undergone and location of a product. Many food producers have good internal, often electronic, systems for recording these parameters. The value and relevance of these recordings is increasing rapidly, for reasons related to food safety, legislation, commercial requirements and competitive advantage. Unfortunately, systematic information loss happens when the data is not passed along to the next link in the supply chain, or not re-used when it is received there. The challenge is to get traceability to work in complete farm-to-fork supply chains, with many-to-many relationships between suppliers and customers, and diverse IT architectures, numbering schemes and naming rules. To eliminate or significantly reduce the existing information loss, globally unique numbering schemes must be adopted, agreement on parameter names and measurements must be established, and standards for electronic interchange of traceability information between software vendors must be developed. TRACE is a large European R&D project where generic principles, methods, standards, and good-practice guides for this type of chain traceability is being developed, applicable in any food chain. In the model used in TRACE and presented here, GS1 codes are used for unique identification, and a generic food industry XML standard is used for information interchange between solution providers. Good-practice guides with recommendations for parameter names and values to be recorded have already been specified for seafood and mineral water; similar guides will be developed for the other pilot chains; i.e. chicken, meat and cereal.

S-99
Worldwide mycotoxin regulations and analytical challenges.
A. FELLINGER (1). (1) R-Biopharm, Vienna, Austria.

Mycotoxins are a worldwide problem and they can cause negative health effects with acute symptoms or long term effects (e.g. cancer). Since the discovery of aflatoxins in the early 1960s, regulations have been established in many countries (about 100 countries) to protect the consumer from the harmful effects of these mycotoxins. Maximum tolerated limits for aflatoxins and some other mycotoxins have been set in different countries around the world, often however on an ad hoc basis. The European Union has recently issued a proposal to lower maximum tolerated limits for several mycotoxins in food and feed. According to a World Bank study the additional cost imposed by the new EU regulations would come to 670 Mio USD per year in Africa and might save 1 life in 2 years in Europe. Currently maximum levels of aflatoxins B1 (2 µg/kg) and B1+B2+G1+G2 combined (4 µg/kg) and ochratoxin A (3 - 5 µg/kg) exist for cereals (including buckwheat and rice) and processed products thereof. Another challenge is the surveillance and control of these limits by employing adequate sampling plans in international trade.

S-100

Food allergens: Legislation, analytical challenges and economic impact. R. E. POMS (1). (1) ICC - International Association for Cereal Science and Technology, Vienna, Austria.

Food allergies represent an important health problem in industrialized countries. Since no cure for allergic patients is available to-date, allergic individuals must strictly avoid the offending allergens in their diet. To assure food safety for allergic individuals stringent labelling regulations and quality assurance procedures are enforced. In the European Union the following ingredients and products thereof liable to cause allergies or intolerances are required to be labelled even if they are only used as processing aids or in minute concentrations: celery, cereals containing gluten (i.e. wheat, rye, barley, and oat), crustaceans, eggs, fish, milk and dairy products (including lactose), mustard, nuts, peanuts, sesame seeds, soybeans, and sulphites at concentrations of at least 10 mg/kg. Both, industry and law enforcement institutions need reliable methods to detect allergenic foods at relevant levels in complex food products.

S-101

A decade of biotech crops/foods: Legislation, analytical requirements and the resulting economic impacts. R. W. GIROUX (1). (1) Cargill Inc., Wayzata, MN, USA.

Several countries have adopted or are in the process of developing regulatory frameworks related to the approval of genetically modified grain and grain products and/or the labeling/traceability of foods containing these products. In the EU there is also the requirement for traceability of such products through the supply chain. Based on these regulatory changes, new markets and their respective supply chains have evolved to meet new customer demands globally. These markets generally require compliance with thresholds for the adventious presence of transgenic material in grain products or the final foods based on a %GM content. To ensure compliance with these new regulatory requirements, industry and governments require analytical methods to monitor supply chains, certify product compliance, and enable enforcement. During this presentation, several of the approaches that have been implemented will be discussed including their fitness, costs, and practical considerations. As well, an overview of international activities relevant to these new markets will be discussed.

S-102

Microbial safety, legal requirements and new opportunities for developing fresh products with a long shelf life. J. W. VAN DER KAMP (1), J. Kastelein (1), R. Montijn (1), J. van der Vossen (1). (1) TNO, Quality of Life, Zeist, Netherlands.

Consumer demands for multi-component 'fresh' products, and producer needs for prolonged shelf life make microbial safety a challenging issue. Insufficient harmonisation of regulations creates complications for the growing international trade. The last decade HACCP systems have been implemented in food factories all over the world. The resulting wide diversity of systems and inspections, with buyers insisting on their own HACCP criteria, caused major inefficiencies. The recent integration of HACCP into ISO 22000 food safety management systems may lead to harmonisation of HACCP systems and auditing methods. Other examples of diverging regulations causing bottlenecks are: the zero tolerance for foods not supporting the growth of *L. monocytogenes*, (non-) acceptance of chlorine to destroy bacteria on produce, and (non-) acceptance of novel preservation methods such as UHP, PEF and HIL. The Global Harmonisation Initiative, endorsed by IFT, IUFoST, ICC and others, aims at eliminating such bottlenecks. Governmental and international (e.g. ISO, CEN) regulations for process equipment, plant lay-out and process conditions are quite generic and not helpful in creating and maintaining optimal hygienic conditions. In these fields, the food industry and suppliers are increasingly relying on guidelines developed and agreed upon by organisations as 3-A, NSF and, especially, EHEDG. Examples will be given of TNO efforts for recently accepted and new guidelines – e.g. for dry material handling and for new criteria for smoothness of equipment surfaces. The time consuming classical tests on microbial growth, are a major drawback in developing and in testing fresh products with a prolonged shelf life. Examples of how advanced, genomics based tests contribute to more rapid development of fresher and safer products will be presented.

S-103

International standards for food safety assessment. M. G. LINDHAUER (1). (1) Federal Research Centre for Nutrition and Food, Detmold, Germany.

Food safety is of growing world-wide concern. Consequently, there is an increasing need for defining internationally accepted safety standards and for the development and/or adaptation of suitable (rapid) methods to control individual safety parameters to achieve a harmonized global risk assessment and to avoid market barriers. In the cereal-related field international organisations such as AACC and ICC have a long tradition in standardising quality and safety assessment methods. In each organisation approved procedures are existing to develop and release standard methods. More recently both organisation agreed to harmonize their comparable individual standards and newly developed methods are standardised in a joint procedure. Furthermore, initiatives are taken to cope with actual challenges. The ICC Task Force on Mycotoxins and Sampling may serve as an appropriate example. To enable control labs to measure and define identical food and health risks ICC, e.g. is also active in the development of reference materials in close cooperation with national labs and responsible bodies of the European Union. It is tradition that existing standards, e.g. such having been developed by ICC, are taken over by international standardisation organisations like CEN (the European standardisation organisation) and ISO and then are incorporated into their specific standardisation process finally ending up with the mutation of an ICC method into an CEN or ICC standard. Recent discussions concerning, for example, mycotoxins, acrylamide or potentially allergenic food constituents may prove the need for an accelerated and intensified cooperation in developing further food safety and traceability standards.

S-104

Sampling practices in the global market. L. FREESE (1). (1) USDA, Kansas City, MO, USA.

Accurate and precise measurements of grain quality are necessary to facilitate the marketing of grain. Several general

sources of variation among measurements have been identified and given in the literature. One categorization of sources of variation is sampling, sample preparation, and analytical method. Technological improvements and standardization in laboratory procedures and analytical methods can help reduce the variation due to sample preparation and analytical method. Variation due to sampling is usually reduced by increasing the sample size or by using a more complex sampling design. Estimates of variation are based on the assumption that samples are taken in a fashion to obtain random samples. In practice, random samples are impractical from large bulk commodity lots. Practical sampling procedures have been developed and are generally used in large grain handling facilities globally. International organizations such as the International Standard Organization and the Codex Alimentarius Commission provide instructions describing many of these procedures. In addition, many countries have regulatory requirements for sampling. The U. S. has extensive instructions for sampling grain lots. Principles of generally accepted sampling procedures and a comparison of instructions will be presented.

S-105
Operational excellence and goal setting. R. LEWIS (1). (1) McKinsey Corp., Los Angeles, CA, USA.

Best practice companies in the brewing industry and beyond set goals on all three aspects of their "Operating System" – the technical, managerial, and behavioral elements of operational excellence. In this discussion, we will explore these three elements, share best practice examples from the brewing industry (and relevant examples from other industries), and address how leading companies integrate goal-setting into their overall strategy.

S-106
Managing change. B. BALES (1). (1) Sierra Nevada Brewing Co., Chico, CA, USA.

Change happens, but many employees don't understand why. Many managers responsible for implementing changes don't understand why their "great ideas" can't get implemented. It doesn't have to be that way. Learn a few basic concepts to help your "great idea" become a reality.

S-107
Project management—Case study: Building a new brewhouse in an operating brewery. J. HIRIS (1). (1) Anheuser-Busch Inc., Fairfield, CA, USA.

It can be said that anyone can build a new Brewery or pub on a green field or vacant lot. This session shows how employees across multiple departments were involved in all phases of a project from initial design through construction, startup and final performance tuning. Slides include many of the promotional materials used to keep the Brewery engaged in the construction progress.

S-108
Global new product trends within sweet and salty snacks. C. BRINNEHL (1). (1) Mintel Market Analysts, Chicago, IL.

A global presentation of Sweet and Salty snacks will be drawn from Mintel Global New Products Database. Christy Brinnehl will highlight key trends and showcase innovative products available to consumers around the world beyond the boundaries of the USA. Mintel is a worldwide leader of competitive media, product and consumer intelligence. For more than 35 years, Mintel has provided key insight into leading global trends. With offices in Chicago, London, Belfast and Sydney, Mintel's innovative product line provides unique data that has a direct impact on client success.

S-109
Challenges of formulating sweet and salty snack products with whole wheat flour. L. SLADE (1). (1) Nabisco, Hanover, NJ.

Whole grain products are riding a freight train, traveling at 100 miles per hour right now. According to the dietary guidelines published by the USDA in 2005, people are encouraged to consume three or more ounce-equivalents of whole-grain products per day, with the rest of the recommended grains coming from enriched or whole-grain products. Consumers of sweet and salty snacks around the world are becoming more health conscious for their food choices and demand health benefits. Products made with whole wheat are among these choices, and companies are striving to put back the goodness of whole grain. This presentation covers the challenges of using whole grain as a functional ingredient and the potential impact on consumer acceptance faced by product developers who choose to use whole wheat as their healthy ingredient. The physical and chemical property of whole wheat flour and the influence of the bran and germ components, which contribute to the challenges of whole grain product texture, flavor, appearance and shelf-life, are discussed.

S-110
New "novel grain" product labeling. T. VOLPE (1). (1) DIAGNOSTICS, Kinnelon, NJ.

In today's global market, many new products finding their way onto supermarket shelves in the US contain "novel" cereals and grains with roots in other regions of the world. They are often included in new formulations for their exotic image and unique functional properties that provide differentiating characteristics in traditional types of products. Furthermore, many of these grains are frequently identified with special health and wellness benefits that contribute distinctive nutritional opportunities and the associated product claims. Advantages are endless for grain based product manufacturers with a strategic "spirit" focused on innovation for today's globe trotting sophisticated consumers. But quality and safety, package labeling information and marketing claims are critical factors that must be carefully considered in the implementation of these unusual grains in new products. A review of several new products containing unique grains will provide a platform to explore the issues of quality and safety, labeling information and marketing claims. In light of recent changes in regulations, special emphasis will be placed on examining labeling practices for nutrition, ingredient and allergen information.

S-111
New developments in whole grain corn products. W. DUENSING (1). (1) Bunge Milling, Danville, IL, USA.

Historically the larger mills in the U.S. corn dry milling industry have utilized the "temper/de-germing" method of corn dry milling to manufacture de-germed corn products

because of the food industry's requirements for high starch content, low oil content and long shelf life. Because these de-germed corn products have most of the bran and germ removed, they do not meet the definition for "whole grains." However, products which exhibit good flavor stability and long shelf life are not available from the corn dry milling industry, including from Bunge Milling, which can be labeled as "whole grains" because they include the principal anatomical components–endosperm, germ and bran–in the same relative proportions as they exist in the intact kernel of corn. This paper will discuss some o the special processing challenges, which were overcome in order to produce a whole grain corn meal with the flavor stability and shelf life, that the customer demands. Additionally, this paper will discuss some of the potential application sin sweet and salty snacks for such a product.

S-112

Proteomic identification of proteins associated with starch and their potential impact in baked product quality. F. M. DUPONT (1), W. H. Vensel (1), W. J. Hurkman (1), D. D. Kasarda (1). (1) USDA ARS, Albany, CA, USA.

Proteins associated with starch granules may affect milling, mixing and baking or nutritional quality. For example, puroindolines are important determinants of milling properties. Proteins become associated with starch granules during commercial starch preparation or dough mixing and may be of interest to end-users because of their effects on food or industrial quality. Contamination of wheat starch with gliadins and glutenins is a problem in preparing gluten-free products. Glutenin association with starch is possibly important to mixing and baking quality, but these interactions have not been studied extensively. Until now, there has been little information on the protein composition of starch granules or the organelles where they are synthesized, the amyloplasts. Using a proteomics approach, we isolated proteins associated with amyloplasts and starch granules and identified them by mass spectrometry. Amyloplasts were isolated 10 days after anthesis and over 200 proteins were identified that were not previously found in the endosperm. The identities of these proteins indicated a larger role for amyloplasts in the metabolism of the developing grain than previously expected. Analyses of commercial starch preparations revealed that over 60 different proteins were associated with the granule surface. Some, such as histones and purothionins, appeared to be non-specifically bound to the granule surface. The amounts of gluten associated with starch preparations from different sources varied, but was low in starch intended for use by celiac patients. Starch biosynthetic enzymes predominated in the granule interior and were only fully extracted by first gelatinizing the starch. Identification of the starch proteome is a first step in understanding starch-protein interactions.

S-113

A review of the plasticizing effect of low molecular weight carbohydrates on gluten matrix. V. HUANG (1). (1) General Mills, Inc., Minneapolis, MN, USA.

In bakery products, low molecular weight carbohydrates function as water activity controllers, browning agents, and sweeteners. Additionally, they can behave as plasticizers for the continuous gluten matrix. Using gluten-based model film matrix, one can understand the impact of low molecular weight carbohydrate-based plasticizers such as glycerol, sorbitol, fructose on rheological and other physical properties. Published literature data on this area will be reviewed.

S-114

Puroindolines: Carbohydrate interactions. C. F. MORRIS (1), A. D. Bettge (1), G. E. King (2), M. J. Pitts (2), K. Pecka (3), P. Greenwell (2). (1) USDA ARS, Washington State University, Pullman, WA, USA; (2) Washington State University, Pullman, WA, USA; (3) University of Idaho, Moscow, ID, USA.

Wheat flour is the world's most important bakery ingredient. Consequently there is a great need to more fully understand the factors that contribute to flour quality. One key quality factor results from the interaction of kernel texture (i.e. 'hardness') with milling, product formulation and processing. The two puroindoline proteins, 'a' and 'b', have been shown to confer the major classifications of kernel texture in wheat, i.e. soft, hard and durum. Here, we will describe the effects of the puroindoline proteins on grain, milling, flour quality and baking in closely related soft and hard winter wheat lines ("near-isogenic lines" or NILs). We will also describe research being conducted to measure the material properties, i.e. the textural differences, between soft and hard wheat kernels using endosperm "bricks" and the TA-XT2i. NILs ranged from 28–80 for NIR hardness, 27–69 for SKCS hardness, 62.2–69.1% for Quadrumat flour yield, 34.7–50.0% for Quadrumat break flour yield, 53.1–68.0% for alkaline water retention capacity, and 8.36–9.80 for cookie diameter. All ANOVA models (9 wheat lines, 5 environments, 2 reps) had good model fit (>0.93% R2). The endosperm bricks were prepared from individual wheat kernels using a special sanding device. Brick dimensions were obtained, then subjected to stress / strain analysis using a TA-XT2i. Grain lots for this study included Madsen and Alpowa soft white, ID377s and a hard Alpowa NIL as hard white spring, and Renville durum wheat varieties. Kernels of each were further segregated into vitreous and non-vitreous classifications. The detailed procedure and analysis of stress / strain data will be presented. Waxy (0 amylose) wheat also exhibits soft and hard grains and expression of puroindolines. Lastly, there is a significant difference ascribed to the combined action of puroindoline a and b on the adherence of remnant endosperm material to the surface of starch granules upon fracture. Scanning electron microscopy was used to document this difference which seems to result from the greater adhesion of endosperm material in the absence of fully functional puroindolines. This greater adhesion manifests itself as kernel hardness, which profoundly affects flour and baking quality.

S-115

How large is the role of proteins and their interactions with starch in gluten-free bread? T. J. SCHOBER (1), S. R. Bean (1). (1) USDA ARS, Manhattan, KS, USA.

Gluten-free breads for celiac patients may be based on isolated starches and cereals including rice, maize or sorghum. This study focuses on the development of an improved gluten-free sorghum-starch bread (70% sorghum flour, 30% different starches) and the understanding of the physicochemical background. Starch-protein interactions in such breads may be relevant in two ways. Within the sorghum endosperm, the embedding of starch into a stable protein matrix might

be responsible for the unavailability of some of the starch and a gritty mouth feel. In the batter, starch surface proteins might enable interactions between the granules. Additionally, solubilized proteins might stabilize bubbles. Starch breads without sorghum could be successfully baked without the addition of hydrocolloids or emulsifier. It was essential to carefully adjust water levels, so that it was just sufficient to create a homogenous batter, without water surplus within which the starch would settle. Individually, wheat starch performed best, maize starch intermediately and potato starch worst, although breads were still leavened. A 70/30 maize/potato starch mixture totally failed. However, adding an excess (100% on a starch basis, sb) of water in conjunction with 2.2% sb hydroxypropyl methylcellulose (HPMC), produced much superior, better aerated bread. In such highly diluted systems, it is unlikely that many starch granules could interact via surface proteins. When using the 70% sorghum system, only the strategy of excess (~100%) water worked. Addition of HPMC, sourdough fermentation of the complete sorghum portion and the addition of a thermostable amylase greatly improved quality. HPMC could not be replaced by sorghum protein solubilized in alkali. It is concluded that in 70% sorghum/30% starch bread, starch-protein interactions play no relevant role in the batter but that it is advantageous to open up the endosperm by sourdough fermentation to release starch.

S-116

Partial restoration of gluten and starch viscoelasticity through optimized high-fiber blends. C. COLLAR (1), E. Santos (1), C. M. Rosell (1). (1) Institute of Agrochemistry and Food Technology, Valencia, Spain.

Beneficial physiological effects of high fiber breads have proved to be significant at higher percentage of flour replacement encompassing an impairment of both the dough viscoelastic characteristics and the functional quality of the resulting fortified breads. This paper aims at optimising fiber mixtures for the manufacture of low-calorie wheat bread meeting acceptable viscoelastic standards. Effects of soluble inulin-, partially soluble sugar beet-, pea cell wall- and insoluble pea hull-dietary fibers on wheat dough mixing, textural and thermal viscoelastic profile have been investigated. Impact of fibers added singly and in associated mixtures at different levels on the investigated viscoelastic parameters involving major dough biopolymers–starch and proteins–has been evaluated by response surface methodology. Measurements were performed at large deformation using empirical rheological methods that simulate mixing, fermentation/resting and baking. Advise of unsuitable fiber combinations and optimum fiber mixtures meeting acceptable functional standards are provided. High replacement of flour by a specific fiber blend into dough formulation allowed to obtain a low calorie high-fiber fresh bread with good physico-chemical profile and high sensory scores undergoing slow rates of both staling and sensory deterioration over a period of 10 days of storage.

S-117

Interaction of arabinoxylan- and beta-glucan enriched barley fractions with gluten in wheat dough and baked products. M. IZYDORCZYK (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada.

Dietary fibre (DF) fractions enriched in beta-glucans (15% dwb) and arabinoxylans (10% dwb) can be generated by roller milling of hull-less barley. This material is a desired ingredient in the new generation of healthy bread products because of clinically proven health benefits of its constituents. However, DF preparations possess both physiologically and technologically functional properties, and their addition does not only increase the nutritional value of bread but also affects the viscoelastic properties of dough and the final quality of bread products. Several mechanisms by which pure arabinoxylans and beta-glucans exert their technological effects have been proposed. The presence of these polysaccharides changes the water balance in the dough system, increases viscosity of the aqueous phase, hinders gluten proteins movement and aggregation and increases resistance of gluten against extension. Arabinoxylans may also be responsible for chemical effects associated with ferulic acid mediated interactions between arabinoxylans and gluten. The overall effect of incorporation of DF on the breadmaking process and quality is, however, complex and influenced by composition and molecular properties of DF components as well as by physical properties of DF preparations (particle size, hydration properties, and solubility). That complexity may be further heightened by a wide range of dough formulations and breadmaking processes.

S-118

The role of water partitioning over starch and protein phases during baking. P. A. M. Steeneken (1), C. DON (1), A. Jurgens (1). (1) TNO Quality of Life, Groningen and Zeist, Netherlands.

Starch and protein are the most important constituents of wheat flour. Many phenomena in the baking process are difficult to understand on the basis of the properties of starch or protein alone. In dough, starch, protein, and water are known to form at least three phases: a free water phase, a proteinous gel, and dispersed starch. Because both starch and protein have particulate structures at the µm scale in dough and crumb, they occupy separate phases. There is much evidence that the major mutual influence between starch and protein in dough and bread making is regulation of the water partitioning over both phases. Interactions between starch and protein at a molecular level (if any) can only occur at the phase interface and hence are likely to be unimportant. This lecture reviews the role of water partitioning in dough making, baking, and storage of baked goods. Water distribution in dough is mainly governed by the limited water uptake capacity of intact starch granules and storage proteins. DSC gelatinization profiles of starch with limited water contents point to a transfer of water from the free water and the protein phase to the starch phase during baking. The transfer of water from protein to starch is continued in the course of storage of bakery products. Water partitioning over starch and protein phases has an influence on the firmness of dough and crumb cell walls. Moreover, the water content of the starch phase dictates the rate of starch recrystallization during crumb aging and in this way has an effect on the development of crumb firmness.

S-119

Impact of exogenous proteins on starch and gluten functionality in enzyme-supplemented doughs. C. M. ROSELL (1), C. Marco (1), A. Bonet (1). (1) Institute of Agrochemistry and Food Technology, Valencia, Spain.

Nowadays, exogenous proteins are commonly added to cereal-based products in order to increase their nutritional value, leading to enriched products. In this study, the effect of different protein sources (soy flour, lupin flour, egg albumin, gelatin powder, whey proteins and pea proteins) on dough properties was investigated in order to determine the cereal-exogenous protein combination giving the best dough properties. Looking forward to creating "artificial viscoelastic" doughs, microbial transglutaminase (TG) was added to the cereal flour-exogenous protein blends. Protein/starch interactions were followed during dough processing and baking by using the Mixolab device. The presence of exogenous proteins significantly modified the mixing behavior of the dough and its viscometric pattern, in an extent dependent on the protein source. Biochemical, rheological and microstructural studies showed that exogenous proteins could be integrated in the dough structure changing their properties, and this effect was even more pronounced in the presence of TG that led to new covalent bonds within the protein network. Among the protein sources tested, legume proteins showed the best fitting within the cereal dough structure. In fact, scanning electron microscopy studies of the wheat-protein doughs in the presence of TG supported the formation of heterologous structures in the wheat-lupin blend dough. Therefore, the combination of TG with legume proteins will be a suitable method to be used for protein enrichment of cereal-based products or even a promising tool for developing gluten-free products.

S-120

Quality variations of rye and their impact on baking quality. K. AUTIO (1), L. Flander (1). (1) VIT Biotechnology, Espoo, Finland.

The baking quality of whole meal rye is dependent on the activity of endogenous enzymes, such as alpha-amylase and xylanase, and the content of soluble pentosans. There was marked annual and varietal differences in rye grain quality grown in Finland in years 1998–2001. In the rainy summer 1998 the yield was low, grains were small and dietary fibre content of the grains was high. Xylanase activity of the grains was high which corresponded to the high content of soluble pentosans. In the dry summer 1999 pentosan content of the grains was low and beta-glucan content high. The effect of weather conditions and cultivar were also apparent in the differences in falling numbers, amylogram and swelling curve results. Xylanase activity was better correlated with the viscous properties of flour-water suspensions than alpha-amylase. The effects of cell wall degrading enzymes in rye baking have also been studied using added enzymes. Both added xylanase and beta-glucanase had a positive effect on the dough volume, but negative effect on the oven rise. During germination of rye activities of alpha-amylase, xylanase, alpha-arabinosidase and beta-glucanase increased significantly already after the 1st day. Two rye varieties, Marder and Motto, with falling numbers 314 and 309, respectively, were germinated in vitro. Germination increased the activity of both alpha-amylase and endo-beta-xylanase. Doughs made from flours of germinated grains (falling numbers 124 and 112 for Motto and Marder, respectively) were always softer than doughs made from flours of native grains, and Marder doughs were always more rigid than Motto doughs. Doughs made of flours with low falling numbers have lower process tolerance.

S-121

Barley grain quality requirements for fractionation-utilization. T. VASANTHAN (1). (1) University of Alberta, Edmonton, AB, Canada.

The average annual Canadian production of barley is approximately 13 million metric tons. Despite the small non-malting food market (<5% of the total production), the demand for Canadian barley, especially the hull-less barley grains, in food uses has been fast growing in the recent years. Indisputably, this growth in demand is primarily attributed to a nutraceutical component in barley grains, the mixed linkage beta-glucan. A number of clinical studies have demonstrated the positive health benefits of increasing the level of barley beta-glucans to physiologically effective concentrations in the human diet. Also, FDA has recently approved a health claim for barley beta-glucan containing foods. Hence the interest of food and supplement industries is fast growing to fractionate barley grains and concentrate this bioactive grain component at a commercial scale and to incorporate it into their formulations. Consequently, establishing grain quality criteria for fractionation and a wholistic approach to utilization of food-barley grains, while ensuring the optimum quality of end products, has become important to the Canadian Barley Industry. The presentation will focus on various dry (i.e. pearling, milling, air-classification, etc) and wet (i.e. aqueous, semi-aqueous, etc) fractionation techniques available for barley grains and the grain quality requirements for these operations.

S-122

The physical basis of test weight in oats. D. DOEHLERT (1), M. S. McMullen (2). (1) USDA ARS, Fargo, ND; (2) North Dakota State University, Fargo, ND, USA.

Test weight or bulk density of oats (*Avena sativa* L.) has a major influence on the value of oat grain yet little is known about the physical basis for test weight in oats. Test weight can be attributed to a combination of kernel density and packing efficiency. We have measured oat kernel volume and density by sand displacement, and thus derived the packing factor for six oat cultivars grown in three environments. Kernel volumes ranged from 31 to 38 mm^3, were highly correlated with kernel mass. Kernel densities ranged from 0.96 to 1.03 g/cm^3. Packing efficiency, which is defined as the percentage of the volume of a container occupied by the grain, ranged from 53 to 55%. Both values exhibited genotypic and environmental variation. Regression analysis suggested that 78% of the variation in test weight could be attributed to kernel density and most of the remaining variation could be attributed to the packing efficiency. Size fractionation of grain by sieving and size analysis by digital image analysis indicated that smaller kernels packed more efficiently than larger kernels within an oat sample, and larger kernels in a sample were less dense than the smaller kernels. Analysis of oat kernel components indicated groat densities were about 1.3 g/cm^3 and hull densities were about 0.7 g/cm^3, with very little genotypic variation in these traits. However, the sum of groat and hull

volumes were consistently less than that of whole kernels, suggesting the presence of empty space within the hulls, which could profoundly affect test weight. The difference in densities of groat and hull provide the physical basis for the recognized relationship between groat percentage and test weight.

S-123
Effect of corn quality on dry grind ethanol production. V. SINGH (1). (1) University of Illinois, Urbana, IL, USA.

In the US, the ethanol industry is growing at a tremendous pace. Current ethanol production is 4.5 billion gallons per year and is expected to reach 5.6 to 6.0 billion gallons by the end of 2006. New advances are being made in different aspects of dry grind ethanol technology including raw material (corn). Corn genetics are known to affect ethanol production. Seed companies are evaluating their existing corn genetics and classifying corn hybrids for dry grind ethanol production. In a conventional corn dry grind ethanol process, exogenous alpha amylase enzymes are added during the liquefaction to break down starch into dextrins. These exogenous enzymes add to the operating cost of an ethanol plant. Corn genetics also are being developed to produce endogenous amylase enzymes within the kernel. Corn quality factors (kernel composition, endosperm hardness, planting location, harvest moisture content, drying temperature) affected or controlled by genetics, environment and post processing are also being were evaluated for dry grind ethanol process. Fermentation characteristics of 18 yellow dent corn hybrids grown at multiple locations were evaluated. Depending upon hybrid, final ethanol concentration varied by 23% (from 11.0 to 14.3% v/v). Fermentation properties of corn with endogenous amylase enzymes (amylase corn) were tested extensively using a small scale laboratory dry grind procedure and compared to the fermentation properties of an dent corn sample. Three to 5% amylase corn was required, in conjunction with dent corn, to achieve ethanol yields similar or higher than the sample processed with exogenous enzymes and 100% dent corn. Planting location, harvest moisture content and drying temperature had significant effect on final ethanol concentration in dry grind corn process.

S-124
Protein composition and grain hardness in sorghum. S. BEAN (1), B. P. Ioerger (1). (1) USDA-ARS, Manhattan, KS.

Grain hardness is an important quality trait in sorghum. Grain hardness has been linked to milling and food quality as well as resistance to insects and mold. Despite the importance of grain hardness in sorghum, its biochemical basis is still not well understood. In sorghum, the grain is composed of areas of both hard and soft endosperm. Past research has demonstrated that the storage protein composition of these endosperm types differs and hypotheses on protein cross-linking have been made to explain grain hardness. Our research into the polymeric protein composition and kafirin subclass composition in sorghum has confirmed that kafirin composition does vary between hard and soft endosperm, with soft endosperm having higher relative amounts of gamma kafirin compared to hard endosperm. Furthermore, the crosslinking of the kafirins appears to differ as the molecular weight distribution of polymeric proteins differs between hard and soft endosperm. The distribution of disulfide bonds and free sulfhydryl bonds also differed between hard and soft endosperm.

S-125
The African Biofortified Sorghum Project—Applying biotechnology to develop nutritionally improved sorghum for Africa. R. JUNG (1). (1) Pioneer Hi-Bred International, Johnston, IA, USA.

The African Biofortified Sorghum (ABS) Project, a joint project of a consortium consisting of Africa Harvest, eight other African organizations and of Pioneer-Dupont, has received funding from the Bill and Melinda Gates foundation to develop nutritionally enhanced sorghum for the arid and semi-arid tropical areas of Africa. Sorghum, the fifth most important cereal crop in the world, is one of the most important staple crops in Africa and represents the only viable food grain for many of the world's most food insecure people. Sorghum grain has a nutritional profile similar to corn and other cereals, i.e. it shares the typical nutritional deficiencies of cereal grains, a low content of several essential amino acids, a low vitamin A and E content and a low bio-availability of iron and zinc. Therefore, a diet, based mostly on sorghum, is not adequate to meet the nutritional growth or maintenance requirements for children and adults and needs to be supplemented with essential amino acids and micronutrients. Further, most sorghum food is cooked or heated during preparation. In contrast to other cereal grains, heat treatment results in a severely reduced digestibility of sorghum grain (up to 50%). The goal of the ABS project is to develop transgenic sorghum varieties that will overcome most of the described nutritional deficiencies by substantially improving grain digestibility, by delivering vitamins, the essential amino acids lysine, threonine and tryptophan, and by improving the bioavailability of iron and zinc. The development of the improved sorghum lines relies on transgenes and technologies that have shown high efficacy in transgenic maize and that resulted in a significantly improved nutritional quality of maize grain. As a proof of concept, a first generation transgenic sorghum line that possesses grain with a 50% increase in lysine has already been developed. The genes and technologies used for this project and first results obtained with transgenic sorghum plants will be discussed in more detail during the presentation.

S-126
Objective methodology to achieve quality goals in Asian noodles. D. W. HATCHER (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada.

Under ideal conditions sensory evaluation of Asian noodles by trained panelists endemic to a specific region offers the highest opportunity for commercial success within that region. However, as many manufacturers are both manufacturing and distributing their products across regions and countries, optimizing for one specific region alone is not viable. Objective assessment of noodle quality offers manufacturers the ability to standardize their testing protocols and evaluate their formulation ingredients; ie flour, salt compositions and ratios as well as specific additives to ascertain their impact. Visual assessment of noodles has only recently moved from subjective descriptions to more objective measurement through either colorimeters or advanced image analysis. Texture attributes of noodles remain a difficult

parameter to subjectively quantify and remain relevant to regional or national differences. Data will be presented highlighting the benefits of objective methodologies for characterizing differences in noodles, both visual assessments and texture characteristics on the basis of flour protein, refinement, particle size and starch damage in combination to common wheat grading factors such as frost, insect damage, sprout damage and hard vitreous kernel content.

S-127

Evaluation of test conditions in terms of sample size and compression degree in noodle texture measurement. S. J. LEE (1). (1) Dongguk University, Seoul, Korea.

In compression test, it is often confusing how much noodle sample and compression should be applied. In this study, those test conditions were evaluated by measuring textural variables according to sample size and compression degree. A fixed amount of cooked noodle piece was taken either on a mass basis, or on a length basis. Various degrees of compression were adopted as test conditions either by length unit (mm), or by strain unit (%). TPA variables of noodles were measured by using a texture analyzer (TA), and by sensory evaluation. Textural data of noodles with different starch contents were statistically analyzed in terms of precision, accuracy and validity. The precision of test conditions was evaluated by principal component analysis. The accuracy and validity were evaluated by comparison in instrumental data between different kinds of noodles and canonical correlation analysis between instrumental data and sensory data.

S-128

Durum wheat, semolina and pasta–Defining and evaluating quality within a quality management system. L. SCHLICHTING (1), B. A. Marchylo (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada.

The concept of durum wheat quality is complex and quality factors have different priorities in durum wheat markets around the world. Canada is a major exporter of durum wheat and therefore its quality management system needs to account for such differences in quality requirements. Within the components of the quality management system, which include variety registration, grading and quality assurance monitoring, these various quality factors must be assessed consistently using a wide variety of visual grading and instrumental procedures. The various quality factors which are considered most important include the physical characteristics of the grain, protein content, protein quality, colour, appearance and cooked product texture. More recently, food safety issues are gaining prominence and merit consideration in the quality management process. Physical characteristics such as sprout damage, black point, smudge and test weight will be discussed in the context of their impact on quality characteristics and how they are measured. Intrinsic quality factors such as protein content, gluten strength and colour have varying degrees of importance in different markets. While protein content is easily determined, numerous techniques are used to measure gluten strength including gluten index, alveograph, physical dough mixing and sedimentation tests. The colour of semolina and end products is increasing in importance as an aesthetic quality factor in most markets. The measurement of these factors and their impacts on end product quality, including cooking quality, and consumer acceptability will be presented.

S-129

An approach to standardize the instrumental texture determination of cooked spaghetti firmness. M. J. SISSONS (1), L. Schlichting (2), N. E. Egan (1), W. Aarts (2), B. Marchylo (2). (1) New South Wales Agriculture, Tamworth, NSW, Australia; (2) Canadian Grain Commission, Winnipeg, MB, Canada.

The firmness of cooked spaghetti is an important quality measure used in durum breeding and quality control laboratories throughout the world. While firmness is only one component of the textural characteristics of cooked pasta, it is one of the most common measurements obtained using instrumental and/or sensory evaluation. Although there is an instrumental method available (AACC 66-50), precise conditions for sample cooking and instrument testing are not well defined. In previous work, we have found that differences in the interpretation of the method as used by different laboratories, affects the ranking of the same unknown samples. In this paper, an analysis of the affect of varying the cooking procedure, sample presentation and instrument settings on cooked firmness, using 10 carefully selected spaghetti samples, will be presented. As a result of this analysis, a "standard method" was adopted and used to compare the firmness values of 30 diverse spaghetti samples in two laboratories. These results were also compared with firmness values obtained using methods based on AACC 66-50 in each laboratory. By using this carefully defined standard method, higher precision and improved reproducibility between laboratories was achieved.

S-130

Selenium and other minerals of nutritional importance in the Italian durum wheat and products. M. CARCEA (1), F. Cubadda (2). (1) INRAN, Roma, Italy; (2) ISS, Roma, Marina, Italy.

The significance of trace elements for human health and well being is a field of interest that has found a development in relatively recent times and knowledge is accumulating regarding their nutritional role, e.g. the essentiality of selenium, an element for long known to be toxic, was only established in the late 1960s. Addition of selenium in fertilizers has been adopted by countries where an inadequate Se status has been recognized. There is also an increasing awareness of the potential role of trace elements in the development of degenerative age-related diseases, such as coronary heart disease, cancer and osteoporosis. Needless to say that progress in trace element research is closely connected to the development and improvement of analytical techniques with respect to sensitivity, precision and analytical quality control. Selenium enters the food chain through plants which absorb it by means of their roots in highly variable amounts according to the levels available in soils. Considering the accumulating evidence on the essentiality and importance of selenium in human biology and the fact that data on Se concentration in the different soil types of Italy are very poor we undertook a study on the spatial and temporal availability of Selenium concentration in the Italian durum wheat grains. Durum wheat is extensively cultivated in central and southern Italy and can does provide a rather complete picture of

geographical distribution of bioavailable selenium in Italian croplands. Moreover, durum wheat based products such as pasta and bread are consumed daily by all sectors of the Italian population and they can themselves be an important source of selenium and other minerals in the human diet. The importance of present durum wheat processing technology in affecting the original selenium content in the grain was also investigated. Other essential trace metals such as copper and zinc have been studied in the Italian durum wheat grains together with nickel which is potentially an essential element for humans but it may stimulate allergic reactions in some individuals. Finally, durum wheat products could potentially be among the major dietary sources of contaminants such cadmium, lead and arsenic. The effects of all the processing steps along the pasta food chain from grain milling to home cooking on the levels of cadmium, lead, arsenic and nickel were also investigated.

Oral Abstracts

O-1

The upcoming crisis in grains. M. LYONS (1), B. Hoskins (2). (1) Heriot Watt University/Alltech, Dunboyne, Ireland; (2) Heriot Watt University/Alltech, Lexington, Kentucky, USA.

How will the world feed its people in fifty years? Thus far in the 21st century, the population growth rate has been approximately 76 million people/year. That is the equivalent of adding the population of the United States every 4 years. To complicate the situation, a hectare of arable land is disappearing every 7 2/3 seconds, while 50% of the people on Earth go hungry. People need to be fed, and they want to be fed better. The demand for grain has never been higher, and the increasing demand for quality protein/meat from higher up on a food chain that consumes grains has become a considerable challenge for farmers to meet demand. Biotechnology provides tools that enable more efficient utilization of grains. While the global supply of grain is limited, cellulose fiber is abundant. Improved utilization of grains and their portions that have been wasted in the past is extremely important in keeping pace with demand. A global perspective on the availability and use of grains and spent grains will be presented along with a strategy addressing the situation that is already upon us today and quickly becoming a crisis. New applications of biotechnology, including solid-state fermentation of microorganisms that can be utilized to enhance the value of spent grains and the impact on our food supply will be discussed.

O-2

Functional drinks based on malted buckwheat, sorghum and triticale. S. KREISZ (1), M. Zarnkow (1), W. Back (1). (1) Institute of Brewing Technology I, Technische Universität München-Weihenstephan, Freising, Germany.

Customers are looking for additional health benefits while consuming food or drinks. This paper gives an overview on the potential of malted buckwheat, sorghum and triticale as an example for using malted cereals and pseudocereals as a substrate for fermented, non-alcoholic beverages. The main focus for the different malting and fermentation procedures was on the one hand to deliver extract for fermentation and on the other hand to enrich bioactive substances like fibres, polyphenols and folates to produce drinks with a special health benefit. Analytical methods: All malt, wort (substrate) analysis were executed according to the Analytica EBC. Special analyses for bioactive substances were executed mostly with HPLC according to different references. Results and discussion: Different varieties of the three candidates have been tested and the most suitable for malting have been chosen. The malting procedure has been adapted to the needs of every cereal and the substrate production has been altered according to the individual enzymatic abilities. The resulting drinks have been evaluated after the fermentation by a taste panel. The results show that malting is a very good procedure to enrich functional components in cereals or pseudocereals and to provide enzymes to solubilize functional components for beverages. For example, it was possible to enrich the rutin content of buckwheat up to eight times compared to the unmalted buckwheat. The paper will present the influence of the different characteristics of buckwheat, sorghum and triticale on the beverage technology as well as the influence on the content development of the functional components. It shows the potential of using malted cereals and pseudocereals as base for functional drinks.

O-3

Nutritional properties of oat-based beverages as affected by processing and storage. H. ZHANG (1), G. Önning (1), R. Öste (2). (1) Biomedical Nutrition, Lund University; (2) Food Chemistry and Applied Nutrition, Lund University.

Oats is known for its compositional beta-glucan, which has been proven to reduce the risk of coronary heart disease. As a new way of applying its healthy beneficial effect, oat-based beverages have been commercialized and shown to have cholesterol-lowering effects. However, during processing and storage of oat-based beverages, other nutritionally important components such as protein, lipids, vitamins, minerals and antioxidants might be negatively affected. To improve the understanding of such consequences, several investigations have been made. The retention of fatty acids, vitamins, minerals, and antioxidants (including avenanthramides and hydroxycinnamic acids) has been followed in different beverage prototypes. Furthermore, the net protein utilization was investigated in rats. The bioavailability of iron from an oat-based prototype was also studied. Our data showed that the fatty acid profile changed only to a minor extent after the processing and storage for one year. Some of the native vitamins and minerals were lost in the processing and some of the vitamins were lost during the storage. Levels of antioxidants were generally decreased during the processing and refrigerated temperature favored the retention of avenanthramides in the iron-absent prototype without loss of the total antioxidant capacity. The protein quality in the oat beverage was as good as casein and wasn't affected by the processing or by up to one year of room temperature storage. The iron absorption in humans was significantly improved by the combined techniques of iron supplementation, phytase treatment and addition of organic acids. These data indicated that the nutritional quality of UHT oat-based beverages can be further improved by optimized processing and storage conditions and that such information can be important for the food industry.

O-4

Pulque fortification with iron, zinc and selenium. L. TOVAR (1), M. Olivos (1), L. Campos-Villegas (1). (1) CIIEMAD/IPN, Mexico City, Mexico.

Pulque is a beverage brewed mainly from the sap of *Agave atrovirens* and *Agave americana*. It has been made in the central highlands since about 1000 AD. Pulque is a white, viscous liquid with about 45 g/l of ethanol and a pH of 3.4. Since iron and zinc deficiencies among the Mexican population are widespread, about one third of children and women of childbearing age are anemic, pulque was fortified with iron, zinc and selenium at the fermentation stage of the agave sap. Selenium was added because we presumed that the intake of this micronutrient in rural diets is below the RDA. Iron and zinc were detected by flame atomic absorption spectrometry. Selenium was quantified by hydride generation. The contents of these trace elements in the fortified pulque compared with the traditional one were several-fold higher. Pulque is mostly consumed by the poor in the rural areas of the country.

O-5

Malting and brewing with buck wheat. B. D. SCHEHL (1), H. H. Wijngaard (1), B. P. Nic Phiarais (1), E. K. Arendt (1). (1) Department of Food and Nutritional Sciences, National University of Ireland, University College Cork, Cork, Ireland.

Buckwheat is pseudo-cereal that is regarded safe for celiac sufferers and may replace other gluten containing cereals in a daily diet especially since it is regarded as highly nutritious grain. Buckwheat contains dietary fibre, resistant starch, D-chiro-inositol, fagopyritols (galactosyl derivatives of D-chiro-inositol), rutin (an anti-oxidant), and a high level of minerals and vitamins. The overall objectives of the study were: i) to develop a malting procedure for buckwheat by optimising the steeping, germination and kilning process; ii) to gain a fundamental understanding of changes taking place during the malting process; iii) to optimise the initial brewing steps, which should lead to the production of a gluten-free beer based on buckwheat. To optimize the malting procedure the controllable malting conditions steeping temperature, steeping time and germination time, as well as kilning time and temperature were optimized in a computer controlled pilot-scale malting machine. The buckwheat malt quality was determined by standard brewing methods as well as by HPLC, enzyme tests and rheological tools. Steeping time was optimized and was shortened in comparison to barley. Buckwheat achenes are smaller in size than barley kernels, and absorbed water more rapidly. The optimal steeping time ranged from 7 to 13 h. An optimal germination temperature of 15 °C (= air-off 16.5 °C) was determined. A higher germination temperatures led to a less controllable and vigorous germination; it also increased malting loss, due to longer rootlets. Hereafter, a germination time of 4–5 days was selected for buckwheat: the grains were modified to a maximum level, but nutrients had not yet been exhausted. Amylolytic activities of buckwheat and barley malted differed significantly. A maximum alpha-amylase activity of 63.07 units g^{-1} was determined in buckwheat malt, which was low in comparison to barley malt (147.4 units g^{-1}). A maximum total beta-amylase activity of 49.97 units g^{-1} was determined in buckwheat malt and 745.96 units g^{-1} in barley malt. The optimum kilning regime was as follows: 5 h at 40 °C, 3 h at 50 °C followed by 3 h at 60 °C. Due to the differences between barley and buckwheat malt, the milling and mashing profile needed to be adjusted. The grist needed to be milled to a very small grist size and mashing procedure for 100% buckwheat malt: 15 min at 35 °C; 15 min at 45 °C; 40 min at 65 °C; 30 min at 72 °C; 10 min at 78 °C. Overall, the malting and mashing process were optimized effectively. A low alcohol beer can be obtained by brewing with the adapted procedures. When a traditional lager is required, industrial enzymes need to be added and the fermentation process needs to be optimized.

O-6

Optimization of the mashing procedure for malted proso millet. M. Zarnkow (2), M. KESSLER (2), F. Burberg (2), E. Arendt (1), W. Back (2), S. Kreisz (2). (1) Department of Food Science and Technology, University College Cork, Cork, Ireland; (2) Lehrstuhl für Technologie der Brauerei I, Technische Universität München, München, Germany.

The incidences of celiac disease, or other allergic reactions / intolerances to gluten are increasing largely due to improved diagnostic procedures and changes in eating habits. Currently it is estimated that 1 in 100 of the world population is suffering from this condition. This creates a high demand for high quality gluten-free products, such as gluten free beer. In this study Proso millet (*Panicum miliaceum* L.), which belongs to the family poaceae, which is regarded as gluten free, was used as raw material for this work. The objective of the study was to optimize the initial brewing steps to produce a good quality gluten free beer based on malted proso millet. The optimization of the brewing procedure was carried in a pilot-scale brewing facility (60 l). The malt quality as well as the analyses carried out on the mashes and worts were based on methods outlined in MEBAK or by the ASBC. It was found that the mashing procedure used for barley was not suitable for malt produced from proso millet, even though the type of amylolytic enzymes found in proso millet are the same as in barley. Nevertheless the activity levels of these enzymes differ significantly. It was found that proso millet has a relatively low alpha and beta amylase activity and a very high alpha-glucosidase activity. The gelatinization temperature of proso millet starch is 68 °C, and is therefore different to barley. With this in mind the mashing procedure for proso millet malt was optimized. Major emphasis was placed on the optimization of the pH, calcium concentration, as well as the time and temperature steps used during mashing. The results from this study clearly show that the optimization of the mashing procedure can lead to the production of wort of good quality, which is the base for a good quality gluten free beer.

O-7

Effect of bread structure and chemistry on moisture diffusion. A. H. BARRETT (2), U. Sajjad (2), G. Kaletunc (1). (1) The Ohio State University, Department of Food, Agricultural and Biological Engineering, Columbus, OH, USA; (2) US Army Natick Soldier Center, Combat Feeding Directorate, Natick, MA, USA.

Military-specification bread, which is stable for 18 months, is also used in sandwiches. While bread and filling are formulated to be similar in a_w, slight variations are magnified during storage. Moisture redistribution from the center to the lower a_w crust occurs in shelf-stable rolls; in sandwiches, slight drying of the crumb will drive moisture from the filling into the bread, leading to textural loss. Manipulation of bread physical/hydrophilic properties was tested as a means of slowing redistribution. Structure was controlled through yeast content and proof time, and chemistry through lipid or resistant starch content. Density, cell size, a_w, and moisture were measured. Five cm cubes of crumb were interfaced with like volumes of cheese, sealed, held at 4 °C and evaluated weekly by determining moisture contents of 5-mm sections. Added-moisture distributions, as a function of time and distance, were fitted to a Fickian diffusion model. Effective diffusion coefficients were calculated. Increasing bulk density slowed diffusion, most likely by increasing tortuousity. Shortening, oil, and resistant starch also slowed water migration by rendering the bread less moisture-affinitive.

O-8

Impact of TGase on the ultrastructure, fundamental rheological and baking characteristics of batters and breads made from different gluten free flours. S. RENZETTI (1), E. K. Arendt (1). (1) Food Technology, Food and Nutritional Sciences Department, UCC, Cork, Ireland.

Gluten-free (GF) breads are generally of poor quality because of the lack of a protein network. Transglutaminase (TGase) has been successfully used in food systems to promote protein crosslinking. In this study, TGase was investigated for network forming potential on flours from six different GF cereals (brown rice, buckwheat, corn, oat, sorghum and teff) used in breadmaking. TGase was added at 0, 1 or 10 U/g of proteins present in the recipe. The effect of TGase on batters and breads was evaluated by fundamental rheological tests, Texture Profile Analysis (TPA) and standard baking tests. 3D elaborations of CLSM images were performed on both batters and breads to evaluate influence of TGase on microstructure. Fundamental rheological tests showed for BW and BR batters a significant increase in elastic modulus when 10U of TGase were used. In breads from BW and BR flours, the effect of 10U was evident as a significant increase in hardness and chewiness along with a decrease in specific volume were observed. These results indicate an effective protein crosslinking catalysed by TGase. 3D CLSM image elaborations confirmed the formation of protein complexes by TGase action. On the other side, TGase showed negative effects on corn flour as its application was detrimental for the elastic properties of the batters. This was confirmed in breadmaking where TPA tests showed a significant decrease in hardness and chewiness. Under the conditions of this study, no effects of TGase could be observed on batters and breads from oat, sorghum or teff. Overall, it can be concluded that TGase can be successfully applied to GF flours to improve their breadmaking potentials by promoting network formation. BW and BR provided the best protein source for TGase action. This study is financially supported by the European Commission in the 6th Framework Programme, Project HEALTHGRAIN FP6-514008.

O-9

Influence of the fatty acid on the baking activity of phospholipids. B. Fischer (1), P. KOEHLER (1). (1) German Research Center of Food Chemistry and Hans-Dieter-Belitz-Institute for Cereal Grain Research, Garching, Germany.

Due to common structural elements phospholipids act as emulsifiers. Therefore, those polar lipids, e.g. lecithin, which can be isolated on an industrial scale from plant sources, are used in improvers for breadmaking. The baking activity of whole lecithin is well known, however, very little information is available about the effect of the fatty acid present in phospholipids. Therefore, the aim of this study was to determine the influence of the fatty acid in phosphatidyl choline on the baking performance. A homologous series of phosphatidyl cholines with fatty acid chain lengths ranging from 6:0 to 20:0 including 18:1, and 18:2 was synthesized by reacting glycerophosphatidyl choline with the respective fatty acid anhydrides in the molten state. The synthetic phosphatidyl cholines were characterized by chromatography, 1H NMR, 13C NMR and mass spectrometry. The functional properties were determined by a micro-scale baking test and by micro-extension tests with 10 g of flour. The baking performance was best for dicaprinylphosphatidyl choline, which caused an increase of the loaf volume by 55%. Longer C-chains (12:0 to 20:0) and double bonds within the chains (18:1 and 18:2) had a less positive effect on the loaf volume (increase by up to 40%). For phosphatidyl cholines with short-chain fatty acids an optimal concentration of 0.2% based on flour weight was found, whereas higher concentrations were required for compounds with longer C-chains. Comparative studies with lysophoshatidyl cholines showed, that longer C-chains were required to get the best baking performance as compared to phosphatidyl choline. Additional rheological tests confirmed the differences between individual compounds and compound classes.

O-10

Role of liquid lamellae in gas cell stability in bread making. B. S. SROAN (1), F. MacRitchie (1). (1) Kansas State University, Department of Grain Science and Industry, Manhattan, KS, USA.

Bread volume is directly related to initial concentration of gas cells during mixing and stability of these gas cells during different stages of bread making. During mixing, gas cells are occluded and concentrated in the liquid phase of dough in the form of small nuclei. These gas cells expand during proofing and baking stages due to release of fermentation gases into them. During late proofing and baking, the liquid lamellae surrounding expanding gas cells act as secondary protection together with the primary gluten film, which may not be continuous at these stages. The objective of the study was to look into the role of liquid lamellae surrounding the gas cells in gas cell stability. The surface properties of the liquid phase of the dough are the result of surface active compounds (proteins and lipids) at the gas-liquid interface. The study also investigated how these surfactants affect gas cell stability. Contributions of the liquid film stability to dough expansion were assessed by baking tests using flours varying in their natural lipid content/composition. Lipids were analyzed by thin layer chromatography (TLC). Incremental addition of natural lipids back into defatted flour causes bread volume to decrease, and, after reaching a minimum, to increase. Polar lipids have beneficial effects on loaf volume whereas certain non-polar lipids such as linoleic acid have detrimental effects. Rheology of the dough varying in lipid content/composition was studied using a bubble inflation system mounted on TAXT-Plus texture analyzer. Lipids are found to have negligible effect on dough rheological properties such as strain hardening.

O-11

Crystalline changes in wheat starch during the bread-making process: Starch crystallinity in the bread crust. C. PRIMO-MARTÍN (3), N. H. Van Nieuwenhuijzen (1), R. J. Hamer (2), T. Van Vliet (1). (1) Wageningen Centre for Food Sciences and Wageningen University, Wageningen, The Netherlands; (2) Wageningen Centre for Food Sciences, Wageningen, and TNO Quality of Life, Zeist, The Netherlands; (3) Wageningen Centre for Food Sciences, Wageningen, The Netherlands.

Confocal scanning laser microscopy has shown that part of the starch in bread crust is present in a non-gelatinised granular form while no granular starch is observed in the crumb. Since the physical state of the starch in the crust likely affects crust properties such as the time it tastes fresh, starch crystallinity in the crust of crispy bread has been studied. Different techniques were employed to quantify starch crystallinity. Differential scanning calorimetry (DSC) of bread crust samples showed an endothermic transition at 70 °C associated with the melting of crystalline amylopectin. The relative starch crystallinity, as determined by X-ray and DSC, for different types of breads was found between 36–41% and between

32–43%, respectively, for fresh bread crust. Storage of breads in a closed box (22°C) up to 20 days showed an increase in crust crystallinity due to amylopectin retrogradation both by X-ray and DSC. However, DSC thermograms of 1 day old bread crust showed no amylopectin retrogradation and after 2 days of storage amylopectin retrogradation in crust was still hardly detectable. In addition ^{13}C CP MAS NMR was used to characterize the physical state of the starch in flour and bread samples. The intensity of the peaks showed a dependence on the degree of starch gelatinization. It can be concluded that the deterioration of bread crust during storage is not due to amylopectin retrogradation but other properties of the bread crust (eg. glass transition, water sorption) can be influenced by the physical state of the starch in the crust.

O-12

Ultrasonic characterization of bread crumb: Application of the Biot-Allard model for porous structures. B. LAGRAIN (2), L. Boeckx (1), E. Wilderjans (2), W. Lauriks (1), J. A. Delcour (2). (1) Laboratory of Acoustics and Thermal Physics, K.U.Leuven, Leuven, Belgium; (2) Laboratory of Food Chemistry, K.U.Leuven, Leuven, Belgium.

The application of the Biot-Allard model, which is commonly used to describe the ultrasonic wave propagation in porous materials, was examined for bread crumb. Different bread types, ranging from fine grain bread with small cells to coarse grain bread with larger gas cells, were analysed using both image analysis (IA) and ultrasonic techniques. IA indicated differences in mean cell area, cell to total area ratio and number of cells/cm^2 for the different bread crumbs. The ultrasonic technique used non-contact air coupled transducers to measure the phase velocity and attenuation of the generated waves in a range of transmission and reflection experiments. The applicability and the usefulness of the Biot-Allard model as a non-destructive method to describe wave propagation in bread crumb for a wide frequency range were demonstrated. In addition the use of non-contact ultrasound allowed estimating flow resistivity, open porosity, a measure for the size of the intersections in the crumb cell walls, and tortuosity, a structural form factor, for different kinds of crumb. These measurements confirmed the structural differences between the different bread types as observed by IA. The cell to total area ratio from IA correlated well with the open porosity as deduced from the Biot-Allard model. As such non-contact ultrasound is not only a valuable addition to IA, but it offers also the possibility of a rapid ultrasonic screening method for bread crumb and contributes to the knowledge of the structural organization of bread which is of critical importance for the understanding of the visual appearance of bread crumb and the concomitant consumer's perception of bread quality.

O-13

Rapid prediction of dough extensibility using near infrared analysis. R. E. DEMPSTER (1). (1) AIB International.

Thirty samples of wheat and flour were used to develop a near infrared reflectance, NIR, calibration that was used to rapidly determine dough extensibility and elasticity. In this study, AACC Method 54-10 was the reference method used for the initial calibration. This method requires use of the farinograph to determine the water absorption, adding to the total time for determination of extensibility. Thus, the total time to determine the extensibility and elasticity was approximately 2.5 hours, whereas, the results of a NIR scan took less than five minutes, including clean up. Furthermore, the extensigraph results vary from practical applications in the bakery, so a new method was developed that emulated processes used in a bakery. The new method was based on a sheeted in which the amount of force required to sheet the dough could be measured. The elasticity was measured over time using a digital camera. These results were also used to refine the NIR calibration. This initial study indicates the feasibility of using a rapid method, scanning NIR, as a good indicator of flour performance in a bakery. This will add value to wheat destined for the export market in which extensibility is an important flour characteristic.

O-14

Boulevard Brewing Company: Brewing up success in Kansas City. K. Wasmuht (2), J. MCDONALD (1). (1) Boulevard Brewing Co., Kansas City, MO, USA; (2) Krones AG Steinecker Plant, Freising, Germany.

Established in 1989, Boulevard Brewing Company is now the Midwest's premier specialty brewery serving 12 states with its selection of eight year-round and seasonal offerings. Through an unwavering dedication to quality, traditional Bavarian brewing practices and selection of the finest ingredients, Boulevard's popularity is reflected in their annual 15-20% growth. As a result of this growth, the inner city-based brewery reached its annual capacity of 120,000 barrels within its current brewhouse and broke ground on a $20 million expansion project in March 2005. The recently completed three-story, 70,000 square foot addition houses a new 150-barrel brewhouse, packaging equipment, administrative offices and hospitality rooms. In addition to their capacity gains, Boulevard's investment has resulted in increased consistency through process automation, improved wort quality and total energy savings. Improvements in technology have also allowed for reduced brewing times, resulting in a possible 12 brews per day. To achieve these benefits Boulevard selected Steinecker, a leading-edge provider of brewing technology and systems engineering, as its partner in the challenging expansion project. Steinecker's equipment, including a ShakesBeer mashing system, Pegasus lautering system, and Stromboli boiling system with energy storage, were each selected for their respective process and technical strengths. The new brewery's official unveiling will take place on September 14. For more information, visit www.boulevard.com or www.kronesusa.com.

O-15

Practical experiences of mash filtration on thin bed filters from brews with all kinds of raw materials. R. BRAEKELEIRS (1). (1) Meura SA, Peruwelz, Belgium.

Mash filtration of certain raw materials, such as those used for extract production, depends a lot on mash filterability. This differs with the kind of raw material, brewing method, use of enzymes and shear forces. Meura Technologies has made several tests to obtain the best filterability. Explanation and figures will be given on brews with 100% malt type A and C, with mixture of malt and barley up to 100%, with wheat, corn as grits and flour, millets, sorgho, black malts, oats and rye. Due to the combination of appropriate milling devices, adapted brewing methods and filters, it was possible to obtain

short filtration cycles, which are impossible with a lauter tun. All these items will be discussed.

O-16

Advantages of whole grain conditioning (WGC) for milling with roller mills (RM) and lautering with a lauter tun (LT). H. MENGER (2), U. Keller (1). (1) Bühler AG, Uzwil, Switzerland; (2) Ziemann Ludwigsburg GmbH, Ludwigsburg, Germany.

Technical and technological complexity and interdependence between the brewing process steps milling, mashing and lautering give the targets for the development of whole grain conditioning (WGC) in combination with new type of roller mills (RM). Targets of the milling process (milling) are free starch particles, which are out of the cellular structure and high permeability of endosperm cell walls to get optimum surface conditions for enzymes. Especially for lautering with lauter tuns it is very important to get husks in their native structure out of the milling process. The new development WGC allows a calculation of the PSD by using different conditioning rates of the water amount of the grains. Most important of milling with WGC is the additional conditioning rate and time. Both values depend on construction details of the WGC and used mills. The experience with the WGC shows a highly effective, homogenous grain conditioning up to the center of the grain. Very elastic husks and seed leaf which are not destroyed during milling are the result of an effective mechanical breakdown of the endosperm, which means high permeability of cell walls. The active surface of the grain substrates improved amylolysis, proteolysis and cytolysis. Milling in an inline process protects the mash against additional oxygen pick up, which means less lipoxigenase (LOX) activity. In case of conditioning up to a level of more than 12% water content the dust explosion risk is also reduced and ATEX protection is not necessary. The new process technology allows very high flow rates and efficiency by highest wort quality. Mathematical and physical basis for the development of lautering of WGC-Grist with lauter tuns are the filtration laws for porosity cakes, the laws from Darcy and Hagen Poiseulle. All described points are tested and realized brew size from 10 kg up to 200 kg.

O-17

Influence of milling and particle sizes on mash conversion and filtration process. J. VOIGT (2), S. Gruener (1). (1) Adalbert-Raps-Zentrum, Freising Weihenstephan, Germany; (2) Technical University Munich Weihenstephan, Freising, Germany.

The influence of milling can affect the performance of mashing and mash filtration significantly. Comparative trials carried out with a standard malt and different milling systems are described Regarding the milling processes, conventional milling in a roller mill was compared with the Dispax© system by Ziemann. Two different settings for course and fine milling were carried out. The new research brewery plant at Ziemann was used for all trial brews using a standard mash vessel and mashing regime. The mash filtration was done with a new type of thin-bed mash filter. The brew size was 120 kg grist. The differences in milling were investigated with regard to the effect on mash conversion, viscosity in the filtration and filtration time. The influences of milling were determined in grist fractions and mash using a laser diffraction technique (Helos). The method, applicable to dry matter and wet suspensions is described in detail since this application to the mashing process in brewing is new. The analytical methods were carried out and developed at Technical University Munich Weihenstephan. The results from this work indicate that milling effects the filtration performance in the mash filter by improving the reaction kinetics in the mash process and gives an influence on the viscosity of the resulting wort during run-off in the mash filter.

O-18

Jetstar, a novel internal boiler concept for wort preparation. T. M. BUEHLER (1). (1) Huppmann AG, Kitzingen, Germany.

Huppmann AG has developed a new boiler generation. The new design enables a division of the process step 'wort boiling' into a thermal conversion and an evaporation phase. It is the first system that allows this process splitting in internal boilers with natural circulation. During the conversion phase homogeneity is the predominant factor for gentle wort treatment and quick degradation of unwanted flavour precursors. In this phase evaporation is an undesired side effect that mainly causes higher energy consumption. With the Jetstar, evaporation can be reduced to a minimum now at optimum mixing patterns within the kettle. Thermal stress is considerably reduced as pulsation (also called geysering) of the wort during heating-up is completely eliminated. Due to efficient volatile stripping in the evaporation phase, total evaporation can be minimized to levels well below 4%. Thus the system saves primary energy and improves wort quality at the same time. The paper will present the concept and results of the first five installations.

O-19

External thermosyphon wort boiling – New plants in USA, Australia, and UK and their impact on flavour stability. J. M. ANDREWS (1), P. Dowd (1). (1) Briggs of Burton plc, Burton on Trent, UK.

Wort boiling has a large influence on the flavour stability of finished beer which is of critical importance to the brewing industry globally. A number of thermosyphon external wort boiling plants have recently been commissioned around the world, operating with very large heating surface areas and consequently low steam temperatures. This results in reduced heat stress on wort as measured by Thiobarbituric Acid (TBA) and furfural levels. In addition, electron spin resonance (ESR), di-phenyl-2-picryl hydrazyl (DPPH), and dimethyl sulphide (DMS) test results will be presented, all of which correlate with flavour and flavour stability in finished beer. The impact of this wort boiling technology is to improve test results by 20% to 40%.

O-20

Effects of eggshell powder as nucleating agent on the structure, morphology and functional properties of normal corn starch foams. Y. XU (1), M. A. Hanna (1). (1) Industrial Agricultural Products Center, University of Nebraska, Lincoln, NE, USA.

Corn starch and two types of eggshell powder (with particle size of 4–5 µm and 8–10 µm, respectively) composite foams were prepared by extrusion. Effects of eggshells on the structure, morphology, physical properties (unit density and expansion ratio), mechanical properties (spring index and

compressibility) and thermal behavior (thermal transition and stability) of the foams were investigated. The foams' cell size decreased and cell population increased with addition of eggshells into starch matrix. The foams' unit density, expansion ratio, and compressibility decreased significantly ($P < 0.05$), while spring index increased significantly ($P < 0.05$) as the eggshells content increased from 0 to 6 wt%. Further increasing eggshells to 10 wt% increased unit density and compressibility and decreased expansion ratio and spring index. The thermal transition and stability increased with addition of eggshells. The optimum eggshells content was 6 wt% and the eggshell powder with small particle size had a favorable effect on the functional properties of the foams.

O-21

Tensile properties of compounded and injection molded corn gluten meal. J. W. LAWTON (1). (1) USDA-ARS-NCAUR, Peoria, IL, USA.

Corn gluten meal (CGM), the co-product from corn wet milling, contains between 60 to 70% protein about 45% of which is zein. The remainder contains about 22% starch and the balance is fiber and lipid. Research was conducted using a Haaka torque rheometer to identify conditions needed to produce thermoplastic melts of CGM. Zein and starch are both in a granular state in CGM. Triethylene glycol (TEG) and decanoic acid (DA) proved to be effective in disrupting and melting the protein. For CGM, the effect of water on its melt was different depending on the plasticizer used. Better melts were obtained for dry CGM with TEG, whereas CGM containing about 7% water gave the best melts with DA. DA was used as the plasticizer for CGM in extrusion runs, as it is not as hygroscopic as TEG. CGM containing 7% moisture and 30% DA was compounded on a Leistritz twin screw extruder, at 90°C, 100RPM, and a feed rate of 17 g/min. The extrudate was injection molded into tensile bars using a Cincinnati Milacron Act-75-B molder. Tensile strength of the bars after storage at RT and 50% RH was 11 MPa. SEM of the fractured tensile bars revealed that the CGM was still granular after processing. To improve the tensile strength of the CGM tensile bars, CGM containing 30% DA and 7% moisture was extruded under various conditions and the SEM of the resulting extrudates examined. Extrusion conditions of 90°C, 100RPM, and 23 g/min showed optimum melting in the extrudate. These conditions were used to compound CGM and the resulting extrudate was injection molded into tensile bars. No improvement was seen in the tensile strength of the bars. SEMs of the fractured surface of the bars showed an uneven surface, indicating that melting of the compounded CGM was incomplete in the injection molder.

O-22

Use of extrusion for synthesis of starch-nanoclay composites for biodegradable packaging films. X. TANG (1), S. Alavi (1). (1) Kansas State University, Manhattan, KS, USA.

In the quest for improved mechanical and barrier performance for biopolymers used for food packaging while maintaining biodegradability and therefore environmental-friendliness, one approach is the use of natural nanoclays to produce nanocomposites. In this study biodegradable starch-nanoclay composites were synthesized by melt extrusion processing. Natural montrorillonite (Na+ MMT) and one organically modified MMT (Nanomer I30E) were chosen in the nanocomposite preparation. The dispersion of the silicate layers in the hybrids was characterized by X-ray diffraction (XRD) and transmission electron microscopy (TEM). Films were made through casting using granulate produced by a twin-screw extruder. It was observed that starch/Na+ MMT nanocomposite films showed higher tensile strength and better barrier properties to water vapor than the starch/I30E hybrids as well as starch blank, due to the formation of intercalated or exfoliated nanostructure. The effects of clay content (up to 21%) and glycerol content (0% to 20%) on the tensile, dynamic mechanical, and thermal stability properties as well as the barrier properties of the nanocomposite films were investigated. With the increased clay content, higher tensile strength, better thermal stability and barrier properties were obtained. Regarding the effects of glycerol content, the films with 5% glycerol exhibited the highest tensile strength and lowest water vapor permeability, whereas 20% glycerol gave the highest elongation.

O-23

Bioethanol production from wheat employing a low temperature process. M. MIEDL (3), S. Cornfine (3), K. A. Leiper (2), M. Shepherd (1), G. G. Stewart (3). (1) Green Spirit Fuels plc, Templecombe, Somerset, UK; (2) North British Distillery Co. Ltd., Edinburgh, UK; (3) The International Centre for Brewing and Distilling, Heriot-Watt University, Edinburgh, UK.

Bioethanol is a renewable natural fuel source which has the potential to serve as an alternative to fossil based fuels, help to meet climate change commitments and reduce reliance on fossil fuels and dependence on foreign oil imports. Inefficiencies in the production process of bioethanol from wheat provide significant scope for innovation. Current practice is to mill and boil the wheat with subsequent addition of exogenous de-polymerisation enzymes for starch conversion into a fermentable substrate thus carrying substantial cost for energy and enzymes. We show that the levels of indigenous enzymes present in unmalted wheat are sufficient to complete the conversion of starch into fermentable sugars during a low temperature process thus significantly reducing production and energy costs. A similar amount of fermentable sugars and FAN was present in both, the wort produced with the low temperature process and the regime employing endogenous enzymes yielding approximately the same ethanol concentration following fermentation. Backsetting (replacement of part of the water for mashing with spent wash) experiments showed further improvements in the energy and water efficacy of the process. Laboratory and pilot scale experimental results were substantiated by 200,000 L industrial trials. Our findings are a technological innovation that will play a key role in enhancing the production of bioethanol from wheat in a cost-effective and energy efficient manner.

O-24

Ozonation: A non-chemical alternative for control of stored product pests and molds in food grains. C. A. CAMPABADAL (1), D. Maier (1), R. Hulasare (1), C. P. Woloshuk (1), L. Mason (1). (1) Purdue University, West Lafayette, IN, USA.

Ozone treatment (ozonation) for post-harvest food grains is a potential alternative that is non-residual and environmentally

sustainable for treatment of stored food grains and end products. Three field trials were conducted with corn, popcorn and blue corn to determine the efficacy of ozonation to control insect pests and inhibit the growth of fungal spores, bacteria and other pathogens. The basic setup for ozonation consists of a commercial ozone generator connected to a storage structure via a circulation and distribution system. Ozonation was done to attain an ozone concentration of 50 ppm in the plenum and maintain that level for a period of 3 days to achieve mortality of insects comparable to phosphine fumigation. Insect bioassays placed at 0.6 m below the grain surface and in the plenum of the bins were used to test the process efficacy. Adults of maize weevil, red flour beetle and larvae of Indianmeal moth were used in the bioassays. The concept for control of ozone concentration in the bins using two phases of ozonation and airflow was evaluated. The trials proved the efficacy of ozonation in achieving insect mortality comparable to phosphine fumigation. The trials at the popcorn and organic blue corn facility confirmed that end-use parameters like popping volume of popcorn and blue corn quality were not affected. Ozonation also reduced or inhibited mold spores and their development. Inhibiting or eliminating fungal spores reduces the production of mycotoxins that can be toxic to humans or mammals when ingested. Therefore, the field trials demonstrated the efficacy of ozonation in controlling stored product pests and reducing mold counts without any detrimental effect on the end-use quality of grain.

O-25

Powder form grain extracts – A new spray process to generate powders from viscous liquids. S. GRUENER (1), F. Otto (2), J. Voigt (3). (1) Adalbert-Raps-Zentrum, Freising, Germany; (2) Adalbert-Raps-Zentrum, TU Muenchen, Freising, Germany; (3) Lehrstuhl Maschinen- & Apparatekunde, Tu Muenchen, Freising, Germany.

In food industry liquids and powders often have to be mixed to get the final product. This mixing could be sophisticated, especially for highly viscous liquids. Mixing of pure powder form materials is much more simple and therefore different methods to produce powders from liquids have been developed. Liquids can be converted into powder form products by drying processes or combining them with powder form solids. CPF technology (concentrated powder form) is a cryogenic spray process which creates free-flowing powders with liquid ratios up to 80 wt%. A gas, normally carbon dioxide, is dissolved under high pressure (80 to 250 bar) in the liquid. The gas-saturated solution is then rapidly expanded in a nozzle. The gas is released and thus very fine liquid droplets are formed. During expansion a powder form carrier is added concurrently to the sprayed liquid and the liquid is adsorbed to the solid surface or in case of porous carriers, the fluid pours into the pores and soaked particles are formed. CPF technology is a gentle process. It takes place in an inert gas atmosphere and at low temperatures (–10 °C to 0 °C). Substances, sensitive to temperature and oxygen, can be processed with negligible changes to their quality. The product remains unaffected by oxidation or thermal stress. CPF process was successfully applied to different grain and spice extracts, which are widely used in the food industry as a flavour or colourant for breads, bakery products, pastas and others. Normally liquid malt extracts are highly viscous concentrates, which cause problems in handling like dosing and mixing. Therefore there is a need for dry free-flowing powder form grain or spice extracts, e.g. malt extracts. Products from spray drying are still available on the market, but they are hygroscopic and tend to agglutinate. Powder form malt extracts from CPF process are a promising alternative.

O-26

Milled rice quality and property variation due to environmental conditions. R. C. BAUTISTA (1), T. J. Siebenmorgen (1). (1) University of Arkansas.

The objective of this study was to determine the reasons for milling quality, lipid content, peak viscosity, and property variation of rice based on individual kernel property distributions, specifically, individual kernel moisture content (MC) and breaking force distributions. Air conditions, particularly during the 50% heading until harvest, were recorded and correlated with the milling quality of nine rice varieties/hybrids grown at three 'soil type-based' ecosystems located in Arkansas, Mississippi, and Missouri. Approximately 5 kg samples of rice from each variety and hybrids were harvested manually, threshed, and cleaned in the field at MCs that ranged from 13.5% to 26.5% in 2004 and 2005. Individual kernel MC distributions of 300 kernels were measured in three replications immediately after harvest using a single kernel moisture meter. Rough rice samples were dried gently to approximately 12%MC. Three hundred rough rice kernels were dehulled manually to produce brown rice for dimensional measurement and fissure enumeration. The breaking force distributions of the 200 rough rice kernels were measured using a texture analyzer. Milling quality was determined using two 150 g rough rice sub-samples from each sample, dehulled and milled for 30 s using a McGill #2 mill. The percentage of head rice was determined using an imaging system. Head rice was separated and used for viscosity and lipid content analyses. Individual kernel MC and dimensional distributions were affected by location among varieties and hybrids. Percent strong kernels was correlated with HRY. There was significant effect of harvest MC, location, and fissured kernels on HRY and peak viscosity among varieties. Fissured kernels percentage in the field was affected by harvest MC. The effect of nighttime temperature on milling quality and property variation was also presented.

O-27

Processing and assessment of ramen noodles: Evaluation of APH, AH and APW wheat grades for the quality attributes of ramen noodles. L. CATO (1). (1) AWB Ltd., Melbourne, VIC, Australia.

Ramen noodles (Chinese type noodles) are one of the most popular noodle types in many Asian countries including Japan. These types of noodles are typically made of hard wheat flours of higher protein content (around 13%) and low extraction rates (50%) and are made from a mixture of flour (100 parts), water 32–35 parts and kansui (a mixture of alkaline salts – about 1 part). Bright and light yellow colour is preferred, free of specks, and excellent colour stability required among with slightly firmer textural characteristics. The aim of this study has been to evaluate Australian wheat grades of different wheat and flour characteristics for ramen noodle processing. The samples evaluated included: Australian Prime Hard (APH), Australian Hard (AH) and Australian Premium White (APW) grown in New South Wales (NSW). The samples had protein content in the range of 9.8–13.3% while ash

content ranged from 0.40–0.46%. Noodles made from APH resulted in best ramen quality characteristics, firmer noodle texture and good colour stability were observed. Texture was measured using the Lloyd texture analyzer, while the colour was measured using the Minolta Chroma Meter (CR300).

O-28

Spaghetti with plantain starch addition: Cooking characteristics and sensory evaluation. R. G. HERNANDEZ-NAVA (1), L. A. Bello-Perez (1), J. Berrios (2), J. Pan (2). (1) CEPROBI-IPN, Yautepec, Morelos, Mexico; (2) U.S. Department of Agriculture, WRRC, Albany, CA.

The effect of substituting semolina by plantain starch at the levels of 5, 10, 15 and 20% on the cooking characteristics and sensory attributes of spaghetti was studied. Spaghetti was processed following standard procedures used by the California Wheat Commission. Sensory evaluation was performed using a hedonic scale 1–5 on a panel of 40 judges. Cooking quality of the products was determined using standard AACC methods. The evaluation of cooking loss of spaghetti with different levels of plantain starch addition was similar ($P < 0.05$) to the control sample. However, their cooking weight increased ($P < 0.05$) with an increase of plantain starch. This could be attributed to the water hydration capacity of the plantain starch in the product. The results of the sensory evaluation demonstrated that spaghetti with 5, 10 and 20% of plantain starch addition, were statistically similar ($P < 0.05$) to the control sample. Additionally, it was found that spaghetti with 15% of plantain starch addition was considered best by the sensory panel. The result of this study shows great potential for using plantain starch in the fabrication of spaghetti.

O-29

Fortification of white salted noodles with pulse flours. J. HAN (2), R. T. Tyler (2), L. J. Malcolmson (1). (1) Canadian International Grains Institute, Winnipeg, MB, Canada; (2) University of Saskatchewan, Saskatoon, SK, Canada.

The beneficial nutritional and functional effects of pulses (grain legumes) in the human diet are well known, but relatively little food product development utilizing pulses has been undertaken. The objective of this project was to develop products containing significant levels of pulse flours, products which would be functional and nutritional, yet not compromise sensory quality. The effects of adding chickpea, lentil or pea flour to a white salted noodle formulation on dough making properties and noodle cooking quality were studied. Noodle processing and cooking characteristics were maintained with the addition of 10 or 20% (w/w) of pulse flour, but deteriorated significantly at higher levels (30% or higher). This was attributed to the dilution of wheat gluten by the addition of the pulse flour. Changes in the sensory properties of noodle products were observed with increasing levels of fortification. These changes did not significantly affect the overall quality of noodles fortified with lentil or chickpea flour at lower substitution levels (20% or lower). More highly fortified products (30% or higher) were dark in color and soft in texture when cooked. In the case of pea flour, a strong flavour was detected, even at 10% substitution. With increasing levels of fortification, the nutritional quality of noodles would be substantially improved with respect to protein, lysine and fibre content, e.g. 20% substitution with lentil flour would increase protein, lysine and fibre contents by approximately 25, 65 and 40%, respectively. It was concluded that hard white spring wheat flour could carry up to 20% (w/w) of chickpea or lentil flour and still maintain the sensory and cooking quality characteristics typical of white salted noodle products.

O-30

Effective moisture diffusivity of durum wheat pasta according to drying temperature and relative humidity. S. VILLENEUVE (1), P. Gélinas (1). (1) Food Research and Development Centre, Agriculture and Agri-Food Canada, Saint-Hyacinthe, QC, Canada.

Drying pasta at high temperature (about 60–80°C) generally gives high-quality pasta. However, studies on pasta drying kinetics have often been obtained under low relative humidity or low temperature conditions, giving a wide range of activation energy (18–33 kJ mol^{-1}). The objective of this study was to determine the effect of high relative humidity in drying chamber on the effective moisture diffusivity of durum wheat pasta. Using durum wheat semolina, pasta was extruded through a 2.0-mm die and dried for 20 h at 40, 60 or 80°C, and 65, 75 or 85% relative humidity inside an environmental chamber. During drying, pasta was weighed online with a 5-kg load cell connected to a data acquisition system. Compared to temperature, relative humidity in drying chamber had a greater effect on pasta effective moisture diffusivity (Alpha < 0.01), and both parameters responded to a modified Arrhenius-type equation. Activation energy of pasta (11.4 kJ mol^{-1}) was lower than data reported in the literature. Close control of relative humidity in pasta drying unit would be critical, especially for high relative humidity and high temperature conditions.

O-31

A preliminary study of applying FT-NIR spectroscopy to predict semolina and pasta quality. M. PAGANI (2), N. Sinelli (2), M. Mariotti (2), M. Riva (2), M. D'Egidio (1). (1) C.R.A. - Experimental Institute for Cereal Crops, Rome, Italy; (2) DiSTAM (Department of Food Science and Microbiology), University of Milan, Milan, Italy.

The aim of this research was to investigate the feasibility of applying FT-NIR spectroscopy both on durum wheat kernels and semolina to predict pasta cooking quality. This work was carried out on durum wheat kernels and the corresponding semolina and pasta produced on pilot-scale. 193 samples of both kernel and semolina were analysed. Pasta cooking quality was determined by a sensory approach. Spectral data were collected by using a FT-NIR spectrometer fitted with an integrative sphere over the range 10000–3700 cm^{-1}. Predictive models (PLS regression) were evaluated using raw data, 1st derivative and 2nd derivative after pre-treatment with standard normal variate (SNV). Protein and gluten content, W and P/L alveographic indices of semolina samples were fitted using durum wheat kernel spectra. Protein content (Rcv = 0.97 for 2002–2003 samples; Rcv = 0.92 for 2003–2004 samples) and gluten content (Rcv = 0.94 for 2002–2003 samples; Rcv = 0.80 for 2003–2004 samples) were well correlated to kernel spectral data. Other semolina attributes, such as W (Rcv = 0.90 for 2002–2003 samples; Rcv = 0.54 for 2003–2004 samples) and P/L (Rcv = 0.93 for 2002–2003 samples; Rcv = 0.64 for 2003–2004) were less successfully modeled to the

raw spectra of durum wheat kernel. Pasta cooking quality was fitted using the 2nd derivative spectra of semolina (Rcv = 0.60 for 2002–2003 samples; Rcv = 0.58 for 2003–2004 samples). These models were less accurate due to the complexity of the phenomena involved in pasta cooking. Overall, these preliminary results show that FT-NIR spectroscopy, being a non-destructive method, could be implemented in conventional techniques to predict semolina behaviour and pasta cooking quality.

O-32

Water uptake of durum wheat endosperm in pasta manufacturing. A. KRATZER (2), S. Handschin (2), D. Gross (1), B. Conde-petit (2), F. Escher (2). (1) Bruker Biospin GmbH, Rheinstetten, Germany; (2) Institute of Food Science and Nutrition, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.

The production of pasta conventionally includes mixing of durum wheat semolina with water followed by compressing and plasticizing the moistened particles to a continuous dough by means of extrusion or sheeting. There is general agreement that an even distribution of water throughout the semolina is a prerequisite for the formation of a sufficiently homogenous pasta dough. So far, optimization of the moistening and mixing process has been carried out empirically and by experience. The present contribution reports on a detailed characterization of the interaction of water and water vapor with durum wheat endosperm and the kinetics of water uptake into semolina by gravimetric methods and by magnetic resonance imaging (MRI). Water vapor sorption of semolina up to saturation, water migration into micropiles of semolina and water uptake of semolina during soaking in water increased with decreasing granulation. Water uptake into semolina became temperature dependent beyond 47.5 °C due to increased swelling of starch. Calibration of MRI measurements for the quantification of local and time dependent water contents during dynamic water uptake test was successful on the basis of cylindrically cut endosperm samples which had been equilibrated to defined moisture levels. The water uptake into and moisture distribution in endosperm cylinders over time as measured by MRI fitted well to water uptake as determined gravimetrically in soaking tests. With these experimental data and by using numerical simulation it was possible to calculate diffusion coefficients of water in endosperm which will now be applied to improve the optimization of various mixing procedures in pasta processing.

O-33

When a white wheat becomes red. P. WILLIAMS (1). (1) PDK Projects, Inc., Nanaimo, BC, Canada.

The prevalent wheat classes grown in the major wheat-producing countries of the world are of red seed-coat colour. White wheat types are capable of matching red wheats in all quality parameters. They tend to be preferred by millers in regions where wheat is milled to high extraction (80% or higher), since the presence of increasing amounts of bran impart less colour to the flour than do particles of bran from red wheats. Raw alkaline noodles prepared from the new Canadian Western Hard White Spring wheat class (CWHW) proved superior to noodles produced from red wheat in terms of color and speckiness. The market potential of hard white wheats of good and consistent processing quality is likely to increase. An apparent influence of growing location on the seed coat colour of hard white spring wheat genotypes has been observed in western Canada. The influence of location was sufficiently marked as to change seed coat colour from white to red in genotypes of a proposed hard white spring wheat class. The white seed coat can become sufficiently "red" as to cause difficulty in distinguishing the white from the red spring genotypes. This could have serious implications in grading and pricing wheat at the time of delivery. Certain genotypes appear to be more susceptible to the phenomenon than others. Stability in seed coat colour should be a factor in selection during the breeding programme.

O-34

Effects of baking and storage on lutein in whole wheat cookie and muffin products naturally high or fortified with lutein. E. M. ABDEL-AAL (1), J. Young (1), I. D. Rabalski (1). (1) AAFC, Food Research Program, Guelph, ON, Canada.

Lutein is a hydroxylated carotenoid found in fruits, vegetables and grains that promotes health of the eyes and skin and is associated with a reduced risk of age-related macular degeneration, cataracts and cancer. Processing of high lutein grain ingredients or inclusion of lutein into food formulas is a challenge due to its sensitivity to oxidation and isomerization by heat and light. In the present study, high-lutein whole wheat flours and lutein-fortified whole grain flours (at approximately 1 mg per serving) were processed into cookies and muffins and the stability of lutein during processing and subsequent storage was assessed. Separation, identification and quantification of lutein and other carotenoids and their isomers were performed by LC-Vis/UV and LC-MS analyses. In raw wheat and corn, trans lutein was the predominant isomer along with small concentrations of cis isomers. Baking process resulted in a significant reduction in trans lutein by about 50–70% depending upon product type and also led to the formation of cis isomers. The effect of baking was more pronounced in the lutein-fortified cookies and muffins perhaps due to higher concentrations of lutein in these products. Storage of cookies and muffins at room temperature for 8 weeks and 3 days, respectively, had slight effects on lutein concentration and isomerization. The results suggest that the processed fortified products still had reasonable amounts of lutein (15–25 mg/kg or 0.5–0.8 mg/serving) which could be used to enhance the daily intake and deliver the effective dose of lutein.

O-35

Reduction of plasma and liver cholesterol in hamsters by extruded legumes. W. H. YOKOYAMA (1), J. De J. Berrios (1). (1) USDA, ARS, Western Regional Research Center.

Legumes are a nutritious food source that is high in protein and fiber and low in fat. Some legumes particularly soy have been shown to reduce plasma cholesterol, a risk factor for cardiovascular disease. Many commonly consumed legumes, including soy, can only be safely consumed after thorough cooking. Extrusion is a continuous cooking method often used to prepare expanded snacks. Male Syrian hamsters fed extruded black beans, pinto beans or white beans for three weeks. Extruded legume flour made up about 40% of the total diet. Casein and microcrystalline cellulose were used to adjust to a total protein content of 20% protein and

10% fiber. Weight gain was the same as the control animals indicating that extrusion conditions were sufficient to destroy anti-nutrients. Undesirable low density lipoprotein (LDL) and very LDL (VLDL) cholesterol were reduced in animals fed black beans. Liver cholesterol was lowered by black and pinto beans, and showed a tendency to reduction by white beans also. Fecal nitrogen was higher in animals fed pinto and white beans than animals fed only casein or black beans.

O-36

Rice amylopectin fine structure is related to lower rapidly digestible starch. M. BENMOUSSA (1), K. A. Moldenhauer (2), B. R. Hamaker (1). (1) Purdue University, West Lafayette, IN, USA; (2) University of Arkansas, Stuttgart, AR, USA.

The goal of this study was both to identify low glycemic index (GI) rice cultivars as well as gain a mechanistic understanding amylopectin fine structure relationship with digestion. Twelve rice cultivars with a narrow range of amylose contents were selected based on their wide variation in rapid viscoanalyzer (RVA) pasting breakdown to study the relationship between starch digestibility, amylopectin fine structure and thermal and pasting properties. Rice samples were cooked and analyzed for in vitro digestibility using the standard Englyst test. RVA and differential scanning calorimetry (DSC) were performed for pasting and thermal properties. Results showed that rapidly digestible starch (RDS) was highly and negatively correlated ($r = -0.86$, $P < 0.01$; $r = -0.81$, $P < 0.01$) with FrI long and FrII intermediate/short debranched amylopectin linear chains, respectively, and positively correlated ($r = 0.79$; $P < 0.01$) with FrIII short linear chains. Slowly digestible (SDS) starch was positively correlated ($r = 0.80$, $P < 0.01$; 0.76, $P < 0.01$) with FrI and FrII, respectively, and negatively correlated ($r = -0.76$, $P < 0.01$) with FrIII. RVA breakdown viscosity was positively correlated ($r = 0.88$, $P < 0.01$) with RDS and negatively correlated ($r = -0.89$, $P < 0.01$) with SDS. RDS was negatively correlated ($r = -0.62$, $P < 0.05$; $r = -0.67$, $P < 0.05$; $r = 0.7$, $P < 0.05$) with DSC gelatinization temperature parameters of To, Tp and Tc, respectively. SDS fraction was positively correlated ($r = 0.64$, $P < 0.05$; $r = 0.70$, $P < 0.05$; $r = 0.73$, $P < 0.01$) with To, Tp and Tc, respectively. This study presents a molecular basis for low GI and slowly digestible starch property in rice cultivars, and could have value in identifying low GI/SDS cultivars as well as developing a breeding strategy to produce these rice types.

O-37

Processing and storage effects on texture, microstructure and functionality of beta-glucan in oat bran muffins. S. M. TOSH (1), P. J. Wood (1), T. M. Wolever (2). (1) Agriculture and Agri-Food Canada, Guelph, ON, Canada; (2) University of Toronto.

There is agreement that viscous soluble fibres attenuate postprandial blood glucose and insulin levels, with attendant health benefits. An associated ability to lower serum cholesterol levels is also well established, but there continues to be conflicting clinical results about the ability of oat products to reduce serum lipids, an effect attributed primarily to the presence of the mixed-linkage cereal beta-glucan. To better understand what is happening during processing, storage and consumption, oat bran muffins were studied since they are a common vehicle for providing beta-glucan rich oat food. Changes in texture and microstructure were followed for a range of formulations both fresh and after frozen storage. Increasing the oat bran to increase the beta-glucan content from 1 to 6 g/65 g muffin increased the density and the hardness of the muffins. Freeze/thaw cycling caused an increase in hardness and a change in the distribution of beta-glucan and starch in the muffin microstructure. An in vitro digestion of muffins showed that the beta-glucan was less soluble and the viscosity of the digesta was reduced. Beta-glucanase was added to some formulations to partially degrade the beta-glucan, which reduced the density and hardness of the muffins and reduced beta-glucan solubility. Clinical trials were carried out to determine the effects of molecular weight and solubility on blood glucose levels after eating a solid beta-glucan containing meal. Blood glucose levels were negatively correlated with beta-glucan solubility at 37°C. Thus, processing and storage can have a major effect on the functionality of beta-glucan in solid foods.

O-38

Modification of molecular weight and solubility of beta glucan in oat bran muffins, and effect on the glycemic response. Y. BRUMMER (1), P. Wood (1), S. Tosh (1), X. Lan-Pidhainy (2), T. Wolever (2). (1) Agriculture and Agri-Food Canada, Guelph, ON, Canada; (2) University of Toronto, Department of Nutritional Sciences, Toronto, ON, Canada.

Viscosity of cereal beta-glucans is associated with physiological effects and health benefits. Apparent viscosity is dependent on the shear rate of measurement, making comparisons difficult. Flow viscosity (at any shear rate) is a function of polymer concentration (C) in solution, and molecular weight (MW) and accordingly a relationship between glycemic response and log (C.MW) of beta-glucan in a drink was demonstrated. For a solid food it was hypothesised that in vivo response might be predicted in vitro by a physiologically based extraction to determine "solubility" and molecular weight. In order to develop a regression relationship a controlled range of solubilities and molecular weights of beta glucan in a suitable product was required. This was achieved in muffins subjected to freeze/thaw cycles to modify solubility, and to which beta glucanase was added to lower MW. Freeze thaw treatment reduced beta glucan solubility from 30–40% in fresh muffins to 10%. MWs were similar for fresh and frozen muffins, but were reduced from over 2 million to less than 0.2 million by enzyme treatment. Blood glucose response was determined in healthy subjects over 2 hr. Peak blood glucose rise (PBGR) after fresh muffins was significantly lower than after muffins treated with 4 freeze-thaw cycles (1.84 ± 0.17 vs. 2.31 ± 0.14 mmol/l, $P = 0.007$). Fresh muffins reduced the area under the glucose response curve twice as much as muffins treated by 4 freeze-thaw cycles. In muffins containing beta glucan of similar MW, there was a significant inverse linear relationship between log (concentration) of solubilised beta glucan and PBGR Thus, an in vitro assay can be used to predict a food's effectiveness in attenuating glycemic response.

O-39

Anti-cancer effects of rice bran peptide hydrolysates on cultured human cancer cell lines. A. KANNAN (1), N. Hettiarachchy (1). (1) University of Arkansas, Fayetteville, AR.

Rice bran is an economical, under-utilized co-product of milled rough rice. The objective of this study was to produce rice bran protein peptides and investigate these peptides for

anti-cancer activity. Rice bran was treated with endoproteases, alcalase and liquipanol. The resulting hydrolysates were treated with simulated gastric and intestinal juices to obtain resistant peptides. These peptides were then fractionated into different molecular size ranges of >50 Kda, 10–50 Kda, 5–10 Kda, and <5 Kda using ultrafiltration unit. The freeze dried peptide hydrolysates were evaluated for anti-cancer activity on human colon cancer cell line (Caco-2) as well as human epithelial liver cancer cell line (HepG2). <5 Kda and 5–10 Kda rice bran peptide hydrolysates resistant to both gastric and intestinal juices inhibited growth of both Caco-2 and HepG2 cancer cells in vitro when compared to peptide hydrolysates that were not resistant to gastric and intestinal juices. A cell titer assay that uses the tetrazolium dye (3-(4,5-dimethylthiazole-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2H-tetrazolium, inner salt (MTS) and an electron coupling reagent, phenazine ethosulfate (PES) was conducted to confirm the anti-proliferative effects of the peptides. The results demonstrated that the 5–10 Kda and <5 Kda gastric and intestinal juices resistant peptide hydrolysate fractions can aid in promoting inhibitory activities against human colon and liver cancer cells. Further, purification to obtain single peptides and evaluating for anti-cancer activities in cell lines is in progress. These peptide fractions and individual peptides that demonstrate anti-cancer activities have the potential for use as functional food ingredients for health benefits.

O-40

Technical and nutritional benefits of acacia gum in bakery and cereal based products. S. BARAY (1). (1) Colloides Naturels Inc., Bridgewater, NJ, USA.

Acacia gum is an all-natural, GMO free, highly functional source of soluble dietary fiber. It is widely used in bakery and cereal based products for its unique technological properties. In recent studies done by The Food Development Group in Toronto, the benefits brought by acacia gum are clearly shown in two sweet baked goods: A chewier and softer texture is observed in muffins during the entire shelf life period when 1% acacia gum is added. The texture of cookies becomes chewier and less crumbly at increased acacia gum levels from 0 to 3% of the total formula. Cookies with 3% acacia gum in the total formula are rated highest, showing superior eating qualities over the control cookie during the entire shelf life. Acacia gum also brings proven nutritional and health benefits to bakery and cereal based products: fiber enrichment and prebiotic effect to improve digestive health and improve regularity. Recent studies proved that addition of acacia gum into different types of bread had a significantly impact on the glycemic index.

O-41

Studies on the uptake and metabolism of wort sugars during brewing fermentations. G. G. STEWART (1). (1) The International Centre for Brewing and Distilling.

Brewers' wort contains five fermentable sugars, namely glucose, fructose, sucrose, maltose and maltotriose. In most worts, maltose is the highest concentration followed by maltotriose and glucose. These sugars are taken up by yeast in a distinct order (or priority) with glucose repressing the uptake of maltose and maltotriose. Glucose is taken up without the expenditure of yeast metabolic energy whereas maltose and maltotriose uptake requires energy (active transport). The concentration of each sugar, together with their relative proportions to one another, will influence overall wort fermentation rate and extent. There are also differences between ale and lager yeast strains with respect to wort sugar uptake characteristics. For example, ale strains are less able to utilize wort maltotriose than lager strains. In addition, the concentration of wort glucose and maltose will influence beer flavour. In particular, wort with elevated levels of glucose produces beer with high concentrations of esters (particularly ethyl acetate and isoamyl acetate). Worts containing high levels of maltose, however, produce beer with much reduced concentrations of esters. This is particularly the case with high gravity worts (>16° Plato).

O-42

Aeration during yeast propagation – A key to control fermentation. C. TENGE (1), S. Schoenenberg (1). (1) TUM-Weihenstephan, Freising, Germany.

The state of the pitching yeast exerts a relevant influence on the quality of the fermentation and the resulting beer. A key step is precise yeast propagation in order to achieve a yeast with high viability and strong fermentation power. To achieve this goal control of aeration during the propagation process is necessary. It is essential to determine the exact amount of oxygen and the exact time intervals for aeration. The results show that saturation of wort with oxygen is far too high and a satisfying yeast growth and a good viability can be achieved with very low amounts of oxygen (< 1 ppm). High oxygen contentcauses oxidation reactions and foam problems in the propagation vessel. A deeper look into yeast metabolism was carried out by determining the activity of key enzymes of carbohydrate-metabolism during propagation. It can be shown that most of the acetyl-CoA was generated via a bypass of the PDH. The acetyl-CoA is important for lipid synthesis in the cell and for yeast growth. It can be influenced via the supply of the yeast with oxygen. With interval aerations it was possible to raise the acetyl-CoA synthesis rate during propagation to achieve a short lag-phase during pitching and an immediate start to fermentation. The results showed that it is possible to influence the starting phase via controlled aeration during propagation. The effected fermentations showed a faster degradation of extract resulting from a shorter starting phase. As a by-product, the shift from aerating the whole pitching wort to proper aeration during propagation, the subsequent beers showed slightly better flavor stabilities. These studies underline that oxygen supply and aeration are not only very important parameters for fermentation but can also be used to influence the starting phase and the course of the fermentation.

O-43

Low carbohydrate beer production: Issues with sticky yeast beds. E. J. SAMP (1), L. Sillberman (2). (1) Coors Brewing Company, Golden CO; (2) Gusmer Enterprises, Inc.

In the production of low carbohydrate beers (LCBs), ergonomic problems arose in the harvesting of yeast in our horizontal box fermenters. Yeast pushers had the extremely difficult task of pushing the yeast out of the tank because the yeast beds set up into a thick and sticky slurry. The initial attempts to try to understand the mechanism of the sticky yeast in our LCB fermentation with common theories on

yeast flocculation were unsuccessful. However, an uncommon flocculation mechanism proposed by Bowen and Ventham was cross-examined. This theory implicates trub binding to yeast cells due to their electrokinetic properties that change during the course of fermentation. By measuring the zeta-potential of both trub and yeast over various pH levels typically observed in LCB fermentations, we speculated that an electrostatic interaction was occurring between the negatively charged yeast cells and positively charged proteins, once the beer pH dropped below a certain threshold. This difference in charge could be causing the sticky yeast issues observed only in our LCB fermentations. Upon formation of this hypothesis, tests were carried to control the pH drop during fermentation and observe the characteristics of the yeast bed. By controlling yeast growth during fermentation and subsequently keeping the beer pH above 4.0, we were successful in alleviating the sticky yeast bed phenomena.

O-44

Modeling ale fermentation parameters: Predicting and improving process control for fermentation and creation of criteria for yeast harvesting. P. F. BOUCKAERT (1), J. C. Biegert (1), W. B. Hepp (1), J. K. Trujillo (1). (1) New Belgium Brewing Co, Inc., Fort Collins, CO, USA.

Modeling software was used to identify parameters, as well as the interaction between those parameters, contributing to variation in fermentation time. Control measures leading to improved consistency in fermentations were subsequently implemented around the largest drivers of variability, namely: a) tank temperature after the first knock out, b) pitching rate, c) fermentation cooling rate and d) yeast health. Modeling was also used to replace operator-conducted VDK (vicinal diketones) measurements to determine end of fermentation and is currently being examined as a potential replacement for the methylene blue test to assess yeast health in selecting yeast crops for repitching. With the exception of yeast cell count, each parameter is temperature and time based and is easily obtained through PLC (programmable logic controller) by the MES (manufacturing execution system). Ten different parameters were used to develop an extremely robust model to predict fermentation time ($R^2 > 0.98$). The robustness of the model increased substantially by replacing viability, as measured by methylene blue, with interaction of the cell count at the start of fermentation with 1) time of the previous fermentation, 2) cool down rate of the previous fermentation and 3) yeast storage time.

O-45

Revolutionary new technology for measuring dissolved oxygen. R. JOHNSON (2), M. Buis (1), F. Verkoelen (1). (1) Haffmans BV, Venlo, The Netherlands; (2) Haffmans North America, Rockford, IL, USA.

The biggest enemy of beers that cause rapid decline in quality and taste is O_2. Together with the content of the dissolved CO_2 (carbon dioxide), O_2 plays a critical role in how the consumer enjoys the beer during its complete shelf life. Breweries control and measure the quantities of O_2 and CO_2 continuously throughout the production of their beverages. For the first time in many years, a completely new O_2 measuring technology is now available for the brewing industry. The principle of measurement is based on the effect of dynamic luminescence quenching by molecular oxygen. The measurement principle provides long term stability, high accuracy at low oxygen values, and a quick response time. In combination with the CO_2 measurement, this new oxygen measurement enables breweries to control the two most important gases in a very efficient manner with the use of only one instrument.

O-46

Effect of hops on production of hydrogen sulfide during beer fermentation. S. T. Moon (1), J. Lee (1), S. K. PARK (1). (1) Kyung Hee University, Department of Food Science and Technology, Yongin-Si, Kyungki-Do, South Korea.

The effect of hops on production of hydrogen sulfide (H_2S) during beer fermentation was studied. Five hop varieties in conjunction with two lager yeast strains were investigated for H_2S production using laboratory scale fermenters. Hydrogen sulfide production was continuously monitored using sulfide detecting tubes. With the exception of one hop variety (Chinook), the wort fermented by a German lager yeast in the presence of hops produced a large amount of H_2S (32.4 µg to 75.3 µg). However, the wort fermented in the absence of hops (the control) produced only a total of 11.1 µg H_2S. The wort fermented in the presence of the hops by the San Francisco lager yeast strain produced much lower levels of H_2S, ranging from 2.2 µg to 25 µg and 1.2 µg from the control. The levels of H_2S production seem to be strongly influenced by both the yeast strain and the levels of sulfur residue remaining on the hops. These results clearly demonstrate that hops are a contributor to H_2S production in brewing. Accordingly, testing hops for potential risk of H_2S spoilage problem before their purchase or production scale fermentation is recommended to reduce or prevent H_2S production during beer fermentation.

O-47

Application of whole waxy wheat for breadmaking and role of enzymes as improvers. P. V. HUNG (2), T. Maeda (1), N. Morita (2). (1) Department of Life and Health Sciences, Hyogo University of Teacher Education, Hyogo, Japan; (2) Laboratory of Food Chemistry, Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Osaka, Japan.

Whole-wheat flour has been developed as the value of fiber-rich foods for healthy bowel function. Nowadays, waxy (amylose-free) wheat starch was found to suppress the firmness of breadcrumbs. In this study, whole waxy wheat flour is characterized and applied for breadmaking. The compositions of whole waxy wheat flour and their effects on dough properties and bread qualities were determined. Amylose content of waxy wheat starch was about 2%. Whole waxy wheat flour contained 13.5% protein, 1.6% ash, and 0.8% lipid, which were higher than the commercial strong wheat flour, Cameria. Dietary fiber of whole waxy wheat flour was 15.3% including 11.2% insoluble dietary fiber and 4.1% soluble dietary fiber. Whole waxy wheat flour had significantly lower gelatinization temperature and paste viscosity than did Cameria. Dough made from whole waxy wheat flour increased water absorption and showed lower stability during mixing than that from Cameria. Whole waxy wheat flour made the dough lower compression stress, modulus of elasticity and viscosity coefficient than the dough of Cameria. Bread baked from whole waxy wheat flour had low specific volume, inferior appearance, dark color and hard breadcrumb.

However, the qualities of breads were improved using 10, 30 and 50% of whole waxy wheat flour to substitute for Cameria. Also, the enzymes (amylase, cellulose and pentosanase) improved the qualities of bread baked from 50 and 100% of whole waxy wheat flour. As a result, whole waxy wheat flour can be used for breadmaking to improve the nutritious quality of bread.

O-48

High temperatures during wheat grain development increase expression of non-gluten protein genes that may be important in quality. S. B. ALTENBACH (1), K. M. Kothari (1), C. K. Tanaka (1), W. J. Hurkman (1). (1) USDA-ARS Western Regional Research Center, Albany, CA, USA.

To provide new insight into the effects of environment on wheat flour quality, the expression of several non-gluten protein genes was characterized in the US spring wheat 'Butte 86' grown in a series of greenhouse experiments under moderate (24/17°C day/night) or high (37/28°C day/night) temperature regimens. High temperatures were imposed from anthesis or 15 days post-anthesis (DPA) until maturity, or for a 5-day period between 15 and 20 DPA. Quantitative real time RT-PCR was used to compare the accumulation profiles of transcripts for tritin, wheatwin, and lipid transfer protein in developing grains and endosperm. Primer design was based on gene assemblies of expressed sequence tags from 'Butte 86' Under moderate temperatures, transcripts for all three proteins were accumulated late in development and transcripts achieved highest levels as grains approached maximum dry weights. Under high temperatures, the timing of transcript accumulation was shifted and maximum transcript levels were as much as 8-fold higher. Proteins corresponding to each of the genes were identified in 2D gels using mass spectrometry. Protein accumulation profiles during grain development reflected transcript profiles and increased amounts of the proteins were observed in grains subjected to high temperatures. Changes in the levels of specific non-gluten proteins in the developing grain in response to high temperatures may have effects on flour quality. Tritin, wheatwin and lipid transfer protein have been reported in a dough liquor fraction from wheat flour, suggesting that they have roles in bubble formation in dough. In addition, lipid transfer protein and wheatwin are of interest because they are suspected food allergens.

O-49

Effect of the addition of high molecular weight glutenin on the secondary structure and viscoelastic properties of polymers of maize zein. C. D. MEJIA (1), D. C. Gonzalez (1), L. J. Mauer (1), O. H. Campanella (1), B. R. Hamaker (1). (1) Department of Food Science, Purdue University, West Lafayette, IN, USA.

The goal of this study is to determine whether maize zein or like proteins can be made to have similar viscoelastic properties as wheat gluten protein for ultimate incorporation into gluten-free products. The effect of the addition of high molecular weight glutenins (HMWG) on the secondary structure and viscoelastic properties of a zein-starch polymer was investigated, and compared to polymers containing wheat gluten. Differences in secondary structure were analyzed using Fourier-transform infrared spectroscopy (FT-IR). Viscoelastic properties and relaxation rate were evaluated simultaneously using a novel rheological technique that applies broad band squeezing flow methodology. Results showed that during the first 6 min of relaxation at 25°C, beta-sheet content of the zein polymer with HMWG was not only stable, but similar to the beta-sheet content of the gluten polymer. This was unlike mixed zein polymer alone that had rapid loss of beta-sheet structure. During the first two minutes of relaxation at room temperature, the zein polymer exhibited the most rapid relaxation time and the most liquid-like behavior. In contrast, polymers containing wheat gluten or the zein-HMWG composite presented resonance values associated with stiffer materials and slower relaxation times. These results suggest that the addition of HMWG to the zein polymer increased the beta-sheet content and its stability as a viscoelastic polymer. The added stability of the beta-sheet structure, known to be formed in the zein polymer upon mixing, was associated with the differences in the viscoelastic properties and relaxation time observed in the zein-HMWG and gluten polymers.

O-50

Slow-tight binding inhibition of TL-XI, a thaumatin-like xylanase inhibitor, from wheat. E. FIERENS (1), S. Rombouts (2), K. Gebruers (1), C. M. Courtin (1), H. Goesaert (1), K. Brijs (1), G. Volckaert (2), S. Van Campenhout (2), J. A. Delcour (1). (1) Laboratory of Food Chemistry, KU Leuven, Leuven, Belgium; (2) Laboratory of Gene Technology, KU Leuven, Leuven, Belgium.

Xylanases are often used to improve cereal processing and end product quality. In wheat bread making the use of these enzymes may result in higher bread volumes and improved loaf texture, while in the case of wheat gluten-starch separation they are used to increase gluten and starch yield and purity. Cereals contain xylanase inhibitors which have a strong impact on the functionality of such xylanases. To improve the efficacy of xylanases a profound knowledge of these inhibitor proteins and their interaction with xylanases is indispensable. To this end, the biochemical and inhibition characteristics of the recently discovered xylanase inhibitor TLXI, i.e. the thaumatin-like xylanase inhibitor, were determined. TLXI was shown to be a basic, glycosylated protein with a molecular mass of approx. 18 kDa on SDS-PAGE. Like TAXI, TLXI inhibits several family 11 xylanases but is inactive towards family 10 xylanases. Progress curves show that the inhibition is time-dependent. The equilibrium between enzyme, inhibitor and complex is only established minutes after mixing. In addition, TLXI is a tight binding inhibitor with an [I]/[E]-ratio to obtain 50% inhibition, lower than one. The slow-tight binding interaction between xylanase and TLXI was examined by introducing site-directed mutations based on a structure model for TLXI and measuring the effect on inhibition activity. During this work, it became clear that TLXI, in addition to binding to xylanases, also binds to (arabino)xylan and other polysaccharides. In conclusion, we can state that, due to their inhibition characteristics, TLXI have a significant impact on the activity of family 11 xylanases. The new insights gained here will contribute to a better understanding of xylanase functionality in cereal processing.

O-51

Comparison of the flow and mixing patterns in laboratory flour testing mixers using numerical simulation. R. K. CONNELLY (2), J. B. Jordan (2), J. L. Kokini (1). (1) Rutgers, The State University of New Jersey; (2) University of Wisconsin-Madison.

The farinograph twin sigma blade mixer and reomixer planetary pin mixograph-type mixer are two common devices for assessing flour properties during mixing. Both mixers provide empirical measurements related to the rheological properties and energy input during mixing of flour/water dough that are used to determine flour quality and moisture absorption, despite dissimilar geometries and mixing actions. The overall objective of this work is to obtain a more complete understanding of the rate, type and range of strain produced by the mixing action of these mixers using numerical simulation. The simulations were done using the computational fluids dynamics software package, Polyflow (Fluent, Inc.). Mixer geometries that represent the fully filled condition with a simple fluid model that represents the behavior of a viscous Newtonian corn syrup were used in mixing simulations at the normal operating speed of each mixer. The simulations produced velocity profiles that were then used to calculate the positions over time of massless material points in order to visualize the flow patterns produced in the mixers. The velocity profiles and massless material point trajectories were also used to calculate measures of dispersive & distributive mixing and mixing efficiency, including shear rate, flow type and length of stretch. These results illustrate the variation in flow and mixing between these two mixers and can help explain the differences in dough development time, energy input and dough properties found in dough mixed in these two very different mixers.

O-52

Effects of laccase and xylanase on the chemical and rheological properties of oat and wheat doughs. L. H. FLANDER (2), X. Rouau (1), M. Morel (1), T. Seppänen-Laakso (2), K. Kruus (2), J. Buchert (2), K. Autio (2). (1) UMR IATE, INRA-ENSAM-UMII-CIRAD, Montpellier, France; (2) VTT, Espoo, Finland.

The effects of *Trametes hirsuta* laccase, xylanase, and their combination on cross-linking of proteins and arabinoxylans in oat and wheat doughs were investigated. The effects of enzymes on maximum resistance to stretching and extensibility of dough samples and on bread quality were also studied. Xylanase doubled the amount of water-extractable arabinoxylans in all doughs. In wheat dough laccase decreased the ratio of SDS-insoluble proteins/total proteins as compared to the control. The amount sulfhydryl (SH) groups in oat doughs decreased by laccase. According to SDS-PAGE analysis, laccase did not polymerize oat albumins, globulins or prolamins. The total ferulic acid content of oat dough was reduced by laccase and xylanase. Laccase increased the resistance to stretching in oat dough and xylanase increased the extensibility of the dough. Laccase and xylanase increased the specific volume of oat/wheat bread, and xylanase softened the oat/wheat bread significantly. The results indicated the critical role of feruloylated arabinoxylan fraction in laccase-catalysed structure formation both in dough and bread, although protein fraction was also affected.

O-53

Influence of genotype and environment on wheat gluten proteins and breadmaking quality predicted by small-scale analytical methods. H. Naeem (1), H. D. SAPIRSTEIN (1). (1) University of Manitoba, Department of Food Science, Winnipeg, MB, Canada.

The efficacy of predicting wheat breadmaking quality in a GxE study was evaluated based on two different determinations of gluten protein composition: 1) SE-HPLC to quantify total polymeric (TPP) and unextractable polymeric (UPP) protein, and 2) UV spectrophotometry of extracts of insoluble (HMW) glutenin. Wheat comprised six hard red and white spring genotypes grown in replicated field plots at seven site years in western Canada. Flour protein was extracted with SDS-phosphate buffer and sonication to determine total and unextractable polymeric protein using SE-HPLC. In the second method, protein was sequentially extracted using 50% 1-propanol without and with 0.1% dithiothreitol to extract HMW glutenin. The latter was quantified by UV absorbance. Wheat technological quality was characterized by tests including farinograph, mixograph, extensigraph, and breadmaking. HMW glutenin determined by spectrophotometry was highly correlated ($r = 0.95$) to both TPP and UPP. Both analytical methods generated similarly strong relationships to measures of dough strength [mixograph band width ($r \sim 0.87$), farinograph dough development time ($r \sim 0.84$), extensigraph Rmax ($r \sim 0.76$)] and bread loaf volume ($r \sim 0.83$). Accordingly, the spectrophotometric method was capable of predicting breadmaking quality as accurately as the sonication/SE-HPLC procedure. The advantages of spectrophotometric measurement of HMW glutenin include its simplicity, lower cost, higher sample throughput, and minimal chemical waste.

O-54

Beer stabilization, comparison of alternative methods and practical application on candle filter. J. P. ZUBER (1), U. Gans (1). (1) FILTROX AG, St. Gallen, Switzerland.

With the increasing industrialization and internationalization of beer production, beer stabilization has become more and more astandard process step. Various methods have been developed over the last 50 years, starting with silica gels and one-way PV(P)P and later on with regenerable PVPP and solid bed adsorbers. It is the interaction of proteins and polyphenols that causes this unwanted colloidal haze. Some of these products reduce the amount of proteins, some the amount of polyphenols, the latest development of DSM just tries to prevent these two groups of molecules from interacting. Looking at the pros and cons of these methods, it is evident that with single use products like silica gels and one-way PVPP, it is possible to produce stabilized beer on an existing production line without investing in hardware, but with high operational cost. The application of regenerable products on the other hand needs substantial upfront investments, but down the road gives considerably lower running costs. With the candle filter for regenerable PVPP, Filtrox presented a very economical solution 8 years ago to the brewing industry. Meanwhile over 80 filters are sold.

O-55

Total filtration concept in breweries – Economical advantages in the right combination of separator, cross flow filtration and cold sterile filtration. D. Weber (2), A. MODROK (1), F. Hoel (1). (1) Alfa Laval Corporate AB, Brussels, Belgium; (2) Sartorius Food & Beverage GmbH, Goettingen, Germany.

Cross flow filtration of beer has already been established in breweries for a few years. In the meantime it could be shown in several test filtrations and also with industrial scale systems with flow rates of up to 300 hl/h, that this new technology in principle is able to replace traditional diatomaceous earth filtration, as well as fine filters like sheet filters or trap filters in one step. After this first step in market introduction, total filtration concepts are becoming more and more important. Under these circumstances it is of importance to consider all filtration and stabilization steps from the storage tank up to the bottling line and to optimize the whole process line in terms of product quality and costs. Beneath the cross flow system itself as the heart of this process line, also an upstream located centrifuge as well as a downstream located membrane sterile filtration are of highest importance for this total filtration concept. The centrifuge works as a first clarification step after fermentation and stabilization and helps to improve the economy of the cross flow system. The additional use of membrane sterile filtration, after the cross flow system, gives the breweries a cold filtered beer of highest quality. This total filtration concept offers the breweries numerous advantages in terms of product quality and costs in comparison to the traditional methods. But before breweries decide to invest into such a total filtration concept, this has to be proven. For this reason in the past few years several data logging systems have been installed, to calculate the detailed process costs and to make this necessary cost comparison possible.

O-56

Water recovery and reuse in malting and brewing – Membrane bioreactor. R. MEIJER (1). (1) Norit Membrane Technology BV, Enschede, Netherlands.

High quality water resources have always been a deciding factor in locating breweries and malt houses. As more demands are placed on water resources and higher costs are incurred for consuming and discharging diminishing water resources, water recovery and reuse is becoming more common and acceptable. In earlier days, conventional technology of sand filtration and activated carbon were used. Today, advances in membrane technology in combination with these conventional approaches gives a broader capability for water reuse than ever before in both economics and quality. Two case studies from European locations will be reviewed showing water reuse in a malt house and in a brewery. This paper will review the technology, application and results.

O-57

Increasing production, product flexibility, and product quality before the filler. R. KOUKOL (1), M. Plutshack (2). (1) Centec GmbH, Frankfurt, Germany; (2) Centec LLC, Germantown, WI, USA.

In today's climate of increasingly trying to reduce costs of beer and malt based production, increase production flexibility, and increase product quality, methods of arranging production lines before the filler to meet these goals was examined. Through the use of on-line measurements for alcohol, extract and CO_2, combined with sophisticated mass ratio and integral process control it is possible to implement a production system which offers the user a reduction in process tankage, greater flexibility in final product through the use of additive blending and increased product quality. The net result is an increase in production output through reduced product loss and tighter alcohol control, an increase in the number of products which can be produced from a single base beer for the ever-changing market, and an increase in product quality with real-time process control. These systems are examined and methods for implementing them in the typical brewing process are explained.

O-58

Instant inline verification of the hygienic condition of process and dispensing lines using recently developed European technology. P. THONHAUSER (1). (1) Thonhauser USA Inc., Cincinnati, OH.

One of the most critical factors in draft beer technology is the requirement for hygiene and cleanliness. The search for innovations related to process and draft line cleaning plus new guidelines in different parts of the world underline a continuing need for ensuring that cleaning regimes are effective. The traditional methods for verifying the success of cleaning beverage lines i.e. microbiological methods, sensory analysis, ATP etc. offer differing levels of accuracy and practicality. A new verification technology is examined that allows instant inline verification through color change of an integrated, highly sensitive color indication of organic soiling. The mineralization of such organic matter is consequently leading to a change of the visible spectrum of an integrated indicator in real time, allowing to correlate the resulting color species to the actual level of soiling (e.g. of a beer line). Commonly, (water) solubility of organic compounds (in bio-films) increases with decreasing molecular size (number of C-atoms) and the number of electronegative atoms (e.g. O, Cl). The oxidation of organic matter takes places in a multi-step process, which is (even in aqueous solution) closely related to burning, leading to mineralization. The electrochemical oxidation potential and the speed of decomposition are brought to a maximum when combining a source of manganate and catalyzed persulphate (preferably in an alkaline environment). Studies by independent labs and field results by brewers and soft drink bottlers validating results of this technology will be presented. This same technology has been used in other applications in beverage and pharmaceutical production facilities. The mechanism of this technology will be discussed and the method of application will be presented.

O-59

DE free filtration: Current state of the art. J. SNYDER (1). (1) Norit Process Technologies, Rockford, IL, USA.

Eliminating DE for beer clarification has been a commercial success in several locations around the world and is growing more common. The technology is being adopted in more and more breweries as the economics improve and quality benefits are realized. Recent developments make this practical for adoption for larger brewers due to larger flow capacities in smaller footprints. This presentation reviews where these systems are being used successfully and what the future may hold.

O-60

Genetic and quality analyses of transgenic durum wheats expressing genes encoding high-molecular-weight glutenin subunits Dx5 and Dy10. A. E. BLECHL (3), A. Gadaleta (4), A. Blanco (4), S. Nguyen (3), J. W. Lin (3), J. S. Quick (2), S. Huang (1). (1) California Wheat Commission, Woodland, CA, USA; (2) Colorado State University, Fort Collins, CO, USA; (3) USDA Agricultural Research Service, Albany, CA, USA; (4) University of Bari, Bari, Italy.

Durum wheat (*Triticum turgidum* L. var. *durum*) is traditionally used for the production of pasta, and significant amounts are also used for bread-making, particularly in southern Italy. In order to investigate the potential for improving the visco-elastic properties of durum wheat gluten, we used genetic transformation to add genes encoding high-molecular-weight glutenin subunits Dx5 and Dy10. These genes are normally found on chromosome one of the D-genome of bread wheats, where their presence in positively correlated with higher dough strength. Three cultivars commonly grown in the Mediterranean areas (Svevo, Creso and Varano) were co-transformed with the two wheat genes *Glu-D1-1b* and *Glu-D1-2b* encoding the glutenin subunits, and a third plasmid containing the bar gene as a selectable marker. Protein gel analyses of T_1 generation seed extracts showed accumulation of Dx5 and/or Dy10 in four different transformed durum wheat plants. Homozygous progeny of each line were grown in field trials, where one line showed increased yield relative to its non-transformed parent. Field-grown seeds were milled to flour and semolina, which were each subjected to end-use quality analyses. The results indicate that the contributions of Dx5 and Dy10 to functional end-uses differ from one another and depend on genetic background. The presence of the Dy10 subunit increased farinograph mix-time, alveograph w, and bread loaf volume. Neither subunit had marked effects on pasta cooking quality.

O-61

Role of chain terminators in the varying UPP values of near-isogenic wheat lines. R. JONNALA (1), F. MacRitchie (1), L. Domenico (2). (1) Kansas State University, Manhattan, KS, USA; (2) University of Tuscia, Viterbo, Italy.

HMW and LMW-GS make up the glutenins that are associated with flour protein quality and baking performance of bread wheats. Reasons for increased UPP values of wheat proteins either may be due to allelic variation of HMW-GS, an increased ratio of HMW/LMW-GS and/or deletion of chain terminators. Near–isogenic lines can be utilized to provide information about how these variables influence UPP values. A set of twenty-four near-isogenic lines based on the bread wheat variety Pegaso (HMW-GS composition null, 7+9, 5+10) was used in the study. Lines varying in number and type of HMW-GS at Glu-A1, Glu-B1, Glu-D1, and null at Gli-A1, Gli-B1, Gli-D1, Gli-A2 and Gli-D2 were included. RP-HPLC was used to separate HMW and LMW glutenin subunit fractions. The UPP versus LMW-GS peak areas showed either positive or negative correlation, which might indicate presence of chain terminators. Specific bands can then be analyzed to check for single cysteine residues.

O-62

Identification of genomic regions associated with pre-harvest sprouting resistance in bread wheat (*Triticum aestivum* L.). R. SINGH (1), M. Matus-cadiz (1), M. Baga (1), P. Hucl (1), R. N. Chibbar (1). (1) Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK, Canada.

Hard white wheat is a new market class of spring wheat being developed for production in western Canada. There is a world wide demand for white wheat because consumers prefer the taste and appearance of food prepared from white wheat. With fewer phenolic compounds and tannins in bran, white wheat also imparts a less bitter taste and a more favorable appearance to the final product. When milling wheat to flour color standard, hard white wheat has flour yield advantage over hard red wheat. For all its advantages, white wheat does have one drawback, i.e., pre-harvest sprouting. Pre-harvest sprouting (PHS) is the germination of mature grain while still in spike. PHS in bread wheat (*Triticum aestivum* L.) crop cause downgrading of grain quality which severely limits its utilization. In western Canada, cool and wet weather during harvest makes the crops susceptible to PHS. Breeding for PHS tolerance in wheat is challenging on phenotypic basis because PHS is inherited quantitatively and strongly affected by environmental conditions. A mapping population of one hundred and fifty one doubled haploid (DH) lines from a cross between two spring wheat cultivars ND690 (non-dormant) and W98616 (dormant) was developed for molecular mapping of PHS resistance loci. Initially, 20 dormant and 20 non dormant lines were used for molecular mapping with SSR (simple sequence repeat) and AFLP (amplified fragment length polymorphism) markers. A total of 613 markers (307 SSR markers and 306 AFLP) markers have been mapped on different chromosomes. Five chromosomal regions on the chromosomes 1A, 3B, 4A, 5B and 6B were found to be associated with PHS resistance. A major QTL was detected on the long arm of chromosome 4A in this mapping population.

O-63

Characterization of thioredoxin h isoforms from wheat showing differential expression in seeds. R. CAZALIS (1), P. Pulido (2), J. Perez Ruiz (2), F. Cejudo (2). (1) ESA Purpan, Toulouse, France; (2) Instituto de Bioquímica Vegetal y Fotosíntesis, Sevilla, Spain.

Plants contain several genes encoding thioredoxin h. In cereals type-h thioredoxins are very abundant both in developing and germinating grains, but the mechanisms regulating the expression of these genes and their specific function is poorly known. Here we describe the cloning of three full-length cDNAs encoding thioredoxin h, stated Trxh1, Trxh2 and Trxh3, from wheat (*Triticum aestivum* cv. Soissons) seeds. TRXh1 and TRXh3 deduced proteins show a high identity among them and with other thioredoxins h previously described from wheat, and contain exclusively the two Cys residues forming part of the active site. In contrast, TRXh2 shows a lower level of identity and contains an additional Cys residue. The three wheat thioredoxins were expressed in *E. coli* and their activity was demonstrated using both the DTT-dependent insulin assay and a coupled assay with recombinant NTR from wheat. Site-directed mutagenesis showed that the additional Cys residue of TRXh2 has a low effect on its activity but is important for dimerization. Specific expression of the three thioredoxin

genes was analyzed by real-time RT-PCR in developing and germinating seeds and seedlings under stressed and unstressed conditions. An increase of Trxh1, Trxh2 and Trxh3 transcripts was detected at the beginning of the desiccation phase during seed development. Early after imbibitionTrxh2, but not Trxh1 or Trxh3, transcripts showed a transient increase. Treatment of wheat seedlings with salt or hydrogen peroxide caused a differential pattern of expression of the three Trxh genes among and within tissues, hence suggesting specific functions for these thioredoxins during germination and early seedling growth.

O-64

Grain softness in wheat requires cooperative binding of puroindoline A and B to starch. H. W. WANJUGI (1), J. M. Martin (1), M. J. Giroux (1). (1) Montana State University, Bozeman.

Endosperm texture is the primary basis on which wheat grain is classified commercially. This largely determines milling characteristics and end-product properties. Grain hardness is controlled by the puroindoline a (Pina) and puroindoline b (Pinb) genes that reside at the hardness, Ha locus. Soft wheats possess the wild type Pina and Pinb alleles while any alteration in Pina or Pinb coding sequence results in hard wheat. Here, we determined the action of Pina and Pinb alone and together on grain hardness and starch binding. Transgenic Pina or Pinb lines were crossed to hard wheats that were either Pina or Pinb null. Recombinant inbred lines (RILs) segregated for the transgene and the Ha locus. Intermediate endosperm texture was obtained on addition of Pina to Pinb null and addition of Pinb to Pina null. Soft endosperm was obtained only when both Pina and Pinb were present. Association of puroindoline to starch required both PINA and PINB leading to soft texture. However, intermediate grain texture was associated with high levels of either PINA or PINB bound to starch. Results demonstrate that either PINA or PINB can act alone in the absence of the other leading to intermediate textured grain but soft texture occurs only when both are present. Results on milling and bread baking traits as affected by either PINA or PINB in the absence of the other protein will be discussed.

O-65

Micro-heterogeneity and micro-rheological properties of high-viscosity oat beta-glucan solutions. J. XU (2), T. Chang (1), G. E. Inglett (2), S. Kim (2), Y. Tseng (1), D. Wirtz (1). (1) The Johns Hopkins University; (2) USDA, Peoria, IL USA.

Soluble fiber beta-glucan is one of the key dietary materials in the healthy food products known for reducing serum cholesterol levels. However, the physical properties of beta-glucan are rarely known. In this work, the micro-structural heterogeneity and micro-rheology of high-viscosity oat beta-glucan solutions were investigated using the technique of multiple-particle tracking (MPT). By monitoring the thermally driven displacements of well-dispersed micro-spheres via video fluorescence microscopy, the beads' displacement distributions are statistically analyzed. By comparing the distribution of the time-dependent mean-square displacement (MSD) and ensemble-averaged MSD of polystyrene micro-spheres imbedded in four concentrations of high-viscosity oat beta-glucan solutions, we found that the solutions exhibited perfectly homogeneous behavior at ≤1%, but the material showed a certain degree of heterogeneity at 2%. Micro-rheology investigation revealed that high-viscosity oat beta-glucan solutions displayed nearly perfect viscous behavior at ≤1%, but the property changed into viscoelastic one at 2%. Both micro-structural heterogeneity and micro-rheological property shifts occurred in a small concentration range, between 1% and 2% of high-viscosity oat beta-glucan.

O-66

Processing of novel wheat varieties: Textural and nutritional attributes challenges. H. CHANVRIER (1), B. Anthony (2), A. Htoon (1), Z. Li (3), M. Morell (3), S. Jay (1), D. Topping (2). (1) CSIRO – Food Futures National Research Flagship and Food Science Australia, North Ryde, NSW, Australia; (2) CSIRO – Food Futures National Research Flagship, North Ryde, NSW, and Human Nutrition, Adelaide, SA, Australia; (3) CSIRO – Food Futures National Research Flagship, North Ryde, NSW, and Plant Industry, Canberra, ACT, Australia.

Novel wheat varieties are of interest for nutritional improvement of cereal products, particularly for the obtention of low GI and high resistant starch products. This study deals with the processability of novel wheat varieties and their ability to be transformed into breakfast cereals. These varieties were obtained by genetic breeding and present different gene depression, related to starch synthases (SSIIa). The rheological properties of the novel varieties were firstly analysed at the lab scale by capillary rheometry in different conditions of moisture, temperature and shear rate. Selected varieties were also extruded at the pilot-plant scale in different processing conditions. End-products were analysed in term of textural/mechanical properties, completed by sensory analysis. Nutritional values were determined by GI values and resistant starch content. It was observed that higher resistant starch content and lower GI values were obtained for the novel wheat products than for products made from commonly used commercial wheat flour. The low expansion of the novel wheat products by extrusion led to harder products. In the purpose of improving the texture, their different expansion behaviour was investigated through glass temperature measurements (by differential scanning calorimetry), shear viscosity and by microscopy observations.

O-67

Yellow pigments in wheat species: Determination and influence of processing. S. SIEBENHANDL (2), H. Grausgruber (1), G. Zweytick (2), F. Eticha (1), T. Pundy (2), C. Gast (2), E. Berghofer (2). (1) University of Natural Resources and Applied Life Sciences, Department of Applied Plant Sciences and Plant Biotechnology, Vienna, Austria; (2) University of Natural Resources and Applied Life Sciences, Department of Food Science and Technology, Vienna, Austria.

With the increasing interest in the possible link between carotenoid intake from foods and health, the need for reliable data on the carotenoid content of raw materials and processed foods has become important. The aim was to study the yellow pigment (YP) content of diverse wheat species according to ICC 152 in comparison with THF/MeOH (1:1) as solvent. Both extraction methods correlated well (r = 0.96); the THF/MeOH mixture resulted in up to 20% higher values. A range of 3 – 30 ppm YP based on dry weight was determined with highest values for einkorn wheat. The influence of processing on the fate of YP was investigated on bread, noodles and

pearled grain. Dough samples after mixing (3 min) and fermentation (80 min, 27°C), and bread crumb and crust samples after baking (220°C, 25 min) were freeze dried before extraction. First losses were observed after mixing, followed by approx. 25% during fermentation. Losses due to baking remain low for the bread crumb, and were significantly higher (approx. 40%) for the bread crust. Cooking of pearled einkorn in excess of water for 15 min resulted in losses of up to 50%. Interestingly, steaming of pearled einkorn for 15 min was considerably gentler (final loss: approx. 15%). HPLC analysis revealed that the major carotenoid was lutein which is supposed to be heat-sensitive. Degradation products of lutein as well as heat stable yellow pigments in wheat species still await their identification.

O-68

Effect of screw speed and feed moisture on the residence time distribution of legume formulation in a twin screw extruder. R. T. PATIL (1), J. Berrios (2), J. Tang (3), B. Swanson (3), J. Pan (2). (1) Central Institute of Agricultural Engineering, Bhopal, India; (2) USDA-ARS, WRRC, Albany, CA, USA; (3) WSU, Pullman, WA, USA.

The residence time distribution (RTD) is considered an important system parameter in the extrusion process as it reflects the effect of material properties and machine parameters. It provides information on the flow pattern of the material under extrusion and describes the mixing capacity of the extruder using average total strain applied to the material during its passage through the r unit. RTD is an important parameter to consider in scaling up extrusion processes. Experiments were conducted on a Clextral EVOL HT32-H twin-screw extruder with co-rotating and closely intermeshing screws with a running capacity of about 50 kg feed/h. The extruder was equipped with six-barrel sections, each with 128 mm in length, twin screws with screw diameter (D) of 32 mm and total configured screw length (L) of 768 mm, which gave an overall L/D ratio of 24. A pulse stimulus response technique was used to obtain the RTD. Tracer was prepared by mixing 0.05 g of erythrosine (red) dye with 5 g of pea flour formulation (patent pending). The tracer was added after the extruder operation was completely stabilized. The RTD experiments were conducted at 400, 500, 600 rpm and at 16, 19 and 22% moisture contents. Ten extrudate samples were collected at 12, 15 and 18 s interval for 400, 500 and 600 rpm, respectively. The color index c derived from the value of a and b in the L a b color space was used as measure of concentration of the tracer. The residence time varied significantly with screw speed and only at $P = 0.146$ with moisture content. Other parameters of the distribution like vessel dispersion number and number of constantly stirred tank reactors (CSTR) were also computed from the residence time determinations.

O-69

Application of spectroscopic methods to reveal changes in food ingredients as a result of extrusion. C. A. LENDON (2), J. A. Engleson (2), B. Atwell (2), D. L. Elmore (1), S. A. Smith (1), A. R. Muroski (1), M. Porter (2), B. Aimutis (2), S. Baier (2). (1) Cargill, Memphis, TN, USA; (2) Cargill, Wayzata, MN, USA.

The high temperature, high shear environment created inside an extruder can produce an ingredient significantly different from the non-extruded counterpart. In this study, extruded proteins showed an improved performance in bread and model snack bars. Bread volume increased greater than 50% and high protein bars remained approximately 50% softer. FT-IR, Raman and florescence spectroscopy were used to analyze both the non-extruded and extruded proteins in order to elucidate a reason for the significant change in performance. The spectroscopic information revealed that extrusion disrupts the protein secondary structure, rendering the extruded protein more inert than the non-extruded form. A 5% relative decrease in beta-sheet structure, a 40% relative decrease in alpha-helical structure, and a 16% relative increase in random coil were measured. Surface hydrophobicity was also significantly increased as determined by fluorescence spectroscopy. Since the protein is more hydrophobic and less ordered, the amount of added protein can be increased, with little to no adverse affect on the food product. More specifically, 50% more protein can be added to a food product.

O-70

Measurement of mechanical properties of co-extruded dual phase products. L. Samuel (1), H. DOGAN (1), J. L. Kokini (1). (1) Rutgers University, New Brunswick, NJ, USA.

Coextrusion has introduced a wide variety of dual phase products (pockets) in snack food, breakfast cereal and pet food sector. Inherent differences in the physical states and compositions of the two phases offer different textural attributes. The main focus in textural characterization of such products is to differentiate between the mechanical properties of each phase (shell and filler). We identified test method and conditions that can objectively differentiate between the textures of phases in dual phase products. Penetration tests with punch probe gave the most reliable, reproducible and comprehensive mechanical characterization. A robust and operator independent macro was developed to derive quantitative measures for the textural properties of the shell and the filler, such as hardness, toughness and elasticity. The differences in the mechanical properties of the shell and filler were used to deconvolute the textural differences between these two phases. In order to evaluate the effectiveness of the test in deconvoluting the textural properties, penetration tests were done on the shell and filler layers individually as well as the whole pockets. The mechanical properties derived for the upper shell by the proposed method corresponded well to those of the individual shell layer. For the filler and lower shell, however, the force readings for the whole pocket were higher than those for the corresponding individual layers, which was due to the continuous resistance offered by the preceding layer(s) as the probe penetrates through the layers. After subtracting the residual forces, the mean force readings for whole pockets showed comparable values with those of the individual phases. Validations on a variety of commercial products have shown that the developed method can accurately differentiate not only between the phases but also among the samples.

O-71

Assessment and reduction of beer soluble iron in new kegs. J. I. MELLEM (1), H. R. Hight (1), G. W. Sanchez (1), K. R. Grossman (1). (1) Sierra Nevada Brewing Co., Chico, CA.

Beer filled into new five-gallon and half-barrel kegs showed a significant increase in iron content despite passivation

treatments by the keg manufacturer, leading to a metallic taint and the possible loss of flavor stability. An initial resolution to this problem was using non-saleable beer to fill kegs and then emptying them, which would substantially reduce iron increases in subsequent fills. An initial trial began to find an alternative to beer using various solutions made with softened or ozonated water, spent yeast, a heavy metal scavenger, iron chelators (EDTA and DTPA), various acids, and isomerized (iso)-alpha-acids. An acceptable level of subsequent iron pick-up in the beer was found using a solution of iso-alpha-acids and water, which is much more economical than beer. In further testing for optimization of this treatment regime, various strengths of iso-alpha-acid solutions were allowed to remain in the keg for different amounts of time, and emptied. The beer refilled into the kegs was tested using inductively coupled plasma – optical emission spectrometry (ICP-OES) for iron, and electron paramagnetic resonance (EPR) for potential free radical oxidation. Additional studies on untreated new kegs showed that the new spear in the keg added a considerable amount of iron to the beer within the spear, in addition to the beer within the keg body. The use of isomerized-alpha-acids was shown to be an effective and economical passivator of kegs to substantially reduce the leaching of iron into beer.

O-72

Could beer components reduce the absorption of dietary cholesterol? Ligand docking studies with cholesterol analogues from barley and yeast. R. F. SHARPE (1), S. Walker (1), J. Brauer (1), M. Junquera (1), R. Muller (1). (1) Brewing Research International, Nutfield, UK.

There are now a number of functional foods on the market which claim to reduce absorption of cholesterol from the diet, thus helping to provide a healthy diet and to reduce the risk of cardiovascular disease. Often these are based on the use of plant sterols which interfere with the absorption of cholesterol by the intestines. Both barley and yeast contain analogues of cholesterol that might potentially act in a similar manner. These include sitosterol (from barley) and ergosterol (from yeast). The aim of the present study is to examine whether these cholesterol analogues could potentially mimic cholesterol in metabolic reactions. Using the 'lock and key' model of enzyme action, a small molecule (the ligand) is expected to fit into the active site of the enzyme before modification takes place. This step is known as ligand docking. Computer programmes are now able to model docking and determine the free energy changes that take place during that process. The results show that the free energy changes docking sitosterol and ergosterol into two cholesterol binding molecules were found to be very similar to the energy changes docking cholesterol. This suggests that sitosterol and ergosterol could compete with cholesterol for the active site. It must be emphasised that this is a theoretical study 'in silico'. Nevertheless the study indicates that cholesterol analogues from barley and yeast could potentially reduce the absorption of cholesterol from the diet. Although both these and other sterols are normally present in beer only in small amounts, it might be possible to increase the levels and BRI is now investigating this approach.

O-73

Reduced iso-alpha acids' impact on beer flavor and appearance: Considerations when replacing iso-alpha acids in beer. T. H. SHELLHAMMER (1), A. N. Fritsch (1), T. Kunimune (1). (1) Oregon State University, Corvallis, OR, USA.

Rho-iso-alpha acids (Rho), hexahydro-iso-alpha acids (Hexa) and tetrahydro-iso-alpha acids (Tetra) offer benefits to brewers in terms of UV light stability and, in some cases, foam enhancing qualities. However, the qualitative impact of these individual compounds, particularly when considering them as replacements for iso-alpha acids (Iso), are not well defined. The objective of this study was to determine the relative bitterness intensity, bitter quality and foam enhancing properties of Iso, Rho, Hexa and Tetra in lager beer. A trained panel evaluated the compounds to determine their temporal and qualitative bitterness. The temporal bitterness was evaluated using a time-intensity protocol across varying concentrations of each compound in an unhopped lager beer. Three key time-intensity parameters, bitterness intensity, duration and total bitter impact, were not found to be significantly different between Iso, Hexa and Tetra, yet Rho was significantly less bitter, had a shorter duration and lower overall bitter impact ($P < 0.1$). The same panel also evaluated the bitter quality of the four compounds at equi-bitter levels using a free-choice profiling method and the compounds were judged as significantly different in bitter quality by generalized Procrustes analysis. Foam stability and degree of cling was assessed using Haffmans NIBEM foam stability tester (NIBEM-TPH) followed by a NIBEM cling meter (NIBEM-CLM) in a dose-response fashion. Compound type and concentration had a significant effect ($P < 0.05$) on foam persistence with rankings from least to most as Rho, Iso, Hexa and Tetra. Tetra and Hexa produced significantly higher cling values than Iso or Rho. Cling patterns could be grouped into three groups based on the visual descriptions "ring", "mesh", and "powdery".

O-74

Possibilities for state of the art production management using the Widmer Brewing Co. as an example. M. S. LUTZ (1). (1) Brewmaxx, Herzogenaurach, Germany.

The Widmer Brewing Co. in Portland, OR, chose to replace the existing process control system with a state of the art solution. Apart from problems resulting from outdated hardware, the motivation for the craft brewers at Widmer was easier access to recipe modifications, the transparent structure of the process definitions in the new system and the clear operational philosophy. A smooth take over without major interference of the production schedule made the project a total success. Process control is implemented now for the complete production process from the malt handling up to the bright beer area. The easy to use recipe handling enables craft brewers to steadily improve their product quality with subtle modifications and gives them the flexibility for product innovations in seasonal beers. Due to the database backbone of the process control system the brewery is now prepared to increase the manufacturing execution level (MES) to a complete integration of the production process in the IT infrastructure of the company. With tracking and tracing possibilities, laboratory data integration and information exchange to the commercial system. These tools enable the

brewers to detect both cost problems and quality defects. The close link of production data with the complete data warehouse of the brewery is another benefit of the solution with an overall process control. It will be the future for an efficient managing of production processes in the food and beverage industry in the 21st century. Not only for large enterprises, but with adapted solutions for smaller companies as well. The presentation gives an overview about integration policies and the possibilities arising for production management out of integrated data solutions.

O-75

Insights on producing and co-packing special products in a brewery environment. R. KLIMOVITZ (1). (1) Master Brewers Association of the Americas.

Brewers developed procedures for the production of high alcohol "clear malt base" in the late 1970's and since that time there have been several periods of consumer interest in malt-based alcoholic refreshment drinks - White Mountain Cooler followed by Zima followed by Smirnoff Ice. Added to this was the interest that many small regional breweries took in producing soft drinks in their breweries attributed to the success of craftbrewed sodas - Henry Weinhard's Root Beer and Sprecher Root Beer to name a few. Next came the proliferation of the energy drinks and natural fruit juice sparklers, many of which are produced in breweries. Brewers naturally have many questions and concerns when asked by management to produce or co-pack special products in their breweries. This presentation will address those questions and concerns.

O-76

Beer as liquid bread: Overlapping science. C. W. BAMFORTH (1). (1) Department of Food Science and Technology, University of California, Davis, CA, USA.

Beer has long since been known as liquid bread. Yet in the public consciousness of many societies, beer and bread occupy rather different standing in the moral high ground. Beer is unfairly pilloried as "empty calories", but it can be demonstrated that it has several beneficial properties owed to its provenance as a grain derivative. Furthermore there is overlap in the relevance of several chemical events in brewing and bread-making, for instance the impact of oxidative cross-linking of polymers. This paper compares bread and beer from cereal to customer.

O-77

Molecular weight distribution of (1-3)(1-4)-beta-glucan and pasting property of the flour from oat lines with high and typical amounts of beta-glucan. N. YAO (2), J. Jannink (1), P. J. White (2). (1) Department of Agronomy, Iowa State University, Ames, IA, USA; (2) Department of Food Science and Human Nutrition, Iowa State University, Ames, IA, USA.

Experimental, N979 and IA95111, and traditional oat lines, Jim and Paul, with % beta-glucan of 6.2–8.1% and 3.2–5.3%, respectively, were grown in three consecutive years. Molecular weight (MW) distributions of the beta-glucan were examined for potential variations among growing years, and for a relationship with pasting properties measured in silver nitrate (SN) solution, hydrolyzed by alpha-amylase to eliminate the effect of starch, and treated with lichenase to remove beta-glucan. The beta-glucan was extracted by a process involving multiple precipitation and dialysis steps, and the MW distributions were determined by HPLC. The % beta-glucans in N979 and IA95111 lines were significantly greater ($P < 0.05$) than Jim and Paul lines during the three growing years. The % beta-glucans of N979 and IA95111 in 2003 were greater than in the other two years, with no difference between 2002 and 2004. Jim and Paul oat lines had a lower % beta-glucan in 2004 than in 2002 and 2003, with no difference between 2002 and 2003. The contribution of beta-glucan to peak viscosity, at 166.9-266 RUV/g beta-glucan, was greater than that of starch, at 52.0-110.0 RUV/g starch, for all three years. The number average (Mn) and peak MW of beta-glucans from N979 and IA95111 were greater than these values for Jim and Paul, and values were consistent among years. Generally no differences in MW distribution were observed among extraction steps, thus, to save time, the extraction method might be further simplified. The MW distributions of beta-glucans obtained were associated with pasting properties after amylase hydrolysis, but not with lichenase or SN treatments. Thus, pasting properties of oat flours hydrolyzed by beta-amylase could be used to predict the MW of the beta-glucan.

O-78

New GPC method for methylcellulose and hydroxypropyl methylcellulose food gums as soluble dietary fiber in foods. R. G. Harfmann (1), M. TUROWSKI (1), J. R. Conklin (1), B. K. Deshmukh (1), S. K. Lynch (1). (1) The Dow Chemical Company, Midland, MI, USA.

Methylcellulose (MC) and hydroxypropyl methylcellulose (HPMC) food gums are water-soluble celluloses, which resist digestion in the human GI tract and exhibit health benefits associated with soluble dietary fiber. Due to their solubility in 80% ethanol solutions they not precipitate during analysis by AOAC methods 985.29 and 993.41. A method has been developed and validated to quantify MC and HPMC in food and food products. It uses the same enzymic digestion principle as AOAC methods, but employs GPC analysis of the aqueous reaction mixture instead of gravimetric determination. The results of single-lab and collaborative study protocol will be presented, previously approved by AOAC to determine method suitability for official AOAC recognition. 14 independent laboratories entered the study and results of those that completed to date indicate repeatability and reproducibility with RSD values at levels typical for such collaborative efforts.

O-79

Gluten contamination of cereal foods in Canada. P. GÉLINAS (1), C. M. McKinnon (1), M. Mena (2), E. Méndez (2). (1) Food Research and Development Centre, Agriculture and Agri-Food Canada, Saint-Hyacinthe, QC, Canada; (2) Unitad de Gluten, Centro Nacional de Biotecnología, CSIC, Cantoblanco, Madrid, Spain.

Celiac persons must avoid foods containing gluten or contaminated with wheat, barley, or rye. In Canada, gluten-free foods must contain less than 20 mg of gluten per kg. This study was designed to estimate gluten contamination of cereal-based foods available in Canada, whatever labeled gluten-free or not. About half of the 148 foods sampled were labeled as gluten-free. According to R5-ELISA, 23 cereal-based foods (or 15%) contained gluten, including 16 regular and 7 gluten-free cereal foods. Rice-, corn-, and quinoa-based foods

were the least contaminated. Based on an AOAC Method, another ELISA kit not detecting barley was a simple tool to roughly estimate the nature of the gluten contamination, which was later confirmed by Real Time PCR for barley. About one third of the 23 faulty cereal foods appeared to be contaminated with barley but wheat would be the main contaminant in most samples.

O-80

Psychophysical markers for crispness and influence of phase behavior and structure. H. DOGAN (1), J. L. Kokini (1). (1) Rutgers University.

Crispness is the most significant and commercially important texture descriptor for cellular foods. In this study we aimed to understand the physical basis of crispness, through elucidation of the role of structure and phase behavior of the food polymer matrix. Corn extrudates were used as model solid food foams. Extrudates of a wide range of cellular characteristics were produced by varying the extrusion parameters in the ranges of 120–200°C barrel temperature; 15–25% feed moisture content, and 200 rpm screw speed using a single screw laboratory extruder (Brabender Instruments Inc.). Cross-sectional images of extrudates were analyzed using image analysis techniques to measure average cell size and cell size distribution, cell density, cell wall thickness and cell wall thickness-to cell radius ratio (t/R). Bulk and solid densities of extrudates were measured using volumetric displacement techniques. Differential scanning calorimetry was used to determine glass transition temperatures (Tg). Uniaxial compression was used for textural characterization. Jaggedness of the resulting force deformation curves was quantified using three techniques: Fractal analysis, ratio of linear distances and the average number of peaks (Np). Accurate mechanical methods were developed to count the peaks and relate them to sensory crispness. Np was found to be a good predictor for sensory crispness scores generated using psychophysical models (R^2 = 0.71). Constitutive models were developed to relate phase behavior and structure of cellular foods to Np. The effect of cellularity and phase behavior on Np was investigated by non-linear regression between Np and t/R and Aw. Np decreased exponentially both with an increase in t/R and water activity level (R^2 = 0.95). This parameter further varied systematically with phase change in extrudates characterized with the use of T-Tg.

O-81

Oat phenolics: Purification and structural elucidation of new avenanthramides from oat kernels. F. COLLINS (1), N. Fillion (1). (1) Agriculture and Agrifood Canada.

Recent interest in the role of bioactive phenolic constituents in oats has necessitated an in-depth evaluation of both their structure in planta and their physicochemical properties. Avenanthramides represent a unique component of the readily bioavailable phenolic components of oats with antiatherogenic activity. An in-depth evaluation of the major and minor components of the total soluble avenanthramide complement of oats was undertaken using novel preparative-scale group separation column chromatography, 2-D HPLC mapping and mass spectrometry to reveal a complex mixture of about 35 different avenanthramides. Group separation of the avenanthramides was carried out on aqueous ethanolic extracts of whole groats using Octyl-Sepharose CL-4B to remove interfering polar lipids. The avenanthramide fraction was then purified by batch column chromatography on Sephadex LH-20 in aqueous ethanol. In addition to the known avenanthramides containing a 5-hydroxyanthranilic acid moiety, new avenanthramides with 4-hydroxy-, 4,5-dihydroxy- and 4-methoxy-5-hydroxy-anthranilic acid moieties were found. A number of new avenanthramides containing avenalumic, 3-hydroxyavenalumic and 3-methoxyavenalumic acids were also detected. The structures and physico-chemical properties of the individual components, methods of synthesis, and biosynthetic pathways proposed for these natural products, as well as potential impact on human health will be presented.

O-82

Acoustic emission, fracture behaviour and morphology of dry cellular crispy foods. T. VAN VLIET (1), H. Luyten (1), W. Lichtendonk (1). (1) Wageningen Centre for Food Sciences, Wageningen, The Netherlands.

For many food products their crispy character is an important sensory characteristic. It is generally accepted that it is related to the fracture behaviour of the food. It requires multiple brittle fractures accompanied by acoustic emission and relatively low work of mastication. These demands set clear requirements to a product both at molecular and mesoscopic scale. The main process acting at molecular scale is the required brittle fracture accompanied by acoustic emission. This means crack growth speeds of about 300 – 400 m s^{-1}. This high speed in combination with the need for multiple fracture events and a low work of mastication sets clear requirements on the morphology of the product regarding optimum beam and pore sizes. Fracture behaviour and sound emission of toasted rusk rolls and biscuits were measured at a data sampling rate of 65000 data points per second, allowing registering the fracture of individual beams or lamellae forming the cellular structure of the crispy food. From measured properties like the occurrence of sound, the sound energy, the duration of single sound events, the minimum time interval between sound events to be heard as separate events by humans and from the required size of the force drops on fracture of a beam or lamellae it was possible to calculate morphological constraints for the cellular structure of the crispy foods. During the presentation we will present data for the minimum and maximum sizes of the pores and of the sizes of the solid material elements surrounding them for a typical dry crispy product. These sizes were found to be of the order of 50–500 micrometer.

O-83

Functional properties of modified wheat proteins and their applications for encapsulating oils. L. DAY (1), M. Xu (2), L. Sanguansri (1). (1) Food Science Australia, Werribee, VIC, Australia; (2) Institute of Land and Food Resources, Gilbert Chandler Campus, University of Melbourne, Werribee, VIC, Australia.

Wheat gluten is a valuable source of plant protein. While the insoluble nature of gluten is a desirable attribute in traditional applications of this protein in bread and baked products, its insolubility in water limits its usefulness in many other applications. Wheat gluten in modified forms (following modification by enzymes, chemicals and/or physical treatments) has attracted much attention in recent years.

The structural modification of gluten can be used to change its functional properties, thereby expanding its utilization and potential as a functional food ingredient, by taking advantage of its relative low cost. In this study, the solubility and emulsification properties of modified wheat proteins (chemically or enzymically modified gluten) were investigated as a function of pH, ionic strength and protein concentration. The results showed that although better solubility was achieved using enzyme modification, the emulsification capacity and stability properties were not as good as chemical modified wheat proteins. On the basis of their functional properties, a modified wheat protein was selected for encapsulating oils, particularly omega-3 rich fish oils to prevent fatty acid oxidation. The new ingredient showed better resistance to food processing stresses such as pH and shear. The application of value added protein/oil ingredient into wheat flour based food products demonstrated the potential of the modified wheat protein to be used as a carrier for fortifying cereal foods enhancing their nutritional benefits.

O-84

Optical properties of mold-damaged free-falling single kernel wheat at the millisecond level. S. R. DELWICHE (1). (1) USDA-ARS.

In the United States, the authority to regulate mycotoxins, inclusive of deoxynivalenol (DON), a by-product of the fungal disease Fusarium head blight (FHB), is codified in the Federal Food, Drug and Cosmetic Act, which places authority with the Food and Drug Administration (FDA). Certain mycotoxins, such as aflatoxin, a recognized carcinogen, are regulated through action levels, which can then necessitate official testing for the mycotoxin and can result in the condemnation of grain lots in excess of the action level. Other mycotoxins, including DON, are not regulated by FDA, per se, but instead are voluntarily controlled under the guidelines of advisory levels. Depending on the intended use (i.e., human food or animal feed), the advisory level for DON in the United States ranges from 1 mg/kg to 10 mg/kg. Our previous research has demonstrated a sorting efficiency of approximately 50% (reduction of Fusarium-damaged kernels) with existing high-speed equipment, but a much higher efficiency (~95%), but much slower throughput rate, when analytical spectrometers are used. The intention of the current work is to bridge this efficiency gap. The current study describes the use of three forms of optical measurement of single wheat kernels for FHB for eventual incorporation in high-speed optical sorters. Several wheat lines, each with 100 normal and 100 Fusarium-damaged kernels, are scanned with an analytical spectrometer, passed through a commercial sorter, and observed by a fiber optic and filter assembly with high frequency silicon detector. Knowledge gained from analysis of the latter two forms will provide design criteria for improvement of high-speed optical sorters for recognition of mold-damaged wheat.

O-85

Nondestructive testing for sprout resistance in wheat via chemical imaging with InGaAs focal plane array spectroscopy. H. KOC (1), V. W. Smail (1), D. L. Wetzel (1). (1) Microbeam Molecular Spectroscopy Lab., Grain Science Department, Kansas State University, Manhattan, KS, USA.

Nondestructive early generation identification of sprout resistance in breeding lines is a distinct asset. The sensitivity of subsurface polychromatic contrast enabled by focal plane array simultaneous imaging of multiple kernels in a single field of view provides an advantage over visual examination. The germination process must be so advanced before visual detection is possible that severe damage to starch in the kernel has already occurred from release of alpha amylase enzyme. After exposure of kernels to moist condition for 3, 6, 12, 24, 36 and 48 hour periods, the imaging method clearly distinguishes between those cultivars that show no evidence of germination prior to 36 hour treatment and those in which there was evidence of germination with shorter exposure times. The traditional destructive bulk test by direct alpha amylase determination applied to kernels from the same lot was unable to detect germination of the more susceptible cultivars at the shorter exposure times. Viscosity testing, dependent on alpha amylase, has the same limitation. More than three thousand kernels were analyzed in this study. Multiple images resulted from each kernel. A GO / NO GO classification of each kernel was done from the contrast provided by select optical factors. For each pixel a full spectrum is captured by the liquid crystal tunable filter in series with the focal plane array. From these data the log 1/R at a chosen wavelength or a principal component analysis factor produces image contrast.

O-86

An ongoing quality control program for an NIR-based service and research laboratory. M. SURYAATMADJA (1), C. R. Hurburgh (1). (1) Iowa State University, Ames, IA, USA.

The Iowa State University Grain Quality Laboratory (ISU-GQL) provides instrument calibration and measurement services for composition of agricultural products using near infrared (NIR) spectrophotometers. Several brands of NIR are utilized in the ISU-GQL: Foss Infratec, Bruins Omega G, and Perten DA 7200. A quality control program was developed to meet the requirements of ISO 17025. The quality control program includes data from daily NIR check samples, NIR duplicate differences, NIR real time prediction comparison to references, periodic checks and reviews of equipment supporting the NIR calibration, and a record of laboratory room climate conditions. The quality control activities include setting tolerances, developing appropriate control charts, interpreting control charts, handling and documenting data, writing standard operating procedures (SOP) of quality control activities, and estimating cost of quality. The tolerance setting of every NIR quality control activity was based on the standard error of performance (SEP) of each instrument, as described in AACC Method 39-00. Instruments of the same brand and model have the same tolerance settings. Similar quality controls for balances, thermometers, dividers, seed counter, and bulk density improved the consistency of supporting data generated by the lab. Humidity and temperature data appear to have potential to increase the accuracy of NIR analysis. By establishing an ongoing quality control program, ISU-GQL will upgrade the overall quality of lab performance, reduce the cost of non-conforming results, and provide documentation that can be audited by third party.

O-87

Wheat aleurone fraction purity via diamond internal reflection infrared spectroscopy. D. L. Wetzel (2), E. S. Bonwell (2), S. FRAZER (1), S. Ellis (1). (1) Horizon Milling, Wayzata, MN, USA; (2) Kansas State University, Grain Science Department, Microbeam Molecular Spectroscopy Laboratory, Manhattan, KS, USA.

Commercially isolated wheat aleurone fractions provide a useful supplement to enhance the fiber and antioxidant content of cereal foods. Purity of the aleurone concentrate is dependent on physical separation of the aleurone layer from the adjacent pericarp layer and the endosperm. For commercial production an on-site rapid purity assessment is desirable. This study is concerned with the use of diamond internal reflection infrared spectroscopy as a means of aleurone purity assessment. The spectroscopic signatures of individual botanical parts of wheat were previously obtained from frozen sections in situ by infrared microspectroscopy in a transmission mode. In the past, milling fractions from conventional dry flour milling operations were probed by the same technique. The spatial resolution of the microspectrometer allowed particles of a heterogeneous mixture to be traced to their individual botanical parts of origin. With the commercial, finely ground aleurone product a small amount is used to obtain its infrared spectrum as a granular solid placed in optical contact with the internal reflection optical system. The idealized pure product has its own specific spectrum when it is free with respect to neighboring botanical parts within the wheat kernel. Spectral features of the adjacent botanical layers (toward the inside of the kernel) and (beyond the aleurone toward the outside) are sufficiently different from the spectrum of the pure commercial aleurone product to allow detection when their presence is at a significant level. Not only is this spectroscopic technique useful in final product inspection, but the nature of the contributing spectral features identifies which tissue is accompanying the aleurone.

O-88

Solvent free technology used in the production of natural oat bran concentrate. J. ZEIHER (1). (1) GTC Nutrition.

Technology has allowed for the development of oat-derived products high in beta-glucan. Oat bran concentrates are known to deliver a variety of nutritional benefits, especially for weight control and heart health. These products can be manufactured without chemical solvents, preserving the whole-grain characteristics of the oat. In addition, this process preserves the integrity of the beta-glucan fraction, the soluble portion of the oat fiber, which is associated with the most important health promoting effects of oats, including blood cholesterol reduction, enhanced weight maintenance, controlling blood sugar and insulin response, and improving digestive function. The process allows for improvements to the oat beta-glucan functionality such as solubility enhancement and protection of the oat lipid fraction against rancidity. Application benefits of the product include minimizing starch retrogradation of baked goods, extension of shelf-life, and the improvement of moisture retention in a variety of applications. The health benefits of this novel ingredient focus on glycemic index control. The proposed mechanism for glycemic control relies on the viscosity-building effect of the beta-glucan in the upper gastrointestinal tract. This results in a slower absorption of energy from a meal, and balances blood sugar levels by reducing the after meal elevation in blood glucose and blunts the insulin response. Research has shown a positive effect on weight control from the inclusion of 4 to 6 grams of beta-glucan, making these oat bran concentrate products ideal for introducing enhanced functional and nutritional benefits to many products.

O-89

Prediction of small scale wheat quality assay and end use behavior using solvent retention capacity test. F. ANJUM (1), I. Pasha (1). (1) Institute of Food Science & Technology, University of Agriculture, Faisalabad, Pakistan.

Fifty spring wheat varieties released in between 1933 and 2004 were subjected to solvent retention capacity tests using whole wheat flour to observe the relationship between different quality parameters and cookie making quality. The water, sodium carbonate, lactic acid, and sucrose SRC values for different wheat varieties ranged 78–98%, 95–127.5%, 101.50–139%, and 125–163%, respectively. SRC profile explained large amount of genetic variability in cookie making quality among all the wheat varieties. Solvent retention capacities of whole wheat flour differed significantly among spring wheat varieties. WSRC positively correlated with cookie spread factor (r = 0.29) while LASRC & SUCSRC positively correlated with cookie thickness (r = 0.31) & (r = 0.23). Negative correlation coefficients were observed in WSRC and cookie thickness (r = –0.27). LASRC also negatively correlated with cookie diameter (r = –0.26) and cookie spread factor (r = –0.34). SOCSRC was found to be negatively correlated with cookie diameter (r = –0.19) and cookie spread factor (r = –0.16). SUCSRC was negatively correlated with cookie spread factor (r = –0.23). Cluster I for wheat flour attained significantly lower SRC values for all the solvents. Cookie spread factor (average 54.71) of cluster I had comparatively higher values. The characterization of wheat on the basis of SRC provides additional complementary information to the AWRC and highlight wheat flour chemical, rheological and baking aspects.

O-90

Synchrotron infrared microspectroscopy determines secondary protein structure of wheat endosperm in situ relative to protein quality. D. L. WETZEL (1), T. Fisher (1), V. W. Smail (1), H. Koc (1), E. S. Bonwell (1). (1) Microbeam Molecular Spectroscopy Laboratory, Grain Science Department, Kansas State University, Manhattan, KS, USA.

Mapping of cross sections of wheat endosperm in frozen sections allows accumulation of data for a number of pixels. Many of these pixels are filled with spectra of large starch granules and in those the starch spectrum predominates. What is observed for a few pixels is primarily interstitial, the spectrum of the protein in interstitial areas between the numerous large starch ranules. From a map of 90-120 pixels, spectral differences permit sorting out the pixels that are predominantly protein from those that are predominantly starch. Although spectral interference is not an issue, the very serious scattering produced by the starch granules is detrimental to obtaining good signal-to-noise ratio for the spectrum of the protein that is being analyzed. With single image plane masking, a pin-hole mask is used that allows illumination of a 5.5 µm spot and with duel-pass single mask

operation a 7 µm × 7 µm image is used. The alpha helix to beta sheet ratio of secondary protein structure is used as a way of assessing the hardness characteristic of hard winter wheats grown in Kansas. With information about the secondary protein structure, Kansas Agricultural Experiment Station wheat breeders can use this information in selection of breeding lines to carry forward in the process of producing a particular wheat with the desirable end-use characteristics (in this case, breadmaking).

O-91

If you don't measure it, you can't manage it. P. ANDERSON (1). (1) JohnsonDiversey/Nalco AllianceCincinnati, OH.

As water costs continue to increase and the impact that a facility has on the community water becomes more of an issue, corporations will be forced to address water use efficiency in order to be competitive. This means taking a proactive and not a reactive approach to water management. Food and beverage producers need to critically evaluate how they utilize this increasingly valuable resource. This paper defines a methodology, Aquacheck, for optimizing facility water use based on a systematic 3-stage approach designed to measure, analyze, and improve the water use efficiency in a brewery. The program identifies cost-saving opportunities and helps manage the use of water more efficiently via the implementation of new technologies, practices, and cleaning products that deliver equal or better results with less environmental impact. The right program can reduce water use, save waste discharge, reduce the total cost of operation, increase operational efficiency, and provide detailed information and metrics for ongoing continuous improvement. For industries such as brewing that rely on water as a major resource for their business, employing a comprehensive water efficiency strategy will be a competitive advantage. Through this program, it is hoped that more industries will be empowered to take action and that new opportunities will be identified for cost-effective eco-efficiency within the brewing industry.

O-92

Stratification in fermenters. D. KAPRAL (1). (1) Anheuser-Busch (retired).

Stratified fermentation occurs in fermenting tanks when conditions are favorable. In this phenomenon, there can actually be two fermentations occurring within the tank. Stratified fermentation has a strong negative impact on beer flavor, peak cell counts, yeast settling, and the performance of the yeast in succeeding generations. A stratified fermentation event can result when adding fresh, unyeasted wort to an active fermentation. The differences in density, temperature, and the mechanics of the fill can result in poor mixing, resulting in displacement of the actively fermenting beer to a point above the temperature transmitter (RTD). The fermentation rate of the main mass of beer above the RTD becomes uncontrolled! Below the RTD, the high-density, low cell count wort is "inactive" for 24 to 48 hours until it reaches a cell count favorable to vigorous fermentation. The two masses will then interact dynamically and vigorously! This mixing results in a third and final fermentation profile that is completely atypical of the normal process. Identification of stratification as the root cause of flavor issues or fermentation problems can be difficult. Dismissal of the event as a "hung fermentation" or a "glycol valve operational problem" often occurs since there is no definitive process data pointing toward stratification as the source of process or flavor problems. This presentation provides data and simulations needed to visualize and understand the dynamics of the stratification phenomenon. The presentation includes discussion of tools and techniques to identify stratification and discusses procedures designed to avoid the occurrence of the event.

O-93

Cys155 of 27 kDa maize gamma-zein is the key amino acid to improve its in vitro digestibility. S. LEE (1), B. Hamaker (1). (1) Purdue University, West Lafayette, IN, USA.

Gamma-zein is a class of maize zein storage proteins that, due to its localization at the protein body periphery, is critical to digestibility characteristics of all zeins. Improvement of corn (and sorghum) protein digestibility has been linked to the digestibility of the gamma-zein protein (sorghum equivalent, gamma-kafirin). For this reason, the 27 kDa gamma-zein was modified to improve its digestibility through site-directed mutagenesis. A 27 kDa gamma-zein cDNA was subcloned into pGEM-11Zf(+) to undergo mutagenesis at the 144th, 148th, 155th, and 156th Cys to Ala, and then the resulting mutant proteins were expressed in *E. coli* using the pET24a(+) expression vector under IPTG induction for 3 hours. The recombinant C155A mutant protein showed a remarkable increase in digestibility to proteases pepsin, chymotrypsin, and trypsin. High conservation of this Cys among cereal prolamins indicates the utility of this finding.

O-94

Enzymatic reduction of acrylamide formation using asparaginase from *Aspergillus oryzae*. B. A. KORNBRUST (1), M. A. Stringer (1), H. V. Hendriksen (1). (1) Novozymes A/S, Bagsvaerd, Denmark.

In 2002, it was discovered that acrylamide is formed in several grain and potato-based foods that are typically prepared at high temperatures. The list includes commonly consumed items such as biscuits, snacks, French fries, and potato chips. Later that year, the mechanism of acrylamide formation was unraveled, demonstrating that asparagine and reducing sugars are the precursors for acrylamide. This pointed to several potential enzymatic approaches to remove the root cause of the problem by degrading the precursors in situ. This presentation will demonstrate that asparaginase from *Aspergillus oryzae* can be used to significantly reduce acrylamide formation in laboratory models of a range of common food products. On the basis of model systems for biscuits, crackers, and crisp bread, the effect of asparaginase on acrylamide reduction as a function of holding time, temperature, and water content will be discussed. Depending on the recipe and processing conditions an acrylamide reduction of up to 90% can be achieved with no changes to organoleptic quality. The technology can potentially be applied in a wide range of products opening up for an overall reduction of average daily acrylamide intake.

O-95
Alpha-D-glucans: Enhanced branching leads to reduced digestibility. Y. YAO (1), J. Shin (1), S. Simsek (1). (1) Purdue University, West Lafayette, IN, USA.

Carbohydrate digestibility, or bioavailability, is associated with obesity, diabetes, cardiovascular disease, and colon health. A variety of physicochemical properties affect the digestion rate of carbohydrates in foods. For alpha-D-glucans (e.g. starch and phytoglycogen), digestibility is governed not only by the content of crystalline units, but also by branch structure. It has been recognized that for oligosaccharides alpha-D-(1,6) glucosidic linkage is less susceptible than (1,4) linkage to intestinal maltase-glucoamylase, sucrase-isomaltase, and fungal amyloglucosidase. We hypothesize that the digestibility of non-crystalline alpha-D-glucans is substantially affected by the percentage of alpha-D-(1,6) linkages (i.e. branch density) in molecules. In this presentation, we will discuss recent progress in understanding the branch-digestibility relationship of alpha-D-glucans including starch, starch hydrolysates, and phytoglycogen. Starch hydrolysates were prepared via specific processing, and maize starch and phytoglycogen were selected from different genetic background followed by treatment using starch branching enzymes. The branch density of these materials ranged from 5% to 50%, as determined by HPLC or 1H-NMR, and digestibility ranged from 100% to 50%, as measured using a modified Englyst assay. Evidently, the results showed that enhanced branching leads to reduced digestibility, and that digestibility can be tailored via genetic or post-harvest modifications. The knowledge obtained from this research will allow us to design specialty alpha-D-glucans with desirable digestibility or prebiotic functions.

O-96
Annealing and gelatinization of waxy rice and wheat starches. Y. SHI (1). (1) Department of Grain Science and Industry, Kansas State University, Manhattan, KS.

Annealing and gelatinization of waxy rice and wheat starches were investigated. A mixture of starch and excess water was heated in a differential scanning calorimeter (DSC) pan to a specific temperature and holding it there for 0.5 hr to 48 hr. Onset gelatinization temperature (To) increased with the increase in annealing temperature whereas gelatinization enthalpy was increased, unchanged, or decreased depending on the annealing temperature. After waxy rice starch was annealed at 70°C, which is 6°C below its onset To, the To of annealed waxy rice starch increased to 83°C after 2 hr and the gelatinization enthalpy remained the same. The second annealing step was done by holding the sample at 77°C, which is 6°C below the To of the first-step annealed waxy rice starch. The To further increased to 87°C after the second-step annealing but the gelatinization enthalpy was significantly decreased. The decrease in crystallinity after the second-step annealing was verified by X-ray diffraction. Similar two-step annealing results were observed for wheat starch. A three-phase model of a starch granule: a mobile amorphous phase, a rigid amorphous phase, and a crystalline phase, will be used to discuss the gelatinization and annealing processes and explain the annealing results.

O-97
Analysis of the degree of polymerization of arabinoxylans in complex cereal systems. C. M. COURTIN (1), J. A. Delcour (1). (1) KULeuven, Laboratory of Food Chemistry, Leuven, Belgium.

Arabinoxylans (AX), non starch polysaccharides that constitute a significant part of cereal cell walls, have a significant impact on cereal processes, including breadmaking and brewing. Their functionality is largely determined by their degree of polymerization (DP). The analysis of the latter against the complex background of glucose polymers, such as in bread or beer, is difficult. In contrast, AX content of samples can be easily measured by gas liquid chromatography (GLC) by the following steps: (i) acid hydrolysis, (ii) conversion of monosaccharides to alditols with sodium borohydride, and (iii) acetylation of the free hydroxyl groups to yield peracetates. We here developed an analytical procedure to analyze reducing end sugar content and composition which, when combined with the above method allows to estimate the average DP of AX populations. This procedure differs from the above method as it consists of the following subsequent steps: (i) reduction of reducing end sugars, (ii) acid hydrolysis, (iii) acetylation, and (iv) analysis of the derivatised sugars by GLC. By doing so, only the reducing end sugars are analyzed as peracetates. Accuracy and repeatability of the method were verified using dextrin and xylooligosaccharide samples of known composition and DP. Results deviated less than 10% from those listed and had a coefficient of variation of less than 3%. Reducing end xylose concentrations down to 1 microgram per ml could be measured, allowing determination of DP of AX up to 5000. In conclusion, the developed method provides a unique tool for determining reducing end sugar content and composition in complex systems. It can be used for the determination of AX DP in e.g. beer and bread and in situ follow-up of xylanase activity in dough, batters and worts.

O-98
Reduction of oligosaccharides in raw and extruded dry beans flours by enzymatic treatment. J. J. BERRIOS (1). (1) USDA-ARS-WRRC, Albany, CA.

Dry beans are rich source of basic nutrients. However, oligosaccharides including raffinose, stachyose and verbascose, in beans are present at levels that cause gastro-intestinal discomfort, which limit their consumption. This research aimed to determine the optimum conditions for enzymatic treatment, in reducing the concentration of oligosaccharides in black and pinto bean flours. Sugar contents and concentrations were then measured by HPLC coupled with refractive index (RI) detector. Beano® is a commercial source of Alfa-Galactosidase. Flours treated with Beano® in liquid or tablet form, at 55 degree Celsius and reduced pH, showed a total oligosaccharide reduction of 78 and 81%, respectively. Production of nutritious, value-added bean products with low concentration of oligosaccharides will improve dry beans' consumer acceptability.

O-99
Go with the grain: Novel ingredients make whole grains easier to swallow. C. R. MITCHELL (1). (1) Creative Research Management, Stockton, CA.

As a result of the USDA's "2005 Dietary Guidelines for Americans" recommendation to consume three servings of whole grain per day, food manufacturers of grain-based products have quickly responded by converting their breads, cereals, and similar food items to whole grain versions. Creative Research Management's GrainLife™ ingredient line is the result of patented process technology that liberates and recombines all the components of whole-grain brown rice, wheat, oats, or corn to yield whole grain powders that have unique functional properties. These whole grain powders can be incorporated into traditionally non-grain foods such as beverages, ice cream, nutrition bars, soups, and other foods to produce enhanced food products that now have the added advantage of providing a serving of whole grain, without sacrificing taste or texture. The product can also be used to add whole-grain nutrition to delicately flavored and textured flour-based products such as cakes while maintaining highly acceptable sensory characteristics. RiceLife™ whole brown rice powder has the additional advantage of being gluten-free, so it can be used as a source of whole grain for consumers who must avoid wheat products. It is also GMO-free and is available in organic as well as conventional forms. This presentation will describe how our products differ from whole grain flour, some unique applications in new retail food products, and formulation/functional advantages.

O-100
Development of a maltogenic amylase for extended shelf-life of cakes and other sweet goods. T. SPENDLER (1). (1) Novozymes A/S, Bagsværd, Denmark.

Freshness and improved shelf life of cakes is a major care about for cake producers. The high sucrose content in a cake dough tends to inhibit the activity of an anti-staling amylase such as Novamyl®, making it less effective to prevent the staling of such products. We have found that a good antistaling effect in cakes can be achieved by using carefully selected anti-staling amylases with certain properties. By analysis of a 3D structure of Novamyl, it was found that sucrose may inhibit by binding in the active site. Sucrose docs into the active site of Novamyl differently from the substrate and this finding have been used to design sucrose tolerant Novamyl variants based on protein engineering. The presentation will focus on the design of such sucrose tolerant Novamyl variants. Accordingly the effects of these in baking applications will be illustrated by analysis of texture and mobility of free water combined with sensory evaluation.

O-101
Solvent retention capacity of mill streams in wheat. E. J. SOUZA (1), M. Kweon (1), L. Andrews (1). (1) USDA-ARS, Wooster, OH.

The USDA-ARS Soft Wheat Quality Laboratory uses four experimental mills for soft wheat quality evaluation: a micro-mill with a single set of break rolls, a micro-mill with a break and reduction set of rolls, and Allis and Miag Multomat experimental mills both with multiple break and reduction rolls. Soft winter wheat cultivars (35) were compared with a micro-mill and Allis mill and 8 different soft and hard winter

wheats compared using a micro-mill and Miag mill. Solvent retention capacity (SRC) tests quantified the relationship of flour from micro-mills with flour of the larger experimental mills, which more closely match commercial mills. The SRC values of flour from micro mill are generally correlated with the flour produced from the Allis and Miag mills. However the SRC profiles of flour from micro mills more closely predicts the quality of short-patent flours than straight grade flours from the larger experimental mills. This is due to high levels of non-gluten protein, pentosans and damage starch present in the extra break and reduction streams that are added to the patent flour to produce straight grade flour. For example, SRC analyses for the streams of 'AGS 2000' soft red winter wheat from Miag milling showed that early break flour streams had sodium carbonate SRC of 65% and lactic acid SRC of 93%, values that were similar to micro-mill flours. By comparison the 3rd break roll and 5th reduction roll flours had much higher sodium carbonate SRC values of 83.1% and 98.0%, respectively, and much lower lactic acid SRC values of 79.0% and 77.5%, which were significantly different from the SRC profile of micro milled flour. The presentation will discuss the impact of these relationships on experimental mill, primarily modifications to interpretation of the micro-milling results.

O-102

Objective measurement of baked and extruded product structure and appearance. M. B. WHITWORTH (1). (1) Campden & Chorleywood Food Research Association, Chipping Campden, UK.

Measurements of product structure and appearance are required for specification, quality control and product development. Digital cameras can be used to document food appearance, but require careful control of the imaging conditions for reliable results. Objective methods were developed to measure baked and extruded products using calibrated imaging systems. The pore structure of sliced products was measured using oblique illumination, collimated to provide a constant illumination angle. Image brightness and uniformity were calibrated with a grey card. A large field of view was used for bread. For small products, the magnification was increased, enabling smaller pores to be resolved. This was used to measure the pore size distribution for a novel baked product with a fine structure and for snack foods produced with a twin screw extruder. Differences in the longitudinal and transverse structure were measured for snack foods. The average pore size was directly related to the screw speed and to concentrations of calcium carbonate added to modify bubble nucleation. Colour images of bread and cakes were taken using an imaging system calibrated against CIELAB colour space. The images can be accurately printed using widely available ICC profiling systems and provide a reliable method of specification. Diffuse illumination was used to suppress shadows, revealing colour variations in the product. Image analysis measurements were developed for products containing added fruit or grains. Colour measurements were made of the crust, crumb and added ingredients. Measurements are also presented of the size distribution and spatial distribution of fruit in a cake. This provided a precise measurement of the degree to which the fruit had sunk during baking.

O-103

Breeding wheat for cookies: Solvent retention capacity, wire cut, and sugar snap cookies. M. J. GUTTIERI (2), E. J. Souza (1), K. M. O'Brien (2), M. Kweon (1). (1) USDA-ARS, Wooster, OH; (2) University of Idaho, Aberdeen, ID.

Soft wheat quality in plant breeding traditionally is measured by the AACC sugar-snap cookie method (AACC 10-52), which was developed as a qualitative measure of damaged starch due to milling, particularly to eliminate cultivars with hard grain. Most current soft wheat breeding programs use rapid methods (e.g. NIR or SKCS) to eliminate hard wheat segregants, but continue to use the sugar snap cookie test as a measure of quality. Using 21 soft white spring wheats grown in 2004 and 2005 at three Idaho locations, we compared the sugar snap cookie method with newer measures of soft wheat quality with measured solvent retention capacity (AACC 56-11), wire-cut cookie quality (AACC 10-54), and TA-XT2 analysis of wire cut cookies. Using the F-test to estimate the power of these quality measures to detect genetic differences, we found genetic differences for all the quality parameters measured, except wire-cut cookie moisture loss and stack height; these two traits were the least sensitive traits for differentiating among genotypes. We found the greatest variation among genotypes, based on the F-test, for the four solvent retention capacity solvents (water, sodium carbonate, sucrose, lactic acid) and the TA-XT2 texture analysis. The cookie diameter, whether wire cut or sugar snap, had intermediate power to differentiate genotypes with F-values of 2.2 to 2.9 ($P < 0.001$). Of the baking test parameters the TA-XT2 snapping force had the greatest differentiation, with an F-test value of 4.2 ($P < 0.0001$). Plant breeders may be able to achieve greater gain from selection if they choose to use other measures of end-use quality besides the sugar snap cookie test. These alternatives to sugar snap cookie include the less expensive solvent retention capacity test and the some what more labor intensive texture analysis of wire cut cookies.

O-104

Citrus fiber ingredients for adding strength to cracker products and moistness to baked products, including whole grain breads. B. LUNDBERG (1). (1) Fiberstar, Inc., Ellsworth, WI USA.

A correlation was found between increasing amounts of Citri-Fi® 100FG and an increase in cracker strength as measured by a texture analyzer. A 24.8% increase in cracker strength was found when Citri-Fi® 100FG was added at 1% compared to a control. This increase in strength significantly reduces potential for breakage and costly amounts of damaged product. Another trend noticed during the testing of the crackers was the numbers of stress fractures were reduced with the presence of Citri-Fi® 100 FG. In terms of adding moistness to baked products, a 17% increase in softness was found when Citri Fi® 300 FG was added at 1% along with additional water at 4.5 times the fiber weight and additional oil at two times the fiber weight compared to a control in a biscuit. Additional testing in other baked products has verified these results over a broad range of baked whole grain applications. The ultra-high water binding and surface area capacity of Citri-Fi® ingredients are the unique features that enable it to function at increasing strength in dry cracker product and adding moistness to baked products. Citri-Fi® ingredients have a water holding capacity over 8 grams water per gram fiber as measured by AACC 56-

30 and contains approximately 33% soluble fiber and 37% insoluble fiber. Citri-Fi® ingredients are all-natural products that do not have negative effects on the volume, taste, or texture.

O-105
Effect of gamma-irradiation on the increase of energy density of cereal porridges. B. EUI-HONG (1), L. Ju-Woon (1), K. Jae-Hun (1), L. Seung-Taik (2), B. Myung-Woo (1). (1) Korea Atomic Energy Research Institute, Jeongeup, Chunbuk, Korea; (2) Korea University, Seoul, Korea.

Cereal porridge has very low energy and nutrient density because viscosity limits cereal contents. The objective of the present study was to evaluate the effect of irradiation on the reduction viscosity and the increasing contents of cereal porridges. The normal starchy cereal (wheat, rice, or maize) the porridge above 107.1–115.0 g/kg rapidly gelled after cooling, however, waxy rice porridge was maintained semi-liquid consistencies until 145.3 g/kg. Gamma irradiation at 20 kGy was allowed that the high viscous and rigid porridges of cereals turned into semi-liquid consistencies and the increasing solid contents. The increasing total solid contents of porridge of wheat, rice, maize and waxy-rice by gamma irradiation were 7.97, 9.85, 18.45 and 80.63 g/kg, respectively. In case of waxy rice, the increasing effect of gamma irradiation higher than other non-waxy cereal.

O-106
Cassava starch modification for wheat based biscuits using ultraviolet radiation and a solar oven. S. PHIMPHILAI (2), K. Phimphilai (3), S. Chotineeranat (1), K. Sriroth (1). (1) Cassava and Starch Technology Research Unit, Kasetsart University, Bangkok, Thailand; (2) Department of Food Technology, Maejo University, Chiangmai, Thailand; (3) Department of Mechanical Engineering, Chiangmai University, Chiangmai, Thailand.

Modified cassava starch for wheat flour substitution was produced in this study. In modification, native cassava starch was soaked in 1% lactic acid solution for 16 hours before treating with ultraviolet (UV, lamda = 254 nm) and a solar oven. The UV-treated times were varied as 0, 2, 4, and 6 hours followed by the solar oven for 6, 4, 2, and 0 hours, respectively. The modifications tended to lower pasting profiles of the starch. The starch treated under solar oven for 6 hours had the lowest swelling properties ($P < 0.05$). However, non-significantly different was found in solubility properties of the starch ($P > 0.05$). Thirty percent of wheat flour portion in a flatted-biscuit formula was substituted with the modified cassava starch. Lower breaking forces were found in all substituted biscuit samples comparing to the control ($P < 0.05$). The substituted biscuits (with 2–6 hour UV-treated cassava starch) had higher acceptable scores than that of the wheat biscuit ($P < 0.05$). Therefore, UV-modified cassava starch can be partially substituted the wheat portion in the studied biscuit formula.

Poster Titles

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See page 117 for Poster Titles and Abstracts. Author index begins on page 233.

Monday, September 18

7:00 – 10:00 a.m. Poster Set-up
10:00 a.m. – 7:00 p.m. Posters available for viewing
4:45 – 6:30 p.m. Beer and Poster Presentations – See categories listed below
Authors of posters 123 – 382 will be present to give a 3-minute poster presentation beginning with the first poster in each group.

Presentation Leaders and Categories

Bread I
Poster Leader: Seok-Ho Park, USDA-ARS, Manhattan, KS, U.S.A.
Analytical Aspects and Functional Properties (Posters 123 – 137)

Bread II
Poster Leader: Floyd Dowell, USDA-ARS, Manhattan, KS, U.S.A.
Analytical Aspects and Functional Properties (Posters 138 – 151)

Bread III
Poster Leader: Natalia Schroeder, University of Minnesota, St. Paul, MN, U.S.A.
Health and Nutritional Aspects (Posters 152 – 166)

Bread IV
Poster Leader: Robin Connelly, University of Wisconsin, Madison, WI, U.S.A.
Processing and Raw Materials (Posters 167 – 181)

Bread V
Poster Leader: Herbert Wieser, DFA Lebensmittelchemie, Garching, Germany
Processing and Raw Materials (Posters 182 – 193)

Bread VI
Poster Leader: Herbert Wieser, DFA Lebensmittelchemie, Garching, Germany
Safety, Processing, and Quality (Posters 194 – 203)

Breakfast Cereals I
Poster Leader: Pamela White, Iowa State University, Ames, IA, U.S.A.
Analytical Aspects and Functional Properties; Health and Nutritional Aspects; Processing and Raw Materials (Posters 204 – 218)

Grain Exchange I
Poster Leader: Sing Kwei, Manchester Metropolitan University, Manchester, UK
Analytical Aspects and Functional Properties (Posters 219 – 231)

Grain Exchange II
Poster Leader: Feng Xie, Kansas State University, Manhattan, KS, U.S.A
Analytical Aspects and Functional Properties (Posters 232 – 244)

Grain Exchange III
Poster Leader: Donald Thompson, Pennsylvania State University, University Park, PA, U.S.A.
Analytical Aspects and Functional Properties (Posters 245 – 257)

Grain Exchange IV
Poster Leader: Thomas Pearson, USDA-ARS, Manhattan, KS, U.S.A
Analytical Aspects and Functional Properties (Posters 258 – 270)

Grain Exchange V
Poster Leader: Keith Petrofsky, University of Minnesota, St. Paul, MN, U.S.A.
Health and Nutritional Aspects (Posters 271 – 283)

Grain Exchange VI
Poster Leader: Rajender Singh, University of Saskatchewan, Saskatoon, SK, Canada
Other (Posters 284 – 292)

Grain Exchange VII
Poster Leader: Benoit Igne, Iowa State University, Ames, IA, U.S.A.
Processing and Raw Materials (Posters 293 – 307)

Grain Exchange VIII
Poster Leader: David Stevenson, USDA-ARS, Peoria, IL, U.S.A.
Analytical Aspects and Functional Properties (Posters 308 – 322)

Grain Exchange IX
Poster Leader: Tom Askin, Agriculture and Agri-Food Canada, Winnipeg, MB, Canada
Safety and Quality (Posters 323 – 332)

Pasta/Noodles I
Poster Leader: Mehmet Tulbek, Northern Crops Institute, Fargo, ND, U.S.A.
Analytical Aspects and Functional Properties (Posters 333 – 340)

Pasta/Noodles II
Poster Leader: Mark Bason, Newport Scientific Pty Ltd., Warriewood, NSW, Australia
Processing and Raw Materials (Posters 341 – 349)

Pasta/Noodles III
Poster Leader: Michelangelo Pascale, National Research Council, Bari, Italy
Safety, Quality, Health and Nutrition (Posters 350 – 356)

Sweet/Salty Foods I
Poster Leader: Meera Kweon, USDA-ARS, Wooster, OH, U.S.A.
Analytical Aspects and Functional Properties; Health and Nutritional Aspects (Posters 357 – 369)

Sweet/Salty Foods II
Poster Leader: Mukti Singh, USDA-ARS, Peoria, IL, U.S.A.
Processing and Raw Materials (Posters 370 – 382)

Tuesday, September 19

8:00 a.m. – 2:00 p.m. Posters available for viewing
12:00 – 2:00 p.m. Authors of posters 107-382 present
2:00 – 3:30 p.m. Authors take down posters

Beer and Other Beverages
Moderator: Gil Sanchez, Sierra Nevada Brewing Co., Chico, CA

107 A simple and highly sensitive method for the analysis of 3-methyl-2-butene-1-thiol (3MBT) in beer. A. UEHARA (1), O. Ogane (1), T. Imai (1), Y. Ogawa (1). (1) Kirin Brewery Co. Ltd., Research Laboratory for Brewing, Yokohama, Japan

108 Analysis of beta-damascenone in beer using the headspace solid-phase microextraction method (SPME) with GC-MS. O. OGANE (1), A. Uehara (1), T. Imai (1), Y. Ogawa (1). (1) Kirin Brewery Co. Ltd., Research Laboratory for Brewing, Yokohama, Japan

109 CO_2 recovery: Advanced energy recovery reduces operating costs by up to 60%. I. WILLIAMS (1). (1) Haffmans BV

110 Comparison of SBSE, HSSE and closed-loop stripping HSSE followed by GC-TOFMS for measuring staling aldehydes and MBT in abused beer. R. T. MARSILI (1). (1) Marsili Consulting Group

111 Comparison of the reference method and NIRS based method for determination of fat content in corn grits. M. M. POJIC (2), J. Mastilovic (2), M. Pestoric (2), S. Dakovic (1). (1) Mirotin, Mlin Tisa, Savino Selo, Serbia and Montenegro; (2) University of Novi Sad, Faculty of Technology, Novi Sad, Serbia and Montenegro

112 Formulation and evaluation of wheat protein-based beverages. M. H. ABUGHOUSH (1). (1) Hashemite University, Zarqa, Jordan

113 Impact of different tank outlets at fermenter tanks on the product quality. K. BOEE (1). (1) Tuchenhagen Brewery Systems GmbH, Büchen, Germany

114 IntelliTank Matrix™ – The new innovative piping system for brewing vessels. J. M. JORDAN (1). (1) Sudmo North America, Rockford, IL, USA

115 Malting quality of barley varieties and lines produced in Golestan Province of Iran. Y. MAGHSOUDLOU (2), S. Hosseini (2), M. Kashaninejad (2), A. Ghodsevali (1). (1) Agricultural Research Center, Jihad-e-Agriculture Organization, Gorgan, Iran; (2) Department of Food Science and Technology, University of Agriculture, Gorgan, Iran

116 Novel online sensor for measuring dissolved CO2 using attenuated total reflectance (ATR) technology. R. O'Leary (1), J. C. Fitzgerald (1), P. J. SLIER (1). (1) Thermo Electron Corporation

117 Nutritional improvement of spent grains using solid-state fermentation. B. J. HOSKINS (1), M. P. Lyons (1). (1) Heriot-Watt University/Alltech, Inc. Nicholasville, KY, USA

118 Potential prebiotic arabinoxylo-oligosaccharides from rye. H. RANTANEN (1), P. Tuomainen (1), J. Arpiainen

(1), L. Virkki (1), M. Tenkanen (1). (1) University of Helsinki, Helsinki, Finland

119 Reduction of malting loss by using specifically selected lactic acid bacteria. A. M. Soriano (1), H. M. Ulmer (2), B. D. SCHEHL (2), E. K. Arendt (2). (1) Department of Analytical Chemistry and Food Technology, University of Castilla-La Mancha, Ciudad Real, Spain; (2) Department of Food and Nutritional Sciences, National University of Ireland, University College Cork, Cork, Ireland

120 The latest water deaeration methods for the brewing and beverage industry. M. PLUTSHACK (2), R. Koukol (1). (1) Centec GmbH, Frankfurt, Germany; (2) Centec LLC, Germantown, WI

121 The ultrastructure of barley and buckwheat during malting observed by scanning electron microscopy. H. H. Wijngaard (1), B. D. SCHEHL (1), E. K. Arendt (1). (1) Department of Food and Nutritional Sciences, National University of Ireland, University College Cork, Cork, Ireland

122 Use of response surface methodology to investigate the effectiveness of commercial enzymes on buckwheat malt for brewing purposes. B. P. Nic Phiarais (1), B. D. SCHEHL (1), J. C. Oliveira (2), E. K. Arendt (1). (1) Department of Food and Nutritional Sciences, National University of Ireland, University College Cork, Cork, Ireland; (2) Department of Process and Chemical Engineering, National University of Ireland, University College Cork, Cork, Ireland

Bread I: Analytical Aspects and Functional Properties

Poster Leader: Seok-Ho Park, USDA-ARS, Manhattan, KS, U.S.A.

123 3D visualization and measurement of the distribution of yeast in bread dough during mixing. T. MAEDA (1). (1) Nisshin Seifun Group Inc., Saitama, Japan

124 Amperometric method: Another way to measure starch damage content. O. LE BRUN (1), A. Dubat (1). (1) Chopin Technologies, Villeneuve la Garenne, France

125 Biological and physicochemical characterization of wheat sourdough produced in Sonora, México, and functionality in bread dough. O. N. Valenzuela-Amavizca (1), R. L. Vidal-Quintanar (1), O. ROUZAUD-SANDEZ (1). (1) Universidad de Sonora, Hermosillo, Sonora, México

126 Characterization of dough texture and adhesiveness in Mexican traditional bread named "Conchas" fortified with heat precipitated whey proteins. E. Diaz-Maldonado (2), S. Soto-Simental (2), M. Reyes-Santamaría (2), J. Franco (2), A. Totosaus-Sanchez (1), N. GUEMES-VERA (2). (1) Instituto Tecnologico de Estudios Superiores de Ecatepec; (2) Instituto de Ciencias Agropecuarias-UAEH, Tulancingo, Hidalgo, Mexico

127 Comparative studies on the effects of glycolipids in breadmaking. P. Selmair (1), P. KOEHLER (1). (1) German Research Center of Food Chemistry and Hans-Dieter-Belitz-Institute for Cereal Grain Research, Garching, Germany

128 Comparison of 5% lactic acid solvent retention capacity and SDS-sedimentation tests in predicting loaf volume of hard winter and spring wheat flour. Z. S. Xiao (1), S. PARK (1), M. S. Caley (1), R. Lyne (1), M. Tilley (1), B. W. Seabourn (1), O. K. Chung (1). (1) USDA-ARS Grain Marketing and Production Research Center, Manhattan, KS, USA

129 Comparison of gluten proteins profile from a hard red spring wheat cultivar grown under optimum and water stressed conditions. F. AL JORF (1), P. Rayas-Duarte (1). (1) FAPC

130 Component migration barriers in model sandwich systems. A. H. BARRETT (1), K. R. Conca (1), U. Sajjad (1), D. Anick (1). (1) US Army Natick Soldier Center, Natick, MA, USA

131 Determination of glutathione and glutathione disulfide in wheat flour, fresh and frozen dough by capillary electrophoresis. L. FUNCK (1), P. Rayas-Duarte (2), C. Escober (2), A. De Francisco (1). (1) CERES, UFSC, Florianópolis, SC, Brazil; (2) FAPC, Oklahoma State University, Stillwater, OK

132 Determination of low levels of beta glucanase in wheat by monitoring molecular weight of beta glucan. M. ROUDSARI (2), Y. Brummer (1), S. Tosh (1), P. Wood (1). (1) Agriculture and Agri-Food Canada, Guelph, ON, Canada; (2) University of Guelph, Department of Food Science, Guelph, ON, Canada

133 Development of an indirect ELISA for quantification of TAXI and XIP type xylanase inhibitors in cereals. J. BEAUGRAND (1), K. Gebruers (1), C. Ververken (2), B. Goddeeris (2), C. M. Courtin (1), J. A. Delcour (1). (1) KULeuven, Laboratory of Food Chemistry, Leuven, Belgium; (2) KULeuven, Laboratory of Livestock Physiology, Immunology and Genetics, Leuven, Belgium

134 Effect of adding different dietary fiber sources on crumb moisture profile of bread during storage. E. L. Almeida (1), Y. K. Chang (1), C. J. STEEL (1). (1) UNICAMP, Campinas, SP, Brazil

135 Effect of addition of L-cysteine on the dynamic rheological properties of gluten proteins. J. RAGUZZONI (2), P. M. Barreto (2), P. Rayas-Duarte (1), A. De Francisco (2). (1) FAPC, Oklahoma State University, OK; (2) UFSC, Florianópolis, Brazil

136 Effect of protein composition of wheat flour mill streams on dough rheological properties and bread crumb characteristics. Y. WANG (1), G. Hareland (2), K. Khan (1), G. Nygard (1). (1) Department of Cereal and Food Sciences, North Dakota State University, Fargo, ND; (2) USDA-ARS, Hard Red Spring and Durum Wheat Quality Laboratory, Fargo, ND

137 Evaluation of corn masa stickiness. R. YGLESIAS (1), D. S. Jackson (1). (1) Department of Food Science & Technology, University of Nebraska, Lincoln, NE, USA

Bread II: Analytical Aspects and Functional Properties

Poster Leader: Floyd Dowell, USDA-ARS, Manhattan, KS, U.S.A.

138 High density measurement of environmental conditions during the growing season and its value for predicting wheat breadmaking quality. H. D. Sapirstein (1), G. J. FINLAY (1), P. R. Bullock (1). (1) University of Manitoba, Winnipeg, MB, Canada

139 Measuring technique of bubble size distributions in dough. G. DO (1). (1) College of Bioresource Sciences, Nihon University, Kanagawa, Japan

140 Mixolab as a tool to investigate the effects of milled flaxseed on rheological properties of dough. M. C. TULBEK (2), C. Hall (1). (1) Department of Cereal Science, NDSU, Fargo, ND, USA; (2) Northern Crops Institute, Fargo, ND, USA

141 Mixolab versus farinograph. O. LE BRUN (1), A. Dubat (1). (1) Chopin Technologies, Villeneuve la Garenne, France

142 Modification of the SDS-soluble protein conformation during mixing with mixograph. O. Surel (1), F. VIOLLEAU (1), D. Kleiber (1). (1) Ecole Supérieure d'Agriculture de Purpan, Toulouse, France

143 Oscillatory water sorption test for determining water uptake behaviour in bread crust. N. H. VAN NIEUWENHUIJZEN (3), H. Tromp (2), R. J. Hamer (1), T. Van Vliet (3). (1) Wageningen Center for Food Science; (2) Wageningen Center for Food Science, Nizo Food Research; (3) Wageningen Center for Food Science, Wageningen UR

144 Predicting breadmaking quality from kernel, flour, and dough properties. F. E. DOWELL (2), R. O. Pierce (3), E. B. Maghirang (2), O. Chung (2), F. Xie (1), G. L. Lookhart (1), S. R. Bean (2), M. Caley (2), J. D. Wilson (2), B. W. Seabourn (2), M. S. Ram (2), S. Park (2). (1) KSU; (2) USDA ARS GMPRC; (3) USDA GIPSA

145 Role of starch and protein in wheat flour tortilla staling. J. ALVIOLA (1), R. D. Waniska (1). (1) Soil and Crop Science Department, Texas A&M University, College Station, TX, USA

146 Supplementation of whole-wheat bread with mushroom powder. M. COREY (1), R. Beelman (1), K. Seetharaman (1). (1) Penn State University, State College, PA, USA

147 The use of selected lactic acid bacteria to improve the baking and rheological quality of gluten-free batter and bread. L. A. Ryan (1), F. Dal Bello (1), S. RENZETTI (1), E. K. Arendt (1). (1) Food Technology, Food and Nutritional Sciences Department, UCC, Cork, Ireland

148 Ultra-fast separation of wheat glutenin subunits by reversed-phase HPLC using a superficially porous silica support column. H. A. NAEEM (1), H. D. Sapirstein (1). (1) Department of Food Science, University of Manitoba, Winnipeg, MB, Canada

149 Use of near-isogenic wheat lines to determine the glutenin and gliadin functionality in flour tortillas. S. MONDAL (2), D. B. Hays (2), R. D. Waniska (2), N. J. Alviola (2), S. Bean (3), M. Tilley (3), K. D. Glover (1). (1) Plant Science Department, South Dakota University, Brookings, SD, USA; (2) Soil and Crop Science, Texas A&M University, College Station, TX, USA; (3) USDA-ARS, Manhattan, KS, USA

150 Visualization and quantification of the three-dimensional structure of porous foods: Bread crumb, a case-study. P. M. Falcone (1), J. E. LAVERSE (1), S. Chillo (1). (1) University of Foggia, Foggia, Italy

151 Wheat kernel associated endoxylanases consist of a majority of microbial and a minority of wheat endogenous endoxylanases. E. DORNEZ (1), I. J. Joye (1), K. Gebruers (1), J. A. Delcour (1), C. M. Courtin (1). (1) K.U. Leuven, Laboratory of Food Chemistry, Leuven, Belgium

Bread III: Health and Nutritional Aspects

Poster Leader: Natalia Schroeder, University of Minnesota, St. Paul, MN, U.S.A.

152 Changes in physical and sensorial properties of cheese breads with or without the addition of pre-gelatinized cassava starch. J. R. Uclés-Santos (1), F. P. COLLARES (1). (1) State University of Campinas - UNICAMP, Department of Food Technology, Campinas, SP, Brazil

153 Consumer acceptance of tortillas made with different particle size whole barley flours. A. TOMA (1), S. Lee (1), N. Prasopsunwattana (1), S. Chongcham (1), R. A. Flores (3), E. A. Arndt (2), M. Omary (1). (1) California Polytechnic University, Pomona, CA, USA; (2) ConAgra Foods, Inc., Omaha, NE, USA; (3) University of Nebraska, Lincoln, NE, USA

154 Development of an innovative elemental iron powder for flour fortification. B. HU (1). (1) North American Hoganas, Inc., Hollsopple, PA, USA

155 Effects of B-glucans and polyphenols components on hemato biochemistry of soy-oats feed rats. A. Montaño-Figueroa (1), Z. Duarte-Valenzuela (1), R. Canett-Romero (1), R. VIDAL-QUINTANAR (1). (1) Universidad de Sonora, Hermosillo, Sonora, México

156 Effects of size of cellulose granule on breadmaking properties. M. SEGUCHI (1). (1) Kobe Women's University, Kobe, Japan.

157 Formulating bread fortified with soluble and insoluble fiber. M. B. NIETO (1). (1) TIC Gums, Inc., Belcamp, MD, USA, in collaboration with Nealanders International, Inc.

158 Glycemic response from a barm leavened whole grain kamut wheat bread containing a mash. G. A. Spiller (1), M. A. SPILLER (2). (1) Health Research & Studies Center, Los Altos, CA, USA; (2) Whole Grain Connection, Los Altos, CA, USA

159 Incorporation of red whole wheat into grain based foods in elementary school cafeterias. N. M. SCHROEDER (2), E. Hystead (2), E. A. Arndt (1), L. F. Marquart (2). (1) ConAgra Foods, Omaha, NE, USA; (2) University of Minnesota, St. Paul, MN, USA

160 Labeling and centesimal composition analysis of white and whole grain breads consumed in Brazil. A. A. ANTON (1), P. Haas (1), P. M. Barreto (1), A. De Francisco (1). (1) Universidade Federal de Santa Catarina, Florianopolis, SC, Brazil

161 Measurement of cross-links in phosphorylated starch and their effect on alpha-amylase digestion. Y. SANG (1), P. A. Seib (1). (1) Department of Grain Science & Industry, Kansas State University, Manhattan, KS, USA

162 Natural and sour cassava starch content in cheese breads: Effect on physico-chemical, rheological and sensorial properties. J. R. Uclés-Santos (1), F. P. COLLARES (1). (1) State University of Campinas - UNICAMP, Department of Food Technology, Campinas, SP, Brazil

163 Particle size effects of whole barley flour on the quality of wheat tortillas. N. PRASOPSUNWATTANA (1), A. Toma (1), S. Lee (1), S. Chongcham (1), P. Cooke (3), R. A. Flores (4), J. Wilson (3), E. A. Arndt (2), W. Yokoyama (5), M. Omary (1). (1) California State Polytechnic University, Pomona, CA, USA; (2) ConAgra Foods, Inc., Omaha, NE, USA; (3) Microscopic Imaging Group USDA/ARS/ERRC, Wyndmoor, PA, USA; (4)

University of Nebraska, Lincoln, NE, USA; (5) USDA, ARS, Western Regional Research Center, Albany, CA, USA

164 Physicochemical, rheological and sensorial characterization of functional cheese bread with addition of soy protein isolate and polydextrose. J. R. Uclés-Santos (1), F. P. COLLARES (1). (1) State University of Campinas - UNICAMP, Department of Food Technology, Campinas, SP, Brazil

165 Plant sterols in wheat samples obtained by scarification. L. NYSTRÖM (1), A. Lampi (1), V. Piironen (1). (1) University of Helsinki, Finland

166 Texture, color and sensory evaluation of bread enriched with wheat white fiber. R. Viquez (1), I. Alfaro (1), M. PINEDA (1), P. Esquivel (1), J. Aiello (1). (1) School of Food Technology, University of Costa Rica

Bread IV: Processing and Raw Materials

Poster Leader: Robin Connelly, University of Wisconsin, Madison, WI, U.S.A.

167 About puffed cereals and their use in breadmaking. M. MARIOTTI (1), M. Lucisano (1), M. Pagani (1), L. Fongaro (1). (1) DiSTAM (Department of Food Science and Microbiology), University of Milan, Milan, Italy

168 Addition of *Agaricus blazei* flour to a reduced fat pan bread formulation. I. B. Cardoso (2), R. F. Rugai (3), A. S. Coelho (3), S. Mendes Filho (1), C. J. Steel (3), Y. K. CHANG (3). (1) Cargill, Tatuí, SP, Brazil; (2) Emulzint, Jundiaí, SP, Brazil; (3) UNICAMP, Campinas, SP, Brazil

169 Application of the two-dimensional near-infrared correlation spectroscopy for the analysis of wheat flour dough kneading. A. AIT KADDOUR (2), C. Barron (2), P. Robert (1), B. Cuq (2). (1) INRA, Nantes, France ; (2) INRA, Montpellier, France

170 Assessment of the suitability of a range of gluten-free cereals for their potential use in gluten-free bread. M. M. Moore (1), S. RENZETTI (1), E. K. Arendt (1). (1) Food Technology, Food and Nutritional Sciences Department, UCC, Cork, Ireland

171 Characteristics of steamed foam-cake containing different flour combinations of high-dietary fiber rice 'Goami 2' and wheat flour. M. Jang (2), B. KIM (1), D. Jun (3), J. Park (2), S. Jung (2), H. Park (2). (1) Department of Food Engineering, Dankook University, Cheonan, Chungnam, Republic of Korea; (2) Department of Food and Nutrition, Dankook University, Seoul, Republic of Korea; (3) Midm Agricultural Union Corporation, Pyungtaek, Gyeonggi-Do, Republic of Korea

172 Characterization of rice bread processed with Goami2 – A high indigestible carbohydrates rice. I. CHOI (2), A. Chun (2), D. Kim (2), K. Kim (2), J. Son (2), C. Yang (1). (1) Genetics and Breeding Division, National Institute of Crop Science, RDA, Suwon, Republic of Korea; (2) Post-Harvest Technology Division, National Institute of Crop Science, Suwon, Republic of Korea

173 Comparing the effect of mixing on dough development between two mixers with different geometries. R. K. CONNELLY (1), R. McIntier (1). (1) University of Wisconsin – Madison, WI, USA

174 Composition and application of banana flour. L. A. BELLO-PEREZ (1), E. Agama-Acevedo (1), E. Juarez-García (2), S. G. Sayago-Ayerdi (2), S. L. Rodriguez-Ambriz (1). (1) CEPROBI-IPN, Yautepec, Morelos, México; (2) Instituto Tecnológico de Acapulco, Calzada Instituto Tecnológico S/N, Acapulco, Guerrero, México

175 Comprehensive evaluation of European imported wheat flour incomparable to local wheat flour in Libya. H. M. GADAN, SR. (1), A. Qasim Akasha (1), A. Daboob (1), M. Abd Alsalam (1). (1) Sebha University, Sebha, Brak, Libya

176 Corn tortillas prepared with TC-20 gum: Effect on in vitro digestibility. R. RENDÓN-VILLALOBOS (1), E. Agama-Acevedo (1), A. Bello-Perez (1). (1) CEPROBI-IPN, Yautepec, Morelos, Mexico

177 Determination of "Besatz" – Results of an international interlaboratory trial. S. SELING (1). (1) Fed Research Centre Nutrition and Food, Detmold, Germany

178 Effect of lactic acid bacterial cultures isolated from rye flour on the quality of wheat bread. D. Savic (1), O. Šimurina (2), B. Filipcev (2), N. Jankovic (2), M. POJIC (2). (1) Faculty of Technology, Leskovac, Serbia and Montenegro; (2) Faculty of Technology, Novi Sad, Serbia and Montenegro

179 Effect of mixing time and water absorption on the quality of Chinese steamed bread. E. ASSEFAW (1), B. X. Fu (1). (1) Canadian International Grains Institute

180 Effect of steaming pressure and time and storage period on quality characteristics of *Baeksulgi* (Korean traditional rice cake). G. RYU (1), J. Park (1), M. Kim (1). (1) Department of Food Science and Technology, Kongju National University, Yesan, Korea

181 Effect of the addition of different levels of "okara" flour on rheological properties of wheat flour and technological properties of pan bread. L. H. Da Silva (2), L. M. Paucar Menacho (2), C. A. Vicente (2), A. Salles (1), C. J. Steel (2), Y. K. CHANG (2). (1) Danisco, Cotia, SP, Brazil; (2) UNICAMP, Campinas, SP, Brazil

Bread V: Processing and Raw Materials

Poster Leader: Herbert Wieser, DFA Lebensmittelchemie, Garching, Germany

182 Emulating industrial dough mixing using the doughLAB. M. L. BASON (1), J. Dang (1), M. K. Guyatt (1), R. I. Booth (1). (1) Newport Scientific Pty. Ltd., Warriewood, NSW, Australia

183 Evaluation of dough development time for wheat-soy flour blends. T. L. TRAYNHAM (1), D. J. Myers (1). (1) Iowa State University, Ames, IA, USA

184 Folates stability in rye bread during processing and freezer storage. E. GUJSKA (1), A. Kuncewicz (1), J. Michalak (1), J. Klepacka (1). (1) University of Warmia and Mazury, Olsztyn, Poland

185 Fungal xylanases and its use for the bread-making process with wheat flour. L. BASINSKIENE (1), S. Garmuviene (1), G. Juodeikiene (1), D. Haltrich (2). (1) Kaunas University of Technology, Kaunas, Lithuania; (2) University of Natural Resources and Applied Life Sciences, Vienna, Austria

186 Influence of harvest year, sowing date, and irrigation management on protein composition, rheological properties and baking performance of wheat lines. A. R. ISLAS-RUBIO (1), T. L. Maldonado-Parra (1), M. A. Camacho-Casas (2), M. Granados-Nevárez (1), B. Siva-Espinoza (1), F. Vásquez-Lara (1), H. González-Ríos (1). (1) CIAD, A.C., Hermosillo, Sonora, México; (2) CIRNO-INIFAP, Ciudad Obregón, Sonora, México

187 Influence of sulfur fertilization on the technological properties of wheat flour. H. WIESER (1). (1) German Research Center of Food Chemistry, Garching, Germany

188 Interactions of DATEM with gluten. R. KIEFFER (1). (1) DFA (German Research Center for Food Chemistry) Garching Germany

189 Production and optimisation of bread from wheat and amaranth flour blends. R. SCHOENLECHNER (2), C. Scelsi (1), M. Mariotti (1), M. Lucisano (1), E. Berghofer (2). (1) Department of Food Science and Microbiology, University of Milan, Milan, Italy; (2) Department of Food Science and Technology, University of Natural Resources and Applied Life Sciences, Vienna, Austria

190 Production and utilization of a fluid monoglyceride hydrate emulsifier in a high speed bakery operation. B. R. SEBREE (1). (1) Archer Daniels Midland

191 Selection of parameters for consistent quality of whole wheat barm bread. M. A. SPILLER (1). (1) Whole Grain Connection, Los Altos, CA, USA

192 Stickiness of wheat flour doughs and relationship to breadmaking performance and other physical dough tests. F. WANG (1), Y. Zhang (1), W. Zhang (1), W. Chen (1), P. Zhang (1). (1) Henan University of Technology, Zhengzhou, Henan, China

193 Technological and sensory evaluation of pan bread elaborated with mixes of wheat flour and unripe banana flour or commercial resistant starch. R. Ormenese (1), C. Batista (2), M. Cáceres (2), Y. K. Chang (2), C. J. STEEL (2). (1) ITAL, Campinas, SP, Brazil; (2) UNICAMP, Campinas, SP, Brazil

Bread VI: Safety, Processing, and Quality

Poster Leader: Herbert Wieser, DFA Lebensmittelchemie, Garching, Germany

194 Available (AS) and resistant (RS) starch of blue corn tortilla. J. P. Hernandez-Uribe (1), E. AGAMA-ACEVEDO (1), R. Rendon-Villalobos (1), J. J. Islas-Hernandez (1). (1) CEPROBI-IPN, Yautepec, Morelos, Mexico

195 Determination of the sensory attributes of commercial whole grain breads. S. A. SJOBERG (1), Z. M. Vickers (1), M. M. Reicks (1), L. F. Marquart (1). (1) University of Minnesota, St. Paul, MN, USA

196 Improvement of frozen dough quality by cold treatment before freezing. Y. PHIMOLSIRIPOL (1), U. Siripatrawan (1), V. Tulyathan (1), D. J. Cleland (2). (1) Department of Food Technology, Chulalongkorn University, Bangkok, Thailand; (2) Institute of Technology and Engineering, Massey University, Palmerston North, New Zealand

197 Isolation and characterisation of antifungal compounds from LAB and their application to improve the shelf-life of wheat bread. F. Dal Bello (3), L. A. Ryan (3), S. RENZETTI (3), K. Ström (2), J. Sjögren (1), J. Schnürer (2), E. K. Arendt (3). (1) Department of Chemistry, Swedish University of Agricultural Sciences, Uppsala, Sweden; (2) Department of Microbiology, Swedish University of Agricultural Sciences, Uppsala, Sweden; (3) Food technology, Food and Nutritional Sciences Department, UCC, Cork, Ireland

198 Procedures for the safe use of potassium bromate in bread making in the Japanese baking industry. K. HIMATA (1), M. Nakamura (1), T. Murakami (1), S. Hosoya (1), Y. Yamada (1). (1) Yamazaki Baking Co., Ltd., Tokyo, Japan

199 The influence of enzymatic treatment on wholegrain bread formulations. C. VAN BENSCHOP (1), B. Fatula (2). (1) DSM Food Specialties, Delft, The Netherlands; (2) DSM Food Specialties, Eagleville, PA, USA

200 The quality implications of changing glutenin alleles in a century of Australian wheat breeding. G. B. CORNISH (1). (1) South Australian Research & Development Institute, Wheat Quality Research Unit, Adelaide, SA, Australia

201 The role of starch in wheat bread dough preparation and rheology. R. KIEFFER (1). (1) DFA (German Research Center for Food Chemistry) Garching, Germany

202 Thermal and rheological properties of tortillas elaborated with germinated corn grain. G. ARAMBULA VILLA (1), C. R. Valderrabano Amador (2), E. Cruz Huerta (2), E. Gutierrez Arias (1), I. Verdalet Guzman (2), A. Arambula Peña (3). (1) Centro de Investigacion y de Estudios Avanzados del Instituto Politecnico Nacional, Santiago de Queretaro, Queretaro, Mexico; (2) Instituto de Ciencias Basicas, Universidad Veracruzana, Xalapa, Veracruz, Mexico; (3) ITESM, Santiago de Queretaro, Queretaro, Mexico

203 Understanding the basis of flour tortilla stickiness. J. H. Rathod (1), H. Dogan (1), J. L. KOKINI (1). (1) Rutgers University

Breakfast Foods: Analytical Aspects and Functional Properties; Health and Nutritional Aspects; Processing and Raw Materials

Poster Leader: Pamela White, Iowa State University, Ames, IA, U.S.A.

204 Determination of malting behaviour and brewing quality parameters of new wheat varieties in a new pilot malting facility. J. VOIGT (1), T. Kraus-Weyermann (2), J. Buhrmann (2). (1) Technical University Munich Weihenstephan, Freising, Germany; (2) Weyermann Specialty Malt, Bamberg, Germany

205 Determination of mixed linkage beta-glucan in high fiber ready-to-eat commercial breakfast cereals. M. R. FALCON-VILLA (1), G. A. Yañez-Farias (1), A. L. Romero-Baranzini (1), J. M. Barron-Hoyos (1). (1) Universidad de Sonora, Hermosillo, Sonora, Mexico

206 Development of an improved quantitative analysis of cereal beta-glucan by high-performance anion-exchange chromatography. D. YOO (1), B. Lee (1), S. Kim (1), S. Yoo (1). (1) Department of Food Science and Technology, Sejong University, Seoul, Korea

207 Physical and functional characteristics of soybeans soaked in *Lactobacillus*-fermented whey solution. C. SUNG (1), D. Yoo (1), S. Kim (1), W. Kim (1), S. Yoo (1). (1) Department of Food Science and Technology, Sejong University, Seoul, Korea

208 Change in vitamin C content in extruded corn starch matrix by process variable and packaging. G. RYU (1), S. Kim (1), J. Han (1), T. Jin (1). (1) Department of Food Science and Technology, Kongju National University, Yesan, Korea

209 Effect of malting and supercritical fluid extraction on the antioxidativity of oats. J. PIHLAVA (1), H. Aro (1), V. Hietaniemi (1), O. Myllymaki (2), A. Kaukovirta-Norja (2). (1) MTT Agrifood Research Finland, Laboratories, Jokioinen, Finland; (2) VTT Technical

Research Centre of Finland, VTT, Finland

210 Impact of oat flours with different beta-glucan amounts on in vitro fermentation and its products. S. Sayar (2), J. Jannink (1), P. J. WHITE (2). (1) Department of Agronomy, Iowa State University, Ames, IA; (2) Department of Food Science and Human Nutrition, Iowa State University, Ames, IA

211 Procyanidins in processed sorghum-based food products. N. R. DLAMINI (1), J. R. Taylor (2), C. M. McDonough (1), L. Dykes (1), L. W. Rooney (1). (1) Texas A&M University, College Station, TX; (2) University of Pretoria, Pretoria, South Africa

212 The effect of cooking on starch digestibility of corn and sorghum porridges. D. L. AUSTIN (1), L. W. Rooney (1), C. M. McDonough (1). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA

213 Development of an organic fiber-rich extruded breakfast cereal using passion fruit fiber and corn flour: Evaluation of technological properties. G. Vernaza (1), C. J. STEEL (1). (1) UNICAMP, Campinas, SP, Brazil

214 Effect of cutter speed on the quality characteristics of legume extrudates. R. T. PATIL (1), J. Berrios (2), J. Tang (3), B. Swanson (3), J. Pan (2). (1) Central Institute of Agricultural Engineering, Bhopal, India; (2) USDA-ARS, WRRC, Albany, CA, USA; (3) WSU, Pullman, WA, USA

215 Properties of extruded products made from high beta-glucan and traditional oat lines. N. YAO (2), J. Jannink (1), S. Alavi (3), P. J. White (2). (1) Department of Agronomy, Iowa State University, Ames, IA, USA; (2) Department of Food Science and Human Nutrition, Iowa State University, Ames, IA, USA; (3) Department of Grain Science and Industry, Kansas State University, Manhattan, KS, USA

216 Reduced-calorie flour containing type 3 resistant starch used in model extruded cereal system. L. C. HAYNES (3), M. Kweon (4), L. Slade (1), H. Levine (1), J. Locke (3), V. Arora (3), J. Zimeri (2). (1) Food Polymer Science Consultancy, Morris Plains, NJ, USA; (2) Fresh Start Bakeries, Brea, CA, USA; (3) Kraft Foods, East Hanover, NJ, USA; (4) USDA, ARS, SWQL, Wooster, OH, USA

217 Starch retrogradation in wheat flour products: Effects of the conditions of storage. H. CHANVRIER (1), S. Uthayakumaran (1), A. Htoon (1). (1) Food Science Australia, North Ryde, NSW, Australia

218 The effect of different levels of corn starch on the textural and functional properties of the extruded ready-to-eat snacks. V. STOJCESKA (1), P. Ainsworth (1), A. Plunkett (1). (1) Manchester Metropolitan University, Department of Food, Clothing and Hospitality Management, Manchester, UK

Grain Exchange I: Analytical Aspects and Functional Properties

Poster Leader: Sing Kwei, Manchester Metropolitan University, Manchester, UK

219 A method of determining the dietary fibre content in extruded food using waveguide cells. S. KWEI (1), P. Ainsworth (1), A. Gibson (2), A. Haigh (2), A. Plunkett (1), V. Stojceska (1), G. Parkinson (2). (1) Manchester Metropolitan University, Manchester, UK; (2) The University of Manchester, Manchester, UK

220 A mutation in the starch-branching enzyme 2a gene leads to high resistant starch in maize leaf blade tissue. H. XIA (1), J. Li (1), M. J. Guiltinan (1), D. B. Thompson (1). (1) Penn State University, State College, PA

221 A simple assay for lipase activity in wheat flour streams. N. ZHOU (2), L. Haynes (2), W. Chung (2), L. Slade (1). (1) Food Polymer Science Consultancy, Morris Plains, NJ, USA; (2) Kraft Foods, East Hanover, NJ, USA

222 Alkaline dissolution of starch facilitated by microwave heating for analysis by size-exclusion chromatography. H. KIM (2), K. C. Huber (2), J. S. Higley (1). (1) TIC Gums, Belcamp, MD, USA; (2) University of Idaho, Moscow, ID, USA

223 Allele composition at the Pina-D1 and Pinb-D1 loci, puroindoline content and seed weight affect grain hardness in common wheat. L. Gazza (1), M. Corbellini (3), N. E. POGNA (2). (1) CRA-Istituto Sperimentale per la Cerealicoltura, Rome, Italy; (2) CRA Istituto Sperimentale Cerealicoltura; (3) CRA Istituto Sperimentale Cerealicoltura, S.Angelo Lodigiano, Italy

224 Analysis of phenols, tannins, and antioxidant activity of grain legumes compared with different whole grain cereals. A. P. CARDENAS-HINOJOSA (1), D. Guajardo-Flores (1), L. Dykes (1), C. M. McDonough (1), L. W. Rooney (1). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA

225 Changes of property and morphology of cationic corn starch granules. W. Kuo (1), H. LAI (1). (1) Dept. Agric. Chem., National Taiwan University

226 Characterization of starches from seven maize amylose-extender mutants. L. LI (1), H. Jiang (1), M. Campbell (2), J. Jane (1). (1) Iowa State University, Ames, IA, USA; (2) Truman State University, Kirksville, MO, USA

227 Comparison of iodine binding ability of maize starch lintners with different amylose content. D. SAIBENE (1), K. Seetharaman (1). (1) Penn State University, State College, PA, USA

228 Comparison of methods for analyzing resistant starch contents. J. HASJIM (1), J. Jane (1). (1) Department of Food Science and Human Nutrition, Iowa State University, Ames, IA

229 Comparison of tannins from sorghum: Differences in chemistry, biological activity and nutritional factors. R. C. KAUFMAN (2), S. R. Bean (2), M. R. Tuinstra (1). (1) Kansas State University Manhattan, KS, USA; (2) USDA/ARS/GMPRC, Manhattan, KS, USA

230 Comparison of the iodine binding ability of A- and B-type crystalline starch lintners. D. SAIBENE (1), K. Seetharaman (1). (1) Penn State University, State College, PA, USA

231 Comparison of total phenol, antioxidant activity and tannin content in different grains. D. GUAJARDO-FLORES (1), A. P. Cardenas-Hinojosa (1), L. Dykes (1), C. M. McDonough (1), L. W. Rooney (1). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA

Grain Exchange II: Analytical Aspects and Functional Properties

Poster Leader: Feng Xie, Kansas State University, Manhattan, KS, U.S.A.

232 Content, composition, and antioxidant capacity of isoflavones in commercial and homemade soymilk and tofu. H. Singh (1), M. NAKAKIHARA (1), G. Chung (1),

C. Tam (1). (1) California State University, Los Angeles, CA

233 Correlation between gluten secondary structures and wheat end-use properties for early generation breeding lines by FT-HATR mid-infrared spectroscopy. B. Seabourn (2), F. XIE (1), P. Seib (1). (1) Department of Grain Science and Industry, Kansas State University, Manhattan, KS; (2) USDA/ARS, Grain Marketing and Production Research Center, Manhattan, KS

234 Development of novel slowly digestible starches from maize. C. MOALLIC (1), A. M. Myers (1), M. G. James (1). (1) Iowa State University, Ames, IA, USA

235 Direct measurement of T_g of complex cereal foods. L. Samuel (1), B. K. Ashokan (1), J. L. KOKINI (1). (1) Rutgers University, New Brunswick, NJ, USA

236 Does increasing protein content through nitrogen fertilization affect protein quality of durum wheat?. N. EDWARDS (2), J. Dexter (2), J. Clarke (1). (1) Agriculture and Agri-Food Canada, Swift Current, SK, Canada; (2) Canadian Grain Commission, Winnipeg, MB, Canada

237 Effect of soaking and cooking on the reduction of oligosaccharides and lectins in a red kidney bean (*Phaseolus vulgaris* L.) snack product. G. NYOMBAIRE (1), K. Dolan (1). (1) Michigan State University

238 Effect of the duration and intensity of heat stress during grain filling on two near-isogenic wheat lines. S. IRMAK (1), F. MacRitchie (1). (1) Kansas State University, Manhattan, KS, USA

239 Effects of channel proteins on crosslinking of normal and waxy corn starch. J. HAN (1), J. N. BeMiller (1). (1) Purdue University, West Lafayette, IN, USA

240 Effects of HCl-methanol modification on the properties of corn starch film. Y. Chung (1), H. LAI (1). (1) National Taiwan University

241 Effects of heat on the structural and functional properties of vital wheat gluten. H. Singh (1), E. A. NAKAKIHARA (1), J. Dancort (1). (1) California State University, Los Angeles, CA

242 Effects of hull-less barley roller mill flow and grinding conditions on the yield, composition and properties of milled products. J. E. DEXTER (1), M. S. Izydorczyk (1), T. L. Chornick (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada

243 Extractability and chromatographic separation of rice endosperm proteins. A. Van Der Borght (1), K. BRIJS (1), G. Daenen (2), J. A. Delcour (1). (1) Laboratory of Food Chemistry, KU Leuven, Heverlee, Belgium; (2) Remy Industries NV, Wijgmaal, Belgium

244 Extraction and characterisation of beta-glucan from Canadian rye. S. RAGAEE (1), P. Wood (1), Q. Wang (1), S. Tosh (1), Y. Brummer (1), G. McLeod (2). (1) Agriculture and Agri-Food Canada, Guelph, ON, Canada; (2) Semiarid Prairie Agricultural Research Centre, Swift Current, SK, Canada

Grain Exchange III: Analytical Aspects and Functional Properties

Poster Leader: Donald Thompson, Pennsylvania State University, University Park, PA, U.S.A.

245 Flavor complexation with high-amylose maize starch as a function of water solubility of the flavor compound. O. Tapanapunnitikul (3), S. Chaiseri (1), D. Peterson (2), D. THOMPSON (2). (1) Department of Food Science, Kasetsart University, Bangkok, Thailand; (2) Department of Food Science, Penn State University, State College, PA, USA; (3) Department of Food Science, Penn State University, State College, PA, USA, and Department of Food Science, Kasetsart University, Bangkok, Thailand

246 Functional properties of wheat flours adjusted to a constant protein content by addition of starch and gluten. H. GUJRAL (1), B. Baik (1). (1) Washington State University, Pullman, WA, USA

247 Generation of thermally stable resistant starch from dispersed maize starches. H. Liu (1), D. B. THOMPSON (1). (1) Penn State University, State College, PA

248 Hard white wheat: Effect of environment on seed color. O. M. LUKOW (1), K. M. Adams (1), D. Fenn (1). (1) Agriculture and Agri-Food Canada

249 Influence of lactic acid on the amylase activity in flour dough. A. Y. TANIGUCHI (2), K. Takano (1), K. Shigeta (2), S. Kikuchi (1). (1) Tokyo University of Agriculture, Tokyo, Japan; (2) Tokyo University of Agriculture, Tokyo Gakuen Women's College, Tokyo, Japan

250 Influence of temperature, cook time, and shear rate on degree-of-cook in starch-based systems. B. GEERA (1), D. S. Jackson (1). (1) Department of Food Science & Technology, University of Nebraska, Lincoln, NE, USA

251 Interaction between hydrocolloids and normal and waxy rice starches. J. TECHAWIPHARAT (1), J. N. BeMiller (1). (1) Purdue University

252 Molecular analysis of segregation of cDNA of Amarantina in plants of transgenic corn. M. EVELIA (2), V. Angel (2), R. Cuauhtemoc (2), P. Octavio (1). (1) CINVESTAV-Unidad Irapuato; (2) Universidad Autonoma de Sinaloa

253 Official wet gluten analysis for hard red U.S. wheat. R. CHINNASWAMY (1), C. A. Brenner (1), T. D. Norden (1), R. O. Pierce (1), D. B. Funk (1), C. W. Burden (1), A. C. Johnson (1), L. D. Freese (1). (1) Grain Inspection, Packers and Stockyards Administration, Kansas City, MO, USA

254 Physicochemical properties of modified starches from large and small wheat starch granules. P. V. HUNG (1), N. Morita (1). (1) Laboratory of Food Chemistry, Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Osaka, Japan

255 Preparation and properties of starch phosphates using waxy corn starches: Oven-heating and extrusion methods. C. A. GÓMEZ ALDAPA (3), K. Torres Martínez (2), B. Murua Pagola (1), F. Martínez Bustos (1). (1) CINVESTAV, Unidad Querétaro, Frac. Real de Juriquilla, Qro, Mexico; (2) Lic. Quimica en Alimentos, CIQ, ICBI, UAEH, Hgo, Mexico; (3) Centro de Investigaciones Quimicas, ICBI, Universidad Autonoma del Estado de Hidalgo, Hgo, Mexico

256 Rapid individual amino acid analysis using an Internet-assisted FT-NIR system. N. WANG (1), C. Tseng (1). (1) Cognis Corp., Cincinnati, OH, USA

257 Rate and extent of digestion of single-mutants (ae, du, su2) and double-mutant combinations for maize starches in the W64A line. L. YEO (1), D. B. Thompson (1). (1) Penn State University, State College, PA

Grain Exchange IV: Analytical Aspects and Functional Properties

Poster Leader: Thomas Pearson, USDA-ARS, Manhattan, KS, U.S.A.

258 Reactivity of native and acid treated normal, waxy and high amylose corn and barley starches towards phosphorylation and cationization. J. GAO (2), T. Vasanthan (2), R. Hoover (1), B. Rossnagel (3). (1) Memorial University of Newfoundland, St. John's, NL, Canada; (2) University of Alberta, Edmonton, AB, Canada; (3) University of Saskatchewan, Saskatoon, SK, Canada

259 Relation of single wheat kernel particle size distribution to Perten SKCS 4100 hardness index. T. PEARSON (2), J. Wilson (2), J. Gwirtz (1), P. McCluskey (3), F. Dowell (2). (1) JAG Services, Manhattan, KS, USA; (2) USDA-ARS, Manhattan, KS, USA; (3) USDA-GIPSA-FMD, Washington, DC, USA

260 Size distribution of polymeric proteins extracted from durum wheat of diverse genotypes as assessed by flow field-flow fractionation. S. G. STEVENSON (1), N. M. Edwards (1). (1) Canadian Grain Commission/Grain Research Laboratory, Winnipeg, MB, Canada

261 Starch fine structure and physicochemical properties associated with the alkali spreading of rice. J. PATINDOL (1), Y. Wang (1). (1) University of Arkansas, Fayetteville, AR, USA

262 Structural changes of wheat flour starch and gluten during heating and shear stress conditions using farinograph-E, Viscograph-E and light microscope. J. DREISÖRNER (1), S. Iaquez (2). (1) Brabender GmbH & Co. KG, Duisburg, Germany; (2) C.W. Brabender Instruments, Inc., South Hackensack, NJ, USA

263 Structure and properties of corn, rice, wheat and potato starch dispersed in the ionic liquid, 1-butyl-3-methylimidazolium chloride. D. G. STEVENSON (1), A. Biswas (3), J. Jane (2), G. E. Inglett (1). (1) Cereal Products & Food Science Research Unit, NCAUR/ARS/USDA, Peoria, IL, USA; (2) Department of Food Science & Human Nutrition, Iowa State University, Ames, IA, USA; (3) Plant Polymer Research Unit, NCAUR/ARS/USDA, Peoria, IL, USA

264 Studies on the physicochemical properties of starches from different areas of kudzu. S. LIN (1), W. Shih (1), J. Chen (1). (1) Graduate Institute of Applied Science of Living, Chinese Culture University, Taipei, Taiwan

265 LC-MS analysis of phenolic acid antioxidants in select botanical parts of wheat. E. S. BONWELL (1), H. Koc (1), D. L. Wetzel (1). (1) Microbeam Molecular Spectroscopy Laboratory, Grain Science Departmetn, Kansas State University, Manhattan, KS, USA

266 Technological quality evaluation in new varieties of chickpeas *Cicer arietinum* L. grown on different soil types in the northwest of Mexico. G. A. YAÑEZ-FARÍAS (2), A. G. Cota-Gastélum (2), M. R. Falcón-Villa (2), R. Anduaga-Cota (2), A. L. Romero-Baranzini (2), J. A. Morales-Gómez (1), J. M. Barrón-Hoyos (2). (1) I.N.I.F.A.P., Hermosillo, Sonora, Mexico; (2) Universidad de Sonora, Hermosillo, Sonora, México

267 The environmental impact on starch size distribution in developing hard red winter wheat. J. D. WILSON (1), R. C. Kaufman (1), S. Park (1). (1) USDA/ARS/GMPRC, Manhattan, KS, USA

268 The use of DSC and FTIR to probe the miscibility in dextrans as model carbohydrate systems. D. Icoz (1), J. L. KOKINI (1). (1) Rutgers University

269 Thermal behavior of resistant starches. W. S. RATNAYAKE (1), D. S. Jackson (1). (1) Department of Food Science & Technology, University of Nebraska, Lincoln, NE, USA

270 Type and concentration of acid on the degradation of acid-methanol treated rice starches. J. Lin (1), C. Pan (1), Y. CHANG (1). (1) Department of Food & Nutrition, Providence University, Shalu, Taiwan

Grain Exchange V: Health and Nutritional Aspects

Poster Leader: Keith Petrofsky, University of Minnesota, St. Paul, MN, U.S.A.

271 Antioxidant activity in sorghum bran diets and their effect on colon carcinogenesis. C. M. McDonough (1), L. Dykes (1), R. J. Carroll (3), L. W. Rooney (1), N. D. TURNER (2). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA; (2) Nutrition and Food Sciences, Texas A&M University, College Station, TX, USA; (3) Statistics Department, Texas A&M University, College Station, TX, USA

272 Antioxidant activity of typical and mutant corn genotypes. W. Li (2), P. J. White (1), C. J. Bern (1), T. BETA (2). (1) Iowa State University; (2) University of Manitoba

273 Barley grains as a source of phenolic compounds. J. Klepacka (1), E. GUJSKA (1). (1) University of Warmia and Mazury, Olsztyn, Poland

274 Comparison of total phenol and antioxidant activity levels of lemon-yellow and red pericarp sorghums. L. DYKES (1), L. W. Rooney (1). (1) Texas A&M University, Cereal Quality Laboratory, College Station, TX, USA

275 Effect of steeping and germination conditions on GABA production in barley. S. JANG (1), S. Lim (1). (1) Korea University, Seoul, South Korea

276 In vitro digestibility of phytoglycogens extracted from sweet corn kernels. J. SHIN (1), Y. Yao (1). (1) Department of Food Science, Purdue University, West Lafayette, IN, USA

277 In vitro digestibility of microwaved amaranth and plantain starches. J. TOVAR (1), S. Silva (1), E. Perez (2). (1) Institute of Experimental Biology, Universidad Central de Venezuela; (2) Institute of Food Science and Technology, Universidad Central de Venezuela

278 Knowledge and attitudes surrounding whole grain foods among school foodservice personnel. K. M. ANDERSON (1), M. M. Reicks (1), Z. M. Vickers (1), L. Marquart (1). (1) University of Minnesota, Saint Paul, MN, USA

279 Nutraceutical content of maltodextrin spray dried with blueberry byproducts. K. MA (1), K. D. Dolan (1). (1) Michigan State University

280 Processing effects on the antioxidant activity of amaranth and quinoa. K. E. PETROFSKY (2), M. E. Chevrel (2), K. A. Evenson (2), F. Rigelhof (2), R. Fulcher (1), L. Marquart (2). (1) University of Manitoba, Department of Food Science, Winnipeg, MB, Canada; (2) University of Minnesota, Department of Food Science and Nutrition, St. Paul, MN, USA

281 Stabilized rice bran – A functional food for the 21st century. R. M. PATEL (1). (1) Nutracea, El Dorado Hills, CA

282 Total phenol content and antioxidant activity of canola grown in North Central USA. P. G. KRISHNAN (1), C. Dwivedi (1). (1) South Dakota State University, Brookings, SD

283 Use of polymer encapsulated starches as a novel method to make low glycemic foods. M. VENKATACHALAM (1), G. Zhang (1), B. R. Hamaker (1). (1) Purdue University, Department of Food Science, West Lafayette, IN

Grain Exchange VI: Other

Poster Leader: Rajender Singh, University of Saskatchewan, Saskatoon, SK, Canada

284 Characterization of native manioc starch composite films and their application as coating in pakan pears preservation. F. M. FAKHOURI (1), F. P. Collares (1). (1) State University of Campinas-UNICAMP, Department of Food Technology, Campinas, SP, Brazil

285 Comparison of different methods for pre-harvest sprouting phenotyping in bread wheat (*Triticum aestivum* L.). R. SINGH (1), M. Matus-Cadiz (1), M. Baga (1), P. Hucl (1), R. N. Chibbar (1). (1) Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK, Canada

286 Composite films elaborated from native, waxy or modified waxy corn starches and gelatin – Visual aspect and opacity. F. M. FAKHOURI (1), F. P. Collares (1). (1) State University of Campinas-UNICAMP, Department of Food Technology, Campinas, SP, Brazil

287 Elucidation of starch granule surface composition and reactivity aided by gel permeation chromatography coupled with fluorescence detection. J. HIGLEY (1), H. Kim (2), K. Huber (2). (1) TIC Gums; (2) University of Idaho

288 Evaluation of legume cooking characteristics using a rapid screening method. H. YEUNG (2), R. W. Waniska (2), J. Ehlers (1). (1) Botany and Plant Sciences, University of California at Riverside, CA, USA; (2) Cereal Quality Laboratory, Texas A&M University, College Station, TX, USA

289 Extrusion of starch-based foams in a single screw extruder. G. SURESH BABU (1), H. A. Pushpadass (1), R. W. Webber (1), M. A. Hanna (1). (1) Industrial Agricultural Products Center, University of Nebraska-Lincoln, Lincoln, NE, USA.

290 Influence of gelatin addition in the opacity of native and modified manioc starch composite biofilms. F. M. FAKHOURI (1), F. P. Collares (1). (1) State University of Campinas-UNICAMP, Department of Food Technology, Campinas, SP, Brazil

291 Modified manioc fecula edible films and their application in strawberry coating. F. M. FAKHOURI (1), F. P. Collares (1). (1) State University of Campinas-UNICAMP, Department of Food Technology, Campinas, SP, Brazil

292 Study of moisture transport properties associated with field fissuring in rice grains – An approach to quantify potential genetic improvement in rice. P. JAT (2), S. G. Osborn (2), T. A. Elizabeth (1), S. R. Pinson (1). (1) USDA ARS, Beamont, TX, USA; (2) University of Arkansas, Fayetteville, AR, USA

Grain Exchange VII: Processing and Raw Materials

Poster Leader: Benoit Igne, Iowa State University, Ames, IA, U.S.A.

293 Composite biofilms manufactured with gluten, gelatin and manioc starch or corn starch (native or modified). L. C. Bertan (2), T. G. Kieckbusch (1), F. P. COLLARES (2). (1) State University of Campinas, School of Chemical Engineering, Campinas, SP, Brazil; (2) State University of Campinas, School of Food Technology, Department of Food Technology, Campinas, SP, Brazil

294 Cooking time of white corn and its effect on grain hardness and water uptake. A. R. ISLAS-RUBIO (1), L. E. Molina-Jacott (1), B. Silva-Espinoza (1), M. Granados-Nevárez (1), F. Vásquez-Lara (1). (1) CIAD, A.C., Hermosillo, Sonora, México

295 Developing quick methods to cook sorghum for different food applications. V. R. CALDERON (1), L. W. Rooney (1), C. M. McDonough (1). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA

296 Effect of pearling on free radical scavenging properties of hulled and hull-less barley. C. F. ROSA (1), G. Fulcher (1), T. Beta (1). (1) University of Manitoba

297 Effect of soaking conditions on color characteristics of soaked and parboiled rice. L. LAMBERTS (1), K. Brijs (1), W. De Man (2), J. A. Delcour (1). (1) Laboratory of Food Chemistry, KU Leuven, Heverlee, Belgium; (2) Masterfoods, Olen, Belgium

298 Effect of variety and crude protein content on dehulling characteristics of red lentils (*Lens culinaris*). N. WANG (1), M. McKinley (1), R. Toews (1). (1) Canadian Grain Commission, Grain Research Laboratory, Winnipeg, MB, Canada

299 Effective communications make the difference: Tracking consumer attitudes toward food biotechnology. A. P. BENSON (1). (1) International Food Information Council, Washington, DC, USA

300 Effects of native lipid content on the gel properties and spherulite formation of jet cooked cornstarch. S. C. PETERSON (1), F. J. Eller (1), G. F. Fanta (1), F. C. Felker (1). (1) NCAUR, ARS, USDA, Peoria, IL, USA

301 Evaluation of preprocessing methods in the development of near-infrared models for triticale protein and moisture. B. IGNE (1), L. R. Gibson (2), G. R. Rippke (1), C. R. Hurburgh (1). (1) Iowa State University, Department of Agricultural and Biosystems Engineering, Ames, IA, USA; (2) Iowa State University, Department of Agronomy, Ames, IA, USA

302 Extrusion on Goami2 rice – A variety high in indigestible carbohydrates. I. CHOI (3), K. Kim (3), J. Son (3), G. Ryu (2), H. Jeong (1). (1) Department of Food Science & Technology, Chungbuk National University, Cheongju, Republic of Korea; (2) Department of Food Science & Technology, Kongju National University, Kongju, Republic of Korea; (3) Post-Harvest Technology Division, National Institute of Crop Science, RDA, Suwon, Republic of Korea

303 Gluten biofilms plasticized with glycerol – Formulation optimization by response surface methodology. L. C. Bertan (2), T. G. Kieckbusch (1), F. P. COLLARES (2). (1) State University of Campinas, School of Chemical Engineering, Campinas, SP, Brazil; (2) State University of Campinas, School of Food Technology, Department of Food Technology, Campinas, SP, Brazil

304 Grain quality analysis of sorghum samples from El Salvador. V. R. CALDERON (2), L. Sandoval (1), L. W. Rooney (2), S. Mason (3). (1) CENTA, San Salvador, El Salvador; (2) Cereal Quality Lab, Texas A&M University, College Station, TX, USA; (3) Department of Agronomy, University of Nebraska, Lincoln, NE

305 Grain sorghum dry grind unit operation influence on lipid content of process streams. E. C. NEWGARD (1), C. L. Weller (1). (1) Department of Biological Systems Engineering, University of Nebraska-Lincoln

306 Identification of barley varieties to suit the needs of industry. S. UTHAYAKUMARAN (1), I. Batey (1), N. Barker (2), C. Wrigley (1). (1) Food Science Australia/ Value Added Wheat CRC, North Ryde, NSW, Australia; (2) Grain Corp., Marong, VIC, Australia

307 Kinetic parameters and degree of hydrolysis of wheat gluten affected by trypsin from tropical fish pyloric ceca. F. CABRERA-CHAVEZ (1), J. R. Herrera-Urbina (1), J. M. Ezquerra-Brauer (1), O. Rouzaud-Sandez (1). (1) Universidad de Sonora, Hermosillo, Sonora, México

Grain Exchange VIII: Analytical Aspects and Functional Properties

Poster Leader: David Stevenson, USDA-ARS, Peoria, IL, U.S.A.

308 Monitoring milling fractions while the mill is running with a commercial acousto-optic tunable filter spectrometer. H. KOC (1), D. L. Wetzel (1). (1) Microbeam Molecular Spectroscopy Lab., Grain Science Department, Kansas State University, Manhattan, KS, USA

309 Production and use of a soluble arabinoxylan containing concentrate from wheat starch plant process water. F. MEUSER (1), J. Dorfer (1), N. Lochow (1). (1) Technical University, Berlin, Germany

310 Properties of defatted and pin-milled oat bran concentrate fractions separated by air classification. D. G. STEVENSON (1), F. J. Eller (3), J. Jane (2), G. E. Inglett (1). (1) Cereal Products & Food Science Research Unit, NCAUR/ARS/USDA, Peoria, IL, USA; (2) Department of Food Science & Human Nutrition, Iowa State University, Ames, IA, USA; (3) New Crops Products Research Unit, NCAUR/ARS/USDA, Peoria, IL, USA

311 Recovery and characterization of lipids from ten grain sorghum parent lines. K. L. CHRISTIANSEN (1), C. Weller (1), V. Schlegel (2). (1) Department of Biological Systems Engineering, University of Nebraska-Lincoln, Lincoln, NE, USA; (2) Food Science and Technology, University of Nebraska-Lincoln, Lincoln, NE, USA

312 Relationships of single kernel characterization system variables and milling quality in hard and soft white winter wheats. J. OHM (2), A. S. Ross (2), J. Peterson (2), M. Beilstein (1). (1) Corvallis, OR, USA; (2) Crop & Soil Science, Oregon State University, Corvallis, OR, USA

313 Rheological characterization of zein-oleic acid doughs as a function of moisture content and mixing time. M. K. Lau (1), H. DOGAN (1), J. L. Kokini (1). (1) Rutgers University

314 Selective formation and yield enhancement of spherulites in jet-cooked high-amylose cornstarch dispersions. F. C. FELKER (1), G. F. Fanta (1). (1) USDA, ARS, NCAUR, Peoria, IL, USA

315 Separation of vital wheat gluten to gliadin-rich and glutenin-rich fractions. T. MCCANN (2), C. Dela Cruz (2), L. Day (1). (1) Food Science Australia, Werribee, VIC, Australia; (2) RMIT University, Melbourne, VIC, Australia

316 The effect of irradiation temperature on the retardation of non-enzymatic browning reaction of cooked rice occurred by gamma-irradiation. K. JAE-HUN (2), O. Sang-Hee (2), L. Ju-Woon (2), R. Gi-Hyung (1), B. Myung-Woo (2). (1) Kongju National University, Yesaneup, Chungnam, Korea; (2) Korea Atomic Energy Research Institute, Jeongeup, Chunbuk, Korea

317 The effect of storage temperature of paddy on willingness to pay by consumers. S. S. KIM (1), H. Kim (1), D. C. Kim (1), S. E. Lee (1), O. W. Kim (1). (1) Korea Food Research Institute, Songnam-si, Kyunggi-do, Republic of Korea

318 The milling ratio effects on physicochemical characteristics of milled rice and sensory quality of cooked rice depending on rice cultivars. E. JANG (1), S. Kim (1), S. Lim (2), H. Kim (1), O. Kim (1). (1) Korea Food Research Institute, Songnam-si, Kyunggi-do, Republic of Korea; (2) Korea University, Seoul, Korea

319 The role of cellular structure and phase behavior on the texture of extruded solid foams. L. Samuel (1), H. Dogan (1), J. L. KOKINI (1). (1) Rutgers University, New Brunswick, NJ, USA

320 Time of extraction influence on level of phytosterols and policosanols extracted from grain sorghum DDG's. C. LEGUIZAMON S. (1), C. Weller (2), V. Schlegel (1), T. Carr (3). (1) Department of Food Science and Technology, University of Nebraska, Lincoln, NE, USA; (2) Department of Biological Systems Engineering, University of Nebraska, Lincoln, NE, USA; (3) Department of Nutrition & Health Sciences, University of Nebraska, Lincoln, NE, USA

321 Understanding organics and the regulations governing this market. B. A. RUSH (1). (1) Briess Malt & Ingredients Company, Chilton, WI, USA

322 Wet milling: An efficient process to recover a recombinant LTB-rich fraction from corn. N. VIGNAUX (2), L. A. Johnson (1). (1) Center for Crops Utilization Research; (2) Iowa State University

Grain Exchange IX: Safety and Quality

Poster Leader: Tom Askin, Agriculture and Agri-Food Canada, Winnipeg, MB, Canada

323 Comparative analysis of wheat classification systems in selected wheat exporting countries. A. Rosenberg (1), J. Kohler (1), T. ASKIN (1). (1) Agriculture and Agri-Food Canada, Winnipeg, MB, Canada

324 Degradation modelling of pyrethroid residues in raw and processed stored wheat. A. Calderon-Flores (2), M. Aldana-Madrid (2), M. SILVEIRA (2), P. Grajeda-Cota (1), M. Salazar-Garcia (2). (1) CIAD, A.C., Hermosillo, Sonora, Mexico; (2) Universidad de Sonora, Hermosillo, Sonora, Mexico

325 Determining corn hardness from grinding time, grinding energy and near-infrared spectroscopy of whole kernel and ground material. P. R. ARMSTRONG (1), J. Lingenfelser (2). (1) GMPRC USDA-ARS; (2) Kansas State University

326 Geographical diagnostics of polished rice based on C, N contents and C, N, O stable isotope analyses. Y. SUZUKI (1), Y. Chikaraishi (2), N. O. Ogawa (2), N. Ohkouchi (2), T. Korenaga (1). (1) Department of Chemistry, Tokyo Metropolitan University, Hachioji, Japan; (2) Institute for Research on Earth Evolution, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan

327 Global grain tracing and recall system: Sampling strategy. K. LEE (1), T. J. Herrman (2). (1) Department of Soil and Crop Sciences, Texas A&M University, College Station, TX; (2) Office of the Texas State Chemist, Texas A&M University, College Station, TX

328 In-house validation of real-time PCR assay for the detection of GT73/RT73 canola GM event. T. DEMEKE (1), I. Ratnayaka (1). (1) Canadian Grain Commission

329 Quantification of food-grade corn density variance components. K. LEE (3), T. J. Herrman (4), T. M. Loughin (1), J. Lingenfelser (2). (1) Department of Statistics, Kansas State University, Manhattan, KS; (2) Department of Grain Science and Industry, Kansas State University, Manhattan, KS; (3) Department of Soil and Crop Sciences, Texas A&M University, College Station, TX; (4) Office of the Texas State Chemist, Texas A&M University, College Station, TX

330 Susceptibility of sorghum for lesser grain borer and their influence on the physicochemical properties of sorghum kernel and flour. S. PARK (1), F. H. Arthur (1), S. R. Bean (1), T. Schober (1), B. Ioerger (1). (1) USDA-ARS GMPRC, Manhattan, KS, USA

331 The study on sanitation and safety management of rice flour noodles in Taiwan. S. LIN (2), W. Kuo (2), Y. Chiang (1). (1) Department of Human Development and Family Studies, National Taiwan Normal University, Taipei, Taiwan; (2) Graduate Institute of Applied Science of Living, Chinese Culture University, Taipei, Taiwan

332 The use of a very low cost extruder on the inactivation of phytohemagglutinin activity in red kidney beans (*Phaseolus vulgaris* L.). G. NYOMBAIRE (1). (1) Michigan State University

Pasta/Noodles I: Analytical Aspects and Functional Properties

Poster Leader: Mehmet Tulbek, Northern Crops Institute, Fargo, ND, U.S.A.

333 Characteristics of starches of Mexican durum wheat cultivars. B. MONTAÑO-LEYVA (2), P. Torres (2), C. Medina-Rodriguez (2), B. Ramirez-Wong (2), F. Martínez-Bustos (1), R. Ramirez-Bon (1), J. Wilson (3). (1) CINVESTAV, Unidad Querétaro, Mexico; (2) Departamento de Investigación y Posgrado en Alimentos, Universidad de Sonora, Hermosillo, Sonora, Mexico; (3) USDA, Manhattan, KS, USA

334 Chemical characteristics of spaghetti fabricated with different levels of plantain starch addition. R. G. HERNANDEZ-NAVA (1), L. A. Bello-Perez (1), J. J. Berrios (2), J. Pan (2). (1) CEPROBI-IPN, Yautepec, Morelos, Mexico; (2) U.S. Department of Agriculture, WRRC, Albany, CA

335 Effects of added ash on the pasting and noodle making properties of wheat flour. H. GUJRAL (1), B. Baik (1). (1) Washington State University, Pullman, WA, USA

336 Evaluation of U.S. durum wheat quality with mixolab. F. Manthey (1), M. C. TULBEK (2), B. Sorenson (2). (1) Department of Plant Sciences, NDSU, Fargo, ND, USA; (2) Northern Crops Institute, Fargo, ND, USA

337 Fortification of spaghetti with *Lupinus mutabilis* derivatives and rheological, processing, and quality evaluation studies. V. López-Santos (3), H. López-López (3), M. Reyes-Santamaría (3), S. Soto-Simental (3), G. Davila-Ortiz (2), R. Peña-Bautista (1), N. GUEMES-VERA (3). (1) Centro Internacional de Mejoramiento de Maiz y Trigo; (2) ENCB-IPN; (3) Instituto de Ciencias Agropecuarias-UAEH, Tulancingo, Hidalgo, Mèxico

338 Glutenin macropolymer from salt and alkaline noodles. Y. L. ONG (1), A. S. Ross (1). (1) Oregon State University, Corvallis, OR, USA

339 Possibility of use of instrument MOM color 100 for objective evaluation of spaghetti color. M. PESTORIC (1), V. Pribis (1), J. Mastilovic (1), M. Pojic (1), M. Sakac (1). (1) University of Novi Sad, Faculty of Technology, Novi Sad, Serbia and Montenegro

340 Protein extractability of wheat flour and noodle dough as a protein quality index for making Asian noodles. S. YOON (1), B. Baik (1). (1) Washington State University, Pullman, WA, USA

Pasta/Noodles II: Processing and Raw Materials

Poster Leader: Mark Bason, Newport Scientific Pty Ltd., Warriewood, NSW, Australia

341 Characteristics of buckwheat flours obtained from gradual milling system and their application for noodle making. P. V. HUNG (2), S. Yamamoto (2), K. Miyake (2), T. Maeda (1), N. Morita (2). (1) Department of Life and Health Sciences, Hyogo University of Teacher Education, Hyogo, Japan; (2) Laboratory of Food Chemistry, Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Osaka, Japan

342 Effect of bran on durum wheat pasta drying. S. VILLENEUVE (1), P. Gélinas (1). (1) Food Research and Development Centre, Agriculture and Agri-Food Canada, Saint-Hyacinthe, QC, Canada

343 High speed dough tests of semolina using the Newport Scientific doughLAB. J. Dang (2), M. L. BASON (2), M. J. Sissons (1). (1) NSW Department of Primary Industries, Tamworth Agricultural Institute, Calala, NSW, Australia; (2) Newport Scientific Pty. Ltd., Warriewood, NSW, Australia

344 Influence of hydration level and mixing time on rheological and structural properties of common and durum wheat milling fractions. V. LANDILLON (1), D. Cassan (1), M. Morel (1), B. Cuq (1). (1) Agro.M-INRA UMR IATE, Montpellier, France

345 Manipulation of starch composition in wheat breeding in Italy. E. DE AMBROGIO (2), G. Ferrazzano (2), R. Ranieri (1), M. Silvestri (1), F. Sestili (3), A. Saliola Bucelli (3), D. Lafiandra (3). (1) Barilla G. e R. Fratelli S.p.A., Parma, Italy; (2) Società Produttori Sementi S.p.A., Bologna, Italy; (3) Università della Tuscia, Viterbo, Italy

346 Noodle quality affected by different cereal starches. Y. Huang (1), H. LAI (1). (1) Dept. Agric. Chem., National Taiwan University

347 Processing and assessment of udon noodles: Evaluation of ANW, APW and ASW for the quality properties of

udon noodles. L. CATO (1). (1) AWB Ltd., Melbourne, VIC, Australia

348 Rapid spectrophotometric method for determination of phosphine in wheat. F. Longobardi (2), M. PASCALE (2), M. Silvestri (1), R. Ranieri (1), A. Visconti (2). (1) Barilla G. e R. Fratelli S.p.A., Parma, Italy; (2) Institute of Sciences of Food Production (ISPA), National Research Council, Bari, Italy

349 The enzyme assays of Australian white wheat flours and Asian noodles: The colour and textural properties of white salted noodles. L. CATO (1), A. L. Halmos (2), D. M. Small (2). (1) AWB Ltd., Melbourne, VIC, Australia; (2) RMIT University, Melbourne, VIC, Australia

Pasta/Noodles III: Safety, Quality, Health and Nutrition

Poster Leader: Michelangelo Pascale, National Research Council, Bari, Italy

350 Evaluation of commercial spaghetti texture at different cooking and resting times. A. COTA-GASTÉLUM (2), M. Salazar-García (2), A. Islas-Rubio (1). (1) Centro de Investigación en Alimentación y Desarrollo. Hermosillo, Sonora, México; (2) D.I.P.A.Universidad de Sonora, Hermosillo, Sonora, México

351 Fluorescence polarization immunoassay for rapid screening of deoxynivalenol in wheat-based products. V. Lippolis (2), M. PASCALE (2), A. D'Alessandro (1), R. Ranieri (1), A. Visconti (2). (1) Barilla G. e R. Fratelli S.p.A., Parma, Italy; (2) Institute of Sciences of Food Production (ISPA), National Research Council, Bari, Italy

352 Improving dough color stability through the isolation and sequence analysis of polyphenol oxidase (PPO) genes in wheat and its wild relatives. B. BEECHER (1). (1) USDA-ARS

353 Pasting and cooking properties of pasta products. C. BRUNEEL (1), B. Pareyt (1), H. Goesaert (1), J. Delcour (1). (1) Katholieke Universiteit Leuven, Leuven, Belgium

354 Polyphenol oxidase (PPO) in wheat and wild relatives: Evidence for a complex multigene family. A. N. MASSA (2), B. Beecher (1), C. F. Morris (1). (1) USDA ARS Western Wheat Quality Laboratory, Pullman, WA, USA; (2) Washington State University - USDA ARS Western Wheat Quality Laboratory, Pullman, WA, USA

355 Resistant starch of white salted noodles with different amylose content. T. SASAKI (1), K. Kohyama (1). (1) National Food Research Institute Ibaraki, Japan

356 Teflon and bronze shaped pasta: Is it only a matter of surface appearance?. M. LUCISANO (1), M. Pagani (1), M. Mariotti (1), D. Locatelli (2). (1) DiSTAM (Department of Food Science and Microbiology), University of Milan, Milan, Italy; (2) Institute of Entomology, University of Milan, Milan, Italy

Sweet/Salty Foods I: Analytical Aspects and Functional Properties; Health and Nutritional Aspects

Poster Leader: Meera Kweon, USDA-ARS, Wooster, OH, U.S.A.

357 Application of time-domain nuclear magnetic resonance to quantify oil content in starch-oil composites prepared by excess steam jet-cooking. J. A. KENAR (1), M. Singh (1). (1) NCAUR/ARS/USDA, Peoria, IL, USA

358 Effect of flour moisture level on biscuit flour functionality. W. CHUNG (1), N. Zhou (1), L. Haynes (1), T. Hansen (2). (1) Kraft Foods, East Hanover, NJ, USA; (2) Kraft Foods, Glenview, IL, USA

359 Effect of starch crystallinity on the mechanical properties of dry and hydrated baked cereal foams. E. LABAT (1). (1) Nestle Research Center, Lausanne, Switzerland

360 Exploration of sugar functionality in cookie and cake baking: Use of predictions from SRC, DSC, and RVA to enable a minimized experimental design. M. KWEON (2), L. Slade (1), H. Levine (1), E. Souza (2), R. Martin (2). (1) Food Polymer Science Consultancy, Morris Plains, NJ, USA; (2) USDA-ARS, Soft Wheat Quality Lab., Wooster, OH, USA

361 Mapping QTL for soft wheat quality in multiple populations. C. Sneller (1), N. Smith (1), M. J. GUTTIERI (3), E. J. Souza (2). (1) Ohio State University; (2) USDA-ARS, Wooster OH; (3) University of Idaho

362 Relationship between hardness and internal structure of high fiber content extruded snacks. R. E. Ferreira (1), Y. K. Chang (1), C. J. STEEL (1). (1) UNICAMP, Campinas, SP, Brazil

363 Effect of incorporation of yacon (*Polymnia sonchifolia*) flour and oat in champurradas type cookies. A. L. Marangoni (1), F. P. COLLARES (1). (1) State University of Campinas, Department of Food Technology, Campinas, SP, Brazil

364 Effect of the addition of wheat bran to cakes according to the requirements of the Brazilian legislation for fiber claims. O. P. Almeida (1), V. C. Terezan (2), V. P. Godoy (2), C. C. Golineli (2), Y. K. Chang (3), C. J. STEEL (3). (1) AB Brasil, Jundiaí, SP, Brazil; (2) Emulzint, Jundiaí, SP, Brazil; (3) UNICAMP, Campinas, SP, Brazil

365 Enhancing extrusion expansion of high fiber puffed products. O. A. BLAKE (1). (1) Purdue University

366 Sensory evaluation of graham crackers enriched with soluble fiber-rich whole barley flour. S. CHONGCHAM (1), N. Prasopsunwattana (1), P. Cooke (3), R. A. Flores (4), E. A. Arndt (2), M. B. Omary (1). (1) California State Polytechnic University, Pomona, CA, USA; (2) ConAgra Foods, Inc., Omaha, NE, USA; (3) Microscopic Imaging Group-USDA/ARS/ERRC, Wyndmoor, PA, USA; (4) University of Nebraska, Lincoln, NE, USA

367 Slowly digestible cookies prepared from resistant starch-rich lintnerized banana starch. L. A. BELLO-PEREZ (1), A. Aparicio-Saguilan (1), S. G. Sayago-Ayerdi (2), J. Tovar (3). (1) CEPROBI-IPN, Yautepec, Morelos, México; (2) Instituto Tecnológico de Acapulco, Calzada Instituto Tecnológico S/N, Acapulco, Guerrero, México; (3) Instituto de Biología Experimental, Universidad Central de Venezuela, Caracas Venezuela

368 Study of the application of yacon (*Polymnia sonchifolia*) flour and flaxseed flour in pound cake by surface of response methodology. A. L. Marangoni (1), F. P. COLLARES (1). (1) State University of Campinas, Department of Food Technology, Campinas, SP, Brazil

369 Withdrawn

Sweet/Salty Foods II: Processing and Raw Materials

Poster Leader: Mukti Singh, USDA-ARS, Peoria, IL, U.S.A.

370 Alternative milk drinks and tofu made from domestic pulses other than soy beans. G. ZWEYTICK (1), M. Jaksch (1), E. Berghofer (1). (1) University of Natural Resources and Applied Life Sciences, Department of Food Science and Technology, Vienna, Austria

371 Effect of amaranth flour addition on technological properties of standard and reduced fat pound cakes. E. L. Almeida (1), R. E. Ferreira (1), V. D. Capriles (2), Y. K. Chang (1), C. J. STEEL (1). (1) UNICAMP, Campinas, SP, Brazil; (2) USP, São Paulo, SP, Brazil

372 Effect of biodegradable edible coatings on physical-chemical properties of chocolate pound cake. L. B. Fontes (1), C. C. Osawa (1), E. M. Walter (1), C. J. Steel (1), Y. K. CHANG (1). (1) UNICAMP, Campinas, SP, Brazil

373 Effect of the extrusion parameters and yacon (*Polymnia sonchifolia*) flour content on the quality of rice flour snacks. A. L. Marangoni (1), F. P. COLLARES (1). (1) State University of Campinas, Department of Food Technology, Campinas, SP, Brazil

374 Expanded *Amaranthus cruentus* seed – A novel raw material for special confectionery products. M. Bodroža-Solarov (1), B. Filipcev (1), O. Šimurina (1), M. POJIC (1). (1) Faculty of Technology, Novi Sad, Serbia and Montenegro

375 Influence of flour chlorination and ingredient formulation on the quality attributes of pancakes. S. M. FINNIE (1), A. D. Bettge (1), C. F. Morris (1). (1) USDA-ARS WWQL, Pullman, WA

376 New developments in whole grain corn products. W. Duensing (1), R. PERRY (2). (1) Bunge Milling, Danville, IL, USA; (2) Bunge Milling, St. Louis, MO, USA

377 Ozonation of cake flour as an alternative to chlorination. S. CHITTRAKORN (1), F. MacRitchie (1). (1) Department of Grain Science and Industry, Kansas State University, Manhattan, KS, USA

378 Particle size affects the physical and pasting characteristics of starch-lipid composites. M. SINGH (1). (1) USDA/ARS/NCAUR, Peoria, IL, USA

379 Reduction of acrylamide in low moisture bakery products. S. GROSSMANN (2), C. Alosco (1). (1) Budenheim USA, Plainview, NY; (2) Chemische Fabrik Budenheim, Budenheim, Germany

380 The effect of pounding temperature on rheological characteristics of pre-cooked glutinous rice flour. S. Teo (1), A. YEH (1). (1) National Taiwan University, Taipei, Taiwan

381 Using non-contact ink jet technology to print high quality text, graphics, and other images directly onto foodstuffs. S. D. LINIGER (1). (1) Sensient Colors Inc., St. Louis, MO, USA

382 Utilization of a new oat beta-glucan rich hydrocolloid to reduce oil uptake in fried foods. S. LEE (1), G. Inglett (1). (1) USDA/ARS

Poster Titles and Abstracts

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Poster Set Up

Monday, September 18 — 7:00 – 10:00 a.m.

Poster Viewing

Monday, September 18 — 10:00 a.m. – 7:00 p.m.
Beer and Poster Presentations — 4:45 – 6:30 p.m.
Tuesday, September 19 — 8:00 a.m. – 2:00 p.m.
Authors Present — 12:00 – 2:00 p.m.

Poster Take Down

Tuesday, September 19 — 2:00 – 3:30 p.m.

Posters

P-107
A simple and highly sensitive method for the analysis of 3-methyl-2-butene-1-thiol (3MBT) in beer. A. UEHARA (1), O. Ogane (1), T. Imai (1), Y. Ogawa (1). (1) Kirin Brewery Co. Ltd., Research Laboratory for Brewing, Yokohama, Japan.

When beer is exposed to sunlight, it produces an unpleasant flavor known as "sunstruck," "burnt" or "skunk" due to the formation of 3-methyl-2-butene-1-thiol (3MBT). 3MBT also forms during wort boiling and wort clarification processes, and reportedly has a very low odor threshold of 4 to 35 ng/L. Since 3MBT is labile and is present in beer in only trace amounts, methods necessary for its quantitation must be selective and sensitive. We have developed such a quantitation method employing the purge-and-double trap technique and a stable isotope dilution assay (SIDA). This new method allows increased sensitivity and reproducibility, improving the detection limit to 0.1 ng/L in beer and making it much simpler than previously published methods due to the use of smaller beer samples and easier sample preparation procedures. This new method can be an extremely effective tool for brewers investigating and assessing the unpleasant sulfur-like flavor in beer and during the brewing process.

P-108
Analysis of beta-damascenone in beer using the headspace solid-phase microextraction method (SPME) with GC-MS. O. OGANE (1), A. Uehara (1), T. Imai (1), Y. Ogawa (1). (1) Kirin Brewery Co. Ltd., Research Laboratory for Brewing, Yokohama, Japan.

Beta-damascenone is a terpenoid that possesses a honey- or baked apple-like flavor, and is found in many beverages such as beer, brandy, rum, whisky and wine. It is considered to be a significant compound to flavor, due to its very low sensory threshold (approximately 0.02–0.09 µg/L in water), and is reported to be useful as an analytical indicator of aging induced by storage temperatures and storage periods. We developed a new method of analyzing beta-damascenone in beer, using SPME with GC-MS. This new method allows highly sensitive, highly accurate, and easily repeatable analysis to be performed on trace amounts of beta-damascenone in beer, making it much simpler than previously published methods due to the use of smaller beer samples and easier sample preparation procedures. This new method can be an extremely effective tool for brewers assessing and investigating stale flavor in beer and during the brewing process.

P-109
CO_2 recovery: Advanced energy recovery reduces operating costs by up to 60%. I. WILLIAMS (1). (1) Haffmans BV.

The application of energy recovery systems with CO_2 recovery is becoming increasingly more commonplace. Ever increasing costs in world energy means that breweries are investing increasingly in energy saving and energy efficient systems. Haffmans will present options for where the brewery can efficiently recover energy within the CO_2 recovery process and provide case studies detailing the results to the breweries that have implemented this technology. Haffmans will detail NEW advanced energy recovery technology which is not only the most efficient in terms of reduced energy operating costs, but also increases the amount of CO_2 recovered leading to complete brewery CO_2 self-sufficiency.

P-110
Comparison of SBSE, HSSE and closed-loop stripping HSSE followed by GC-TOFMS for measuring staling aldehydes and MBT in abused beer. R. T. MARSILI (1). (1) Marsili Consulting Group.

Carbonyl compounds, particularly aldehydes, are considered to play an important role in the development of stale off-flavors in beer samples that have been heat abused during shelf life. 2-Methyl-2-butene-1-thiol and other organic sulfur compounds have been shown to contribute skunky off-notes in light-exposed beer. Polydimethylsiloxane (PDMS)-coated magnetic stir bars (Gerstel Twister®) can be used as an extraction medium for these odor-active compounds and can be applied in different formats, including placement in the beer sample (stir bar sorption extraction or SBSE) and placement in the headspace above the beer sample (headspace sorbent extraction or HSSE). Another headspace modification called closed-loop stripping HSSE (CLSHSSE) was also investigated. The goals of this research were to determine which sample preparation approach is able to detect the greatest number of odor-active chemicals and which technique might be most useful for quantitation.

P-111
Comparison of the reference method and NIRS based method for determination of fat content in corn grits. M. M. POJIC (2), J. Mastilovic (2), M. Pestoric (2), S. Dakovic (1). (1) Mirotin, Mlin Tisa, Savino Selo, Serbia and Montenegro; (2) University of Novi Sad, Faculty of Technology, Novi Sad, Serbia and Montenegro.

The non-malt brewing materials used in greatest quantity today are mainly derived from corn, mainly because of extract

of a lower cost, availability and other advantages regarding beer properties as well as increased production capabilities. The quality of brewer's grits is defined by individual brewing industry specifications that require uniform and certain quality in the terms of moisture and fat content, extract and particle size. The fat content of the grits product is affected by the degree of degermination during the dry milling procedure and it is extremely important to the dry millers for monitoring of milling procedure as well as to the brewers at the receiving stage of raw materials. The common requirement for fat content of brewer's grits is less than 1%. The reference fat content determination is time-consuming, expensive, hazardous and requires considerable amounts of laboratory space, capital equipment and technical expertise. The present study was conducted to investigate the potential of NIR spectroscopy for the analysis of fat content in brewer's grits. Commercial corn grits samples (n = 50) were derived from the corn dry-milling industry in Serbia. Samples were characterized with different particle size and fat content from 0.5% to 2.0%. The reference method for each sample was carried out in five replicates. A scanning monochromator Infratec 1241 grain analyzer (Foss Analytical) with application model for corn grits developed by Foss was used for NIRS measuring performed in five replicates. The statistics of the most interest were the following: laboratory standard error (SEL), standard error of performance, coefficient of determination (R^2) and linear correlation coefficient (r^2) between reference method and estimated values by prediction model.

P-112

Formulation and evaluation of wheat protein-based beverages. M. H. ABUGHOUSH (1). (1) Hashemite University, Zarqa, Jordan.

The wheat industry has done little to promote the use of wheat protein in beverages. Wheat protein can be an alternative and can compete with other proteins in beverage production as a replacer for casein and soy proteins due to its functional and dietary benefits. The objective of this research was to study the rheological properties and physical attributes of wheat protein and iota carrageenan complex base beverages under controlled conditions (pH, concentrations, and temperatures). Soluble wheat protein (4%, Midsol WPI 2100 from Midwest Grain, Inc.) was added to iota carrageenan gum at two different concentrations 0.5% and 0.05%, pH 3.5 and 6.5, and 3 temperatures (5, 20, and 50°C). The viscosity and elasticity of the complex were determined at a frequency of 0.5 Hz within a shear rate range of 0.1 to 100 s-1. All the measurements showed that the viscosity decreased with increasing temperature (1.3 E-3 at 5°C to 4.7 E-4 Pa.s at 50°C). The viscosity and elasticity of wheat protein-carrageenan combinations were affected by changing concentrations. When the concentration increased from 0.05%–0.5%, the viscosity and elasticity increased by 15%, and 60%, respectively. These results will help producers in formulating products that rely on wheat-gum combinations for viscosity and mouthfeel.

P-113

Impact of different tank outlets at fermenter tanks on the product quality. K. BOEE (1). (1) Tuchenhagen Brewery Systems GmbH, Büchen, Germany.

Horizontal tank outlet pipes at CCTs do not only generate particular problems for the product quality of fermented products, but also induce process technological challenges on the microbiological situation after tank cleaning. 1) As horizontal pipes are in the majority of cases neither insulated nor temperature-controlled, an undefined fermentation process takes place. 2) The content in the horizontal pipe does not take part in the mass transfer process with the content of the CCT, because the pressure applied is at maximum. Yeast cells trapped in this area tend to autolyse with the excretion of amino acids, short chain fatty acids and proteinase A, which are not wanted in the final product. Excretion of these substances results in limited foam stability and off flavor.

P-114

IntelliTank Matrix™ – The new innovative piping system for brewing vessels. J. M. JORDAN (1). (1) Sudmo North America, Rockford, IL, USA.

Matrix piping arrangements have been used successfully in breweries for more than 20 years. Breweries have benefited by achieving safety of product and personnel as well as through reduced operating costs. To meet the higher demands for an even faster ROI, shorter processing time, and quicker CIP cycles, the IntelliTank Matrix™ system has been introduced by Sudmo. IntelliTank Matrix™ is a valve system that connects directly to the bottom of a brewing vessel and eliminates the long lines between vessels and manifolds in traditional mix proof valve systems. The system is totally pocket free and reduces the pipe work considerably. It also eliminates the cleaning problems related to traditional systems. The system is quick to install, very compact, and reduces capital and operating costs considerably. Design and benefits of this system, as well as a cost comparison with traditional systems, will be detailed.

P-115

Malting quality of barley varieties and lines produced in Golestan Province of Iran. Y. MAGHSOUDLOU (2), S. Hosseini (2), M. Kashaninejad (2), A. Ghodsevali (1). (1) Agricultural Research Center, Jihad-e-Agriculture Organization, Gorgan, Iran; (2) Department of Food Science and Technology, University of Agriculture, Gorgan, Iran.

Barley (*Hordeum vulgare*) is one of the strategic crop products produced (~three million tons in Iran), out of which over 100,000 tons are produced in Golestan Province. Since barley consists of alpha- and beta-amylase, fermentable sugars, dextrin and vitamins, it is used mainly in the food industry as a raw material for malt production. This investigation was carried out to study the malting quality of Sahra, Dasht and Jonoub varieties and EBYT.79.10, EBYT.79.12 and EBYT.79.19 lines of barley produced in Golestan Province of Iran. Malting process and several attributes of the produced malts and worts were studied. Completely randomized design following the analysis of variance (ANOVA) method was used. After analysis, the significant means were compared using Duncan test at 5% level. Also a linear regression procedure was performed to find out the best relationship between effective parameters. The

results showed that the effects of treatments were significant on different attributes except germination capacity, diastatic power, maltose, and total soluble nitrogen. Regression equations showed the significant relationship between barley protein and warm water extract, total soluble nitrogen and diastatic power, cold and warm water extract and maltose, warm water extract and produced wort Brix and color. Based on the results of this investigation, lines and varieties with lower protein are more suitable for malt beverage industries. Among the different varieties and lines studied, EBYT.79.10 showed the highest extract yield, followed by sahra and EBYT.79.12. and thus are more appropriate for production of non alcoholic beverage. Malts produced from other varieties, especially Dasht, were found suitable as an enzymatic source, color and flavor for bakery and confectionery industries.

P-116

Novel online sensor for measuring dissolved CO_2 using attenuated total reflectance (ATR) technology. R. O'Leary (1), J. C. Fitzgerald (1), P. J. SLIER (1). (1) Thermo Electron Corporation.

Traditional methods for measuring carbon dioxide both in the laboratory and online are based on Henry's Law and use pressure and temperature to calculate the dissolved CO_2 concentration. These methods are not specific to carbon dioxide and measure all gases including oxygen and nitrogen. A novel sensor has been developed which measures only CO_2 and is suitable for online applications. Based on Infrared spectroscopy, the sensor uses the attenuated total reflectance sampling technique to continuously analyze the beverage in flow and no flow applications. The sensor is compact and fits directly into the process. The operation and design of the sensor will be presented. The performance of the ATR-based sensor will be compared with traditional temperature-pressure based devices. The ATR-based sensor provides improved measurement accuracy which is not dependent on beer type, density or alcohol content, is not affected by pressure surges and can operate during CIP cycles.

P-117

Nutritional improvement of spent grains using solid-state fermentation. B. J. HOSKINS (1), M. P. Lyons (1). (1) Heriot-Watt University/Alltech, Inc. Nicholasville, KY, USA.

With the rapid growth of the human population and the resulting increase in demand for grain while arable land is disappearing at an alarming rate, the global community faces an enormous challenge to keep up with demand. Biotechnology offers a unique opportunity to address the challenge allowing more efficient utilization of grain. Solid-state fermentation (SSF) with filamentous fungi is an important technology for the production of enzymes, but can also be utilized to improve the nutritional quality of residues from many industries such as the spent grains from ethanol production processes. This has obvious implications for the feed industry, as these residues are often included in livestock diets as farmers continue to look for ways of meeting the nutritional requirements of their livestock more efficiently. Spent grains from a brewery, whisky distillery and a fuel ethanol plant were upgraded nutritionally by the use of SSF. Three solid-state fermentations using two organisms were performed to evaluate the changes in the nutritional characteristics of dried distiller's grains with solubles (DDGS). Changes in dry matter (DM) mass, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), ash, and fat content were determined. The results indicated that DDGS is a viable substrate for solid-state fermentation and that the changes in the nutrient profiles of these materials would be beneficial to livestock, particularly with respect to crude protein content.

P-118

Potential prebiotic arabinoxylo-oligosaccharides from rye. H. RANTANEN (1), P. Tuomainen (1), J. Arpiainen (1), L. Virkki (1), M. Tenkanen (1). (1) University of Helsinki, Helsinki, Finland.

Arabinoxylans are the most abundant hemicelluloses in cereals. They are potential raw materials for physiologically beneficial oligosaccharides. Arabinoxylo-oligosaccharides (AXOS) are reported to have prebiotic properties which means that AXOS are utilized by health promoting bacteria (lactobacilli and bifidobacteria) in the large intestine. In the fermentation these probiotic bacteria produce acetate and lactate which causes pH to decrease and inhibits the growth of potentially pathogenic microorganisms. Also short chain fatty acids (SCFA), which protect against colon cancer, are produced in the fermentation. The backbone of arabinoxylan is constructed from 1,4-linked beta-D-xylopyranosyl units, which are usually branched at position C3 or both C2- and C3-positions with alpha-L-arabinofuranosyl units. The degree of substitution varies between grain species and even between different parts of the same plant. For example in oats whole grain arabinoxylan arabinose to xylose ratio is 1:6 while in rye it is 1:2. Arabinoxylan can be hydrolysed into arabinoxylo-oligosaccharides in a controlled way using enzymes. In this research different arabinoxylo-oligosaccharides produced by endoxylanases from rye arabinoxylan were studied. Hydrolysed sample was purified with gel permeation chromatography (GPC) using Bio-Gel P-2 material. The elution of the components was detected with thin layer chromatography (TLC) and the fractions were then analysed using high performance anion exchange chromatography with pulsed amperometric detector (HPAEC-PAD). The most chemically homogeneous fractions were studied further using mass spectrometry (MS) and nuclear magnetic resonance (NMR) techniques. The prebiotic effects of the main AXOS will be evaluated separately.

P-119

Reduction of malting loss by using specifically selected lactic acid bacteria. A. M. Soriano (1), H. M. Ulmer (2), B. D. SCHEHL (2), E. K. Arendt (2). (1) Department of Analytical Chemistry and Food Technology, University of Castilla-La Mancha, Ciudad Real, Spain; (2) Department of Food and Nutritional Sciences, National University of Ireland, University College Cork, Cork, Ireland.

The malting and brewing industry is highly dependent on the export market, therefore innovative solutions to improve the quality of malt and beer are vital to secure this position. To increase the competitiveness of the malting industry, it is essential to reduce the production costs of malt as much as possible. A significant amount of the original barley weight is lost during the malting process in form of malting loss. Malting loss is approximately 10% and 4% of this is due the removal of rootlets. The objective of this project was to use

selected lactic acid bacteria, which significantly reduce the malting loss and still retain good quality malt. During a large scale screening one strain namely *Lactobacillus plantarum* was selected, since a reduction in rootlet growth during laboratory conditions was observed. The efficacy of *Lactobacillus plantarum* was than tested in a number of pilot scale malting experiments. The anti-rootlet components producing strain was compared to a number of lactic acid bacteria, a chemical rootlet growth inhibitor (potassium bromate), a control containing lactic acid and an unacidified control. The quality of the malt was analysed using a wide range of EBC methods. The enzymatic activity of the malt was also determined. The pilot-scale malting trials revealed that the malting loss of malt treated with *Lactobacillus plantarum* was reduced by 50% in comparison to the controls. The selected *Lactobacillus plantarum* performed significantly better than the chemical rootlet inhibitor (potassium bromate) currently employed by the industry. Furthermore best filterability, distinct less rootlet growth and slightly lower viscosity was reached using the selected lactic acid bacteria strains, whereas no significant differences in colour, fermentable extract, FAN and TSN could be observed. The control showed a noticeable higher enzyme activity (alpha-/beta-amylase) in compare to all other employed treatments. The results of this project revealed that specifically selected lactic acid bacteria can significantly reduce the malting loss while still maintaining good quality malt.

P-120

The latest water deaeration methods for the brewing and beverage industry. M. PLUTSHACK (2), R. Koukol (1). (1) Centec GmbH, Frankfurt, Germany; (2) Centec LLC, Germantown, WI.

Five methods of producing deaerated water for utility use, blending and high gravity brewing within the brewing and beverage industry are examined and compared. Simple gas sparging, cold column, hot column, catalytic and membrane deaeration systems are examined and compared to determine the advantages and disadvantages in water quality for beer and beverage use. Cost associated with purchase, installation, operation, maintenance and the appropriate situations to use each method will be discussed.

P-121

The ultrastructure of barley and buckwheat during malting observed by scanning electron microscopy. H. H. Wijngaard (1), B. D. SCHEHL (1), E. K. Arendt (1). (1) Department of Food and Nutritional Sciences, National University of Ireland, University College Cork, Cork, Ireland.

Scanning and electron microscopy (SEM) is a good tool to study the microstructure in grains, since high magnifications can be achieved. Samples of buckwheat and barley were taken and observed by SEM at different stages of the malting process. In unmalted buckwheat, starch granules are located in big ridged cells, surrounded by relatively thin cell walls. Buckwheat starch granules range in size from approximately 4–7 µm. Starch granules located directly next to the cotyledons showed a looser structure than the structure observed in other areas of the buckwheat kernel. In barley, in the loosely packed endosperm the difference between small and big starch granules was more apparent than in the more compact endosperm. The small starch granules are approximately 2 to 4 µm, while the big granules range from 15 to 25 µm in size. During malting, the ultrastructure of both buckwheat and barley is degraded. SEM proved that buckwheat starch granules are attacked by both pitting and surface erosion. A concentric sphere structure was visible when buckwheat starch granules were severely broken down. In barley, small starch granules, show surface erosion and nopitting like big barley starch granules. Barley starch is mostly attacked near the equatorial groove. In barley, both big and small starch granules are degraded, which caused a loss of the closely packed arrangement. Barley starch seemed more disintegrated than buckwheat starch. In barley, the breakdown of endosperm cell walls is more evident. The presence of cell wall pieces indicated that after 2 days germination cell walls were severely attacked. In conclusion, SEM can be used as a tool in industry to couple processing characteristics to structure of grains.

P-122

Use of response surface methodology to investigate the effectiveness of commercial enzymes on buckwheat malt for brewing purposes. B. P. Nic Phiarais (1), B. D. SCHEHL (1), J. C. Oliveira (2), E. K. Arendt (1). (1) Department of Food and Nutritional Sciences, National University of Ireland, University College Cork, Cork, Ireland; (2) Department of Process and Chemical Engineering, National University of Ireland, University College Cork, Cork, Ireland.

Common buckwheat (*Fagopyrum esculentum* Moench) is becoming increasingly popular as a brewing ingredient due to the absence of gluten and the presence of positive physiological attributes. The effects on wort quality when mashing with 100% malted buckwheat in combination with industrial enzymes were evaluated due to its low level of essential endogenous enzymes. The effects of increasing dosage levels of the commercial enzymes Biocellulase W, Amylo 300, Hitempase 2X, Bioxylanase 10L, Bioferm, Bioglucanase B-10L and Bioprotease N-100L on buckwheat wort quality, were determined. Further to this, the influence of two factors, total concentration and fraction of three pairs of enzymes, which showed statistical significance (Biocellulase W with Hitempase 2XL, Biocellulase W with Amylo 300 and Amylo 300 with Hitempase 2XL), were studied for their overall effect on the buckwheat wort quality using response surface methodology (RSM). This study revealed that the addition of increasing levels of Hitempase 2XL to the buckwheat mash increased colour, extract levels, wort filtration, fermentability and total fermentable (TFE), along with decreasing viscosity values. Results also determined a high level of fermentability when an enzyme combination of 30% of Biocellulase and 70% of Hitempase was added to the mash. The addition of increasing levels of Amylo 300 to buckwheat mashes resulted in increases in fermentability and total fermentable extract (TFE), along with increases in total soluble nitrogen (TSN), free amino nitrogen (FAN) and Kolbach index (KI). With regard to the proposed optima regime, although no synergistic effect was found when all three enzymes were used together, the optimum conditions for the production of buckwheat wort with lowest viscosity, highest extract and optimal fermentability was achieved using a joint model. This model can be used to predict any outcome when using these enzymes as the results found are very accurate and can be relied upon. Overall, the findings of this study demonstrate the feasibility of producing wort suitable for the brewing of gluten-free beer from 100% malted

buckwheat with careful optimisation of enzyme types and dosage levels.

P-123

3D visualization and measurement of the distribution of yeast in bread dough during mixing. T. MAEDA (1). (1) Nisshin Seifun Group Inc., Saitama, Japan.

The procedure for analyzing the yeast distribution patterns during dough mixing was developed. Dough development during mixing is achieved in five stages. First is the blending stage, where ingredients are blended together. Secondly, as mixing continues, the dough enters the pick-up stage, where gluten becomes lumpy. Thirdly, if mixing is continued the dough progresses into the clean-up stage, where it becomes dryer and more elastic. Fourth is the final stage. The gluten becomes more extensible and the dough takes on a dry, satiny sheen. When dough mixing is continued beyond the optimum, dough breakdown took place. This is called the letdown stage. The objective of this research was to develop 3D fluorescent bio-imaging instruments (3DFBI) for analyzing the yeast dispersion at each dough mixing-stage. For the preparation of dough samples, the weighed EGFP-yeast, flour, and water were mixed to the desired degree. Quickly frozen dough samples were placed on the microslicer. The cross-sectional image sequence of exposed surfaces after slicing was captured directly with a CCD camera through a fluorescent microscope. A series of 300 images was processed for 3D visualization using the volume rendering techniques. The yeasts distributed in 3D space were also statically analyzed. Somewhat incomplete yeast distribution was still observed at the stage of both pick up and cleans up. At the final stage, the thoroughly and uniformly dispersed yeasts were confirmed in dough. However, additional dough mixing beyond the optimum again produced the localization of yeast distribution. These results indicated that the combined use of cell surface engineering technique, microslicer microscope system and volume rendering technique could allowed us to 3D-visualize and measure the yeast distribution in the dough.

P-124

Amperometric method: Another way to measure starch damage content. O. LE BRUN (1), A. Dubat (1). (1) Chopin Technologies, Villeneuve la Garenne, France.

Flour starch damage content is related to wheat hardness and milling process, and it is of a major importance in all wheat flour based products. It is generally agreed that a shortage of damaged starch causes low flour water absorption capacity, and on the contrary, an excess of damaged starch can cause sticky dough, and a later stage, flat underdeveloped breads with a very coloured (red) crust. The existing flour damaged starch measurement methods, for the most part enzymatic, are quite long and complicated. The amperometric method, which will be described, is a simple, effective and high-performance option for determining the starch damage content of a flour. A single test can be performed in less than 10 minutes and permits to obtain results which can be compared with different units, using other method type: UCD, AACC, Farrand ...

P-125

Biological and physicochemical characterization of wheat sourdough produced in Sonora, México, and functionality in bread dough. O. N. VALENZUELA-AMAVIZCA (1), R. L. Vidal-Quintanar (1), O. Rouzaud-Sández (1). (1) Universidad de Sonora, Hermosillo, Sonora, México.

The objective of this work was to investigate dough functionality and diversity of microorganisms communities in ancient sourdough used for traditional bread in Sonora, México. Temperature and relative humidity were parameters studied for the production of mother dough, (25°C and 23%, 37°C and 30% and ambient conditions). Cell count, pH, lactic and acetic acids productions and total titratable acidity were measured during sourdough development. Cellular morphology and biochemistry characterization were applied for the identification of microorganisms isolated from mother dough developed. The effect of sourdough addition (20, 25 and 30%) on rheological and fermentative properties was evaluated used Brabender farinograph and Chopin rheofermentometer, and compared with sponge dough (commercial yeast). Baking test was also done. Three different species of lactic acid bacteria were identified and classified as homofermentative lactobacilli. Yeast specie was isolated from sourdough produced at 37°C at 30% RH and identified as *S. cerevisiae*. The sourdough special formulation was effective to produce proper acidity for specific microbial growth. The rheological and baking quality characteristics of bread with different concentration of sourdough showed that an addition of 30% decreased dough stability, whereas the 20% increased the stability, time of maximum dough height, and CO_2 production. Sponge dough had maximum CO_2 production and volume. The best bread quality was obtained with 25% sourdough addition, it showed the highest loaf volume and lowers firmness.

P-126

Characterization of dough texture and adhesiveness in Mexican traditional bread named "Conchas" fortified with heat precipitated whey proteins. E. Diaz-Maldonado (2), S. Soto-Simental (2), M. Reyes-Santamaría (2), J. Franco (2), A. Totosaus-Sanchez (1), N. GUEMES-VERA (2). (1) Instituto Tecnologico de Estudios Superiores de Ecatepec; (2) Instituto de Ciencias Agropecuarias-UAEH, Tulancingo, Hidalgo, Mexico.

Mexico has serious nutritional problems, due low income of the population. In spite of that Mexican people consuming a variety of traditional breads, but there are disposal of animal protein like whey proteins considered an environmental problem. Thus, this research will be contribute diminish that nutritional problems. There is not information about the effects of whey heat-precipitated in dough of this kind of traditional bread. The aim of the present work was to characterize the dough texture and adhesiveness of sweet bread named "conchas" fortified with heat-precipitated whey proteins. A proximal analysis was developed. After that dough was prepared with wheat flour (WF) fortified with various levels of whey proteins (10, 15, 20, 25 and 30%). Later the rheological analyses (TPA and adhesiveness) were performed by using a TA.XT2i texture analyzer (Stable MicroSystems Ltd., Surrey, UK) in a compression mode. The chemical composition of the flour was 9.0% protein for WF and 20% protein for whey heat-precipitated. The bakery

product fortified with 15% of precipitate had 23% protein as compared to 17% in the regular product, which agreed with other results reported in the literature. The addition of 10% whey protein precipitate produced a decrease in the firmness and consistency, and an increase in the cohesiveness of the dough. Generally speaking, higher amounts of precipitate (30%) did not significantly affect the firmness, consistency or cohesiveness of the dough. The adhesiveness increased particularly in samples prepared with 25 and 30% of whey protein precipitate. The presence of whey proteins produced a decrease in the firmness and consistency of the dough and an increase in its cohesiveness, which favours the production of a high-quality product.

P-127

Comparative studies on the effects of glycolipids in breadmaking. P. Selmair (1), P. KOEHLER (1). (1) German Research Center of Food Chemistry and Hans-Dieter-Belitz-Institute for Cereal Grain Research, Garching, Germany.

Glycolipids from cereals show good rheological properties, a high baking performance, and they can act as "endogenous" emulsifiers already in very low concentrations. Therefore, it would be desirable to use them as part of emulsifiers in the production of bread. However, up to date there is no information on how glycolipids perform as flour improvers and how the chemical structure of glycolipids affects their techno-functional properties. Therefore, the potential of glycolipids from different sources (cereals, crude and defatted commercial lecithins) in breadmaking was studied in comparison to classical emulsifiers like DATEM, monoacylglycerols and two synthetic glycolipids. In the first part of the study monogalactosyl dilinoleylglycerol (MGDG) and the corresponding lyso compound monogalactosyl monolinoleylglycerol (MGMG) were synthesized as reference compounds. A four-step synthesis was required to successfully synthesize the compounds. The same reaction pathway was used for both compounds, except the third step (esterification), which was stopped in due time providing the lyso compound. The structures of all intermediates and end products were confirmed by mass spectrometry as well as one- and two-dimensional NMR spectroscopy (1H, 13C). Furthermore, fractions rich in glycolpids were isolated from commercial lecithin samples or oat oil and their baking performance was determined by a micro-scale baking test with 10 g of flour. By comparing the baking activity with those of the reference compounds and other commercial emulsifiers, a sample work-up scheme was developed to produce samples with a very high amount of active glycolipids, which can be used in breadmaking.

P-128

Comparison of 5% lactic acid solvent retention capacity and SDS-sedimentation tests in predicting loaf volume of hard winter and spring wheat flour. Z. S. Xiao (1), S. PARK (1), M. S. Caley (1), R. Lyne (1), M. Tilley (1), B. W. Seabourn (1), O. K. Chung (1). (1) USDA-ARS Grain Marketing and Production Research Center, Manhattan, KS, USA.

The 5% lactic acid solvent retention capacity (SRC) test and SDS-sedimentation test were investigated to find their relationships to loaf volumes (LV) of hard winter wheat (HWW) and hard spring wheat (HSW) flour. A total of 196 flours, 98 HWW and 98 HSW with protein ranges of 8.2–14.2% and 10.4–17.8%, respectively, were used. The 5% lactic acid SRC value was a good indicator for LV, showing high correlations for both HWW and HSW flours (r = 0.84, respectively, $P < 0.0001$). On the other hand, SDS-sedimentation volume was highly correlated only with LV of HWW flours (r = 0.76, $P < 0.0001$), but not with HSW flour (r = 0.47, $P < 0.0001$). Even though this r value is statically significant, the r value is lower than that obtained by 5% lactic acid SRC test. In addition, the 196 samples were divided into low and high protein groups (8.2–13%, n = 135 and 13.1–17.8%, n = 61, respectively) to find how those two tests correlated to the LV of each group. We found that both 5% lactic acid SRC and SDS-sedimentation tests showed strong correlations with the LV of the low protein group (r = 0.83 and 0.78, respectively), whereas with the high protein group, only 5% lactic acid SRC test showed a high correlation (r = 0.81) and SDS-sedimentation test showed a lower correlation (r = 0.38, $P < 0.01$). Similar results were obtained when each HWW and HSW flours were divided into low and high protein groups. Wheat class had little influence on the 5% lactic acid SRC test results, whereas protein content did. The results demonstrate that 5% lactic acid SRC test is a more robust test to predict the LV of both classes of wheat flours over a broad range of protein content.

P-129

Comparison of gluten proteins profile from a hard red spring wheat cultivar grown under optimum and water stressed conditions. F. AL JORF (1), P. Rayas-Duarte (1). (1) FAPC.

It is well reported that 50% or more of the variation on protein and its effect on baking properties of wheat is accounted by the environment. A systematic approach to the comparison of the gluten protein profiles of Triticum aestivum cv Butte 86 grown under optimum and 30% water stressed conditions is reported. Both plant treatments received adequate nitrogen fertilization. Enriched fractions of gliadin, low molecular weight- and high molecular weight-glutenin subunits (LMW-GS and HMW-GS) of the mature wheat were differentially extracted with solvents. Subfractions were obtained by reverse phase-high performance liquid chromatography (RP-HPLC), protein profiles by capillary electrophoresis (CE), SDS-PAGE, 2-dimensional electrophoresis and identification of proteins by peptide mass fingerprinting. Protein profiles from RP-HPLC and SDS-PAGE appear to be similar but the absolute amounts of polypeptides were different in the optimum and water stressed extracts, specifically of the HMW-GS fraction. Differences in the HMW-GS profile obtained from CE and 2-D electrophoresis will be discussed.

P-130

Component migration barriers in model sandwich systems. A. H. BARRETT (1), K. R. Conca (1), U. Sajjad (1), D. Anick (1). (1) US Army Natick Soldier Center, Natick, MA, USA.

Edible barriers can minimize moisture and lipid transfer in shelf-stable sandwiches. Corn zein and Na-caseinate films were tested in model bread-cheese composites, evaluated for H_2O transfer weekly for 4 weeks. Three film thicknesses and plasticizers (glycerol, stearic acid, oleic acid, Durkex) were tested. Moisture transfer was assessed gravimetrically. All zein films reduced moisture migration ($P < .05$), and barrier

properties increased with film thickness and some plasticizers. Na-Cas films inhibited moisture transfer to a lesser extent, with no effect of thickness. A test procedure was developed to measure lipid permeability of cornstarch-cellulose, zein and Na-Cas films. Pheophytin was extracted from olive oil and measured by right angle fluorescence at 409 nm and emission from 650–700 nm. Solvent extraction systems, paper oil receptor, sensitivity of fluorescence measurements, and compatibility with food model components were tested. Order of effectiveness to reduce lipid migration was starch-cell>caseinate>zein. 0.2% stearic acid added to Na-Cas and zein significantly increased effectiveness. Other plasticizers and film alone were not as effective.

P-131

Determination of glutathione and glutathione disulfide in wheat flour, fresh and frozen dough by capillary electrophoresis. L. FUNCK (1), P. Rayas-Duarte (2), C. Escober (2), A. De Francisco (1). (1) CERES, UFSC, Florianópolis, SC, Brazil; (2) FAPC, Oklahoma State University, Stillwater, OK.

Methods for capillary zone electrophoresis (CZE) using ultraviolet detection (UV) were developed for quick and sensitive separation of glutathione (GSH) and glutathione disulfide (GSSG) in wheat flour, fresh and frozen doughs. The flour sample was characterized by physico-chemical, microscopic and rheological (gluten strength) analysis. The extracts were diluted, centrifuged, ultra filtrated (Microcon, cut-off 3000 kDa), freeze dried and reconstituted in 20 mM bicarbonate buffer (pH 6.0). The analysis were done in a Beckman P/ACE MDQ system equipped with UV detector at 200 nm. The minimum quantification limits were 5 and 15 µM for GSSG and GSH respectively. The method showed good linear correlation and the correlation coefficients (r) were 0.9977 for GSH and 0.9994 for GSSG ($P < 0.005$). Glutathione and glutathione disulfide concentrations in flour samples were 21.87 and 26.90 nmol/g flour respectively. Only GSSG was found in dough samples, equivalent to 10.60 e 9.09 nmol/g fresh and frozen dough respectively and without significant differences among them. GSSG levels were higher in fresh and frozen doughs than in flour, probably because GSH oxidation during mixing and freezing. The new method showed easy extract preparation of the samples, short migration time of analytes (2–3 min.), high analytical performance (it's specified to detect GSH and GSSG and has good linearity, repeatability and reproducibility).

P-132

Determination of low levels of beta glucanase in wheat by monitoring molecular weight of beta glucan. M. ROUDSARI (2), Y. Brummer (1), S. Tosh (1), P. Wood (1). (1) Agriculture and Agri-Food Canada, Guelph, ON, Canada; (2) University of Guelph, Department of Food Science, Guelph, ON, Canada.

Molecular weight (MW) and viscosity are important for functionality and physiological efficacy of beta-glucan and therefore minimizing or eliminating beta glucanase activity in food preparation is desirable. This contrasts with malting and brewing, or animal feed production, where degradation of beta-glucan is required. Although depolymerisation of beta-glucan is known in oat or barley breads, there is little known about the basis for this. The putative enzyme activity is weak and is not readily evaluated by extraction methods such as used for malt. With development of food products, especially baked goods, with maximum bioactivity in mind, an assay of such low levels of beta glucanase was needed. High performance size exclusion chromatography with Calcofluor detection determines MW distribution of beta glucan at concentrations well below those required for monitoring viscosity, allowing an assay with a favourable improvement in substrate enzyme ratio. A known weight of flour, or ingredient, was added to a solution of beta-glucan and the enzyme activity determined from the rate of change of the reciprocal of MW. Extent of depolymerisation was related to amount of sample and concentration of substrate. Both wheat flour and vital gluten contained depolymerising activity which was removed by heat treatment, confirming that enzymes are responsible for the depolymerisation. Incorporation of the wheat gluten into an oat bran bread resulted in a change in MW of beta glucan from about 2.2 million to 140,000 g/mole. Different flour ingredients for bread making and other foods and beverages may therefore be evaluated for beta glucanase activity and strategies for modifying this activity developed accordingly.

P-133

Development of an indirect ELISA for quantification of TAXI and XIP type xylanase inhibitors in cereals. J. BEAUGRAND (1), K. Gebruers (1), C. Ververken (2), B. Goddeeris (2), C. M. Courtin (1), J. A. Delcour (1). (1) KULeuven, Laboratory of Food Chemistry, Leuven, Belgium; (2) KULeuven, Laboratory of Livestock Physiology, Immunology and Genetics, Leuven, Belgium.

Proteinaceous xylanase inhibitors in cereals are of high technological relevance, as they inhibit the majority of microbial xylanases often used in cereal based biotechnological processes. They are equally believed to be involved in the defense mechanism of wheat. An important challenge is the separate and accurate quantification of the three known types of cereal xylanase inhibitors. Here we report on the development of an indirect sandwich enzyme-linked immunosorbent assay (ELISA) for TAXI (*Triticum aestivum* xylanase inhibitor)- and XIP (xylanase inhibiting protein)-type xylanase inhibitor quantification. Polyclonal antibodies were raised against wheat TAXI and XIP xylanase inhibitors by rabbit immunization, and subsequently purified by affinity chromatography. The purified antibodies were then used for indirect ELISA. The sandwich format of the essay consisted of a layer of *Bacillus subtilis* and *Aspergillus oryzae* xylanases coated into the wells of a multiwell plate and able to catch the TAXI and XIP proteins, respectively, from sample extracts. The purified antibodies were then allowed to bind to captured antigen and served as a tag recognised by anti rabbit IgG labeled with horseradish peroxidase. The activity of the latter enzyme was quantified. The procedure was optimised for reproducibility and accuracy. It allows high throughput analysis and permits the routine detection and quantification of TAXI and XIP levels as low as 40 and 3 ng by ml, respectively. As the antibodies against the wheat xylanase inhibitors cross-reacted with their homologous targets from other cereals, the technique could also be used for quantification of these proteins.

P-134

Effect of adding different dietary fiber sources on crumb moisture profile of bread during storage. E. L. Almeida (1), Y. K. Chang (1), C. J. STEEL (1). (1) UNICAMP, Campinas, SP, Brazil.

Bread staling is characterized by many physical and chemical phenomena such as changes in texture, water migration, starch crystallization, and component interactions. Many studies have showed the effect of dietary fiber in retarding these phenomena and increasing the sensorial shelf-life of bread. The objective of this work was to study the crumb moisture profile of bread produced with different dietary fiber sources during storage. A central composite rotational design (CCRD) was used with the different sources of dietary fiber being the independent variables: wheat bran (0–20%), resistant starch (0–20%) and locust bean gum (LBG) (0–3%). Results were analyzed using the Response Surface Methodology (RSM). The dependent variables were the crumb moisture contents of breads after one, four and seven days from baking. Moisture content was determined according to AACC Method 44-10. The results showed that there was a reduction of moisture during storage, as expected. The values after one, four and seven days varied between 41.98% and 45.78%, 33.92% and 41.29%, and 31.63% and 38.71%, respectively. The factors that had an influence on crumb moisture after one day from baking (wheat bran and LBG) were the same that had an influence on crumb moisture after four and seven days. The highest moisture contents could be observed when the content of wheat bran was above 16% and the content of LBG was above 2.4%, being the content of resistant starch fixed at 10%. Moisture content is related to the freshness of bread and this study showed how some fiber sources have a greater influence on this parameter than others.

P-135

Effect of addition of L-cysteine on the dynamic rheological properties of gluten proteins. J. RAGUZZONI (2), P. M. Barreto (2), P. Rayas-Duarte (1), A. De Francisco (2). (1) FAPC, Oklahoma State University, OK; (2) UFSC, Florianópolis, Brazil.

The storage wheat proteins (gliadins and glutenins) are responsible for the functional properties of dough. The disulphide bonds play a role in structure development, gluten properties and are formed between sulphydryl groups of cysteine residues. The aim of this study was to analyze the effects of addition of L-cysteine 100, 200, 250 ppm, in the commercial samples Gliadin and Arise 8000 (gliadin, HMW and LMW) through dynamic rheology under oscillatory shearing using water as control. All measurements were obtained at 25°C. Three determinations were made for each L-cysteine concentration. A TA Instruments Rheometer with parallel plates was used. The gap was adjusted to 2.5 mm with a frequency sweep from 1 to 100 Hz. The samples were allowed to relax for 1h. Gliadin results showed that the viscous modulus (G″) was higher than elastic modulus (G′) indicating viscous characteristics. The addition of L-cysteine 100 e 250 ppm did not have any significant difference compared to the water control. All samples were frequency-dependent (increased with increasing frequency). Lower values corresponded to the 200 ppm sample. Arise 8000 showed elastic modulus (G′) higher than viscous modulus (G″) indicating the elastic characteristics of sample. Again, all samples showed frequency-dependence. Higher values were obtained for the 100 ppm L-cysteine. When compared, Gliadin was more frequency-dependent than Arise 8000. These results are important in getting to know the rheological behaviour of gluten components as affected by L-cysteine.

P-136

Effect of protein composition of wheat flour mill streams on dough rheological properties and bread crumb characteristics. Y. WANG (1), G. Hareland (2), K. Khan (1), G. Nygard (1). (1) Department of Cereal and Food Sciences, North Dakota State University, Fargo, ND; (2) USDA-ARS, Hard Red Spring and Durum Wheat Quality Laboratory, Fargo, ND.

Flour mill streams, obtained from three samples of Nekota, a hard red winter wheat, were used in this study. The objective was to assess the contribution of protein composition on dough rheological properties and bread crumb characteristics of bread made from the mill streams. Flour proteins were fractionated into gliadin, albumin+globulin, HMW-GS, LMW-GS and residue protein. Farinograph absorption was used to measure dough rheological properties. The internal bread crumb characteristics were measured using the C-CELL imaging system. The results showed that the quantity and distribution of protein fractions in break and reduction streams were different. The quantities of total flour protein, gliadin, albumin+globulin, HMW-GS and LMW-GS were greater in break than in reduction flour streams. For break and reduction flour mill streams, gliadin and residue protein were positively and significantly correlated with flour total protein. Albumin+globulin, HMW-GS and LMW-GS were positively and significantly correlated with break flour total protein, but negatively correlated with reduction flour total protein. The results of other correlations (between farinograph absorption, bread slice area, number of cells, slice brightness and protein fractions) also showed opposite results for break streams compared to reduction streams. Gliadin content in total protein was positively and significantly associated with farinograph absorption. HMW-GS and LMW-GS content in total protein were positively and significantly associated with slice area, number of cells and slice brightness. These results suggest that the quantities and distributions of protein fractions in the various mill streams make different contributions to dough rheological properties and internal bread characteristics.

P-137

Evaluation of corn masa stickiness. R. YGLESIAS (1), D. S. Jackson (1). (1) Department of Food Science & Technology, University of Nebraska, Lincoln, NE, USA.

Stickiness is a physical attribute greatly impacted by masa moisture content, starch degree of cook and protein alterations. To better understand stickiness in corn masa, white corn (1851W, 2000 crop year) was cooked at 100°C for 20, 30 and 40 minutes using a laboratory nixtamalization method, and ground using a small scale stone grinder. Stickiness was measured over time for 2 hours using a TA-XT2i texture analyzer in Adhesiveness Test mode. Masa moisture contents and temperatures were also determined over time. Temperatures of ground masa significantly ($P < 0.05$) increased as the time of cooking increased. Stickiness of masa cooked for 20 minutes was significantly lower ($P < 0.05$) than

stickiness of masa cooked for 30 or 40 minutes. Changes in masa stickiness significantly ($P < 0.05$) decreased over time for masa samples cooked for 20 minutes and maintained steady for masa samples cooked for 30 or 40 minutes. Masa stickiness for undercooked corn (20 minutes cooking time) significantly decreased with moisture loss, where for cooked and overcooked corn (30 and 40 minutes cooking time) moisture loss was not the primary variable influencing stickiness properties. This suggests that masa stickiness is a phenomena caused by multiple factors.

P-138

High density measurement of environmental conditions during the growing season and its value for predicting wheat breadmaking quality. H. D. Sapirstein (1), G. J. FINLAY (1), P. R. Bullock (1). (1) University of Manitoba, Winnipeg, MB, Canada.

Wheat grain properties and flour and dough quality for breadmaking are strongly influenced by the effects of growing season weather. Apart from acute weather events that can degrade wheat quality due to such things as heat and frost damage and pre-harvest sprouting, understanding the relationships between specific weather parameters during the growing season and harvested wheat quality is quite limited. To date, six commercial wheat cultivars have been grown in five locations across the Canadian prairies over two years. Intensive weather data (air temperature, precipitation, relative humidity, wind speed, solar radiation, soil temperature and moisture) was instrumentally collected at hourly intervals from planting to harvest at each location, and used to calculate accumulated heat stress, useful heat, moisture stress, etc. for numerous crop development stages. The technological quality of the wheat for breadmaking was characterized and numerous biochemical determinants of quality were quantified. Quality variation due to the environment was generally much higher than that due to genotype. Many important wheat quality parameters such as protein content, farinograph absorption, stability, etc. could be very well forecasted between two to four weeks prior to harvest using multivariate models incorporating up to three environmental variables. Methodology used in this study appears very suitable to improve wheat sourcing and logistic planning activities, and strategic grain marketing.

P-139

Measuring technique of bubble size distributions in dough. G. DO (1). (1) College of Bioresource Sciences, Nihon University, Kanagawa, Japan.

A novel technique to recognize bubbles in bread dough and analyze their size distribution was developed by using a micro-slicer image processing system (MSIPS). Samples were taken from the final stage of the mixing process of bread dough which generally consists of four distinctive stages. Also, to investigate the effect of freeze preservation on the size distribution of bubbles, comparisons were made between fresh dough and the dough that had been freeze preserved at ˆ30°C for three months. Bubbles in the dough samples were identified in the images of MSIPS as dark gray area and defocusing spots due to the difference in focal distance created by vacant spaces. In case of the fresh dough, a total of 2,136 bubbles were recognized and their maximum diameter ranged from 0.4 to 216.2 μm with an average of 36.8 μm. On the other hand, a total of 6,348 bubbles were recognized from the freeze- preserved sample, and the maximum diameter ranged from 0.9 to 117.6 μm with an average of 12.6 μm. Small bubbles with maximum diameters less than 30 μm comprised approximately 57% and 94% of total bubbles for fresh and freeze-preserved dough samples, respectively. The results indicated that the bubble size of frozen dough is smaller than that of unfrozen one. The proposed method can provide a novel tool to investigate the effects of mixing and preservation treatments on the size, morphology and distribution of bubbles in bread dough.

P-140

Mixolab as a tool to investigate the effects of milled flaxseed on rheological properties of dough. M. C. TULBEK (2), C. Hall (1). (1) Department of Cereal Science, NDSU, Fargo, ND, USA; (2) Northern Crops Institute, Fargo, ND, USA.

Flaxseed use in foods has increased due to the presence of functional compounds such as alpha-linolenic acid, lignans and fiber. Mixolab is a quality control device which is used to determine the effects of various ingredients on rheological and gelatinization properties of flour and semolina. The objective of this study is to determine the effects of milled flaxseed on dough properties. Fine (600 micron) and granular (850 micron) milled flaxseed fractions were used. Flaxseed was mixed at 5, 10, 15 and 20% (flour weight basis) with flour and semolina, and physical properties were determined with mixolab. Samples were held at 30, 45 and 60°C bowl temperatures and showed significant differences ($P < 0.05$) in terms of flaxseed fortification. Flaxseed addition at 20% showed the lowest stability, C1 and C2 scores, whereas 5 and 10% additions showed similar results lower than control. Fine flaxseed addition gave superior results compared to granular flaxseed, with higher hydration scores. High temperature (45–60°C) mixing decreased C1 and C2 scores of all samples compared to 30°C tests. Gelatinization properties varied, however increase in flaxseed concentration significantly decreased ($P < 0.05$) final torque scores (C5). Fine flaxseed fortification gave higher C5 scores, compared to granular flaxseed. Gelatinization properties were significantly ($P < 0.05$) affected by higher bowl temperatures, which showed higher final torque scores (C5) for all fortification levels. The results indicated high variability in terms of flaxseed particle size and concentration, which showed us that mixolab could be used to determine the effects of non-traditional ingredients in bread and pasta making.

P-141

Mixolab versus farinograph. O. LE BRUN (1), A. Dubat (1). (1) Chopin Technologies, Villeneuve la Garenne, France.

Mixolab is a polyvalent dough mixer which is used to determine the rheological and gelatinization properties of flours. Its ability to work with variable kneading stresses and temperature conditions enables the study of many different types of flours, as well as the effect of many different additives. The objective of this study is to establish a relation between mixolab and farinograph values, concerning four parameters : water absorption capacity, development time, stability and softening. Thirty different flours, collected around the world, are analysed simultaneously on farinograph (standard protocol) and on mixolab (simulator protocol). The statistical

analysis by multi-linear regression of obtained results allows to build an efficient predictive model for each parameter : for example, the correlation coefficients (r^2) for water absorption capacity and development time are greater than 0.90. To finish, 19 BIPEA flour samples (French inter-comparison circuit) are used to validate the models. The obtained results show there are no significant differences between obtained values and reference values in most cases (95% of tests reach their target). This study proves that simulator protocol permits to obtain data that are comparable (values and units) to farinograph.

P-142

Modification of the SDS-soluble protein conformation during mixing with mixograph. O. Surel (1), F. VIOLLEAU (1), D. Kleiber (1). (1) Ecole Supérieure d'Agriculture de Purpan, Toulouse, France.

A study of kneading with 10 g mixograph has been performed. Doughs at different mixing and resting time have been compared in regard to SDS soluble (Fs) and insoluble fraction (Fi). The molecular mass and giration radius of the Fs fraction has been determined thanks to SE-HPLC fitted with multiangular light scattering detector. A kinetic of the modification of the above fractions has been realized from 2 to 20 minutes. A decrease of the quantity of the Fi fraction (from 3 to 0.6% of the total protein of the flour) and a concomitant increase of the Fs fraction has been observed (from 6.75 up to 8% of the total protein content in the flour). In the soluble fraction, an initial increase of the polymeric fraction was noticeable during the initial stages of mixing. The analysis of the molecular mass of the aggregates in the Fs fraction was quite similar from one time to another and increased slowly during mixing. On the contrary giration radii exhibited a very particular phenomenon since radii of protein solubilised by SDS increase up to 75 nm at 8 minutes and decreased when the mixing time was higher. This latter result suggested that overmixing has been reached with this mixer. This latter result is confirmed by the analysis of the protein conformation thanks to the MALLS data.

P-143

Oscillatory water sorption test for determining water uptake behaviour in bread crust. N. H. VAN NIEUWENHUIJZEN (3), H. Tromp (2), R. J. Hamer (1), T. Van Vliet (3). (1) Wageningen Center for Food Science; (2) Wageningen Center for Food Science, Nizo Food Research; (3) Wageningen Center for Food Science, Wageningen UR.

Crust crispiness is an important driver of consumer appreciation for baked goods. Loss of crispiness is a relevant problem, poorly understood on a molecular level. This requires detailed knowledge of the behaviour of water. Unfortunately, interpretation in kinetic terms of results obtained by current sorption tests requires knowledge of the shape and surface area of the sample. We present a new sorption method where water uptake and the amount of exchanging water are followed while the relative air humidity (RH) oscillates between two set values. The obtained curves are analysed using a Langmuir-type adsorption model. Factors studied were the rate limiting step for water uptake, the effect of crust particle size on the Langmuir sorption parameters and the use of the Langmuir equation for the calculation of the number of sorption sites ($deltam_{max}$). Different crust components were considered. Both the Langmuir sorption parameters and $deltam_{max}$ were found to depend on the crust particle size. Results showed no significant difference between oscillation times of 28 and 48 minutes. Based on these results we conclude that the water uptake kinetics over these times is dominated by one process. Likely this is water diffusion into the particles. Surface adsorption (wetting) will proceed faster while effects due to structural reorganisation of the solid crust matrix will take hours to days. The maximum RH level at which the test can be used is around 60%. At higher RH, large structural changes of the material occur. With this constraint, our test allows a quantitative and physically sound analysis of water uptake behaviour, without prior knowledge of shape and surface area of the sample.

P-144

Predicting breadmaking quality from kernel, flour, and dough properties. F. E. DOWELL (2), R. O. Pierce (3), E. B. Maghirang (2), O. Chung (2), F. Xie (1), G. L. Lookhart (1), S. R. Bean (2), M. Caley (2), J. D. Wilson (2), B. W. Seabourn (2), M. S. Ram (2), S. Park (2). (1) KSU; (2) USDA ARS GMPRC; (3) USDA GIPSA.

We conducted research to identify grain, flour, and dough properties that could be combined into equations to predict breadmaking quality of hard red winter (HRW) and hard red spring (HRS) wheat. We measured about 50 characteristics of 100 HRS and 100 HRW wheat samples that were then combined into prediction equations to predict bake water absorption (WA), bake mix time (MT), crumb grain, loaf volume (LV), and LV potential. HRS LV was predicted with R^2 = 0.91 when using flour protein content (PC), gluten index, flour particle size, the ratio of gliadins to total glutenins, mixograph mix time, and mixograph tolerance. HRW LV was predicted with R^2 = 0.91 with grain PC, farinograph stability and absorption, flour particle size, test weight, thousand kernel weight, and falling number. HRW WA was predicted with R^2 = 0.75 when including mixograph, farinograph, and alveograph measurements, and non-polar or polar lipids. HRS WA could be predicted with R^2 = 0.87 when including PC, PPO, moisture content, polar and free lipids, gluten index, and farinograph absorption and stability. HRS MT was predicted with R^2 = 0.93 when using mixograph mix time, farinograph quality number, free lipids, gluten index, and single kernel moisture content and hardness. HRW MT was predicted with R^2 = 0.82 when using mixograph mix time, PC, glutenins, farinograph stability, gluten index, kernel size, and flour brightness. Other properties could be included in all equations to give similar prediction accuracy and will be reported in the poster. Neither LV potential nor crumb grain was predicted well by any model. These prediction equations will help identify what variables need to be included in equations to predict end-use quality.

P-145

Role of starch and protein in wheat flour tortilla staling. J. ALVIOLA (1), R. D. Waniska (1). (1) Soil and Crop Science Department, Texas A&M University, College Station, TX, USA.

The involvement of starch and protein in the staling process of wheat flour tortillas was studied. Control tortillas were compared with amylase-treated (100 ppm) tortillas, then with tortillas with protease (40 ppm) and vital wheat gluten (0.5–5.0%). Samples were taken at 0.04, 1, 3, 7, 14 and 21 days after baking, and evaluated for physical properties

and shelf-stability. Amylase-treated tortilla was analyzed for amylopectin crystallinity, and protease-treated tortilla for a protein profile using PAGE. Amylase-treated tortillas were shelf-stable (i.e., did not break when rolled) for 21 days while the control tortillas were breaking after 14 days. Up to 35% of the starch was hydrolyzed to oligosaccharides and sugars in amylase-treated tortillas. Amylopectin crystallinity was not significantly different between control and enzyme-treated tortillas after 14 days, which means that amorphous starch is involved in firming and staling of flour tortillas. Tortillas with protease had larger diameter (191 vs 171 mm for control) and broke when rolled after one day of storage. In contrast, the tortillas with 3–5% vital wheat gluten were flexible after 21 days. Hence, proteins contribute to the initial structure of the tortilla and contribute to flexibility during storage. PAGE results were inconclusive. Proteins and starch structures in baked tortillas contribute to textural changes during storage.

P-146

Supplementation of whole-wheat bread with mushroom powder. M. COREY (1), R. Beelman (1), K. Seetharaman (1). (1) Penn State University, State College, PA, USA.

The objective of this study was to develop new value-added uses for off-grade and/or over-mature mushrooms as a functional ingredient in foods. White whole-wheat flour breads were baked in a bread machine using a standard formulation. Breads were also made by substituting the flour with Portabella mushroom powders at 0, 5, 10 or 20% (w/w) levels. The products were evaluated up to 7 days of storage for moisture content, crust and crumb color, loaf volume, firmness, and starch retrogradation. Breads made with up to 10% mushroom powder exhibited a pleasant aroma and were generally acceptable, while those made with 20% substitution were not appealing from a sensory stand point. Bread moisture content remained unchanged at 43% following 7 days of storage. L* decreased for both crust and crumb with increasing mushroom powder substitution. The loaf size decreased with increasing levels of mushroom substation with up to 50% reduction at 20% substitution. Bread firmness increased with increasing levels of mushroom powder. However, the change in firmness following storage was minimal in mushroom substituted breads compared to control breads. Amylopectin recrystallization in the control bread was very low (<1.0 J/g) following 7 days of storage, likely because of the higher moisture content in these breads compared to traditionally baked breads. Breads with mushroom powder exhibited little or no amylopectin recrystallization following 7 days of storage. The use of mushroom powders in baked products appears to have both a functional and nutritional benefit and can be used for developing new products.

P-147

The use of selected lactic acid bacteria to improve the baking and rheological quality of gluten-free batter and bread. L. A. Ryan (1), F. Dal Bello (1), S. RENZETTI (1), E. K. Arendt (1). (1) Food Technology, Food and Nutritional Sciences Department, UCC, Cork, Ireland.

In recent years the demand for gluten-free (GF) cereal products has increased, due to the fact that it is estimated that 1 in 100 people worldwide is suffering from celiac disease. The only treatment for this condition involves a GF diet that avoids ingestion of gluten-containing cereals and their products. GF products are generally considered of poor quality, especially when compared to their gluten-containing counterparts. The aim of this study was to improve the quality of GF bread by addition of sourdough. GF sourdough (dough yield of 200) was fermented for 24 hrs at 30°C using selected lactic acid bacteria (LAB) isolated from cereal environments. The sourdough was added at 20% of the total flour and the GF bread was baked. A variety of tests including volume, colour, moisture, digital image analysis as well as texture profile analysis were performed. Rheological tests were carried out to determine structure development during sourdough fermentation as well as after the addition of sourdough to the bread batter. The rheological tests included oscillation at varying frequencies, viscometry as well as creep analysis. The rheological development of the sourdough during fermentation was performed using a single frequency oscillation test over 12 hrs. Results indicate that addition of LAB in the form of sourdough to a GF bread recipe has a positive effect on the baking quality, particularly regarding the volume and texture. Interestingly, the rheological properties of the GF sourdough were found to be different from common wheat and rye sourdoughs, with an increase in elastic modulus being observed over the initial fermentation period. In conclusion, results collected so far indicate that the addition of sourdough fermented by selected LAB strains can positively influence the baking and rheological properties of GF bread and dough.

P-148

Ultra-fast separation of wheat glutenin subunits by reversed-phase HPLC using a superficially porous silica support column. H. A. NAEEM (1), H. D. Sapirstein (1). (1) Department of Food Science, University of Manitoba, Winnipeg, MB, Canada.

A relatively new silica support for RP-HPLC was evaluated for the separation of wheat gluten proteins. The product named "Poroshell" by the manufacturer consists of a solid core and a porous coat instead of solid silica spheres used in conventional RP-HPLC column packings. This architecture favours rapid mass transfer thus facilitating faster separation of biomolecules. The main objective of this study was to evaluate the quality of separations of glutenin subunits (GS), as well as to optimize conditions to produce the fastest possible run times without sacrificing resolution using a Poroshell 300SB-C8 12.5 × 2.1 mm column. Two different bread wheat genotypes were used for optimisation of separation conditions and six more genotypes possessing different subunit combinations were used for further evaluation. Glutenins were extracted with 0.08M Tris-HCl buffer (pH 7.5) containing 50% 1-propanol under reducing conditions after pre-extraction of soluble proteins with 50% 1-propanol. Different flow rates, acetonitrile (ACN) gradients, and column temperatures were tested. The best resolution was obtained in ~13 min using a 23–44% ACN gradient and a flow rate of 0.7 mL/min at 65°C. Quantitative results were highly repeatable even after several hundred injections. Highly satisfactory separation of HMW-GS and quantification of ratios of HMW- to LMW-GS was achieved in less than 4.5 min per sample. Results indicated the usefulness of the ultra-fast HPLC procedure to screen HMW-GS in wheat cultivar development and for rapid prediction of dough strength and baking quality.

P-149

Use of near-isogenic wheat lines to determine the glutenin and gliadin functionality in flour tortillas. S. MONDAL (2), D. B. Hays (2), R. D. Waniska (2), N. J. Alviola (2), S. Bean (3), M. Tilley (3), K. D. Glover (1). (1) Plant Science Department, South Dakota University, Brookings, SD, USA; (2) Soil and Crop Science, Texas A&M University, College Station, TX, USA; (3) USDA-ARS, Manhattan, KS, USA.

The synthesis of high molecular weight glutenin (HMW), low molecular weight glutenin (LMW) and gliadin proteins are controlled by nine major loci present in wheat chromosomes. The loci Glu A1, Glu B1, Glu D1 and Gli A1, Gli B1, Gli D1 and Gli 2 and their allelic variants play important roles in determining the functional properties of wheat flour. Our study has focused on understanding the functionality of these protein subunits with respect to tortilla quality and also to develop varieties with ideal tortilla baking quality. Near-isogenic wheat lines in which one or more of these loci are absent or deleted have been used in the study. These lines were analyzed by the using of SSR primers to verify the chromosome deletions. SDS PAGE and lab on chip capillary electrophoresis methods were done to confirm the protein composition of the deletion lines. Tortillas have been prepared from each of these lines and the quality evaluations have been performed. The analysis has revealed that elimination of certain HMW-GS results in gain of function both for tortilla diameters and overall tortilla quality.

P-150

Visualization and quantification of the three-dimensional structure of porous foods: Bread crumb, a case-study. P. M. Falcone (1), J. E. LAVERSE (1), S. Chillo (1). (1) University of Foggia, Foggia, Italy.

The aim of this work is to present a quantitative method which can be used to characterize with accuracy the inner structure of porous foods, so that relationships between microstructure and mechanical properties may be analyzed by means of directionally-dependent morphological parameters. In order to achieve this purpose, bread samples having the same moisture content but different porosity degree were scanned using Phase-Sensitive X-ray Computerized Microtomography for the non-invasive acquisition of digital images, then they were submitted to destructive compression tests to obtain the stress-strain curves. After image acquisition, numerical algorithms were used for the slice reconstruction, volume rendering and features measurement. A stereological technique provided quantitative and accurate information on spongy structure of bread in terms of porosity and some directionally dependent parameters such as cell wall number and cell wall thickness. Moreover, the preferential orientations of the spongy structure and anisotropy degree were also determined. Finally, the impact of the structural parameters on the elastic modulus of the bread crumb was also investigated through the principal component analysis (PCA). Results from statistical analysis suggest that in addition to the void volume fraction, the parameters describing anisotropy degrees and those indicating the favorite orientation of cell structure are crucial to describe crumb architecture and its mechanical behavior.

P-151

Wheat kernel associated endoxylanases consist of a majority of microbial and a minority of wheat endogenous endoxylanases. E. DORNEZ (1), I. J. Joye (1), K. Gebruers (1), J. A. Delcour (1), C. M. Courtin (1). (1) K.U. Leuven, Laboratory of Food Chemistry, Leuven, Belgium.

Endoxylanases (EXs) are enzymes which hydrolyze the backbone of cell wall arabinoxylans and which, in doing so, can have a significant impact on cereal based processes and end products. The EXs associated with wheat kernels consist of wheat endogenous EXs and kernel associated microbial EXs. As assessment of the presence of these EXs can be significantly hampered by the presence in wheat of high levels of endogenous EX inhibitors, it is likely that the importance of wheat kernel associated EXs in cereal processing and in year-to-year wheat quality variation has been persistently underestimated. To substantiate this hypothesis, an extensive washing procedure was developed which provided near quantitative separation of the microbial EXs located on the surface of wheat kernels from the endogenous EXs and EX inhibitors located in such kernels. The EX activity in the washing liquid, shown to correspond to the microbial EXs, and the washed kernels, shown to correspond to the endogenous EXs, allowed estimation of the total EX activities associated with wheat. Using the developed procedure on 3 wheat varieties, it became clear that microbial EXs can account for over 90% of the total wheat associated EX activity and that the latter can be at least 5 times higher than apparent EX activity. In addition, it became clear that the total wheat kernel associated EX activities were of the same order of magnitude as the EX activities commonly added to wheat flour in bread making. In conclusion, the results of this study indicate that wheat kernel associated EX levels are underestimated when using standard EX determination methods. A more correct EX activity determination will allow to better assess the contribution of EX to wheat quality variation.

P-152

Changes in physical and sensorial properties of cheese breads with or without the addition of pre-gelatinized cassava starch. J. R. Uclés-Santos (1), F. P. COLLARES (1). (1) State University of Campinas - UNICAMP, Department of Food Technology, Campinas, SP, Brazil.

Cheese bread is a product that can incorporate functional ingredients without altering its physical and sensorial properties. The aim of this work was to study the effects of adding sour cassava starch (0 to 100%), soy proteic isolate (0 to 10.54%) and polydextrose ((0 to 5.07%) to cheese breads, using a surface response method with three variables and five levels (-alpha, –1, 0, +1, +alpha), applied twice (with or without scalding), in their physical and sensorial properties. Initially, the functional ingredients and the pre-gelatinized cassava starch were characterized physico-chemically and morphologically. The particle size distribution of soy proteic isolate and pre-gelatinized cassava starch presented diameters of 86.72 µm and 42.53 µm, respectively, meanwhile, polydextrose didn't attain satisfactory results due to the presence of a wide range of particle sizes. The results obtained trough the experimental designs, did not present significant difference ($P \leq 0.05$) for texture, luminescence and saturation of crust and crumb, concluding that the use of any concentration studied for each variable, does not interfere in

a significant way with these properties with or without pre-gelatinized cassava starch. The cheese breads elaborated with the addition of pre-gelatinized cassava starch presented a mathematical model, explaining the behavior of the variables studied in relation to the cheese bread volume, noting that the ranges of concentration obtained through the response surfaces showed that it is possible to obtain volumes as high as 4.286 cm^3/g and 5.03 cm^3/g. For sensorial analysis six different formulations of cheese breads were evaluated by 30 panelists, who did not detect significant difference ($P \leq 0.05$) in terms of overall appearance, aroma, color of the crumb and flavor.

P-153

Consumer acceptance of tortillas made with different particle size whole barley flours. A. TOMA (1), S. Lee (1), N. Prasopsunwattana (1), S. Chongcham (1), R. A. Flores (3), E. A. Arndt (2), M. Omary (1). (1) California Polytechnic University, Pomona, CA, USA; (2) ConAgra Foods, Inc., Omaha, NE, USA; (3) University of Nebraska, Lincoln, NE, USA.

The sensory characteristics of tortillas containing different particle sizes of whole barley flour (WBF) rich in beta-glucan soluble fiber were determined. Data on ethnicity, frequency of tortilla consumption, and daily effort to include fiber in the diet were also collected. Four different tortillas containing a regular WBF at 237 microns, an intermediate WBF at 131 microns, a microground WBF at 68 microns and a control flour at 72 microns were prepared. They were compared to two commercial brands. Ninety-five untrained students, faculty and staff tested the tortillas using a 9-point hedonic scale for overall acceptability (OA). There were 30 Caucasians, 27 Hispanics, 31 Asians; 14 panelists who reported consuming tortillas at least once a day, 40 panelists who consume tortillas at least once a week, and 21 panelists who consume tortillas at least once a month; 52 panelists who make a daily effort to include fiber in their diet, and 40 panelists who do not make an effort to include fiber in their diet. Hispanics rated microground tortillas (6.4) significantly higher ($P < 0.05$) than Caucasians (5.48) but gave similar scores to Asians. People who reported consuming tortillas at least once a day rated intermediate and microground tortillas similar ($P > 0.05$) to one of the commercial brands (7.6). Panelists who reported making a daily effort to include fiber in their diet rated the control significantly higher ($P < 0.05$) than intermediate and regular tortillas but similar to microground and one of the commercial brands (6.6). Results show potential for tortillas made with intermediate and microground WBF.

P-154

Development of an innovative elemental iron powder for flour fortification. B. HU (1). (1) North American Hoganas, Inc., Hollsopple, PA, USA.

Food fortification with iron is known as the best long-term approach in preventing and/or reducing iron deficiency. Both elemental irons and iron compounds are widely used for flour fortification. Commercial practices indicate that elemental irons are superior to iron compounds in the key components such as unite iron content, stability and cost-efficiency. However, not all commercial elemental irons can be used for food fortifications. Strict requirements are applied for the iron sources. For the past few decades elemental iron manufacturers have struggled to meet the increasing market demand for capacity and purity. Traditionally, chemical reduced iron powders, the most widely used elemental iron for fortification, were produced as byproducts that were not designed specifically for food fortification. Starting in 2000, great R&D efforts have been made to directly produce a cost-effective food grade iron powder and increase capacity. With a better understanding of requirements for flour fortification, a new type of reduced iron, NutraFine, has been developed through extraordinary innovations in product/process design. Compared to currently produced reduced iron powder, the new grade iron powder has far fewer impurities (>50% reduction) and higher surface area (>15% increase). Commercial production started in early 2005 and the capacity has been significantly increased, sufficient to meet current demand and the projected future demand.

P-155

Effects of B-glucans and polyphenols components on hemato biochemistry of soy-oats feed rats. A. Montaño-Figueroa (1), Z. Duarte-Valenzuela (1), R. Canett-Romero (1), R. VIDAL-QUINTANAR (1). (1) Universidad de Sonora, Hermosillo, Sonora, México.

Male rats (Wistar) were fed for 6 weeks with a diet contenting 60–87 meq/g soy-oats polyphenols, 0.5–2% of beta-glucans from oats and 8% of fat from shortening, fish oil or olive oil. The variables responses studied were; viscosity of intestinal fluid and blood (CP40), total antioxidants (TAS 2332), erythrocytes aggregation (ACCU), blood lipid and glucose (Randox). The intestinal viscosity increased 32% with significantly decreased on blood (24.4%) depending on diet composition and feed time. Rats feed with 50% oats and fish oil showed a decreased of 25% on blood viscosity. Intestinal viscosity showed a second order model depending on soy-oats consumption and time, in addition blood lipids parameters decreased. Total blood antioxidants increased depending on diet polyphenols concentration and time of consumption. The rats feed with 50% oats showed an increased of 66% blood antioxidants. The aggregation of erythrocytes decreased as the concentration of diet polyphenols increased, these animals also significantly improved the form and separation among red cells. Combination of oat-soy diets improved viscosity and blood parameters over 42 days of consumption.

P-156

Effects of size of cellulose granule on breadmaking properties. M. SEGUCHI (1). (1) Kobe Women's University, Kobe, Japan.

Breadmaking was performed with cellulose-blended wheat flour. Cellulose granules (8 kinds) having various size (diameter) were prepared by alkali-solubilized method (Kamide et al 1992). With increase of the blend-percent of the cellulose samples from 10 to 30%, breadmaking properties such as bread height and specific volume (SV) were gradually decreased in every samples, however, the decreasing levels of the properties were various. These bread height and SV were associated with the size of the cellulose granule. It was observed that same bread height and SV to the bread baked with unblended wheat flour could be obtained when the diameter of cellulose granule was selected above 128 micrometer in cellulose/wheat flour breadmaking, on the other hand, they were gradually decreased with decrease

below 128 micrometer. When the largest cellulose granules were mechanically ground to smaller ones following to use in breadmaking, the bread height and SV were decreased with increase of the grinding time. It was ascertained that the size of the cellulose granule was important in the breadmaking. Cellulose-blended wheat flours were subjected to mixograph tests. When the cellulose granule having above 128 micrometer diameter were blended, the profile of the mixogram was almost same to that of wheat flour, that is, the profile had a short mixing time and showed a viscous gluten matrix, however, when the cellulose granule having below 128 micrometer diameter were blended, the different curve showing a non-viscous doughs due to breakdown of the gluten protein was observed, which was ascertained by a microscopy.

P-157

Formulating bread fortified with soluble and insoluble fiber. M. B. NIETO (1). (1) TIC Gums, Inc., Belcamp, MD, USA, in collaboration with Nealanders International, Inc.

Fiber bread containing insoluble fiber as high as 20% flour basis has been successfully developed and commercialized for many years now. However, recipes that contain the same amount of soluble fiber proved to be a challenge. In this work, gums were studied for their gluten compatibility, and to achieve the target usage level of 20%, they were carefully selected based on viscosity and water absorption. A gum system that could be used at the same level of 20% flour basis was developed for a total of 40% combined soluble and insoluble fiber. Gums, as the main source of soluble fiber, are complex polysaccharides that are either branched or linear, and neutral or charged. This structural feature and the electrostatic charge on the molecule have a profound effect on the gluten in the formation of disulfide bonds and the elasticity of the dough. Neutral and linear gums proved to be compatible with the gluten. Therefore, a gum system consisting of inulin, guar and methylcellulose was developed. This gum system has the same water absorption as the flour when supplemented with vital wheat gluten. High fiber breads using this gum system combined with the insoluble fiber such as cellulose powder produced loaves with good volume and bread structure, and the breads were soft and had a moist mouthfeel.

P-158

Glycemic response from a barm leavened whole grain kamut wheat bread containing a mash. G. A. Spiller (1), M. A. SPILLER (2). (1) Health Research & Studies Center, Los Altos, CA, USA; (2) Whole Grain Connection, Los Altos, CA, USA.

Glycemic response from whole wheat bread (WWB) is variable. Kamut (*Triticum turgidum* ssp. *turanicum*) provides proportionately less bran, than hard red wheat, and imparts a light color to bread. Half of the whole kamut wheat flour (WWF) in bread dough was made into a mash, i.e. hot water was mixed with WWF and enzyme active malted wheat flour (0.4%), to give 65°C in the mixture. Alpha-amylase from the malt acts on the gelatinized starch, and beta-amylase is inactivated when the mash is held at 60°C for 1–3 hours. Cool mash is used as an ingredient in the bread, and alone in barm leavening. The barm leavening contains *Saccharomyces dairensis* and *Lactobacillus brevis*, which produces acids including lactic acid. Available carbohydrate on a dry basis, in kamut WWF, and in kamut WWB (containing 50% of the flour as a mash, salt, water and barm leavening) was 67.2 and 62.5; soluble fiber was 3.6 and 2.4; insoluble fiber was 7.5 and 11.8; and total fiber was 11.1 and 14.2% respectively. A portion (149 grams) of kamut WWB equivalent to 50 grams available carbohydrate was fed to 11 fasting, healthy (BMI 19-26) subjects. Blood samples were drawn at known times approximately 15, 30, 60 and 120 minutes after beginning to eat the bread. For comparison, 2 weeks later, the same subjects were tested in the same way after consuming 50 grams glucose in 250 mL water. After consuming the kamut WWB, average maximum serum glucose was 145 mg/dL at 32 minutes, and after glucose drink 163 mg/dL at 27 minutes. Average maximum insulin levels after kamut WWB and after glucose drink were 50 microIU/mL at 51 minutes and 53 microIU/mL at 49 minutes respectively. Average change in serum glucose from baseline 2 hours after consuming kamut WWB was 15 mg/dL below baseline, and 24 mg/mL below baseline value after glucose drink.

P-159

Incorporation of red whole wheat into grain based foods in elementary school cafeterias. N. M. SCHROEDER (2), E. Hystead (2), E. A. Arndt (1), L. F. Marquart (2). (1) ConAgra Foods, Omaha, NE, USA; (2) University of Minnesota, St. Paul, MN, USA.

School foodservice personnel have recently introduced grain products made with a 50:50 blend of red whole wheat flour to refined flour into school cafeterias. The dietary intake of these grain items in a school setting has not been assessed. This study examined the feasibility of serving pizza and French bread made with a 50:50 blend of red whole wheat (50% RW) flour in elementary school cafeterias. Subjects included K-6th graders from 2 elementary schools in a large urban school district with diverse ethnic backgrounds. Each product was served with the 50% RW on two days at two week intervals. Plate waste was used to measure consumption of pizza and French bread each time it was served. The pizza containing 50% RW flour was consumed at approximately 70% acceptance levels. Consumption of French bread made with the 50% RW flour was consumed at a lower level than pizza made with the same 50% RW flour content. This study suggests that the consumption of grain based foods made with red whole wheat flour depends on the type of food that it is delivered.

P-160

Labeling and centesimal composition analysis of white and whole grain breads consumed in Brazil. A. A. ANTON (1), P. Haas (1), P. M. Barreto (1), A. De Francisco (1). (1) Universidade Federal de Santa Catarina, Florianopolis, SC, Brazil.

The consumption of whole grain breads in Brazil is increasing, following the growing scientific evidence proclaiming its positive health effects. In Brazil, due to the lack of a specific legislation, the benefits originated from these foods are questionable. However, the consumer still prefers the white breads, what is justified by the sensorial aspects of the dark ones and the lack of education regarding it. This study compared the centesimal composition, mainly concerning the total dietary fiber (DF) content, of the most consumed white

and whole grain breads available in the Brazilian market with the data displayed on its labels and among themselves. DF and the physic-chemical analysis were proceeded according to the AACC methods (32-05, 08-01, 44-15A, 46-13, 30-10). Significant differences were observed between the data displayed on the labels and the one found experimentally. The reduced calorie white bread showed a DF content reduced in 61%, as well as the calorie value was found reduced in just 4% comparing to the ordinary product (white bread) of the same brand, excluding it of the reduced calorie food category. The DF content from the different samples varied significantly, where the reduced calorie whole grain rye bread showed the highest mean (6,84%) while the most consumed bread product in Brazil, the French bread, showed the lowest (2,37%). Even being out of the legislation labeling requirements and demonstrating nutritional values lower than expressed on its labels, the DF content mean of the whole grain breads was 86% higher than in the white ones. This study evidenced the fails of the Brazilian Sanitary Authority (ANVISA) in means of labeling inspection and whole grain ingredients content in bread products.

P-161

Measurement of cross-links in phosphorylated starch and their effect on alpha-amylase digestion. Y. SANG (1), P. A. Seib (1). (1) Department of Grain Science & Industry, Kansas State University, Manhattan, KS, USA.

The structure of phosphate esters in cross-linked resistant starch (RS4) is important to understand its digestibility by pancreatic alpha-amylase. Wheat starch was reacted at pH 11.5, 45C, and 3h with 12% (starch basis, sb) of a 99/1 (w/w) mixture of sodium trimetaphosphate/sodium tripolyphosphate (STMP/STPP) to give modified starches with ~0.4% phosphorus (P) and a ~1/1 molar mixture of distarch monophosphate (DSMP) and monostarch monophosphate (MSMP) determined by 31P NMR spectroscopy. RS4 wheat starches prepared at pH 9.5–10.5 showed a decreasing ratio of DSMP/MSMP plus an increasing level of monostarch diphosphate (MSDP) and cyclic monostarch monophosphate as reaction pH decreased. A series of RS4 wheat starches were prepared where all contained ~0.4% P with levels of DSMP (cross-links) varying from one cross-link per 40 to 143 AGU's. The level of DSMP (cross-links) positively correlated with the level of RS4 (r = 0.96) measured by a modified Englyst method and with the level of total dietary fiber (r = 0.90).

P-162

Natural and sour cassava starch content in cheese breads: Effect on physico-chemical, rheological and sensorial properties. J. R. Uclés-Santos (1), F. P. COLLARES (1). (1) State University of Campinas - UNICAMP, Department of Food Technology, Campinas, SP, Brazil.

Cheese bread is considered a baked product that does not contain gluten, because it uses native cassava starch, naturally fermented and/or modified in its elaboration. The present work analyzed the incorporation of different contents of natural and sour cassava starch (0%, 30%, 50%, 70% e 100%) to the cheese bread dough, with the objective of choosing a formulation for cheese bread with optimized expansion coefficient, low compression force and good sensorial acceptance. Prior to the formulation choice, the cassava starches were characterized physically, chemically, rheologically and morphologically. The values of pH, acidity and moisture were within the parameters established by Brazilian legislation for amylaceous products. The particle size was 21.76 µm for natural cassava starch and of 3 to 20 µm for sour cassava starch. The B pattern of X-ray diffraction found was characteristic for tuber starches. The natural and sour cassava starches presented paste temperatures of 66 and 67 °C, respectively. The specific volume of cheese breads ranged from 3.23 to 4.19 cm^3/g. The compression force obtained for the cheese bread ranged from 15.29 to 23.59 N. The cheese breads elaborated only with natural or sour cassava starch presented greater values of luminescence, saturation and shade angle, parameters obtained through the analysis of color. The affective sensory analysis performed with 30 untrained panelists, showed that the cheese breads elaborated with high contents of natural cassava starch presented the best sensorial scores as to overall appearance, aroma, texture and flavor, if compared to the ones elaborated with high contents of sour cassava starch. The formulation of cheese bread with 70% of manioc starch and 30% of sour starch was chosen as the best formulation.

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Particle size effects of whole barley flour on the quality of wheat tortillas. N. PRASOPSUNWATTANA (1), A. Toma (1), S. Lee (1), S. Chongcham (1), P. Cooke (3), R. A. Flores (4), J. Wilson (3), E. A. Arndt (2), W. Yokoyama (5), M. Omary (1). (1) California State Polytechnic University, Pomona, CA, USA; (2) ConAgra Foods, Inc., Omaha, NE, USA; (3) Microscopic Imaging Group USDA/ARS/ERRC, Wyndmoor, PA, USA; (4) University of Nebraska, Lincoln, NE, USA; (5) USDA, ARS, Western Regional Research Center, Albany, CA, USA.

Low-fat high-fiber wheat tortillas enriched with 9% whole barley flour (WBF) rich in total dietary fiber and beta-glucan soluble fiber were prepared. Four treatments including a control-C (72µ), and WBF with three different particle sizes, microground-MG (68µ), intermediate-I (131µ), and regular-R (237µ) were evaluated. Ninety-five untrained panelists tested the tortillas for appearance, color, flavor, texture and overall acceptability using a 9-point hedonic scale. Data on water activity, color, texture, and SEM imaging of dough and tortillas were also collected. Two commercial products (CP) were also included for comparison. The MG and R tortillas were not significantly different ($P > 0.05$) from C on flavor (5.8) and texture (5.7) scores, respectively; but were rated significantly lower ($P < 0.05$) than both CP on the same attributes. Water activity was significantly different between C (0.972) and R (0.981). No significant differences in water activity were found among MG, I and R (0.98). Tortillas made with MG, I, and R were significantly darker (61) than the two CP. The firmness was significantly higher for MG, I, and R (0.76 kg) than both CP (0.44 kg). No significant differences were found in toughness for one of the CP, C and R (2.4 kg.s); however, I and MG tortillas were significantly less tough (1.96 kg.s). Elasticity among the experimental tortillas (0.16 kg/mm) was not significantly different. The two CP were significantly less elastic (0.078 kg/mm) than all experimental products. Similar amounts of beta-glucan were found among all WBF tortilla doughs. The microstructure of protein matrices and starch granules in the tortillas was more compact and uniform than corresponding doughs.

P-164

Physicochemical, rheological and sensorial characterization of functional cheese bread with addition of soy protein isolate and polydextrose. J. R. Uclés-Santos (1), F. P. COLLARES (1). (1) State University of Campinas - UNICAMP, Department of Food Technology, Campinas, SP, Brazil.

In Brazil, cheese bread is a widely consumed food with no functional component. The objective of this work is to compare two formulations of functional cheese bread with regard to their physicochemical, rheological and sensorial properties. The two formulations assessed here have been previously obtained as the result of two independent experimental selection processes; one of them involved the scalding of the powdered ingredients. The two formulations selected were: (i) FCE (with scalding): 35% of native cassava starch, 5.50% of soy protein isolate and 6.04% of polydextrose; (ii) FSE (without scalding): 7.00% of pre-gelatinized cassava starch; 35% of sour cassava starch, 5.50% of soy protein isolate and 1.03% of polydextrose. The others ingredients added to these formulations were: whole milk, soy oil, margarine, salt, whole eggs and half-cured 'Minas' cheese. The study of dough consistency by Brabender farinograph showed that the dough elaborated from FCE formulation presented a consistency of 40.66% superior to the ones obtained for dough elaborated from FSE formulation. The FCE formulation presented specific volume and coefficient of expansion, respectively, 1.84% and 50.0% smaller than the ones obtained by the FSE formulation, which was also confirmed through the analysis of compression force. The centesimal composition determined for the FCE and FSE formulations, presented a content of lipids of 31% and 28%, protein around 8%, fixed mineral residue between 1% and 3% and total carbohydrates (in dry basis) from 58 to 60%, respectively. The sensory analysis for preference, by paired comparison, showed that the consumer presented the same acceptance (50%), from the already 30 panelists used. These results showed that despite the fact that the products have different physicochemical and rheological properties, they are equally accepted by sensorial analysis.

P-165

Plant sterols in wheat samples obtained by scarification. L. NYSTRÖM (1), A. Lampi (1), V. Piironen (1). (1) University of Helsinki, Finland.

Outer layers of cereal kernels are known to be rich sources of various bioactive compounds like vitamins, minerals and plant sterols, which are beneficial for the human nutrition. Enriching the amounts of this type of components in raw materials of foods and hence in consumer products and overall diet is of importance in the development healthier foods. For this study wheat kernels were scarified using a laboratory seed scarifier and samples (the fines produced) were collected after each consecutive abrasion as the scarification proceeded towards the inner layers of the kernel. The content of total plant sterols was determined after acid and alkaline hydrolyses with GC-FID. All of the samples were also analyzed using fluorescence microscopy to quantify the content of the aleurone layer in the samples. The content of plant sterols decreased as the scarification proceeded to the endosperm. Significant differences were found in both the total sterol content and sterol composition of the samples. The highest sterol content (171 mg/100 g wb) was found in the fines from the first scarification containing mostly pericarp and some aleurone. Sitosterol and campesterol were the most common sterol species found in the samples, contributing over 70% of all sterols, followed by stigmasterol, which was especially rich in the outermost layers. The proportion of stigmasterol ranged from 1.8 to 6.3%. The particle size of the fine fraction produced by scarification was very small and even the bran layers were flourlike. This type of products, which are rich in bioactive compounds but have a fine structure could be easily introduced into bakery products to increase their nutritional quality, but without having to make great compromises in the sensory quality.

P-166

Texture, color and sensory evaluation of bread enriched with wheat white fiber. R. Viquez (1), I. Alfaro (1), M. PINEDA (1), P. Esquivel (1), J. Aiello (1). (1) School of Food Technology, University of Costa Rica.

The nutritional advantages of fiber consumption are known. Consumers dislike in many cases fiber-enriched foods due to the texture and color of them. Different types of improved fiber additives are reachable nowadays with a lot of valuable characteristics. Use of white wheat fiber in bread might be useful, due to its water binding characteristics and general appearance. Wheat flour substitution (0, 5, 10 and 15%) by wheat fiber was evaluated on texture, color and sensory acceptance without the addition of sorbate. Moreover, the same parameters were measured after 8 days of storage at room temperature in polypropylene sealed bags on bread with added sorbate. When no sorbate was added, the elasticity of the bread crumb and humidity increased at higher fiber contents. No changes on firmness were observed as the amount of fiber increased. Compared with the bread without fiber added, the firmness of the substituted breads was lower. A decrease on chroma values was evident with higher fiber contents. When sorbate was included, a decrease on the firmness of the bread without substitution was evident, but also an increase on the bread crumb firmness of the substituted breads with sorbate addition was observed. Also, an effect of sorbate addition was observed as an increase on L*-, a*-, hue and humidity values for breads with different fiber contents. Three clusters were observed when sensory acceptance was evaluated for bread before and after storage with added sorbate. In two of them the amount of fiber and storage time had no effect on the acceptance of the product. In the third cluster a diminished acceptance, only for the samples without the addition of fiber, was evident.

P-167

About puffed cereals and their use in breadmaking. M. MARIOTTI (1), M. Lucisano (1), M. Pagani (1), L. Fongaro (1). (1) DiSTAM (Department of Food Science and Microbiology), University of Milan, Milan, Italy.

Puffed cereals are commonly used as ready-to-eat breakfast foods or as ingredients in snack formulations and are appreciated mainly for their lightness and crispness. Since few investigations have been made on puffed cereal grains and flours, the aim of this study was to evaluate the changes associated with the puffing process as applied to three grains (wheat, rye, rice) and to investigate their use in breadmaking. The kernels were evaluated for chemical-physical (moisture, bulk density, hectolitric weight, water absorption, geometric

indices) and ultrastructural properties (SEM): the morphology and composition of the kernel strongly affected the characteristics of puffed products. The flours obtained by milling the kernels at the same conditions in a hammer mill were also analyzed. Puffing caused significant changes in the physical properties of starch: higher levels of starch damage (10 times), increased water absorption capacity (2–3 times) and different viscoamylographic behavior. The puffed flours were added at different levels (from 1 to 7%) to wheat flour and the resulting mixtures, evaluated by conventional previsional tests, were baked using a straight-dough method. The breads were characterized after baking and during storage (52 hours) at controlled conditions (20°C, 60%RU) for weight, height, volume, moisture, a_w, color, bubbles distribution and staling kinetics. The best performances were obtained using the 3% integration level: it led to higher (7–9%) dough development and to slower crumb hardening during storage. The results suggest that flours from puffed cereals could be used also as a good means for controlling water migration in baked products: the use of low amounts of puffed flours, in fact, allowed the product to remain softer for a longer period.

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Addition of *Agaricus blazei* flour to a reduced fat pan bread formulation. I. B. Cardoso (2), R. F. Rugai (3), A. S. Coelho (3), S. Mendes Filho (1), C. J. Steel (3), Y. K. CHANG (3). (1) Cargill, Tatuí, SP, Brazil; (2) Emulzint, Jundiaí, SP, Brazil; (3) UNICAMP, Campinas, SP, Brazil.

Agaricus blazei (AB) is an edible mushroom of high nutritive value, with a protein content almost equivalent to meat, being a source of almost all essential amino acids. It is also rich in vitamins, minerals and is low in fats and carbohydrates. Antitumor, immunomodulating, antiviral, antimicrobial and antiparasitary activities have been attributed to it. The objectives of this work were to evaluate the rheological properties of mixtures of wheat flour and AB flour in different proportions (0%, 1%, 3% and 5%) and the application of these mixtures in a formulation of reduced fat pan bread. AB was ground and passed through a 0.5 mm sieve. Rheological properties were determined in a farinograph and in an extensigraph (Brabender). The reduced fat pan breads were produced using the following formulation: wheat flour (100%); *Agaricus blazei* flour (0, 1 and 3%); vital gluten (2%); salt (2%); DATEM (0.4%); calcium propionate (0.15%); ascorbic acid (0.02%); maltogenic alpha-amylase (0.3%); fungal alpha-amylase (0.02%); instant baker's yeast (1%) and water (64%). The rheological parameters obtained showed that the addition of AB flour to wheat flour reduced dough development time and stability, as well as resistance and extensibility. In the breads, an expressive reduction of specific volume with the increase of the percentage of AB was observed (from 5.24 mL/g, to 4.50 mL/g, and to 2.83 mL/g, for the breads with 0, 1 and 3% addition, respectively). The results indicated that the use of AB flour in reduced fat pan bread is possible, however, at low concentrations. The technological effects observed suggest the presence of a substance that can interfere in the formation of the gluten network.

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Application of the two-dimensional near-infrared correlation spectroscopy for the analysis of wheat flour dough kneading. A. AIT KADDOUR (2), C. Barron (2), P. Robert (1), B. Cuq (2). (1) INRA, Nantes, France; (2) INRA, Montpellier, France.

The NIR spectroscopy presents a huge interest in exploring chemical changes during dough mixing. The purpose of the present study is to investigate the potential of two-dimensional correlation spectroscopy (2DCOS) to explore the time dependence of NIR spectral responses during wheat flour dough mixing. NIR spectra were continuously recorded (between 1400 and 2325 nm) during mixing of bread type-dough (flour, water, and yeast), using a FT-NIR spectrometer with a deported probe, positioned inside the mixer directly in contact with the dough. The mixer was also equipped with a temperature-consistency sensor. The 2D spectra were interpreted in term of physicochemical events. Nine different industrial flours classified according to bread, pastry or biscuit specifications were used as raw material to validate the analysis. The 2DCOS method was applied to analyze the spectra recorded between 3 and 21 min of mixing. The synchronous 2D spectrum presents two autopeaks at 1460 nm and 1940 nm. The first one can be associated to modifications of hydrogen bond density between water molecules, starch, and proteins. The second one was associated to proteins and water interactions. The asynchronous 2D spectrum indicates that the changes in NIR absorption intensity at 1940 nm occurs at a longer mixing time when compared to the event monitored by all the other NIR regions. The 2DCOS method was then applied to a sequential analysis of dough mixing. Dough mixing time was divided into 7 successive periods of 3 min, and the 2D spectra were constructed for each period. The results indicate new spectral bands movement associated to specific kneading period and to specific physicochemical modifications for the flours studied.

P-170

Assessment of the suitability of a range of gluten-free cereals for their potential use in gluten-free bread. M. M. Moore (1), S. RENZETTI (1), E. K. Arendt (1). (1) Food Technology, Food and Nutritional Sciences Department, UCC, Cork, Ireland.

The suitability of white rice, brown rice, corn, tef, buckwheat, sorghum and oats for their potential use as ingredients for a gluten-free bread was assessed. Rheological tests on the bread batters and standard-baking tests on the resulting breads were carried out. Significantly higher elastic and complex modulus values were found for the OF, S and BW GF bread batters ($P < 0.05$). These bread batters exhibited more elastic properties similar to that of wheat dough than their counterparts. Furthermore significantly higher complex viscosity values were found for the OF and S GF breads, which rapidly decreased overtime ($P < 0.05$). Baking tests revealed the BRF, TF and BW breads to yield the highest loaf volumes ($P < 0.05$), lower bake loss and crumb hardness values ($P < 0.05$). Significantly lower crust colour values were found for the OF, BRF, TF and BW breads indicating that these breads were darker in colour ($P < 0.05$). The hardness of all breads significantly increased over storage time ($P < 0.05$), although the increase from day 2 to day 5 was no longer significant for OF and BW. Regarding the BW and OF GF breads, although high crumb hardness

values were obtained, the rate of staling was less pronounced when compared to the WRF, TF, CF and S GF breads. Fracture occurred only for most of the GF breads (BRF, TF, CF, S and BW) at day 2 and 5 with the exception of GF bread. Overall it can be concluded that OF, BRF and BW were the most suitable GF cereals for potential use in GF bread production.

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Characteristics of steamed foam-cake containing different flour combinations of high-dietary fiber rice 'Goami 2' and wheat flour. M. Jang (2), B. KIM (1), D. Jun (3), J. Park (2), S. Jung (2), H. Park (2). (1) Department of Food Engineering, Dankook University, Cheonan, Chungnam, Republic of Korea; (2) Department of Food and Nutrition, Dankook University, Seoul, Republic of Korea; (3) Midm Agricultural Union Corporation, Pyungtaek, Gyeonggi-Do, Republic of Korea.

A new high-dietary fiber rice cultivar 'Goami 2' (GA), developed in Korea using mutation breeding methods among japonica cultivars is known to have 33% increase in amylose content, quadrupled lipid content, and three to five-fold increases in dietary fiber content from the ecotype rice. In contrast to the oven for bakery use, many people still prefer conventional steam cooking in Korea because of its handling convenience and healthy images in which the least fatty materials are involved for cooking. Steamed foam-cake was prepared according to 'sponge and dough procedure' to evaluate the effect GA addition, up to 30% in volume of wheat flour, on the quality characteristics of the product. With the 30% substitution of GA in wheat flour, viscosity of the bread dough decreased by 28% at 30% substitution ratio while the specific gravity of the dough was not affected. The original loaf volumes were kept unchanged at 5% and 10% substitution levels of GA while it decreased progressively at above 10% substitution levels. The addition of GA flours raised the gelatinization temperatures and restricted swelling of the dough starch. The colorimetric lightness (L) in both crust and crumb of the bread increased with GA substitution while decreases in redness (a) and increases in yellowness (b) were also noted. Textural parameters of the cake showed rapid increases in hardness (17 to 39%), gumminess (22 to 47%), and chewiness (12 to 32%) as substitution level increased from 5 to 20%. Springiness and cohesiveness were not affected significantly ($P < 0.05$) by the added GA. In conclusion, inclusion of GA up to 10% in volume of the wheat flour seemed to be suitable based on the physical and textural quality of the product for enhancing the dietary fiber content and other nutritional densities as long as the original qualities were unimpaired.

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Characterization of rice bread processed with Goami2 – A high indigestible carbohydrates rice. I. CHOI (2), A. Chun (2), D. Kim (2), K. Kim (2), J. Son (2), C. Yang (1). (1) Genetics and Breeding Division, National Institute of Crop Science, RDA, Suwon, Republic of Korea; (2) Post-Harvest Technology Division, National Institute of Crop Science, Suwon, Republic of Korea.

Goami2 (G2), a mutant rice of Ilpum (IP), was identified to have higher indigestible carbohydrates (IDC), but to impart poor cooking quality for cooked rice. Objectives were to determine optimum G2 levels processing into rice bread, to compare G2 bread qualities with IP made with optimum level and to evaluate consumer acceptance. G2 rice was soaked for overnight, drained completely, ground and air-dried for 5 hr. To determine the optimum G2 level, rice bread was prepared with 55, 65, 75, 85% of G2, and evaluated for their physical properties. Bread quality processed with optimum rice flour was compared with G2 and IP. Loaf volume (ml) was determined by rapeseed displacement, and specific volume (ml/g) was determined by dividing loaf weight by volume. texture profile analysis (TPA) was conducted, and IDC was determined by total dietary fiber analysis with defatted bread sample. Thirty consumers evaluated those bread using a nine-point hedonic scale. Specific volume of 55–75% G2 bread ranged 2.49 to 2.95 ± 0.39, whereas 2.02 ± 0.04 for 85%, indicating significant depression on volume expansion. Compression force (505.44) increased significantly in 75% compared to 65% bread (426.90). Thus, 65% G2 and IP rice flour, sieved through 80 mesh, was further processed. Specific volume of G2 (3.11) was higher compared to IP (2.76), and G2 bread was high in hardness and chewiness, but low in adhesiveness and cohesiveness by TPA. IDC was significantly higher in G2 (6.45 ± 0.28) than IP (2.46 ± 0.13). Consumers rated on overall acceptance G2 and IP bread as 4.91 and 7.42, respectively, suggesting they preferred IP to G2. Although consumers were not favored to G2 bread, G2 processing into value-added products is highly expected to enhance nutritional and functional properties due to higher IDC contents.

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Comparing the effect of mixing on dough development between two mixers with different geometries. R. K. CONNELLY (1), R. McIntier (1). (1) University of Wisconsin – Madison, WI, USA.

The farinograph and reomixer (mixograph-type mixer) are two common devices for assessing flour properties during mixing. Both mixers provide empirical measurements related to the torque and work input required to produce optimally mixed dough, despite dissimilar geometries and mixing actions. The overall objective of this work is to obtain a more complete understanding of the effect of the rate, type and range of strain experienced by dough as it is mixed to peak development over a range of strain rates. Initial testing focused on mixing flour-water dough to peak development at varying speeds. Work input to reach peak torque was determined and used to compare the two mixers. Results confirm the dependence of the work needed to fully develop dough on mixing speed at low speeds and its independence at high speeds. The speed at which dough development becomes rate independent is different for each mixer and serves as a comparison point. Subsequent testing focused on full formula bread dough mixed to peak development at varying speeds. Differences in the fully developed dough were sought by measuring small strain rheological properties of the dough following thermal yeast inactivation, extensional properties using the Keiffer rig on the texture analyzer and near-infrared spectra. Dough was also baked and assessed for loaf volume, color and texture. Results of tests conducted on full formula dough from each mixer were compiled separately and analyzed using a multivariate ANOVA, and additional points of comparison between the two mixers were identified. Ultimately, the work unites information gained on both the farinograph and the reomixer and conveys them into a unified theory leading to more reliable mixer characterization methods.

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Composition and application of banana flour. L. A. BELLO-PEREZ (1), E. Agama-Acevedo (1), E. Juarez-García (2), S. G. Sayago-Ayerdi (2), S. L. Rodriguez-Ambriz (1). (1) CEPROBI-IPN, Yautepec, Morelos, México; (2) Instituto Tecnológico de Acapulco, Calzada Instituto Tecnológico S/N, Acapulco, Guerrero, México.

One of the current tendencies in nutrition and health is to consume low-carbohydrate food products. Unripe banana fruit represents an alternative source of indigestible carbohydrates, due to a number of reasons such as, starch content of the pulp, high cellulose, hemicellulose and lignin levels, as well as the low cost of the fruit that may allow the preparation of banana flour (BF) with attractive chemical and functional characteristics. The aim of the present work was to evaluate the chemical and functional properties of BF from unripe banana fruit and its application in a bakery product BF was obtained from unripe banana (*Musa paradisiacal* L.) and characterized in its chemical composition. Experimental bread was formulated with BF flour and the product was studied regarding chemical composition, available starch (AS), resistant starch (RS) and rate of starch digestion in vitro. The chemical composition of BF showed that total starch (73.36%) and dietary fiber (14.52%) were the highest constituents. Of the total starch, available starch was 56.29% and resistant starch 17.50%. BF bread had higher protein and total starch content than control bread, but the first had higher lipid amount. Appreciable differences were found in available, resistant starch and indigestible fraction between the bread studied, since BF bread showed higher resistant starch and indigestible fraction content. HI-based predicted glycemic index for the BF bread was 65.08%, which was significantly lower than control bread (81.88%), suggesting a "slow carbohydrate" feature for the BF-based goods. Results revealed BF as a potential ingredient for bakery products containing slowly digestible carbohydrates.

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Comprehensive evaluation of European imported wheat flour incomparable to local wheat flour in Libya. H. M. GADAN, SR. (1), A. Qasim Akasha (1), A. Daboob (1), M. Abd Alsalam (1). (1) Sebha University, Sebha, Brak, Libya.

Libya imports 95% of the flour needed for its baking industry from European countries. This study focused on evaluation of chemical composition of six types of European wheat flour from Holland as well as wheat flour milled from a local variety. The wheat flour contained 12.4–13.8% protein, 1.32–2.5% lipid, 0.16–1.91% ash, and 70.5–70.8% carbohydrate. Wet gluten was 319–427 sec. The viscosity at maximum point of gelatinization using a Brabender amylograph was 370–1,294 BU. Data from a Brabender farinograph indicated that the flour water absorption capacity was 63.8–75.5%. Dough stability was 3.27–7.50 min. Data from Extensograph revealed that resistance to extension (174–440 BU) increased with increase in fermentation time, while extensibility (98–171 mm) decreased with increase in fermentation time.

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Corn tortillas prepared with TC-20 gum: Effect on in vitro digestibility. R. RENDÓN-VILLALOBOS (1), E. Agama-Acevedo (1), A. Bello-Perez (1). (1) CEPROBI-IPN, Yautepec, Morelos, Mexico.

Corn tortillas have been a staple food in México for many centuries, however these and other starchy products have a problem of retrogradation that in many cases is decreased adding gums. The objective was to investigate the influence of a commercial gum on in vitro digestibility of starch. Masa was mixed with the gum (2% in base of weight of masa) to obtain tortillas that were baked and stored for up 15 days at 4 °C, and then analyzed for Available Starch (AS), Resistant Starch (RS) and Digestion Rate (DR). All results were compared with tortillas without gum (control sample). AS in control sample ranged from 76.7 and 65.9%, and for the tortilla with gum between 68.6 to 64.1% without significant differences ($P < 0.05$), this pattern may be explained due to the retrogradation. RS values in control tortillas increased ~50% after storage for 7 days, tortillas with gum had low retrogradation tendency, because gum impede interactions between starch chains solubilized during gelatinization. In general, DR decreased with storage. Tortillas with gum had lower DR and the patterns were slower than the control. The gum can be used for obtaining tortillas with better texture and lower RS content.

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Determination of "Besatz" – Results of an international interlaboratory trial. S. SELING (1). (1) Fed Research Centre Nutrition and Food, Detmold, Germany.

The term "Besatz" applies to all components of a grain sample which differ from the normal basic variety. It comprises the following groups: broken grains, shriveled grains, other cereals, grains damaged by pests, grains with discoloured germ, grains overheated during drying, sprouted grains, extraneous seeds, unsound grains, ergot, smutty grains, extraneous matter, husks and impurities of animal origin. The amount of Besatz and its including groups is important for human and animal health, cleaning, milling and further processing aspects. For these reasons Besatz is a component of contracts in grain trade and also of the grain intervention system of the EU. The principle of the determination of Besatz is to separate all the groups of Besatz from the normal basic grains by sieving and manual selection out of a subsample and to quantify them. There are three problems in the determination of Besatz: First, the identification of the different groups of Besatz depends strongly on the experience and the knowledge of the investigator. But also experienced investigators can differ in their characterization of grains. Finally, one is faced with the fact that grain, even after mixing, is rarely homogenous. In other words, if a sample was divided by a sample divider into some portions, the amount of a special group of Besatz in each portion could be different, even if absolutely no human or machine error occurred in each determination. These problems will result in variation of the results of the determination. An international interlaboratory trial for the determination of Besatz in soft wheat, hard wheat and rye was accomplished with 15 laboratories in order to get an idea from the height of these variations, and the results will be presented on the poster.

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Effect of lactic acid bacterial cultures isolated from rye flour on the quality of wheat bread. D. Savic (1), O. Šimurina (2), B. Filipcev (2), N. Jankovic (2), M. POJIC (2). (1) Faculty of Technology, Leskovac, Serbia and Montenegro; (2) Faculty of Technology, Novi Sad, Serbia and Montenegro.

Prevailing trend in contemporary baking is production of rustic bread characterized with thick and crunchy crust and mild sour taste. The formation of desirable aromatic characteristics in rustic wheat bread making is due to sour doughs. The advantages of the sour dough method are as follows: improved flavour and aroma of the finished product, bread with prolonged shelf-life, delayed staling of bread. The starter culture was formulated with heterofermentative lactic acid bacteria isolated from rye flour. The starter was added directly to rye flour dough and was given a fermentation time of 16 hours. The obtained sour dough was used in wheat bread making. In the paper methods of isolation of lactic acid bacteria, preparation of sour dough and sensory evaluation of bread are described. Total titratable acidity and pH value of dough and bread was recorded.

P-179

Effect of mixing time and water absorption on the quality of Chinese steamed bread. E. ASSEFAW (1), B. X. Fu (1). (1) Canadian International Grains Institute.

Early research in our laboratory has shown that mixing time and water absorption are key processing parameters affecting steamed bread quality. Detailed understanding of their impacts is critical for establishing laboratory steamed bread processing and quality evaluation procedures which can objectively demonstrate the quality of flour or wheat for steamed bread processing. To this end, steamed breads were processed under varying levels of mixing time and water absorption from flour milled from Canada Western Hard White Spring (CWHWS) wheat. The resulting steamed breads were evaluated in terms of volume, color, exterior appearance, and crumb structure and texture. There are minimum levels of water absorption and mixing time below which the dough would be too stiff for steamed bread processing. The results showed that the overall steamed bread quality improved with the increase of mixing time, and bread quality deteriorated significantly beyond certain water absorption level. It was found that long mixing time and low water absorption usually produce good quality steamed breads as long as the dough consistency can meet the processing requirements.

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Effect of steaming pressure and time and storage period on quality characteristics of *Baeksulgi* (Korean traditional rice cake). G. RYU (1), J. Park (1), M. Kim (1). (1) Department of Food Science and Technology, Kongju National University, Yesan, Korea.

The objective of the study was to investigate the effect of steaming pressure (0.5, 1.0, and 1.5 bar), steaming time (5, 10, and 15 min), and storage period on hardness, hardness rate constant, and sensory characteristics of Baeksulgi prepared with optimum formula (rice flour 100%, water 60%, salt 1.5%, and sugar 15%). Although the hardness was slowly increased during storage period from 0 hr to 8 hr and sharply increased after 12 hr of storage in case of 0.5 bar steam pressure, it was slowly increased after 12 hr storage time in case of steaming pressure at 1.0 bar. Hardness rate constant of Baeksulgi was 0.217–0.184 hr^{-1} within range of steaming time for 8–10 min and pressure at 0.8–1.0 bar which was relatively low. Hardness and elasticity of sensory evaluation were increased with the increase in steaming pressure, steaming time, and storage period but cohesiveness was decreased. The highest overall preference was steaming pressure at 10 bar, steamed for 10 min, and storage period for 12 hr. In conclusion, steaming pressure, steaming time, and storage period influenced Baeksulgi quality such as hardness and sensory characteristics.

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Effect of the addition of different levels of "okara" flour on rheological properties of wheat flour and technological properties of pan bread. L. H. Da Silva (2), L. M. Paucar Menacho (2), C. A. Vicente (2), A. Salles (1), C. J. Steel (2), Y. K. CHANG (2). (1) Danisco, Cotia, SP, Brazil; (2) UNICAMP, Campinas, SP, Brazil.

The commercialization and consumption of products containing soybean derivatives has grown intensely. The processing of soy milk and tofu produces a great amount of a by-product called "okara", that has high quantities of fibers and proteins, being a potential source for use in bakery products. The aim of this work was to study the effect of the addition of "okara" flour to wheat flour on the rheological properties of dough and on technological properties of pan bread. "Okara", dried to 8% moisture content and milled, was used to substitute 0, 5, 10 and 15% of wheat flour in a pan bread formulation. Dough rheological properties were evaluated using Brabender farinograph and extensigraph, bread specific volume was determined by seed displacement and bread moisture content using AACC Method 44-15A. The results indicated that the addition of "okara" flour in levels above 5% interfered in the rheological properties of the dough. Farinograph parameters showed an increase of absorption, arrival time, development time, departure time and mixing tolerance index, and a reduction of stability. Extensigraph parameters showed a reduction of extensibility. The addition of "okara" flour lead to an unbalance of the elasticity/extensibility ratio and negatively affected the specific volume of the loaves, which were 5.41, 4.96, 4.76 and 2.97 mL/g, respectively, for 0, 5, 10 and 15% levels. The addition of "okara" flour increased the moisture content of breads from 29.88% in the control (0% "okara") to 33.46% in the formulation with 15% substitution. It was concluded that adding 10% "okara" flour to the formulation of pan bread altered the rheological properties of the dough, but yielded acceptable results for specific volume and moisture content, and can be recommended for substitution.

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Emulating industrial dough mixing using the doughLAB. M. L. BASON (1), J. Dang (1), M. K. Guyatt (1), R. I. Booth (1). (1) Newport Scientific Pty. Ltd., Warriewood, NSW, Australia.

Modern bakeries employ high energy and low temperature mixing in the production of raw and frozen dough products. However batch variation in mixed dough quality remains a problem. Current instruments used to study the mixing characteristics of doughs are unable to mimic this low temperature mixing process. Recently Newport Scientific has

developed the doughLAB, a z-arm dough mixer which can alter thermal and mechanical energy inputs during mixing. The objectives of this study were to assess the capability of the doughLAB, coupled with a chiller, to mix and assess dough at high energies and low temperatures similar to industrial practice. Hard, soft and wholemeal flours were tested on the doughLAB fitted with a 300-g bowl, using AACC Method 54-21 (63 rpm, 30°C, 20 min.). The optimum water absorptions for each flour at standard testing conditions were used for subsequent tests at low temperatures (15°C isothermal, and 15 to 30°C ramp) and high energies (up to 120 rpm). Decreasing mixing temperature to 15°C resulted in higher overall torques, higher energies to mix to peak, and different curve shapes for all flours. Increasing mixing speed at each test temperature resulted in higher torques, better peak resolution and more rapid dough development. Ramping the temperature from 15 to 30°C during mixing, similar to adiabatic systems, resulted in more rapid breakdown (lower stability) of the dough compared to tests at constant 15°C. By emulating and quantifying the effects of low temperature and high energy mixing on dough rheology, this technique offers a tool to better predict the performance of flour batches in industrial mixers, and to adjust mixer conditions for a more consistent dough product.

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Evaluation of dough development time for wheat-soy flour blends. T. L. TRAYNHAM (1), D. J. Myers (1). (1) Iowa State University, Ames, IA, USA.

The practice of using flour blends for the production of bread can cause alterations to dough development and bread quality. In this study, the effect of flour blends containing extruded-expelled (EE) low fat soybean flour on dough development was investigated. Wheat flour (WHT) was replaced by defatted (DSF) or low fat soy (LSF) flour based on sample weight and protein content at 2, 6, and 12%. Peak time (minutes) was recorded by a 10–g mixograph. Peak time for optimum dough development ranged from 5.40–6.56 minutes. WHT–DSF blends had the lowest mean peak time overall. Based on replacement by sample weight, WHT–DSF and WHT–LSF blends produced dough with mean peak times that were significantly different ($P < 0.05$) from wheat flour alone. More time was required to achieve optimum dough development when wheat flour was partially replaced with low fat soy flour than with only wheat flour. Peak time for dough development in blends containing EE low fat soy flour was considered comparable to that of WHT–DSF blends.

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Folates stability in rye bread during processing and freezer storage. E. GUJSKA (1), A. Kuncewicz (1), J. Michalak (1), J. Klepacka (1). (1) University of Warmia and Mazury, Olsztyn, Poland.

Folates have been identified as one of the most important vitamins for normal human metabolic function. Rye is very important source of folates and in Poland is consumed as fermented bread made from whole grains flour. The objective of this study was to examine the effect of different preparation of sourdough on folates content during processing and during freezer storage. Sourdough was made by mixing whole rye flour with water and leaving the mixture for fermentation. Some kind of baker's yeast was also added. Breads were frozen at –20°C and held for up to 16 weeks. Folates were measured after tri-enzyme treatment and cleaned-up by affinity chromatography using folate binding protein (FBP) bovine milk. Folate monoglutamates were separated by HPLC with a Phenomenex Luna C18 column and with a combination of fluorescence and ultraviolet detection. Total folate content of rye whole grains flour was found to vary from 67 to 91 micrograms/100 g dry basis. The total losses of folates from flour to bread stage depend on sourdough preparation. No folates were lost during storage of the rye breads in freezer for 2 weeks but after 5, 10 and 16 weeks of storage folates decreased significantly ($P < 0.05$).

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Fungal xylanases and its use for the bread-making process with wheat flour. L. BASINSKIENE (1), S. Garmuviene (1), G. Juodeikiene (1), D. Haltrich (2). (1) Kaunas University of Technology, Kaunas, Lithuania; (2) University of Natural Resources and Applied Life Sciences, Vienna, Austria.

Xylanases are widely used as additives in the baking industry to improve the process and product quality. A variety of the commercial xylanase preparations made from different kinds of fungi is industrially produced or under development. Due to differences in their substrate specificities, action patterns, interactions with inhibitors and kinetics capabilities, not all xylanases are effective in baking. Our study was focused on the comparison of the activities among different xylanases obtained from *Aspergillus oryzae*, *Humicola insolens* and *Trichoderma reesei* and the investigation regarding the abilities of these xylanases to improve the quality of bread made from wheat flour type 550 and 1050. All tested xylanases showed the highest activity at pH 6 and 50°C. The final products obtained by hydrolysis (24 h) of birchwood xylan with xylanases from *H. insolens* and *T. reesei* was xylose and from *A. oryzae* – xylobiose. The most active was xylanase produced by *A. oryzae.* The optimal amount of xylanase was determined, which gives the guaranty for the best dough rheology and final bread properties: specific volume increased by 8–13%, crumb firmness decreased by 15–24% in comparison with bread without xylanase. The results also showed that all tested xylanase preparations could be used as wheat bread staling inhibitors. The maximum bread quality improving effect was obtained with xylanase from *A. oryzae* and anti-staling effect – with xylanase from *T. reesei*.

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Influence of harvest year, sowing date, and irrigation management on protein composition, rheological properties and baking performance of wheat lines. A. R. ISLAS-RUBIO (1), T. L. Maldonado-Parra (1), M. A. Camacho-Casas (2), M. Granados-Nevárez (1), B. Siva-Espinoza (1), F. Vásquez-Lara (1), H. González-Ríos (1). (1) CIAD, A.C., Hermosillo, Sonora, México; (2) CIRNO-INIFAP, Ciudad Obregón, Sonora, México.

Wheat quality is determined by genetic and environmental factors. The type of soil, climate, time and year of harvest and management practice are some of the environmental factors that influence the quality of wheat. The aim of this work was to evaluate the effect of year of harvest (YH), sowing date (SD), and irrigation management (IM) on protein composition, rheological measurements, and baking performance of three experimental bread wheat lines

(EBWL) grown at the Yaqui Valley Experimental Station in Sonora, México, during two consecutive years. Polymeric and monomeric proteins were evaluated by SE-HPLC. Dough rheological measurements were conducted using the National mixograph and a texture analyzer TA-XT2 with the Kieffer extensibility rig. Baking performance was evaluated by the direct dough method. The main factors and some of their double interactions had a significant effect on protein composition. Most of the rheological measurements were significantly influenced by EBWL, YH, SD, interactions YH and EBWL, YH and SD, YH and IM, EBWL and IM. IM had no significant effect on baking performance, but its interaction with YH had. In general, flours from EBWL-3 had significant lower proportions of polymeric and non-extractable protein, and lower bread volume than flours from the other EBWL.

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Influence of sulfur fertilization on the technological properties of wheat flour. H. WIESER (1). (1) German Research Center of Food Chemistry, Garching, Germany.

The aim of the present study was to investigate the influence of sulfur (S) fertilization on the rheological properties and baking performance of wheat dough. Wheat cv. Star was cultivated in pots and fertilized with six different levels of S (0–150 mg per pot). Flours of the six wheat samples were analyzed for the N- and S-content and the quantitative composition of gluten protein types. Dough properties were studied by extension tests, stress rheometry and baking tests on a micro-scale. The S-content of the flours ranged from 0.066 to 0.158% and the N/S ratio from 32 to 17. Flours with a low S-content showed poor technological properties such as short dough development time, low extension area, high dynamic viscosity and low bread volume. In conclusion, high quality wheat flour should have an S-content of at least 0.150% and an N/S ratio of 17 or lower.

P-188

Interactions of DATEM with gluten. R. KIEFFER (1). (1) DFA (German Research Center for Food Chemistry) Garching Germany.

DATEM (diacetyl tartaric acid esters of monoglycerides) improve the manufacturing properties of dough, its stability during fermentation and oven rise and by that the baking results. Therefore DATEM is assumed to strengthen gluten. Comparative investigations of the rheological properties of gluten and dough by the SMS/Kieffer method and by dynamic methods however show that the rheological changes monitored for gluten cannot explain the changes in dough properties. It was observed that increasing DATEM concentrations solubilise especially the low-molecular weight glutenins until the wheat-typical viscoelastic properties of dough are lost. At the same time the shape of the gluten network in dough is changed as monitored by microscopy. This may explain why a certain amount of DATEM has not to be exceeded to get best baking results. In addition DATEM was found to get firmly bound to the residual gluten proteins, what however did not substantially change their rheological properties as long as enough salt was present. This explains the reduced effect of DATEM when dough is made without salt.

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Production and optimisation of bread from wheat and amaranth flour blends. R. SCHOENLECHNER (2), C. Scelsi (1), M. Mariotti (1), M. Lucisano (1), E. Berghofer (2). (1) Department of Food Science and Microbiology, University of Milan, Milan, Italy; (2) Department of Food Science and Technology, University of Natural Resources and Applied Life Sciences, Vienna, Austria.

Amaranth, a grain which can be used similarly to cereals, is a nutritionally rich plant. As it is not botanically a true cereal, its chemical composition is quite different, especially as regards protein quality: amaranth, in fact, does not contain gluten, which is responsible for the network development and the gas holding capacity of a dough. As reported in literature, blends of wheat (70–80%) and amaranth (20–30%) flour showed decreased dough mixing time, mixing tolerance, stability, gelatinization temperatures, viscosities and increased water binding capacity. Breads showed lower loaf volumes, higher moisture retention and longer shelf life. In this study, blends enriched with high amounts (40%) of amaranth wholemeal flour were used in the bread making process. To increase the quality of the final products, the effect of different additives was evaluated by applying statistical experimental designs. In particular, the addition of emulsifiers, guar gum and gluten as well as water were investigated. All breads were evaluated for their textural properties, as crumb firmness and relative elasticity (texture analyser), porosity (image analysis), volume (rapeseed replacement) and crust colour (Dr. Lange Microcolor). The highest influence on improving bread quality was related to the increase of water in the dough, which had a strong interaction with the emulsifiers. Guar gum had good effects when added in low amounts, while gluten addition caused contradictory results and its use at the present stage is questionable. Sensorial evaluation of the optimised breads proved that their textural properties were within the range of breads available on the market.

P-190

Production and utilization of a fluid monoglyceride hydrate emulsifier in a high speed bakery operation. B. R. SEBREE (1). (1) Archer Daniels Midland.

It has long been known that a hydrate form of a fully saturated monoglyceride provides for improved functionality (starch complexing) in a bakery system. This is due to the pre-hydration of the product making it instantly functional in the bakery system. However, current monoglyceride hydrates are available only in a difficult to use paste/shortening form. A process was developed to produce such a product in a fluid/pumpable form that could be more easily utilized in a bakery operation. Microscopic and analytical testing shows the product to be a mixture of alpha-gel and beta-crystalline material very similar to that of the currently used paste/shortening monoglyceride hydrates. The liquid-hydrate product was tested at AIB in a no-time dough system against a powdered-fully saturated distilled monoglyceride, a 22 IV self-hydrating distilled monoglyceride and a standard monoglyceride hydrate (along with a control containing no monoglyceride addition) at equal total monoglyceride inclusion. Bread made from the liquid-hydrate and standard-hydrate emulsifiers scored highest on texture/mouthfeel characteristics and had the highest specific volumes. The 2 hydrate products outperformed the dry-addition

monoglycerides for staling properties (firmness at 7 days) and were not significantly different from each other.

P-191

Selection of parameters for consistent quality of whole wheat barm bread. M. A. SPILLER (1). (1) Whole Grain Connection, Los Altos, CA, USA.

There is a need for whole wheat breads (WWB) that are pleasing in flavor and texture, and are slow to dry out or mold. WWB made with a mash and barm leavening (natural mixture of known yeasts and lactic bacteria in mash) have these characteristics, but it was necessary to evaluate the parameters needed to give consistently high quality with the wide range of available wheat; this was the objective here. The method was to use one batch of hard red wheat grain, stone ground to whole wheat flour (WWF) and obtain protein, moisture and falling number (FN), so that protein could be brought to 14–15% with added vital wheat gluten, and FN to within the known successful breadmaking range of 200–250 by addition of enzyme active malted wheat flour (MWF). Water containing 270 mg/L calcium was used throughout the process because it is known to stabilize alpha-amylase. Optimal conditions for mashing for breadmaking, amounts of MWF to be added to WWF for the mash, the extent of acidification and brining of the mash as a sponge to adequately deactivate excess alpha-amylase from MWF, and the amount of water that could be held in a dough containing 50% of the flour mashed, were not known and were determined. The results for these optimal conditions were as follows: The mash was best if mixed at 65°, held at 60°C for 1–3 hours and allowed to cool to 30°C before use. Up to 2% MWF could be used in the mash when it was pre-fermented to pH 3.5 – 4 with all the barm and proportionate brine from the total bread formula. When 50% of the WWF in formula was mashed, the total dough water could be 90% with respect to total WWF. The significance of these results is that they can be applied to other wheat types such as white wheat, for the production of desirable bread.

P-192

Stickiness of wheat flour doughs and relationship to breadmaking performance and other physical dough tests. F. WANG (1), Y. Zhang (1), W. Zhang (1), W. Chen (1), P. Zhang (1). (1) Henan University of Technology, Zhengzhou, Henan, China.

Measurements of stickiness of wheat flour doughs were made using a TX-XT2 texture analyzer with a dough stickiness cell-probe. A series of wheat flours with various breadmaking potentials were tested at farinograph water absorption and optimum mixing. The flour-water doughs of Chinese wheats exhibited stickier behavior. The stickiness of doughs was highly negatively correlated (r = –0.83) to bread loaf volume for Chinese wheats. Lower dough stickiness favored larger loaf volume of bread. However, there was no correlation (r = –0.13) between dough stickiness and Chinese steamed bread volume. The stickiness of flour-water doughs also was highly correlated to some of the physical dough parameters provided by mixograph, farinograph, and extensograph.

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Technological and sensory evaluation of pan bread elaborated with mixes of wheat flour and unripe banana flour or commercial resistant starch. R. Ormenese (1), C. Batista (2), M. Cáceres (2), Y. K. Chang (2), C. J. STEEL (2). (1) ITAL, Campinas, SP, Brazil; (2) UNICAMP, Campinas, SP, Brazil.

Resistant starch (RS), that resists digestion in the small intestine and is fermented in the large intestine, has effects similar to dietary fiber and is considered a functional ingredient. In this work, the effect of two different sources of RS, unripe banana flour (UBF) or commercial resistant starch (CRS), on technological and sensory properties of pan bread were studied. Wheat flour was substituted by three different levels (10, 15 and 20%) of UBF or CRS. A control bread was prepared with 100% wheat flour. UBF and CRS presented 9% and 60% RS, respectively. Specific volume, moisture content, water activity and texture (firmness) of breads from all formulations were determined. Results were analyzed by ANOVA and the Tukey test. Volume decreased significantly with an increase in the percentage of UBF or CRS, with UBF having a greater effect. The highest value was 4.91 mL/g (control) and the lowest value was 2.92 mL/g (bread with 20% UBF). Only the bread with 20% UBF had a higher moisture content than the rest (35.63%, compared to the control with 32.66%). Water activity was the same for the control (0.968) and for the breads with CRS (average of 0.958), and lower for the breads containing UBF (average of 0.942). With respect to firmness, breads with CRS presented values that ranged from 263.33 to 325.31 gf, breads with UBF ranged from 215.10 to 338.17 gf and the control was 218.53 gf. The sensory acceptance test carried out with 35 untrained panelists showed that the breads with 10% UBF or 10% CRS were satisfactory. The levels of RS (dry basis) of these breads (10.21% RS for the bread with 10% UBF and 13.16% RS for the bread with 10% CRS) showed significant increases with respect to the control (8.45% RS). Thus, it is possible to substitute 10% of the wheat flour in bread by up to 10% UBF or CRS to produce pan bread with greater health benefits.

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Available (AS) and resistant (RS) starch of blue corn tortilla. J. P. Hernandez-Uribe (1), E. AGAMA-ACEVEDO (1), R. Rendon-Villalobos (1), J. J. Islas-Hernandez (1). (1) CEPROBI-IPN, Yautepec, Morelos, Mexico.

Tortilla is the most important source of calories, proteins and calcium for many people of sub-urban and rural areas. Nowadays, pigmented corn tortillas have importance due to the anthocyanins present and their nutraceutical effects. Few studies have been carried out on the effect of nixtamalization of pigmented corn on starch digestibility. The objective was to evaluate the influence of cold storage on the AS and RS contents in tortilla made with blue corn. Blue corn was nixtamalized in the laboratory by the traditional process. White tortilla was purchased in local "tortillería". Samples were stored at 4°C for up to 168 hours and their in vitro starch digestibility features were evaluated. The control tortilla (time 0) made with white corn contained the highest available starch (AS) content and that value decreased when tortilla was stored for 2 days, no statistical differences were found when storage time increased. Similar pattern was obtained for blue tortilla; however, the AS values were lower than white tortilla.

Similar pattern for AS content was found for resistant starch (RS) level, after 2 days the RS content did not show differences ($P > 0.05$). Blue tortilla had lower RS level than white tortilla, pattern than agrees with those AS values determined in the pigmented tortilla. A determined level of RS is due to retrograded resistant starch (RRS). The RRS values were higher in white tortilla, although this parameter did not show differences after 4 storage days. Similar behavior was obtained for blue tortilla, although the RRS values in the pigmented tortilla were lower than those of white tortilla, pattern than agrees with those values obtained for AS and RS contents. Blue corn tortillas had lower AS and RS content than white tortilla and those results may have influenced in the texture of the pigmented tortilla.

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Determination of the sensory attributes of commercial whole grain breads. S. A. SJOBERG (1), Z. M. Vickers (1), M. M. Reicks (1), L. F. Marquart (1). (1) University of Minnesota, St. Paul, MN, USA.

The objective of this study was to characterize 12 commercial 100% whole grain breads using a lexicon developed by nine trained panelists. Panelists were provided initial vocabulary lists from previous bread studies and then generated a lexicon for each category: flavor, texture, appearance, aroma and aftertaste. Panelists were trained to understand and examine 12 whole grain breads for each of the five different categories for both the crumb and the crust (top and bottom). The final lexicon consisted of 59 attributes that described the crumb of the breads and 58 attributes that described the crust. All participants rated the intensity of all 12 breads for each of the five categories and sensory characteristics using a labeled magnitude scale. Principal components analysis (PCA) was used to describe sensory profiles of all 12 breads. By PCA, one bread sample had extreme loading for all five categories for the crumb. This bread sample was characterized as having a not sweet, nutty, grainy, and toasted flavor; and being dry and firm in texture. The following attributes were highly significantly different among the crumb of the breads: sweet taste and honey flavor; fermented aroma; texture; color; sweet aftertaste; and gritty and smooth oral texture. The following attributes were highly significantly different among the crust of the breads: sweet flavor of bottom crust; grain topping size; softness and grittiness of the bottom crust; and sweet aftertaste of top and bottom crust. Overall, this study developed a lexicon for the description of commercial 100% whole grain breads.

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Improvement of frozen dough quality by cold treatment before freezing. Y. PHIMOLSIRIPOL (1), U. Siripatrawan (1), V. Tulyathan (1), D. J. Cleland (2). (1) Department of Food Technology, Chulalongkorn University, Bangkok, Thailand; (2) Institute of Technology and Engineering, Massey University, Palmerston North, New Zealand.

Frozen bread dough use is increasing rapidly in the baking industry. Maintenance of yeast viability and high CO_2 production rates during proofing are key quality attributes of frozen dough. Cold treatment (CT) of yeast suspensions has been shown to improve yeast survival after frozen storage. The objective was to investigate whether similar CT of dough prior to freezing would significantly affect the quality of a straight bread dough. Doughs held at 0°C or 10°C for 1 h or 3 h before air-blast freezing were compared with dough frozen without CT and fresh dough. Cumulative CO_2 production measured in a risograph was used to quantify the dough quality after storage at –18 ± 0.1°C for 1, 7 and 17 days. Each CT and frozen storage combination was replicated 3 times. Analysis of variance and Duncan's multiple range test ($P < 0.05$) was used to detect differences between treatments. CO_2 production relative to fresh dough significantly reduced after freezing for all treatments. The reduction was about 5% for the 0°C/1h, 0°C/3h and 10°C/1h treatments and about 10% for no CT and the 10°C/3h treatment. Dough quality further reduced during frozen storage. Again, the reduction was significantly less for the 0°C/1h, 0°C/3h and 10°C/1h treatments (about 12% reduction after 7 days) than for no CT and the 10°C/3h treatment (about 20–26% reduction after 7 days). After 17 days storage, the doughs with the 0°C/1h, 0°C/3h and 10°C/1h treatments had no significant difference in cumulative CO_2 production but were significantly better than the dough with no CT or with the 10°C/3h treatment. It was concluded that CT before freezing provided significant quality benefits for frozen dough. Future work is required to optimize the temperature and duration of the CT for various yeast strains.

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Isolation and characterisation of antifungal compounds from LAB and their application to improve the shelf-life of wheat bread. F. Dal Bello (3), L. A. Ryan (3), S. RENZETTI (3), K. Ström (2), J. Sjögren (1), J. Schnürer (2), E. K. Arendt (3). (1) Department of Chemistry, Swedish University of Agricultural Sciences, Uppsala, Sweden; (2) Department of Microbiology, Swedish University of Agricultural Sciences, Uppsala, Sweden; (3) Food technology, Food and Nutritional Sciences Department, UCC, Cork, Ireland.

In this study, screening for in vitro antimicrobial activity identified several lactic acid bacteria (LAB) strains active against a wide range of spoilage moulds and bacteria. Isolation of antimicrobial compounds from cell-free supernatant of the strains identified lactic acid, phenyllactic acid and the two cyclic dipeptides cyclo (L-Leu-L-Pro) and cyclo (L-Phe-L-Pro) as the major components responsible for the antifungal activity. To our knowledge, this is the first work describing the isolation of cyclo (L-Leu-L-Pro) from LAB. Antifungal LAB were tested for antifungal activity during wheat sourdough fermentation as well as bread production. As controls, a dough with the addition of the isolated antifungal compounds, a sourdough fermented by a non-antifungal LAB, a chemically acidified (mixture of lactic and acetic acids) dough as well as a non-acidified dough was used. The antifungal activity in sourdough was evaluated using an agar diffusion assay against spores of the fungi *Aspergillus fumigatus*, *Penicillium expansum*, or *Fusarium culmorum*. Antifungal activity in bread was evaluated against the above mentioned fungi as well as common bakery moulds contaminants. Briefly, after baking, bread slices were exposed for 10 minutes to the air in a pilot scale bakery facility, or challenged against the selected fungi applied by nebulisation (circa 104 spores) to each bread slices surface. Mould growth was evaluated over a twelve-day storage period. Remarkably, all LAB strains showed varying levels of antifungal activity both in the form of sourdough or resulting bread against both the environmental and selected fungi. The results of this study

clearly indicate that, compared to the non fermented controls, the antifungal LAB have the potential to increase the shelf-life of wheat bread.

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Procedures for the safe use of potassium bromate in bread making in the Japanese baking industry. K. HIMATA (1), M. Nakamura (1), T. Murakami (1), S. Hosoya (1), Y. Yamada (1). (1) Yamazaki Baking Co., Ltd., Tokyo, Japan.

Potassium bromate (PB), used in bread making for many years around the world, helps bread to rise in the oven and creates a good loaf texture and quality that is pleasing to consumers. In Japan, regulation restricts the use of PB in bakery products to keep bromate residues in final products under 0.5 ppb as measured with a post-column HPLC test. A bread-making method has been developed which results in residues below 0.5 ppb in Pullman-type bread when PB is added at the rate of 12 mg/kg flour or less. The Bromate Sub-committee of the Science & Technology Committee of the Japanese Bakers Association has developed a self-regulatory GMP to use $KBrO_3$ safely, and under which Pullman-type bread has been marketed since June 2004. As part of a strict program of quality control, finished products are tested by the Japan Institute of Baking Technology (JIB) and voluntarily by individual baking companies to verify that no bromate residues are detected. Each facility is inspected periodically by JIB for all the elements of the GMP. The results of the latest Japanese animal feeding studies on the correlation between low dose PB and carcinogenicity in rats will be also reported.

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The influence of enzymatic treatment on wholegrain bread formulations. C. VAN BENSCHOP (1), B. Fatula (2). (1) DSM Food Specialties, Delft, The Netherlands; (2) DSM Food Specialties, Eagleville, PA, USA.

Wholegrain foods are a vital source of nutrients and phyto-protective components. Experts advise that grains are an essential component to all diets and that at least half the grains we consume should be "whole grains". Consumers are becoming increasingly aware of the health benefits associated with wholegrain and are seeking ways to incorporate them into their diet. The main problems related to the manufacture of wholegrain bread are related to the stability of the gluten network and the gas retaining properties. This presentation discusses the issues involved in using whole grains in bread production and the enzyme solutions possible to improve dough and bread characteristics. Results of the addition of specifically acting enzymes will be presented to show their important role in partial breaking down of wholegrain fibers and subsequent restoration of the gluten network structure. This will result in better dough handling characteristics, improved gas retaining property resulting in increased loaf volume and improved softness of the crumb.

P-200

The quality implications of changing glutenin alleles in a century of Australian wheat breeding. G. B. CORNISH (1). (1) South Australian Research & Development Institute, Wheat Quality Research Unit, Adelaide, SA, Australia.

High molecular weight (HMW) and low molecular weight (LMW) glutenin alleles in wheat are coded by the genes *Glu-1* and *Glu-3*, on the long and short arm of chromosome 1 respectively. The glutenin alleles have a major influence on the rheological properties of dough and hence are a major determinant of end-product quality. In the period 1901–2001, 244 wheat varieties have been released by Australian wheat breeding programs. By looking at the changing frequency of glutenin alleles it is possible to observe concurrent shifts in wheat quality. In the past the major driving force for new wheat varieties has been to improve the agronomic yield and the disease resistance. However this emphasis is changing to now selecting varieties for quality traits on the basis of their genetic composition. By following the movement of glutenin alleles in and out of the gene pool it is possible to determine the source of alleles, which have produced improved quality varieties. In the past some of the quality gains have been fortuitous. With the increased knowledge of the effects of various glutenin alleles, it is possible to make much faster gains in quality by increasing the selection pressure on alleles associated with improved quality.

P-201

The role of starch in wheat bread dough preparation and rheology. R. KIEFFER (1). (1) DFA (German Research Center for Food Chemistry) Garching, Germany.

Tensile tests with wheat dough showed that gluten contributes to less than 30% to dough firmness. Therefore the role of the starch fraction during dough preparation and its contribution to the final dough properties were investigated. A new device and a new method for the determination of the rheological properties of highly concentrated starch in water was used. The amount of free water added to pure starch was similar to the free water concentration in wheat dough of 500 BU. Big differences in viscosity and dilatancy were monitored between probes containing small and large starch kernels. Microscopy showed that when these starches were mixed with gluten, specific gluten networks were built up. In the presence of small kernels these networks were weak and the fermented dough collapsed easily.

P-202

Thermal and rheological properties of tortillas elaborated with germinated corn grain. G. ARAMBULA VILLA (1), C. R. Valderrabano Amador (2), E. Cruz Huerta (2), E. Gutierrez Arias (1), I. Verdalet Guzman (2), A. Arambula Peña (3). (1) Centro de Investigacion y de Estudios Avanzados del Instituto Politecnico Nacional, Santiago de Queretaro, Queretaro, Mexico; (2) Instituto de Ciencias Basicas, Universidad Veracruzana, Xalapa, Veracruz, Mexico; (3) ITESM, Santiago de Queretaro, Queretaro, Mexico.

A highly consumed food in Mexico is the maize tortilla, which has low protein quality due to it is deficient in lysine (L) and tryptophan (T). During germination process of maize grain, the L and T concentrations are highly increased and the protein quality is increased too. Besides of nutritional changes, all properties of tortillas produced with this type of maize grain change, and the acceptance by the customer is affected. In this work the thermal and rheological properties of germinated grain and tortillas produced, were evaluated. Two maize varieties, common (CM) and quality protein (QPM), with three germination times (24, 48, 72h) were used and processed by traditional method. Enthalpy, heat capacity (Cp), gelatinization (Gv) and retrogradation (Rv) viscosity

of grain and tortillas were determined. The enthalpy, Gv and Gr decreased and Cp was similar for both grain varieties, as germination time was increased. Comparing the germinated grain and tortillas produced, the enthalpy decreased and Cp did not show significant changes for both maize varieties. The best tortillas were those elaborated with CM and QPM, with 48 h germination time.

P-203
Understanding the basis of flour tortilla stickiness. J. H. Rathod (1), H. Dogan (1), J. L. KOKINI (1). (1) Rutgers University.

Tortilla stickiness is highly undesirable for the food service industry. In this study it was aimed to understand the factors which control stickiness in wheat flour tortilla products based on a phase/state-change approach and measurement of surface properties. A variety of commercial wheat tortillas with a wide range of stickiness scores as indicated by sensory panels were selected. Tortilla samples were equilibrated to different water activity (A_w) levels in the range 0.12–0.97 to characterize the phase/state of the tortilla at controlled relative humidity and temperature. Moisture sorption isotherms were developed. Differential scanning calorimetry (DSC) and mechanical spectroscopy were used to characterize the phase behavior. We used wide-angle X-ray scattering to understand the effect of crystallinity, contact angle measurements to determine the surface hydrophobicity through surface energy calculations. An objective instrumental test technique was developed using a texture analyzer to quantify the stickiness in tortilla samples. Instrumentally observed stickiness was linked to surface chemistry of the tortilla samples by contact angle measurements. Instrumental stickiness scores showed a close agreement ($R^2 = 0.85$) with the sensory scores. The developed state diagram has shown that both sticky and non-sticky tortillas have similar phase behavior. Water activity had a significant impact on tortilla stickiness. Polar component of surface energy was found to have a strong correlation with stickiness. Higher product A_w resulted in increase in surface energy which in turn caused an increase in instrumental stickiness scores ($R^2 = 0.82$). Tortillas with high surface energy (driven by high A_w) are more likely to stick to each other.

P-204
Determination of malting behaviour and brewing quality parameters of new wheat varieties in a new pilot malting facility. J. VOIGT (1), T. Kraus-Weyermann (2), J. Buhrmann (2). (1) Technical University Munich Weihenstephan, Freising, Germany; (2) Weyermann Specialty Malt, Bamberg, Germany.

Malt from wheat requires special attention during steeping, germination and kilning. Because there are no binding definitions of Wheat for brewing, the selection of suitable wheat varieties need great care. Malting behaviour and product quality of wheat malts from 3 varieties (Flair, Maltop, Dekan) where investigated by using a new pilot malting plant. The malting conditions are documented and show that these varieties are suitable for Bavarian-style wheat beers like Hefeweizen. The pilot plant consists of a one-vessel HDP system from using a load of 100 kg. The system is described and modifications with regard to the air-flow and air-conditioning as necessary for the specific process. Malting methods for wheat were adapted. The 3 varieties were in tested in their physical-chemical quality, product specification and behaviour in trial brewing. Beers from these trials were produced and analysed including tasting and flavour characterization. Flair, Maltop and Dekan are varieties recommended for the production of wheat brewing malt because of their agricultural production behaviour, even though the production yield in farming may be smaller compared to other wheat varieties. The paper presents suggestions how to use such varieties in the production of wheat beers.

P-205
Determination of mixed linkage beta-glucan in high fiber ready-to-eat commercial breakfast cereals. M. R. FALCON-VILLA (1), G. A. Yañez-Farias (1), A. L. Romero-Baranzini (1), J. M. Barron-Hoyos (1). (1) Universidad de Sonora, Hermosillo, Sonora, Mexico.

The importance of dietary fiber and the contribution of fiber rich ready-to-eat (RTE) commercial breakfast cereals to the diet has been long recognized. Three high fiber commercial RTE cereals (A, and B wheat bran based, C wheat and corn bran based), commonly consumed in the northwest part of Mexico, were selected from the local market. A highly consumed corn flake brand and a rolled whole oat cereal were also included as references. All samples were analyzed for their chemical composition, total dietary fiber (both soluble and insoluble fractions) and mixed linkage beta-glucan, using the official recommended methods. Breakfast cereals showed differences in their dietary fiber and also in mixed linkage beta-glucan. The oat cereal showed the highest value of mixed linkage beta-glucan, followed by the A and B cereals, with the lowest value shown by the C cereal. According to these results the consumption of wheat bran based high fiber RTE cereals is highly recommended, not only for their high insoluble fiber, but also because of their relatively high mixed linkage beta-glucan contents.

P-206
Development of an improved quantitative analysis of cereal beta-glucan by high-performance anion-exchange chromatography. D. YOO (1), B. Lee (1), S. Kim (1), S. Yoo (1). (1) Department of Food Science and Technology, Sejong University, Seoul, Korea.

Cereal beta-glucan is a linear biopolymer linked by beta-(1,3)/(1,4)-glycosidic bonds. Cereal beta-glucan is known to have biological functionalities, such as hypo-cholesterolemic and hypo-glycemic effects. An enzymatic assay kit and a high-performance anion-exchange chromatography (HPAEC) method have been widely used for the structural and quantitative analysis of cereal beta-glucan. The HPAEC method is associated with enzymatic hydrolysis with a lichenase that cleaves the beta-(1, 4)-linkage adjacent to a beta-(1, 3)-linkage. In this procedure of beta-glucan quantification, most abundant hydrolyzed products were 3-O-beta-cellobiosyl-D-glucose and 3-O-beta-cellotriosyl-D-glucose. However, the absence of available standard oligosaccharides was a potential problem to quantify them. Until now, either alpha-(1, 4)-linked or beta-(1, 4)-linked G3 and G4 has been frequently used for this purpose, but these oligosaccharides had different chromatographic elution times and response sensitivities from the hydrolyzed products of cereal beta-glucans. In this study, hydrolyzed products were generated from the lichenase-treated barley beta-glucan, and

3-O-beta-cellobiosyl-D-glucose and 3-O-beta-cellotriosyl-D-glucose were separated and highly purified by recycling preparative HPLC technology. Structural analysis of purified 3-O-beta-cellobiosyl-D-glucose and 3-O-beta-cellotriosyl-D-glucose was performed with an enzymatic method. Using these structurally confirmed oligosaccharides, the exact amounts of beta-glucan hydrolyzates were quantified, and this improved analytical method was applied to determine the beta-glucan content of selected barely varieties.

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Physical and functional characteristics of soybeans soaked in *Lactobacillus*-fermented whey solution. C. SUNG (1), D. Yoo (1), S. Kim (1), W. Kim (1), S. Yoo (1). (1) Department of Food Science and Technology, Sejong University, Seoul, Korea.

Our study was designed to observe the changes in physical and functional characteristics of soybeans during the soaking in LAB (lactic acid bacteria)-fermented whey solution. The objectives of this study were to decrease the possibility of microbial contamination in the soybean process and to find out the effect of the fermentation soaking on functional component contents of soybean products. As the fermentation soaking proceeded in the ABT-3 (*Lactobacillus acidophilus*, *Bifidobacterium longum*, *Streptococcus thermophilus*) cultured whey, pH decreased to 5.1 and titratable acidity (TA) increased to 0.2% after 24 hr soaking at 40°C. General bacterial count substantially decreased from 1.6×10^4 to less than 1.0×10^3 CFU/mL in the soybean soaked by ABT-3 cultured whey while the number of LAB changed from 1.5×10^4 to 6.6×10^8 CFU/mL within 18 hr of the soaking period. Meanwhile, soaked soybean samples in the K-9 (*Bifidobacterium infantis*) cultured whey decomposed at 30–50°C within 12 hr. Because K-9 strain did not grow well and prevent other microbial contamination, K-9 fermentation soaking would not be useful for soybean processing. The GABA (gamma-aminobutyric acid) content in the soybean soaked in ABT-3 cultured whey changed from initial 12.5 mg/100 g to 29.1 mg/100 g and to 80.3 mg/100 g at 40°C during 6- and 24-hr soaking, respectively. Especially, the increase in GABA content was proportional to the soaking time at 40°C. The GABA accumulating rate of this process was comparable to that of typical water-based soaking process. Using ABT-3 cultured whey as a soybean soaking solution, therefore, microbial contamination was effectively prevented without sacrificing GABA accumulation. Changes in isoflavone and soyasaponin contents were also observed.

P-208

Change in vitamin C content in extruded corn starch matrix by process variable and packaging. G. RYU (1), S. Kim (1), J. Han (1), T. Jin (1). (1) Department of Food Science and Technology, Kongju National University, Yesan, Korea.

The objective of study was to determine effect of extrusion variables (barrel temperature and water content) and package methods on vitamin C loss rate in the extruded corn starch matrix. Extrusion conditions were barrel temperature (80, 90, 100, 110°C), water content (25, 30%), and die diameter (3.0 mm). The vitamin C content decreased as barrel temperature increased from 80°C to 110°C and water content increased from 25% to 30%, when same loss was found from both the general packing and the vacuum packing. As barrel temperature and water content increased, vitamin C decreased in both the general packing and the vacuum packing. Vitamin C content was higher in the vacuum packing than that of the general packing. As storage period increased by 5 weeks, vitamin C content was decreased. Difference in vitamin C content was larger in the non-extruded group than the extruded group, while destruction was lower in the extruded group than the non-extruded group. In conclusion, the higher temperature and the more water content, the less vitamin C content implied the increasing of surface area, thickness of the air cell wall decreased, and loss rate of vitamin C in the matrix became faster with increase in expansion ratio of the matrix.

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Effect of malting and supercritical fluid extraction on the antioxidativity of oats. J. PIHLAVA (1), H. Aro (1), V. Hietaniemi (1), O. Myllymaki (2), A. Kaukovirta-Norja (2). (1) MTT Agrifood Research Finland, Laboratories, Jokioinen, Finland; (2) VTT Technical Research Centre of Finland, VTT, Finland.

In order to produce new value-added oat fractions for food, feed and/or cosmetic applications, supercritical carbon dioxide (SC-CO_2) extraction was studied as one of a potential processing techniques. As a raw material stabilized flaked oats and malted rolled oats were studied. Oat samples (2 kg) were extracted in pilot-scale using pure CO_2 at 70°C and at 450 bar (CO_2 flow 0,4 l/min, 5 h). SC-CO_2-extraction reduced the DPPH-antioxidativity in oat flakes and rolled malted oats by 30 and 32% respectively. In the malted oats the antioxidativity was almost twice as high as in the oat flakes. SC-CO_2-extraction did not affect the content of avenanthramides in oat flakes (31 ppm). However, in the rolled malted oats the content of avenanthramides decreased by 20% from the original 208 ppm. It can be concluded that tocols and other SC-CO_2-extractable minor components contribute a great deal of DPPH-antioxidativity in oats.

P-210

Impact of oat flours with different beta-glucan amounts on in vitro fermentation and its products. S. Sayar (2), J. Jannink (1), P. J. WHITE (2). (1) Department of Agronomy, Iowa State University, Ames, IA; (2) Department of Food Science and Human Nutrition, Iowa State University, Ames, IA.

Flours from two commercial oat lines with 4.7% and 5.3% beta-glucan, and from two high-beta-glucan experimental lines with 7.6% and 8.0% beta-glucan were evaluated for their potential to alter gut microflora growth and the accompanying formation of desirable short-chain fatty acids (SCFA) and lower pH. Flours were digested by an in vitro digestion system, using alpha-amylase (from human saliva), porcine pepsin and pancreatin enzymes. Digestion residues (indigestible part) were fermented by using an in vitro batch fermentation system under anaerobic conditions for 24 h. The progress of the fermentation was studied by following the change in pH of the fermentation medium, production of SCFA and gases, and consumption of carbohydrates. The substrate from the flour with the greatest amount of beta-glucan tended to have the greatest pH decline and also the greatest total SCFA production. A significant correlation occurred between the total SCFA produced and the pH decrease. Total SCFA production was between 14.3–15.9 mmol/g of digestion residue; greater than values given for other dietary fiber-rich substrates reported in the literature. More acetic and propionic

acids were produced from flours with greater beta-glucan concentrations. However, there were no significant differences in butyric acid production. The correlation between SCFA and total gas production also was not significant. With the given fermentation conditions more than 80% of the total carbohydrates was depleted by the bacteria after 24 h. Glucose was the fastest consumed carbohydrate among other available monosaccharides in the fermentation medium.

P-211

Procyanidins in processed sorghum-based food products. N. R. DLAMINI (1), J. R. Taylor (2), C. M. McDonough (1), L. Dykes (1), L. W. Rooney (1). (1) Texas A&M University, College Station, TX; (2) University of Pretoria, Pretoria, South Africa.

The processing of tannin sorghum grains alters the profile of measurable procyanidins (condensed tannins) in sorghum-based foods; this affects astringency, enzyme inhibition and antioxidant activity. The objective was to quantify, using normal-phase HPLC and fluorescence detection, the procyanidin profile in porridges, extrudates and bread containing tannin sorghum bran. The HPLC resolved procyanidins up to octamers (DP 8), while those with DP > 8, were grouped into a single peak. The tannin content and antioxidant activity of the grains and processed products were evaluated using the vanillin-HCl and ABTS methods respectively. Generally processing decreased measurable tannin content and in vitro antioxidant activity. The porridges had significantly lower polymer and total procyanidin contents (7 and 12 mg/g respectively), compared to unprocessed grain (17 and 24 mg/g). The procyanidin oligomer content did not differ significantly between porridges (5 mg/g) and the grains (7 mg/g), although extrudates had lower values (3 mg/g). The baking process of bread (containing sorghum bran) significantly decreased (95–97%) measurable tannin content of the bran. The results suggest that high molecular weight procyanidins interact with food components during cooking and baking. The extractable oligomers mainly contribute to in vitro antioxidant activity of processed food. Preliminary work with amylase-treated processed products indicates an increase (200%) in measurable tannins and antioxidant activity. These observations suggest that during digestion, antioxidants may become more available.

P-212

The effect of cooking on starch digestibility of corn and sorghum porridges. D. L. AUSTIN (1), L. W. Rooney (1), C. M. McDonough (1). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA.

The glycemic index (GI) measures how quickly blood sugar level increases with respect to carbohydrate consumption. High GI foods produce a greater increase in blood glucose levels than low GI foods. The objective was to evaluate the effect of cooking on EGI via in vitro starch digestibility of sorghum starch and flours. Initial solid contents of porridges were 16% (starch/flour: water). Porridge mixture was cooked on a stovetop for 7 min with constant stirring. The porridges were stored at 23 C for 12 h before analysis; samples were collected in duplicate. In vitro starch digestibility (SD, % digested starch) was determined by pepsin followed by alpha-amylase. A non-linear model was applied to describe the kinetics of starch hydrolysis: $C = C_{\infty}(1\text{-}e)^{-kt}$ (Goñi et al 1997). The hydrolysis index (HI) was obtained by dividing the area under the hydrolysis curve of each sample by the corresponding area of a reference sample, fresh white bread. The estimated glycemic index (EGI) was calculated using the equation EGI = 39.71 + 0.549(HI). SPSS v11.5 was used with one-way ANOVA with a confidence level of 95% (alpha = 0.05). Porridge cooking significantly increased digestibility of corn and sorghum starches. Cooked sorghum starch was significantly ($P < 0.05$) less digestible than cooked corn starch. Cooking of sorghum flour into porridges significantly ($P < 0.05$) decreased SD. The rapidly digested starch (RDS) was defined as the percentage of starch digested at 30 min, and the slowly digested starch (SDS) as the percentage of starch digested at 120 min. A significant ($P < 0.05$) correlation ($R^2 = 0.84$) was established between EGI and RSD of sorghum porridges. Porridges made with combinations of different sorghum bran, flour and starches will be evaluated, including sorghum flours and sorghum brans with and without condensed tannins.

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Development of an organic fiber-rich extruded breakfast cereal using passion fruit fiber and corn flour: Evaluation of technological properties. G. Vernaza (1), C. J. STEEL (1). (1) UNICAMP, Campinas, SP, Brazil.

Consumers are more and more aware of the health benefits they can obtain from their food and the demand for both functional and organic foods is increasing. Among functional foods, those enriched with fibers have had a positive acceptance. The aim of this study was to evaluate the effect of thermoplastic extrusion and the addition of an alternative fiber source (organic passion fruit fiber) on technological properties of an organic fiber-rich extruded breakfast cereal. A 23 central composite rotational design (CCRD) was used, permitting the analysis of the results by the response surface methodology. The effects of raw material moisture content (18–28%), added fiber (0–30%) and second and third zone barrel temperatures (120–160°C) on the expansion index (EI), instrumental hardness and color (CIELCh system) were studied. The EI ranged from 1.02 to 4.11. Maximum EI is desirable. The response surfaces demonstrated that at lower moisture content, fiber and temperature, higher expansion was obtained. Hardness varied from 9.36 to 25.73 N. Minimum hardness is desirable. The response surfaces showed that at lower moisture content and fiber; at lower fiber and temperature; and at lower moisture content and higher temperature, lower hardness values were obtained. Color is the result of the mix of ingredients and can be an indicator of extruder parameters and the intensity of the Maillard reaction. The response surfaces for chroma (C) indicated that at the lowest values of the three variables studied, the maximum values for this response were obtained. The response surfaces for lightness (L) showed that higher fiber contents yielded darker products; higher temperatures yielded lighter products; and moisture had little effect.

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Effect of cutter speed on the quality characteristics of legume extrudates. R. T. PATIL (1), J. Berrios (2), J. Tang (3), B. Swanson (3), J. Pan (2). (1) Central Institute of Agricultural Engineering, Bhopal, India; (2) USDA-ARS, WRRC, Albany, CA, USA; (3) WSU, Pullman, WA, USA.

Legumes are nutritious foods because they contain about 65% complex carbohydrates, 20–25% protein and 15–20% dietary fiber. Twin screw extrusion technology is suitable for production of legume based ready to eat products. The effect of cutter speed at two 500 rpm (low) and 2000 rpm (high) at 55° angle of inclination was studied on sensory and textural properties of the extrudate. The shape of the product greatly varied with cutter speed. At lower speed the product was cylindrical where as at 2000 rpm the ball shaped product was obtained. The functional properties of extrudates like expansion ratio, bulk density, water holding capacity, water absorption index and water solubility index were not significantly affected due to cutter speed. However, the textural properties like hardness, fracturability, cohesiveness, chewiness and resilience were significantly affected ($P > 0.01$) due to change in cutter speed. All sensory attributes evaluated by hedonic scale for uncoated extrudates indicated no significant difference due to change in cutter speed or change in shape of the product. The results throw new light on the capability of extrusion cooker to produce variety of products even with the externally mounted accessories like the cutter.

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Properties of extruded products made from high beta-glucan and traditional oat lines. N. YAO (2), J. Jannink (1), S. Alavi (3), P. J. White (2). (1) Department of Agronomy, Iowa State University, Ames, IA, USA; (2) Department of Food Science and Human Nutrition, Iowa State University, Ames, IA, USA; (3) Department of Grain Science and Industry, Kansas State University, Manhattan, KS, USA.

The impact of extrusion processing on the physical and sensory properties, and on in vitro bile acid (BA) binding of two oat lines, N979 and Jim, with beta-glucan concentrations of 8.1% and 4.8%, respectively, were examined. For optimization purposes, cereal based on the Jim variety was extruded at 16%, 18%, 21%, 25%, 28% and 30% moisture contents, and final zone temperatures of 125, 150, 165 and 180°C. Based on hardness and edibility, moisture contents of 16 to 21%, and temperatures of 165 and 180°C were selected for N979 oat cereal extrusion. Jim-based extruded cereal had a significantly greater ($P < 0.05$) expansion ratio than that based on N979 at most moisture contents. Water hydration of Jim cereal either was greater than N979 cereal or not different at different conditions. N979 cereal was browner, but not harder, than Jim cereal. Cereal made from N979 and Jim had 5.29–5.99% and 3.38–3.94% beta-glucan, respectively. Changing extrusion temperature and/or moisture content did not affect beta-glucan concentration in the final products. Oat cereal made from the N979 line at 165°C and 16% moisture had greater BA binding than did Jim and Cheerios cereal, and had comparable crunchiness. BA binding of Jim cereal tended to increase, whereas BA of N979 cereal tended to decrease when processing temperature increased from 165 to 180°C. Results suggested that proper processing and preparation techniques can generate high quality products with potential physiological benefit from high beta-glucan oat lines.

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Reduced-calorie flour containing type 3 resistant starch used in model extruded cereal system. L. C. HAYNES (3), M. Kweon (4), L. Slade (1), H. Levine (1), J. Locke (3), V. Arora (3), J. Zimeri (2). (1) Food Polymer Science Consultancy, Morris Plains, NJ, USA; (2) Fresh Start Bakeries, Brea, CA, USA; (3) Kraft Foods, East Hanover, NJ, USA; (4) USDA, ARS, SWQL, Wooster, OH, USA.

A reduced-calorie flour replacer containing type 3 resistant starch, made from a process comprised of a gelatinization, nucleation/propagation, and heat treatment stage for an amylose extender corn starch (aeWx VII), was evaluated in a extruded cereal formula. The densified, recrystallized starch has increased total RS yield, reduced water-holding capacity and increased granular density comparable to wheat flour. The flour replacer contains more than 50% by weight, high-melting RS3, which was used to replace 50% of the flour blend in an extruded cereal formula. Superior cereal extrusion characteristics were the result, such as cereal volume, crispness and toasted brown color, comparable to those achieved with conventional soft wheat flour, in contrast to commercially available RS ingredients used at such a high level. In addition, the high melting point of this RS permitted its use in extruded cereal formulations, without substantial loss of enzyme resistance.

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Starch retrogradation in wheat flour products: Effects of the conditions of storage. H. CHANVRIER (1), S. Uthayakumaran (1), A. Htoon (1). (1) Food Science Australia, North Ryde, NSW, Australia.

Six commercial wheat flours were selected for the study according to their starch properties, such as amylose and amylopectin content and gelatinisation temperature and enthalpy measured by differential scanning calorimetry (DSC). The flours were processed using a capillary rheometer under two different conditions of moisture content (MC) and temperature to mimic extruded snack products (28% MC-140°C) and bread products (45% MC-110°C). The latter conditions did not give satisfactory products. The products processed at 140°C were then stored at 22% MC for three days at three temperatures (40°C, 60°C and 80°C). The amount of retrograded starch, obtained from retrograded amylopectin and amylose in the stored samples, as evaluated by DSC, was observed to be higher for the products made from soft wheat than for the ones made from hard wheat. The amount of retrograded amylopectin appeared to increase with the storage temperature, whereas retrograded amylose did not seem to be affected by the storage temperature. Dynamic mechanical analysis on the end-products was performed with the objective of relating the thermomechanical properties of the products to the amount of retrograded starch. Broader transitions were observed on the DMA thermograms for stored samples presenting retrograded starch. Storage modulus was also increased with the increasing amount of retrograded starch. This study is of interest to the generation of retrograded starch in cereal products via processing, particularly to obtain type III resistant starch, and for the control of its formation without compromising the textural attributes of the products.

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The effect of different levels of corn starch on the textural and functional properties of the extruded ready-to-eat snacks. V. STOJCESKA (1), P. Ainsworth (1), A. Plunkett (1). (1) Manchester Metropolitan University, Department of Food, Clothing and Hospitality Management, Manchester, UK.

A ready-to-eat snack product based on wheat flour with high levels of protein, vitamins and minerals was developed using extrusion technology. In order to obtain an acceptable product with expanded texture the product was reformulated by replacing the flour with different levels of corn starch (30–100%). The extrusion cooking was carried out using twin-screw extruder. Process conditions were utilized at constant feeding rate of 21 kg/h, barrel temperature 40–40-70-100-130-1500C and three different screw speeds of 200, 300 and 400 rpm. Pressure, torque and material temperature were recorded during each experimental run. The extrudate properties of sectional expansion index (SEI), water absorption index (WAI), water solubility index (WSI), protein content, bulk density and colour (L, a and b) were measured. Digital image analyses were employed to determine the number and the area of the bubbles in the finished product. Bubbles were selected and placed in the three different categories according their sectional area: 0–1 mm^2, 1–5 mm^2 and above 5 mm^2. It was found that increasing the corn starch level was positively related to the SEI ($P < 0.001$), the number of the bubbles with area of above 5 mm^2 ($P < 0.001$) but was negatively correlated to the number of bubbles with the size of 0–1 mm^2 and bulk density. Increasing the screw speed, with the samples containing the same level of starch resulted in decreased expansion. Results indicated that the most acceptable texture was obtained at 30% level of corn starch at 250 rpm screw speed.

P-219

A method of determining the dietary fibre content in extruded food using waveguide cells. S. KWEI (1), P. Ainsworth (1), A. Gibson (2), A. Haigh (2), A. Plunkett (1), V. Stojceska (1), G. Parkinson (2). (1) Manchester Metropolitan University, Manchester, UK; (2) The University of Manchester, Manchester, UK.

Dietary fibre is essential in the human diet and knowledge of fibre content is therefore important for clinical programmes and legal requirements such as food labelling in grain-based food industries. Conventional measurement of dietary fibre is a difficult, off-line and time-consuming activity. Consequently, there is a need for a rapid, reliable and non-invasive technology for fibre content determination. A knowledge of the complex permittivity of materials at microwave frequencies is important in the description of their physical and chemical properties. Using a waveguide cell, a non-invasive microwave technique is used to extract the complex permittivity of extruded food samples at 2.5–3.5 giga Hertz. Extruded samples with varying dietary fibre content ranging from 0%–30% fibre were produced from rice flour and resistant starch. Parameters such as particle size and moisture content, which influence the permittivity of a material, were carefully controlled. Measurements were conducted using a calibrated vector network analyzer (HP8510B). Milled fibre samples with unknown complex permittivity were placed inside a custom-built sample holder made with waveguide and Perspex windows. The Musil-Zacek model was used to convert the S-parameter measurement to a complex permittivity value for the sample in the cell. The results obtained showed that the real permittivity of the sample increased consistently as the dietary fibre content is increased. This clearly demonstrated that the real part of the permittivity is a reliable indicator for determining the dietary fibre content in a sample. In conclusion, microwave measurement techniques can potentially offer online, non-invasive and real-time measurement of dietary fibre in food processes.

P-220

A mutation in the starch-branching enzyme 2a gene leads to high resistant starch in maize leaf blade tissue. H. XIA (1), J. Li (1), M. J. Guiltinan (1), D. B. Thompson (1). (1) Penn State University, State College, PA.

Although reserve starch formed in amyloplasts of maize kernel endosperm has been widely studied, less attention has been paid to the transitory starch formed in maize leaf chloroplasts. Maize starch-branching enzyme IIa (SBEIIa) is the major SBE isoform expressed in leaves. In plants, leaf starch accumulates during the day and is readily degraded during the dark cycle. However, for the sbe2a mutant, leaf starch appears not to be degraded during the night and remains at the same levels as during the day (unpublished data). The objective was to determine susceptibility of this sbe2a mutant leaf starch to pancreatic alpha-amylase. Leaves were harvested from plants after 1 month and 2 months of germination. An in vitro digestion timecourse was employed to examine the course of starch digestion over 16 hr by analysis of the supernatant. Starch from wild type leaves was digested rapidly and completely. A portion of the sbe2a leaf starch exhibited a very fast digestion rate during the first hour; the remainder showed an extremely slow digestion rate after that. Both the 1-mo and 2-mo old sbe2a leaf starch produced a high resistant starch (RS) value (52% and 45%), comparable to the RS (52%) of commercial high amylose maize starch (aeVII); however, the digestion rate for sbe2a leaf starch during the first two hours was much faster than for aeVII. Leaf starch from sbe2a maize appears to be a unique combination of enzyme susceptibility and enzyme resistance.

P-221

A simple assay for lipase activity in wheat flour streams. N. ZHOU (2), L. Haynes (2), W. Chung (2), L. Slade (1). (1) Food Polymer Science Consultancy, Morris Plains, NJ, USA; (2) Kraft Foods, East Hanover, NJ, USA.

Whole grain flour tends to have a shorter shelf life, due to rancidity. Lipase, rich in germ and bran, has been shown to cause hydrolytic rancidity. It hydrolyzes triglycerides into free fatty acid and glycerol. Free fatty acid may have a soapy flavor, and is more susceptible to oxidation and rancid flavor development. A spectrophotometric assay to quantitatively measure lipase activity in cereal products, specifically for wheat flours, was developed. The method uses p-nitrophenyl butyrate (p-NPB) as substrate. Lipase hydrolyzes p-NPB into p-nitrophenol (p-NP) and butyric acid. The absorption of p-NP was measured at 400 nm at pH 7.5 with spectrophotometer. The kinetics of lipase was studied with wheat germ lipase standard. The maximum reaction velocity (Vm) and Michaelis constant (Km) are 0.005891 A/min/0.5 mg and 0.1139 mM/0.5 mg, respectively. The method was used to evaluate lipase activity in a variety of wheat mill streams during whole grain milling. The results indicated that

the wheat germ and bran contain significantly higher lipase activity than endosperm. This method is simple, easy, fast, and sensitive. It may be a useful tool for whole grain research and product development.

P-222

Alkaline dissolution of starch facilitated by microwave heating for analysis by size-exclusion chromatography. H. KIM (2), K. C. Huber (2), J. S. Higley (1). (1) TIC Gums, Belcamp, MD, USA; (2) University of Idaho, Moscow, ID, USA.

Dissolution of starch in aqueous media represents a critical step for the analysis of starch structure by size-exclusion chromatography (SEC). Traditional starch dissolution methods involve initial heating of starch in aqueous dimethyl sulfoxide (DMSO), followed by precipitation of solubilized starch in ethanol and a final re-dissolution of starch molecules in an aqueous medium with aid of physical and/or thermal treatments. However, traditional methods are both labor- and time-intensive, and expose starch molecules to extensive heat and/or shear. The objective of this work was to investigate the use of alkali combined with microwave heating to facilitate rapid dissolution of starch for SEC. Soft wheat starch, which was dispersed in a mixture of 6 M urea and 1 M KOH and heated for 35, 45, or 60 sec in a microwave oven, was fractionated using size-exclusion chromatography (SEC). Starch solubility was 91.2, 97.3, and 98.1% for 35, 45, and 60 sec of microwave heating, respectively. A steady decrease in amylopectin peak area, along with an increased tailing of the amylopectin peak, was observed as microwave heating time was increased from 35 to 60 sec. Overall, a decrease in the amylopectin:amylose ratio from 2.9 to 1.2 was observed with increased microwave heating times. Microwave heating for 35 sec offered reasonable separation of starch fractions, while limiting molecular degradation. This procedure provides a fast, simple, and effective starch dissolution method for preparation of starches for SEC analysis.

P-223

Allele composition at the Pina-D1 and Pinb-D1 loci, puroindoline content and seed weight affect grain hardness in common wheat. L. Gazza (1), M. Corbellini (3), N. E. POGNA (2). (1) CRA-Istituto Sperimentale per la Cerealicoltura, Rome, Italy; (2) CRA Istituto Sperimentale Cerealicoltura; (3) CRA Istituto Sperimentale Cerealicoltura, S.Angelo Lodigiano, Italy.

Thirteen common wheat (*Triticum aestivum* L.) cultivars possessing wild type allele Pina-D1a encoding for puroindoline a (pin-A) were grown in six Italian locations and compared for their seed weight, protein content and kernel hardness as determined by the SKCS method. Moreover, the amounts of puroindolines a (pin-A) and b (pin-B) were determined by densitometry scanning of acidic PAGE fractionations of proteins bound to the starch granules. Seven cultivars with wild type allele a at the Pinb-D1 locus coding for puroindoline b (pin-B) showed soft grain with mean SKCS value of 33.6 ± 9.8 (SD), whereas six cultivars with allele b or d at the same locus exhibited hard kernels with mean SKCS value of 64.8 ± 10.9. Variation of grain texture was found to be significantly correlated with seed weight in hard cultivars (r = –0.80 to –0.94), as well as in three soft cultivars (r = –0.74 to –0.88). On the contrary, no correlation was found between protein content and seed weight or SKCS value. The soft-textured varieties accumulated high amounts of pin-B on the starch granules as compared with the hard–textured cultivars. Moreover, the amount of both pin-A and pin-B was not correlated with protein content. The present results suggest that variation in grain texture is largely due to puroindoline allele composition and seed weight.

P-224

Analysis of phenols, tannins, and antioxidant activity of grain legumes compared with different whole grain cereals. A. P. CARDENAS-HINOJOSA (1), D. Guajardo-Flores (1), L. Dykes (1), C. M. McDonough (1), L. W. Rooney (1). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA.

Phenol content, tannin content and antioxidant activity of grain legumes were analyzed and compared with whole grains of seven cereals. Total phenol content, tannin content and antioxidant activity were analyzed using the Folin-Ciocalteu, the Vanillin-HCl, and the ABTS methods, respectively. Red beans had higher but similar amounts of phenols as black and pink beans. Cowpea Vas 462 had the highest levels of phenols (12.5 mg GAE/g). Tannins were present in all colored beans; with red beans having the highest levels (8.3 mg CE/g). Cowpea Vas 462 had the highest tannin content (10.8 mg CE/g). The antioxidant activity of red and black beans (87.9 and 85.3 µmol TE/g, respectively) was higher than pink (74.5 µmol TE/g) and white beans (10.6 µmol TE/g). Cowpeas Vas 462 and Chinese Reds cowpeas had the highest antioxidant activity (104.9 and 104.6 µmol TE/ g, respectively). All colored beans and cowpeas had more phenols content, tannin content, and antioxidant activity than corn. Red wheat, white sorghum, white beans, and white cowpeas had similar low values. In general, cowpeas and beans had more phenols content, tannin content, and antioxidant activity than the major whole grain cereals. However, Tannin sorghums had the highest antioxidant activity among all the grains evaluated.

P-225

Changes of property and morphology of cationic corn starch granules. W. Kuo (1), H. LAI (1). (1) Dept. Agric. Chem., National Taiwan University.

Cationic starches with a series of degree of cationization were prepared by the reaction of 18% corn starch slurry with cationizing agent (CHPTAC/AGU = 1 and 1.71) at 40° for 2, 5 and 24 h. The pasting and thermal properties and morphological changes of cationic starch granules, stained with APTS, were investigated. The results show that the DS of cationic starches increased with increasing in the amount of CHPTAC and reaction time from 0.015 to 0.131. Lower pasting and peak temperature, but higher peak viscosity and breakdown were found in all cationic starches. The transition temperature and gelatinization enthalpy of cationic starches were lower and smaller than native one, indicating the decreases of crystallinity of cationic starch granules. Interruption of starch molecular arrangement of cationic starch, especially on granular periphery, was evidenced by the strong intensity of APTS and the void spaces around the central helium region of 24 h-cationized starch granules were observed.

P-226

Characterization of starches from seven maize amylose-extender mutants. L. LI (1), H. Jiang (1), M. Campbell (2), J. Jane (1). (1) Iowa State University, Ames, IA, USA; (2) Truman State University, Kirksville, MO, USA.

Endosperm starches from seven maize *ae* mutants were analyzed for their structures, thermal properties, and resistant starch (RS) contents. The RS contents were measured using AOAC method for total insoluble dietary fiber. The RS contents of three new lines (39.4%–43.2%) were higher than those of four inbred lines, OH43*ae*, H99*ae*, B89*ae*, and B84*ae* (11.5%–19.1%). Gel permeation chromatograms revealed that all the seven starches contained large proportions of amylose and intermediate component (66.5%–89.3%). The starches isolated from the three new lines consisted of more amylose and intermediate component (86.1%–89.3%) than the others (66.5%–74.6%). The RS contents of the starches were positively correlated with the contents of amylose and intermediate component, with a correlation coefficient of 0.94. After the amylose was removed from the starches by butanol precipitation, the remaining supernatant contained 46.4%–80.1% intermediate component, which were positively correlated with the RS contents of the starches with a correlation coefficient of 0.83. All the seven starches displayed similar onset gelatinization temperatures (64.5–66.7°C). However, broader gelatinization temperature ranges were observed for the starches from the three new lines. The conclusion temperatures of the starches isolated from the three new lines (106.0–107.7°C) were higher than those of the starches isolated from the four inbred lines (88.0–99.8°C). The results suggested that the starch of the three new lines were not completely gelatinized during the boiling process of RS content measurement and the semi-crystalline structure was partially maintained. Therefore, the starches of the three new lines were resistant to enzyme hydrolysis and resulted in higher RS contents.

P-227

Comparison of iodine binding ability of maize starch lintners with different amylose content. D. SAIBENE (1), K. Seetharaman (1). (1) Penn State University, State College, PA, USA.

The objective of this study was to investigate the iodine binding ability of maize starch granule remnants obtained following acid hydrolysis, when equilibrated at different water activity (a_w). Common corn (CC), waxy corn (WC) and high amylose corn (ae VII) starch samples were solubilized in 2.2M HCl to achieve different levels of solubilization. The lintners were collected and the extent of hydrolysis was monitored by Sepharose CL-2B chromatography. Saturated salt solutions were used to equilibrate lintners to a final a_w of 0.15, 0.33, 0.75 or 0.97. The samples were then exposed to iodine vapor for 24 hr and the absorption spectra (K/S) of the starch powders were subsequently measured. The intensity of the K/S spectra was lower for WC at all a_w levels where iodine binding was observed when compared to the other starches. CC and ae VII equilibrated at 0.75 a_w exhibited an increased K/S value even after 2 hours hydrolysis; while, for WC, 6 days of hydrolysis were required before higher K/S values were observed. No significant differences were observed for CC and ae VII lintners when equilibrated to 0.97 a_w. Furthermore, results show that iodine binding occurred even in samples that had been hydrolyzed for 21 days (36, 16 and 20% starch solubilization for CC, ae VII and WC, respectively). X-ray data show decreased scattering intensity for CC and ae VII lintners (0.97 a_w) following exposure to iodine. No effect was observed on WC X-ray patterns even at the highest a_w treatments. Therefore, in the absence of amylose, even though iodine binding was observed, the crystalline structure of the granule was not affected. These studies help explore the architectural makeup of starch granules and can help elicit the differences in starch granules from different species.

P-228

Comparison of methods for analyzing resistant starch contents. J. HASJIM (1), J. Jane (1). (1) Department of Food Science and Human Nutrition, Iowa State University, Ames, IA.

Selected starch samples were analyzed using three different methods to determine the resistant starch (RS) contents. Among those three methods, two were enzymatic-gravimetric methods using either a thermal stable bacterial alpha-amylase (AOAC Method 991.43) or porcine pancreatin (Shi et al., 2004) and one was pancreatin-colorimetric method (Englyst et al., 1992). The results showed that the pancreatin-gravimetric method produced the largest value of the RS content, whereas the pancreatin-colorimetric method produced the least value of the RS content. The results obtained from the pancreatin-colorimetric method were sample-size dependent. The RS content increased with the increase in sample size. The pancreatin-colorimetric method had limitation on the analysis of highly digestible starch, such as native maize starch. The two enzymatic-gravimetric methods gave the same trend in the RS contents of the test samples. The RS content obtained using the pancreatin-gravimetric method, however, was about 10–20% larger than that obtained using the thermal-stable bacterial alpha-amylase-gravimetric method. The results showed that different analytical methods produced different values of the resistant-starch contents, which depended on the structure of the resistant starch.

P-229

Comparison of tannins from sorghum: Differences in chemistry, biological activity and nutritional factors. R. C. KAUFMAN (2), S. R. Bean (2), M. R. Tuinstra (1). (1) Kansas State University Manhattan, KS, USA; (2) USDA/ARS/GMPRC, Manhattan, KS, USA.

Tannins are large polyphenolic polymers consisting of flavan-3-ol subunits that are deposited in the pigmented testa layer of sorghum kernels. Tannins are known to bind proteins, limiting their digestibility, as well as having excellent antioxidant potential. Studies were done on seven tannin cultivars grown at the Ashland Bottoms Research Farm in 2003 and 2004. Sorghum cultivars were analyzed for tannin content using a modified vanillin-hydrochloric acid method (MV-HCl). The tannin content of the 14 cultivars tested ranged from 2.3 to 67.2 catechin equivalents (mg/g grain), this range can be attributed to both environmental and genetic factors. To examine the precise impact of tannin content and composition on biological activities (protein binding, protein digestibility, and antioxidant capacity), each of the 14 samples were decorticated to remove the outer 20% of the kernel (bran and testa layer). This bran was mixed

at five levels with a base endosperm from a non-tannin sorghum. Pepsin protein digestibility of the reconstituted sorghums ranged from 8% to 58% at the highest tannin levels. The bran fractions were studied for their impact on protein binding and antioxidant capacity. Protein binding ranged from 3.11 to 16.33 mg blue-BSA/g bran. Antioxidant activity ranged from 195.41 to 251.28 µmol TEAC. High performance size exclusion chromatography (HP-SEC) was performed on the 14 cultivars to provide detail into the molecular size distribution of the tannin polymers and relationship to tannin functionality. Variation in tannin content and composition were related with differences in tannin functionality. These differences may allow for selections of high tannin sorghums having customized biological activities.

P-230
Comparison of the iodine binding ability of A- and B-type crystalline starch lintners. D. SAIBENE (1), K. Seetharaman (1). (1) Penn State University, State College, PA, USA.

The granular organization of A- and B-type crystalline starches is characteristically different. This study utilizes the ability of iodine to form different colored complexes with linear starch polymers to elicit differences in the granular organization of different starch crystalline types. A-type (corn) and B-type (potato) starch samples were subjected to mild acid hydrolysis. The granular lintners were then exposed to iodine vapor following equilibration to different moisture contents. The two starches showed similar extent of acid hydrolysis (~37% starch solubilized in 21 days at 29°C). As the extent of hydrolysis increased, the iodine absorption maxima of the dispersed lintners and their molecular weight, as determined by Sepharose CL-2B chromatography, decreased. The granular lintners were equilibrated to final water activities (a_w) of 0.15, 0.33, 0.75 or 0.97, using different saturated salt solutions and subsequently exposed to iodine vapor for 24 h. Potato lintners exhibited slightly higher moisture content than the corn lintners at all a_w; however, the iodine absorption intensity (K/S = ratio of absorbance and scattering coefficients) was higher for corn lintners at all a_w as compared to potato lintners. Furthermore, corn lintners exhibited a K/S maxima at all a_w values higher than 0.33, while potato lintners exhibited an absorption maxima only at a_w 0.97. The formation of the V-type complex at a_w 0.75, as shown by X-ray diffraction, was observed in potato lintners even in absence of the typical blue color. These results suggest that A- and B-crystalline starch lintners present different structural flexibility.

P-231
Comparison of total phenol, antioxidant activity and tannin content in different grains. D. GUAJARDO-FLORES (1), A. P. Cardenas-Hinojosa (1), L. Dykes (1), C. M. McDonough (1), L. W. Rooney (1). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA.

Benefits of whole grain consumption are attributed in part to the presence of phytochemicals. Since different authors utilize varying procedures, the objective of this study was to compare the phenol content, antioxidant activity and condensed tannins in different cereals using the same extraction methods and analytical procedures. This would permit comparisons among the cereals, which included wheat, corn, finger millet, rice, pearl millet samples. Sumac and High tannin sorghums had the highest values for total phenol (17.9 and 14.6 mg GAE/g of grain), antioxidant activity (334.1 and 289.1 µmol TE/g of grain) and tannin content (36.2 and 34.6 mg CE/g of grain). Among the pearl and finger millets, pearl millet had the highest values for total phenol content and antioxidant activity; none had significant levels of tannins. Both red and black quinoa grains had higher values of GAE and TE and had no detectable tannins. None of the corn samples had tannins. Black barley had higher values of GAE and TE than pearled and dehulled barleys. Wheat had lower phenol content and antioxidant activity than other cereals. Black and red rice had relatively high phenol content and antioxidant activity values and did not have detectable tannins.

P-232
Content, composition, and antioxidant capacity of isoflavones in commercial and homemade soymilk and tofu. H. Singh (1), M. NAKAKIHARA (1), G. Chung (1), C. Tam (1). (1) California State University, Los Angeles, CA.

Isoflavones present in soy products are well documented for their phytoestrogenic and antioxidant activities. However, manufacturing procedures of soy food products significantly affect the isoflavone composition. Apart from several commercial brand soy products available in the market, semi-automated soymilk maker with tofu kits is also available that produce soymilk and tofu. The objective of this study was to compare the content, composition and antioxidant activity of isoflavones in commercial and homemade soymilk as well as in tofu made using a semiautomatic machine. Homemade tofu and various homemade soymilk samples were made by different soaking, grinding and cooking parameters. Isoflavone content was determined by reverse phase high performance liquid chromatography (RP-HPLC). Antioxidant activity of isoflavones was determined using a modified ABTS method and total antioxidant capacity (TAC) was represented as ascorbic acid equivalents (AA). Contents of the total isoflavone, aglycone, and genistein in soymilk and tofu were significantly higher in homemade than commercial samples (2–5 fold). Homemade soymilk yielded 1574 to 2567 ug in isoflavone content, 785 to 1347 ug in aglycone, and 943 to 1446 ug in genistein. A positive correlation was observed between the total isoflavones content, aglycone and genistein to antioxidant capacity. Among homemade samples, genistein showed the highest increase in antioxidant activity followed by total isoflavone, daidzein, and glucosides. These results suggest that processing conditions affect the extraction of isoflavones.

P-233
Correlation between gluten secondary structures and wheat end-use properties for early generation breeding lines by FT-HATR mid-infrared spectroscopy. B. Seabourn (2), F. XIE (1), P. Seib (1). (1) Department of Grain Science and Industry, Kansas State University, Manhattan, KS; (2) USDA/ARS, Grain Marketing and Production Research Center, Manhattan, KS.

It was reported previously that dough optimum mixing time (MT) was closely related to gluten protein secondary structures (GPSS) developed early in the mixing cycle. To fully understand the role of GPSS in dough rheology, the relationship between GPSS and other wheat end-use properties was studied. Fifty-five hard red winter wheat flours with varying protein contents (8.7–14.2%) and MTs (1.63–7.38 min) were scanned by FT-HATR (4000–700 cm^{-1}) after

being mixed with optimum water absorption by a mixograph (MIXO) for 1 min. Thirty-four end-use properties were evaluated including milling, baking, noodle making, PPO, RVA, SKCS, Mixograph, and other analytical tests. The second derivative band areas at 1339 cm^{-1} (alpha-helix), 1285 cm^{-1} (beta-turn), 1265 cm^{-1} (random coil), and 1242 cm^{-1} (beta-sheet) were highly correlated to MIXO MT, MIXO tolerance, baking MT, and LV potential. The beta-sheet band area and MIXO tolerance had the highest correlation coefficient (r) –0.89. Crumb grain was negatively related to beta-sheet and beta-turn structures with r value –0.61, respectively. Multiply regression results showed that 73%, 81%, and 70% of the total variance in MIXO MT, MIXO tolerance, and bake MT could be explained by the relationship between GPSS and these parameters, respectively.

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Development of novel slowly digestible starches from maize. C. MOALLIC (1), A. M. Myers (1), M. G. James (1). (1) Iowa State University, Ames, IA, USA.

Our aim is to develop novel forms of resistant starch (RS) that enhance the nutritional quality of starch-containing foods for humans. RS is defined as the portion of ingested starch that passes through the stomach and small intestine to the large intestine, without digestion by alpha-amylase or absorption by the gut. Such slowed or limited digestibility helps combat both type 2 diabetes and obesity by lowering blood glucose levels and slowing insulin release. This project focuses on a novel form of starch developed in our laboratory by over-expressing a particular enzyme involved in starch biosynthesis. This starch, termed long-chain amylopectin starch (LCAPS), is potentially a slowly digestible starch form. The chain length distribution of the amylopectin component (the branched glucose polymer comprising ca. 75% of starch) was analyzed by fluorescence assisted capillary electrophoresis. LCAPS amylopectin has fewer short chains and more intermediate and long chains than the wild type, features predicted to increase granule crystallinity. Highly crystalline granules limit access of water and digestive enzymes to the starch, rendering it "resistant" to digestion. Preliminary measurements of in vitro digestion of LCAPS with pancreatic alpha-amylase indicated slower hydrolysis rate, approx. 30% the rate of normal starch. That relative resistance persisted, to a lesser extent, after retrogradation of the starches. The analyses of the viscosity of LCAPS, its texture, its gelatinization and retrogradation properties are in progress, to assess a change of functionality and identify its potential uses as a food ingredient. A measurement of the glycemic index by monitoring glucose levels in blood samples collected from human subjects after the ingestion of LCAPS is also planned to establish that LCAPS is in practice more slowly digested than normal starch.

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Direct measurement of T_g of complex cereal foods. L. Samuel (1), B. K. Ashokan (1), J. L. KOKINI (1). (1) Rutgers University, New Brunswick, NJ, USA.

Amorphous materials undergo transition from a glassy to viscous state at a material specific temperature called the glass transition temperature (T_g). Several techniques such as differential scanning calorimetry, rheometry, dilatometry and dielectric constant measurements are used to identify T_g in food systems. During transition from glassy to rubbery state, properties such as heat capacity and thermal expansion show a discontinuity, which is used as the basis for most of the experimental techniques for T_g measurements. Differential scanning calorimetry (DSC) and rheometry are the most common techniques used to study the glass transition of biopolymers. In this study, the performance and effectiveness of measurement of T_g using a DSC, mechanical spectroscopy (small amplitude oscillatory shear and extensional experiments) and with a new technique called phase transition analyzer (PTA) were explored and compared. The T_g of monodisperse polystyrene was determined to be 97.2°C and 101.0°C with the DSC and PTA respectively. When a fairly homogenous (monodisperse) zein sample was used, the reported T_g's from DSC and PTA were 113.6°C and 99.4°C respectively. The lower PTA values were attributed to moisture uptake by the sample during testing. The analysis was then extended to polydisperse extruded food samples whose T_g values from DSC were inconclusive due to the heterogeneous nature of the sample. The PTA showed a measurable transition at 67.7°C but it was away from the T_g's measured by more conventional techniques such as small amplitude oscillatory shear (84.9°C) and extensional (85.5°C) experiments. Further experiments are needed to conclusively determine the performance and suitability of each of these T_g measurement techniques.

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Does increasing protein content through nitrogen fertilization affect protein quality of durum wheat? N. EDWARDS (2), J. Dexter (2), J. Clarke (1). (1) Agriculture and Agri-Food Canada, Swift Current, SK, Canada; (2) Canadian Grain Commission, Winnipeg, MB, Canada.

Nitrogen (N) fertilizer is used to increase durum wheat protein content to meet the requirements of the pasta processing industry. Four cultivars of durum wheat representing a range in gluten strength were grown with three levels of N fertilizer application (0 and 80 kg/ha, and 120 kg/ha applied at seeding plus 40 kg/ha top-dressed at head emergence) over three years at Swift Current, Canada, in order to determine the impact of N fertilization on protein quality. As expected, protein content increased with application of N. Mixing time, as measured by 2 g mixograph, was not significantly affected ($P > 0.05$) by N application, however peak resistance, bandwidth and work input all exhibited significant ($P < 0.05$) responses. Creep compliance measurements made over 10,000 s in the linear viscoelastic regime demonstrated differences among cultivars, but little impact attributable to N application or environment. Tan delta did demonstrate some dependence on protein content, and differed among cultivars. Increased protein content led to a greater contribution of the viscous modulus (G"). High and low molecular weight glutenin subunits were quantified using RP-HPLC in order to calculate the ratio of high to low. Significant differences ($P < 0.0001$) were found in high to low ratio among cultivars. Nitrogen application at 80 kg/ha and at 120 + 40 kg/ha significantly increased ($P < 0.05$) high to low ratio, but there was not a significant difference between those two levels of application. The lower proportion of low molecular weight material with increased protein content may have contributed to the increase in tan delta.

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Effect of soaking and cooking on the reduction of oligosaccharides and lectins in a red kidney bean (*Phaseolus vulgaris* L.) snack product. G. NYOMBAIRE (1), K. Dolan (1). (1) Michigan State University.

Sugar-cooked beans are a popular snack in many Asian countries. The present study monitored the effect of soaking and cooking on the hydration, and oligosaccharides (raffinose and stachyose) and lectin contents, determined as phytohemagglutinating (PHA) activity, in sugar-coated red kidney beans (*Phaseolus vulgaris* L.). Beans were soaked at an initial temperature of 77 °C and then let to hydrate in the same water at ambient temperature (24 ± 1 °C) for 12 hours and then cooked in boiling water for 14 min. Finally, the cooked beans were sugar-coated by dipping in 20%, 35% or 50% sugar syrup for 45 min at 70 °C. A 105-member consumer panel evaluated the sensory quality of beans for color, texture, flavor, and overall acceptability. About 81% of the weight gain was observed during the first hour of soaking. Soaking for 12 hours resulted in significant reduction ($P < 0.05$) in raffinose and stachyose contents, 80.83% and 83.44%, respectively. Cooking beans further reduced raffinose (95.84%) but had no effect on stachyose. A total of about 90% reduction in lectins was observed, with slightly over half of this reduction occurring during soaking. The sugar-coating process did not effect oligosaccharides or lectin content. Beans coated with 50% sugar syrup were rated best overall with a score of 6.1 on a hedonic scale of 1–9 (1-dislike extremely, 9-like extremely). The bean processing conditions used in this study effectively reduced oligosaccharides and lectins, with acceptable sensory quality.

P-238

Effect of the duration and intensity of heat stress during grain filling on two near-isogenic wheat lines. S. IRMAK (1), F. MacRitchie (1). (1) Kansas State University, Manhattan, KS, USA.

Heat stress is considered to be a major environmental factor affecting grain quality. It causes detrimental effects on the polymerization of glutenin subunits into the large glutenin polymers that are required for optimum dough rheological properties. Timing during grain filling when heat shock is applied and duration of stress is important for the polymerization stage and molecular size distribution of glutenin, which is major determinant of dough strength in wheat. The main objective of this study was to determine the stage at which grain growth is most sensitive to a heat stress and genetic differences in heat tolerance. The near-isogenic wheat lines; Lance A (HMW-GS 2*, 17+18, 2+12) and Lance C (HMW-GS 2*, 17+18, 5+10) were used. Plants of these wheat lines were grown under various temperature regimes in greenhouse (Department of Agronomy, KSU) for different stress levels and the seeds were collected at intervals from times midway between anthesis and maturity. Quantitation of polymeric protein, gliadin and albumin/globulin contents of the samples was determined by SE-HPLC. Protein was extracted from flour samples in pH 6.9 of phosphate buffer containing 0.5% (w/v) SDS. Results for protein content and percentages of polymeric protein, gliadin and albumin/globulin as a function of days after anthesis (DAA) showed no significant differences in both sets of heat treated wheat lines. However, a clear trend was observed in large glutenin polymers measured by unextractable polymeric protein (UPP). Polymerization stage started at 31 DAA for both wheat lines; however, Lance A showed a steep increase in UPP values at a later stage (34 DAA). The results showed that Lance A is more susceptible to heat changes than Lance C. Regardless of heat stress, Lance C always had more large glutenin polymers than Lance A.

P-239

Effects of channel proteins on crosslinking of normal and waxy corn starch. J. HAN (1), J. N. BeMiller (1). (1) Purdue University, West Lafayette, IN, USA.

Channels of corn starch granules are lined with proteins and phospholipids. When corn starch granules are treated with phosphoryl chloride ($POCl_3$), three types of crosslinks could be produced: protein-protein, protein-starch, starch-starch. To determine which of these may be occurring and the effect(s) on crosslinking of removal of channel proteins, normal and waxy corn starches were treated with a proteinase before and after crosslinking and the properties of the products were compared with those of a control (crosslinking without proteinase). First, it was established that treatment of starch with thermolysin alone had no effect on the RVA trace. Then, three reaction sequences were used: crosslinking alone (CL), proteinase treatment before crosslinking (Enz-CL), proteinase treatment after crosslinking (CL-Enz). Two crosslinking reagents were used: $POCl_3$ (0.05, 0.075 and 0.10%), STMP (0.05%), and RVA analysis was used to determine relative degrees of crosslinking. For both normal corn starch (NCS) and waxy corn starch (WCS) reacted with $POCl_3$, the trends were generally the same, with relative degrees of crosslinking indicated to be CL-Enz = CL > Enz-CL, but the effects were greater with NCS and, of course, there were differences when different concentrations of reagent were used. Crosslinking with STMP was done both in the presence and the absence of sodium sulfate (SS). Both with and without SS and with both NCS and WCS, the order of indicated crosslinking was generally the same as found after reaction with $POCl_3$, with the indicated swelling inhibition being greater when SS was present in the reaction mixture. All in all, it is indicated that the crosslinking reaction involves protein molecules and less effective when the protein is removed. Since the effect is more pronounced in NCS, protein-amylose or GBSS-starch crosslinks may play a significant role.

P-240

Effects of HCl-methanol modification on the properties of corn starch film. Y. Chung (1), H. LAI (1). (1) National Taiwan University.

Native corn starch was modified with 0.36% HCl in methanol at 25° and 45° for different periods of time. The molecular characterization of HCl-methanol modified corn starch and the properties of starch film made of were investigated. The weight-averaged molecular weight (M_w) and the number of long-chain branches (DP13-36) of amylopectin decreased with increasing in the degree of acid modification, but the number of short-chain branches (DP < 6) increased. The HCl-methanol modification significantly decreased the starch film-forming solution's viscosity and the ghost formation in gelatinized starch solution. The opacity and water vapor permeability of starch film made of proper HCl-methanol modification with M_w = 1.6–8.7 × 107 were lower than that

made of native corn starch. Under high relative humidity (RH = 97%) condition, low moisture content and slow moisture absorption rate of film made of HCl-methanol modified starch were also observed.

P-241

Effects of heat on the structural and functional properties of vital wheat gluten. H. Singh (1), E. A. NAKAKIHARA (1), J. Dancort (1). (1) California State University, Los Angeles, CA.

Modification of functional properties of wheat gluten has been a challenge due to its unique molecular characteristics. The objectives of this study were to enhance the functionality of VWG by modifying the molecular characteristics of VWG protein using a hydrothermal treatment. Functional and molecular properties of modified VWG were compared with those of control VWG. Samples of VWG protein slurries were made at various concentrations (2, 4, 6, 8, 10%) and pHs (3, 4, 5 and 6). The slurries were heated under pressure, separated into fractions (soluble and insoluble) and freeze-dried. The resulting samples were analyzed for their foaming properties and molecular changes using standard whipping method and size exclusion high performance liquid chromatography (SE-HPLC) respectively. The foaming properties of VWG changed with pH, reaching the maximum between pH 5 and 6. The soluble and total protein samples had significantly better foaming stability as compared to the insoluble fraction. This indicated that the liquid fraction of the sample was responsible for the foaming functionality. An increase in protein concentration in total protein solution was directly correlated to foam stability. Heat treatment of 2% solution increased the solubility of protein by 6%. SE-HPLC of heated samples indicated an increase in polymeric fraction with increase in concentration of VWG from 2, 4 to 6%.

P-242

Effects of hull-less barley roller mill flow and grinding conditions on the yield, composition and properties of milled products. J. E. DEXTER (1), M. S. Izydorczyk (1), T. L. Chornick (1). (1) Canadian Grain Commission, Winnipeg, MB, Canada.

Two hull-less barley cultivars, one with waxy starch and the other with high amylose starch, were roller milled unpearled and 15% pearled. Flows of varying length, with diverse roll settings and surfaces were used to determine effects on yield, composition and properties of milled products. Similar trends were noted for the two cultivars. When using a short flow comprising four breaks and a corrugated sizing passage followed by impacting, power consumption during grinding was reduced by 20% when roll flute orientation was changed from dull-to-dull to sharp-to-sharp. Flute orientation had minimal effects on yields of flour and of a fiber-rich fraction (FRF). FRF yield and composition are of particular interest because FRF has potential as a functional food ingredient due to elevated levels of beta-glucans (BG) and arabinoxylans (AX). When using a smooth roll sizing passage, power consumption increased by about 50%, accompanied by a moderate increase in FRF yield and a moderate increase in FRF BG content. FRF starch damage increased when smooth sizing rolls were used, and water swelling, a measure of water hydration capacity, also increased. Setting break and sizing rolls sharp-to-sharp significantly lowered the mean particle size of the FRF fraction, accompanied by moderate declines in FRF BG and AX content. FRF yield decreased by up to 50% when the milling flow was lengthened to three sizing passages. Only a moderate increase in FRF fiber content was achieved, regardless of roll conditions. Pearling reduced FRF yield by about 30% and moderately reduced flour yield. The by-product generated by pearling is rich in protein, AX and phenolics. When barley was pearled, FRF exhibited greater water swelling, and contained higher amounts of BG, a lower proportion of soluble BG, and lower amounts of AX, phenolics, ash and protein.

P-243

Extractability and chromatographic separation of rice endosperm proteins. A. Van Der Borght (1), K. BRIJS (1), G. Daenen (2), J. A. Delcour (1). (1) Laboratory of Food Chemistry, KU Leuven, Heverlee, Belgium; (2) Remy Industries NV, Wijgmaal, Belgium.

The molecular weight (MW) distribution of proteins extracted with different solvents from defatted rice endosperm was examined by size exclusion high-performance liquid chromatography (SE-HPLC) with 2.0% sodium dodecyl sulfate (SDS) (w/v) as mobile phase. The resulting protein peaks were further characterized by SDS-PAGE. Under the experimental conditions, 2.0% SDS extracted 64% of the proteins. The addition of 6.0M urea resulted in a 15% increase in extractability (up to 79%). When using 20 or100 mM NaOH, 70 or 81% of the proteins were extractable. Maximum extractability was reached with 2.0% SDS, 6.0M urea and 0.5 to 1.5% dithiothreitol (DTT). Apparent MW profiles of rice endosperm proteins allowed classification into 6 fractions of decreasing apparent MW. Fraction VI contained the lower MW albumin, globulin, and prolamin protein material. Fractions IV and V originated from alpha and beta glutelin subunits, respectively. The polypeptides of fraction III consisted of an alpha and a beta subunit linked by an intermolecular disulfide bond. The polypeptides of fractions I and II were dimers, trimers or higher polymerized forms of the (alpha–beta) glutelin subunit dimer in fraction III. While the work confirmed that rice glutelin is composed of an polymerization of alpha and beta subunits, remarkably, higher MW glutelin aggregates (fractions I, II and III) only partly dissociated upon reduction. Lower MW protein material (fraction IV) was entrapped in the aggregated protein network and was released upon reduction. It can be concluded that a rapid and reproducible method for the study of rice protein using SE-HPLC was developed. This method can be used to determine and compare the MW distribution of proteins from different rice varieties and different botanical parts within the kernel, and to determine the changes in protein aggregation due to various industrial processes and applications.

P-244

Extraction and characterisation of beta-glucan from Canadian rye. S. RAGAEE (1), P. Wood (1), Q. Wang (1), S. Tosh (1), Y. Brummer (1), G. McLeod (2). (1) Agriculture and Agri-Food Canada, Guelph, ON, Canada; (2) Semiarid Prairie Agricultural Research Centre, Swift Current, SK, Canada.

Whole meal rye products may have a variety of health benefits. Cereal beta-glucans have clinically proven health benefits, for example oat beta-glucan reduced serum cholesterol levels and attenuated postprandial blood glucose and insulin response. The structure, molecular weight (MW) and physical

properties of beta-glucan from oat and barley have been extensively examined. Canadian rye contains up to 2.9% beta-glucan (ranges from 2.1 to 2.9%) but there has been little published on cultivar content or structure and properties of its beta-glucan. The main objective of this study was to optimise the extraction of beta-glucan from rye whole meal and determine its structure. Several extraction procedures were tested to optimise the extraction of beta-glucan from rye whole meal. The amount and molecular weight of beta-glucan solubilised in the extracts was determined based on its specific binding of Calcofluor. Variables investigated that could affect the extractability and MW of beta-glucan included sodium hydroxide concentration, extraction time and temperature, sample hydration prior to extraction, and removal of arabinoxylan with barium hydroxide before extraction. The results indicated that extraction with 1.0N sodium hydroxide at room temperature for 90 min, after refluxing with aqueous ethanol recovered the highest yield and MW of beta-glucan. The structure and MW of the isolated and purified beta-glucan from Canadian rye whole meal was evaluated using high performance anion exchange chromatography of oligosaccharides released by lichenase, and by high performance size exclusion chromatography with MW sensitive (Viscotek) detection, respectively.

P-245

Flavor complexation with high-amylose maize starch as a function of water solubility of the flavor compound. O. Tapanapunnitikul (3), S. Chaiseri (1), D. Peterson (2), D. THOMPSON (2). (1) Department of Food Science, Kasetsart University, Bangkok, Thailand; (2) Department of Food Science, Penn State University, State College, PA, USA; (3) Department of Food Science, Penn State University, State College, PA, USA, and Department of Food Science, Kasetsart University, Bangkok, Thailand.

Flavor encapsulation by inclusion complexation can have an advantage in flavor stability compared to other encapsulation techniques. Complexation with cyclodextrin and with amylose has been described, but little work has been done with high amylose maize starch. The objective of the present research was to use HAMS to produce flavor complexes with molecules of low water solubility. HAMS and lipid-free (HAMS-L) were used. Two pairs of terpenes, having high and low water solubility but similar in MW and shape were used to study the effect of water solubility on the production of complexes. HAMS-L or HAMS (0.8%w/v) were dispersed in a pressure vessel by heating at 200°C for 75 min, and then cooled to 80°C for flavor addition. Then the mixtures were cooled to room temperature over 6 hr. Starch-flavor precipitates were studied by X-ray diffraction and gas chromatography (GC). For HAMS-L precipitation occurred only with addition of high solubility flavor compounds, producing the V6-III pattern. For HAMS without added flavor, precipitation produced the V6-I pattern. For HAMS with high and low solubility compounds, precipitates showed V6-III and V6-I patterns, respectively. For the precipitated HAMS, GC analysis showed that approximately 1% (w/w) of the low solubility flavor compounds were observed in the co-precipitate. This work shows that co-precipitation of low solubility flavor compounds with HAMS only occurs in the presence of native lipid, suggesting a physical interaction between the lipid and low-solubility flavor molecule.

P-246

Functional properties of wheat flours adjusted to a constant protein content by addition of starch and gluten. H. GUJRAL (1), B. Baik (1). (1) Washington State University, Pullman, WA, USA.

Evaluation of protein quality and its significance in processing and product quality is a challenging task due to a large variation in the protein content of wheat flours. We determined the validity of adjusting protein content of wheat flours to a constant value by addition of starch and gluten for the evaluation of protein quality independent of protein content. Wheat flours of varying protein contents were milled from two hard (Lolo and Winsome) and one soft white spring (Nick) wheat cultivars grown in five different locations. Flour protein contents ranged from 12.5 to 18.6% for Lolo, 12.3 to 17.3% for Winsome and 10.7 to 15.7% for Nick. The protein content of the flours was adjusted to 14.1% in Lolo and 16.4% in Winsome for the determination of bread making quality parameters and to 12.5% in Lolo and 10.7% in Nick for the noodle making quality tests by adding starch or gluten. Flours of adjusted protein content from Winsome and Nick exhibited lower standard deviation (2.2 and 1.6 mL) in SDS sedimentation volumes than the original flours (3.2 and 3.0 mL). On the other hand, Lolo and Nick showed increased variation in RVA peak viscosity of flours after the protein content adjustments. The variations in dough sheet thickness and cooking water retention of noodles significantly decreased by adjusting flour protein content. The standard deviation in hardness of noodles decreased from >1.37 N in the original flours to <0.69 N in flours of adjusted protein content. The variations in mixograph water absorption; mixing time and loaf volume of bread were also much smaller in flours of adjusted protein content compared to the original flours.

P-247

Generation of thermally stable resistant starch from dispersed maize starches. H. Liu (1), D. B. THOMPSON (1). (1) Penn State University, State College, PA.

High amylose starch (HAMS) is commonly required as a starch source for ingredients with high levels of thermally stable resistant starch (RS). In this work, HAMS and common corn starch (CCS) were fully dispersed in 90% DMSO or 0.5 N NaOH and then precipitated with ethanol added either in one-step at 80% (v/v) or stepwise sequentially increasing concentration to 40%, 50%, 60% then 80% (v/v). After drying, the precipitated starches showed the V-type X-ray diffraction pattern, and NMR evidence was consistent with the presence of single helices. A B-type pattern was produced after controlled rehydration. This material was highly resistant to amylolysis compared to the V-type polymorph. Debranching with isoamylase during the rehydration resulted in 42% RS for CCS and 40% RS for HAMS. The RS produced in this way was unaffected by a boiling treatment. This study describes a novel strategy for generating thermally stable RS from either HAMS or CCS.

P-248

Hard white wheat: Effect of environment on seed color. O. M. LUKOW (1), K. M. Adams (1), D. Fenn (1). (1) Agriculture and Agri-Food Canada.

Seed color variation of hard white wheat can be a concern in the production of consistent light colored whole wheat

food products. To examine the variability of hard white wheat kernel color, commercial samples of the Canadian hard white spring wheat cultivar, Snowbird, were obtained from multiple western Canada locations in 2003 and 2004. Results showed that white wheat seed could range from very white to dark grey-red in color. Snowbird seed samples grown in 2004 appeared visually darker and less vitreous than the 2003-grown samples. In addition to seed color, the 2003-grown samples had higher test weight and protein content, stronger rheological properties and higher whole wheat bread loaf volume compared to the 2004-grown samples. There were more significant correlations of seed color with whole wheat flour color and end-product (bread, tortilla) color in 2003 than in 2004. In overall assessment, the 2004-grown Snowbird samples produced darker reddish colored whole wheat tortillas and pan bread crumb compared to the 2003-grown samples. In both years, there were negative relationships between seed L* and b* values with seed protein content, farinograph water absorption and mixograph strength properties. Positive relationships occurred between seed L* values and particle size index and between seed a* and b* values and test weight.

P-249

Influence of lactic acid on the amylase activity in flour dough. A. Y. TANIGUCHI (2), K. Takano (1), K. Shigeta (2), S. Kikuchi (1). (1) Tokyo University of Agriculture, Tokyo, Japan; (2) Tokyo University of Agriculture, Tokyo Gakuen Women's College, Tokyo, Japan.

To investigate the relation between enzyme activity and flour dough formation and the influence of organic acid, we have concentrated on studying enzymes inside the flour. Especially in this study, to investigate the influence of lactic acid on flour dough formation, we have analyzed the amylase activity and glucide behavior after adding lactic acid to the dough. By targeting the enzyme activity inside the flour and studying the influence of organic acid on flour dough formation, this is a new enzymologic approach. Dough with lactic acid was prepared by adding water to 68% and lactic acid to 0.14% to strong flour and kneading for 15 minutes at low speed with a mixer. Similarly, dough without lactic acid was prepared in the same way only without adding lactic acid. Crude enzyme solution was prepared as follows. To the flour dough, 0.1M citric acid was added, enzyme was extracted and precipitated with ammonium sulfate. The optimum pH was 5.5 and the optimum temperature was 37°C for the amylase in dough without lactic acid. In dough with lactic acid however, the optimum temperature was 40°C though the optimum pH was the same. Besides, the specific activity under the respective optimum temperature was 90 units/g in dough without lactic acid but 180 units/g in dough with lactic acid, showing an increase of about 2 folds in specific activity by adding lactic acid. Moreover, addition of lactic acid resulted in a 2-fold increase in the content of water-soluble glucides. In TLC, amylase in dough without lactic acid produced many oligosaccharides from the amylose substrate, while amylase in dough with lactic acid produced a maltose only.

P-250

Influence of temperature, cook time, and shear rate on degree-of-cook in starch-based systems. B. GEERA (1), D. S. Jackson (1). (1) Department of Food Science & Technology, University of Nebraska, Lincoln, NE, USA.

Understanding and analyzing "degree-of-cook" in starch-based processed foods is often an essential product quality trait. Degree of starch-cook methods, however, are often product specific, difficult to interpret, and confounded by starch degradation. The objective of this study was to develop an accurate, interpretable and more universal method of measuring the degree of cook in starch-based systems. Response surface methodology (RSM) was used to study the effect of temperature (50–95°C), cook time (5–60 min), and shear rate (160–560 rpm) on the degree of cook as measured by water solubility index (WSI), water absorption index (WAI), and other responses. In our first study, 17 experimental trials were conducted. Regular corn starch (7.5 g (db) of starch and 40 g of distilled water) samples were treated in a rapid visco analyzer (RVA). After treatment in the RVA, starch was frozen using liquid nitrogen, suspended in absolute alcohol, recovered on a Büchner funnel, and allowed to air dry. RSM data exhibited a significant ($P < 0.05$) quadratic model for WSI ($P = 0.0087$, $R^2 = 0.60$, lack of fit $P = <0.0001$), and WAI ($P = 0.0002$, $R^2 = 0.79$, lack of fit $P = <0.0001$). Cook temperature appears to be the primary factor influencing WSI/WAI, while both cook time and shear rate also contribute to the model. The significant lack of fit values and the shape of the response surface graphs suggest that additional experimentation in a narrower temperature treatment range will help to refine the statistical models that will lead to improved degree-of-cook measures.

P-251

Interaction between hydrocolloids and normal and waxy rice starches. J. TECHAWIPHARAT (1), J. N. BeMiller (1). (1) Purdue University.

Hydrocolloids are frequently used in starch-based foods to improve stability, modify texture, facilitate processing, retain moisture and maintain overall product quality. Hydrocolloids may also modify the pasting and paste properties of starches. To understand the interactions between hydrocolloids and starches, guar gum, xanthan gum, low-methoxyl pectin, high-methoxyl pectin, gellan and sodium alginate were used with normal and waxy rice starches. Pasting and paste properties of each starch-hydrocolloid mixture were investigated using a rapid-visco analyzer (RVA). Guar gum produced highest peak and final viscosities with normal rice starch. With waxy rice starch, xanthan gum produced the highest values of these parameters. Increases of these values were greater with normal rice starch than with waxy rice starch. Reactive Blue 15 was coupled to all the hydrocolloids. These products were used with both starches in the same manner as the underivatized hydrocolloids. Pates generated in RVA were cooled to room temperature and examined using a LABORLUX 12 POL microscope. Images for normal rice starch were similar and showed two distinct phases in all cases. The hydrocolloids may be associated with leached amylose molecules. With waxy rice starch, some guar gum was associated with starch, but the rest was in separated, small, widely scattered areas, producing patterns very similar to those observed starch. The stained hydrocolloids were more widely scattered in waxy rice starch pastes than in normal rice starch pastes.

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Molecular analysis of segregation of cDNA of Amarantina in plants of transgenic corn. M. EVELIA (2), V. Angel (2), R. Cuauhtemoc (2), P. Octavio (1). (1) CINVESTAV-Unidad Irapuato; (2) Universidad Autonoma de Sinaloa.

The corn has been the base in the feeding in Mexican culture since pre-Hispanic times. This culture at the present time, along with the rice and wheat, are the principal cereals consumed in the world. Although its use is versatile, the direct consume in the human feeding is fundamental, represent one of the principals sources of energy and nutriments in poor zones; furthermore, is strongest used for animal feeding, and like raw material for industrials uses. Because of the main reserve proteins in the grain used for human consume are deficient in tree amino acids considered essentials (lisina, isoleucina and tryptophan), the corn is a food nutritionally poor; due to it, with the finality to obtain lines of improved corn with nutritional message, some research incorporated cDNA of the principal of reserve protein from amaranth (called amarantina) in the genome of corn, obtaining transgenic plants whose the grains have mayor levels of total protein (+32), lysine (+18) and isoleucine (+36), the amarantina is a protein that furthermore of has a good nutritional quality, it have been associated that it has a nutraceutical properties, like to capacity to diminish the levels of cholesterol in blood. With the finality to obtain lines of transgenic corn which inherit homogeneo and stably the nutritional improved proportioned by the expression of the cDNA of amarantina in the grain, the objective in the present research was to make the analysis of the segregation of this cDNA in the genoma of 30 lines of transgenic corn (To). With the purpose to carry out the genetic analysis, we have obtained standardize the methodology for efficient extraction, based in precipitation with ethanol and potassium oxalacetate, the genomic DNA obtained was with high integrity and was digested with the efficient form.

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Official wet gluten analysis for hard red U.S. wheat. R. CHINNASWAMY (1), C. A. Brenner (1), T. D. Norden (1), R. O. Pierce (1), D. B. Funk (1), C. W. Burden (1), A. C. Johnson (1), L. D. Freese (1). (1) Grain Inspection, Packers and Stockyards Administration, Kansas City, MO, USA.

GIPSA, as part of its mission to establish and maintain grain grading standards and procedures, continues to evaluate new and relevant wheat functional quality tests and standards in response to grain marketing needs. The wheat functional quality tests examine the rheological properties of the dough. The U.S. Wheat Associates global tests survey revealed wet gluten test as one of the most requested tests for determining wheat functional quality. Wet gluten represents the fraction of the total wheat protein that agglomerates upon hydration leading to dough formation. GIPSA recently implemented official testing and certification of wet gluten values as official criteria for hard red wheat. Official determinations are made using an NIRT protein-based wet gluten calibration. In developing the regression equation, GIPSA collected Foss Infratec 1241 spectra on 950 U.S. wheat samples and obtained reference values on milled wheat flour samples using the AACC Glutomatic method. Prior to calibration development, reference laboratory procedures were refined and a within laboratory method validation was completed. The within lab repeatability was determined by ten separate analyses and the relative standard deviations for the wet gluten method were 2.64% and 0.91%, respectively, for soft and hard wheat flours. For those wheat samples that clogged the Glutomatic sieves leading to sample flooding, testing was repeated using 4.2 ml of 2% sodium chloride solution with a 10 minute rest time to allow for additional hydration. Performance of the protein-based calibration [NIRT Wet gluten (14% mb) = 3.029 × NIRT Protein (12% mb) – 7.83] was evaluated using a set of 301 Hard Red Winter and Hard Red Spring wheat samples. Wet gluten was predicted with $R^2 = 0.91$ and a standard deviation of differences between predicted and reference values of 1.60.

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Physicochemical properties of modified starches from large and small wheat starch granules. P. V. HUNG (1), N. Morita (1). (1) Laboratory of Food Chemistry, Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Osaka, Japan.

Large and small wheat starch granules were characterized and used for chemical modification. The large granules had higher amylose content and transition enthalpy, and lower gelatinization temperature than the small granules. The viscosity of paste from the large granules was higher than that of the small granules. Both large and small granules had the characteristics of A-type crystal determined by X-ray diffractions. However, the large granules contained lower amount of amylose-lipid complex than did the small granules. The large granules showed less reactivity with cross-linking reagents than the small granules. In contrast, the large granules reacted more with reagents of acetylation or hydroxypropylation as compared to the small granules. The cross-linked starches from the large granules had lower gelatinization temperature and higher enthalpy, and reduced rapidly paste viscosities and swelling factors as compared with those from the small granules. However, the pastes of cross-linked starches from the small granules were more stable than those from the large granules during freeze-thaw treatments. The acetylated starches (AS), and acetylated and cross-linked starches (ACS) from the large granules showed lower gelatinization temperature, and higher enthalpy and paste viscosities than those from the small granules. The pastes of AS and ACS from the large and small granules had similar resistance to freeze-thaw treatments. The hydroxypropylated starches (HS), and hydroxypropylated and cross-linked starches (HCS) from the large granules showed higher swelling power and paste consistency, and more clarity than those from the small granules. The starches modified by hydroxypropylation and cross-linking had lower gelatinization temperature and more tolerance to freeze-thaw, higher swelling power and paste consistency than the native starches.

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Preparation and properties of starch phosphates using waxy corn starches: Oven-heating and extrusion methods. C. A. GÓMEZ ALDAPA (3), K. Torres Martínez (2), B. Murua Pagola (1), F. Martínez Bustos (1). (1) CINVESTAV, Unidad Querétaro, Frac. Real de Juriquilla, Qro, Mexico; (2) Lic. Quimica en Alimentos, CIQ, ICBI, UAEH, Hgo, Mexico; (3) Centro de Investigaciones Quimicas, ICBI, Universidad Autonoma del Estado de Hidalgo, Hgo, Mexico.

Phosphorylated waxy corn starches were produced using an oven heating method and the extrusion process. The starch

prepared by the oven heating method was extruded before phosphorylation. In the other case, starch phosphorylation was performed using a single-screw extrusion process. The physicochemical properties and encapsulation capabilities of both phosphorylated starches were analyzed. The starch phosphates prepared by either oven heating or the extrusion process were also compared. Phosphorus (%) and degree of substitution were measured for both modified starches. The effects of acid concentration, temperature and hydrolysis time on waxy corn starch were also studied. The influence of independent variables on some physicochemical characteristics of the extruded starch was evaluated using response surface methodology (RSM). A second order central composite routable design with three factors and five levels was used. The factors analyzed were hydrochloric acid concentration, temperature and hydrolysis time. The response variables measured for the extruded products were expansion index, bulk density, water absorption index and water solubility index. Data analysis showed that only the temperature-acid concentration interaction was statistically significant ($P < 0.05$). The highest WSI was achieved at 50°C with 3.4% HCl and 6.3 hours of hydrolysis. Phosphorylated starches were used as materials for encapsulating orange peel oil by spray drying. Waxy starch phosphates prepared by extrusion exhibited the highest level of oil retention (38.95%).

P-256

Rapid individual amino acid analysis using an Internet-assisted FT-NIR system. N. WANG (1), C. Tseng (1). (1) Cognis Corp., Cincinnati, OH, USA.

In grain, food, and feed applications, we often need to measure individual amino acids, especially the essential amino acids. Traditional method for amino acid analysis needs sample preparation, protein hydrolysis, chromatographic separation and quantitation. It is a lengthy procedure and many factors influence the final results. In this study, rapid and easy to use multivariate calibration methods that produce accurate and consistent results without sample preparation are developed using an internet-assisted FT-NIR system for the analysis of 17 individual amino acids for both whole kernel corn and milled corn samples. Good to excellent correlations between NIR spectra and HPLC results are obtained for many amino acids. The use of Chingometrics technique allows the calibration models being shared on different instruments without any calibration transfer. Experiments were also designed to break correlation between individual amino acid and protein. Excellent correlation was obtained between NIR spectra and amino acid concentration, indicating that NIR is able to analyze individual amino acids, without correlating to protein.

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Rate and extent of digestion of single-mutants (ae, du, su2) and double-mutant combinations for maize starches in the W64A line. L. YEO (1), D. B. Thompson (1). (1) Penn State University, State College, PA.

The rate and the extent of digestion of starch both have potential health importance. Resistant starch (RS) is related to the extent of digestion in the small intestine. Both rate and extent of digestion of maize starch are influenced by genetic mutations, but data are incomplete, and comparisons among genotypes are often among samples differing in background. The objective of this study was to investigate the rate and the extent of digestion of three single-mutant (ae, du, su2) maize starches and their three double-mutant combinations in the W64A inbred line. A 16-hour digestion using pancreatic alpha-amylase and amyloglucosidase at 37°C, pH 6, was performed. At selected time intervals (0, 1, 3, 5, 15, 30, 60, 120, and 960 min) the supernatants were analyzed for total carbohydrate. The digestion was assumed to consist of two first-order decay reactions, and graphs of ln % NDS (non-digested starch) versus time were plotted. The two linear regions of the graphs suggest the presence of two components (1 and 2): substrate that is readily attacked and substrate that is less readily attacked; RS appears to be a portion of the latter. The % RS increased as follows: wx (0.4), normal (0.5), du (3.2), su2 (5.4), du su2 (15.2), ae du (31.5), ae su2 (62.7), ae (69.2). The rate constant k1 increased in the order of ae < ae su2 < ae du < du < normal < wx < du su2 < su2. In general, as % RS increased, k1 decreased. The ae gene was epistatic to su2, but not to du. du and su2 were also roughly additive.

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Reactivity of native and acid treated normal, waxy and high amylose corn and barley starches towards phosphorylation and cationization. J. GAO (2), T. Vasanthan (2), R. Hoover (1), B. Rossnagel (3). (1) Memorial University of Newfoundland, St. John's, NL, Canada; (2) University of Alberta, Edmonton, AB, Canada; (3) University of Saskatchewan, Saskatoon, SK, Canada.

It has been hypothesized that chemical modification occur mainly in the amorphous domains of the starch granule. The objective of this study was to determine the effect of acid hydrolysis on the reactivity of corn and barley starches of varying amylose contents towards phosphorylation and cationization. This study showed that the reactivity (monitored by determining the extent of substitution) of both native corn and barley starches followed the order: high amylose>waxy>normal. However, no significant ($P < 0.05$) difference in reactivity was observed among acid (1.0N & 2.2N HCl) hydrolyzed (30 min & 60 min) normal, waxy and high amylose corn and barley starches. Furthermore, all of the above starches showed significantly ($P < 0.05$) decreased reactivity on acid treatment. Swelling factor, amylose leaching and X-ray diffraction studies showed that the erosion of the amorphous regions by acid hydrolysis might have been the major causative factor influencing the degree of substitution.

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Relation of single wheat kernel particle size distribution to Perten SKCS 4100 hardness index. T. PEARSON (2), J. Wilson (2), J. Gwirtz (1), P. McCluskey (3), F. Dowell (2). (1) JAG Services, Manhattan, KS, USA; (2) USDA-ARS, Manhattan, KS, USA; (3) USDA-GIPSA-FMD, Washington, DC, USA.

The Perten SKCS 4100 is the current reference method to determine single kernel hardness (AACC Method 55-31). However, some genetically hard wheat has been classed by the SKCS 4100 as soft or mixed; likewise, some genetically soft wheat has been classed as hard or mixed. It is not known whether these classifications are due to the SKCS 4100 hardware or software limitations, or whether the samples are truly classed correctly. The objective of this research is to develop a single kernel hardness reference based on

single kernel particle size distributions (PSD). This reference method can then be used to quantify the error in the SKCS 4100, and lead to improved classifications. Material from single kernels crushed on the SKCS 4100 was collected and milled in a fabricated mill, which simulates the last two rolls of a Quadramat Jr. The PSD of each single kernel was then measured using a laser particle counter. It was found that the difference between the maximum and minimum slope of the PSD below 55 µm could distinguish most of the hard and soft kernels. These slopes correspond to a peak in the PSD between 20 to 30 µm. Particle size distributions from soft kernels normally have a peak in this particle size range while hard kernels have a small, or no, peak. SKCS low level data, as well as the raw crush profile, were analyzed to find a correlation with this slope. After stepwise selection, HI, and three normalized crush profile values were used to predict the PSD slope. The predicted slope correctly classified 95% of the hard and soft kernels. These results indicate that a calibration for the SKCS based on single kernel particle size is possible and this may give a better indication of end use quality of a wheat sample.

P-260
Size distribution of polymeric proteins extracted from durum wheat of diverse genotypes as assessed by flow field-flow fractionation. S. G. STEVENSON (1), N. M. Edwards (1). (1) Canadian Grain Commission/Grain Research Laboratory, Winnipeg, MB, Canada.

The relationship of durum high molecular weight glutenin subunit (HMW-GS) composition to dough strength, quality of pasta and baked products continues to be ambiguous, with the exception that there is agreement HMW-GS 20 confers poor quality. Size distribution of glutenin proteins is related to dough strength properties, and flow field-flow fractionation (FFF) has been effectively applied to the study of HMW material in common wheat. Very little, however, has been reported on the use of this technique with durum wheat. Semolina from durum wheat samples with five different HMW-GS patterns (6+8; 7+8; 14+15; 20; 2*, 20) was reduced to produce flour by repeated passage through sizing rolls to improve protein extractability. Samples were extracted using a sequential extraction procedure with 0.05 M acetic acid without, then with sonication to remove monomeric and polymeric proteins respectively. Protein partitioning among the extracts was determined using FFF. Residue protein content was determined using combustion nitrogen analysis. Extraction without sonication removed 80–90+% of the extractable protein. Regardless of genotype, FFF fractograms showed similar size distribution patterns with the majority of material falling within the small polymeric (8–19 nm) range. Sonication removed an additional 5–20% of the extractable protein. Fourteen to 30% of the protein remained unextractable even with sonication. Differences in HMW-GS composition resulted in differences in fractograms of sonicated extracts, indicating variations in size distribution of the extractable proteins. The 2*, 20 sample exhibited the most striking difference among sonicated extracts, with as much as 7 times more material in the monomeric (<8 nm) range compared with the other genotypes, suggesting that expression of Glu-A1 proteins may skew the overall size distribution of glutenin protein.

P-261
Starch fine structure and physicochemical properties associated with the alkali spreading of rice. J. PATINDOL (1), Y. Wang (1). (1) University of Arkansas, Fayetteville, AR, USA.

Alkali spreading test measures the extent of disintegration of milled rice kernels in alkali solution (1.7% KOH for 23 hours). The test has long been used as an index of rice gelatinization temperature and cooking quality. This work investigated the structural features of endosperm starch to better understand the basis for cultivar differences in alkali spreading. Six rice cultivars (2 medium-grain and 4 long-grain type) with alkali spreading scores of 2.5–6.5 were used. For each cultivar, starch samples were isolated from the fraction that leached and formed the collar (collar starch), and the fraction that remained in the corroded kernel crust (remnant starch). Total starch was 81.1–84.4% for the collar, and 87.1–94.1% for the remnant kernel. Collar particles consisted of a mixture of jumbled lumps and polyhedral granules whereas remnant particles consisted mainly of polyhedral granules as viewed under a scanning electron microscope. The weight-average molar mass (Mw) of collar starch amylopectin (1.4–2.2 × 108 g/mol) was smaller compared with that of the remnant starch amylopectin (1.5–2.7 × 108 g/mol). Amylopectin radius of gyration (Rz) was also shorter for collar starch (262–341 nm vs. 293–395 nm for remnant starch). Collar starch amylopectin tended to have higher percentage of A1 chains and lower percentage of B1 chains; whereas remnant starch amylopectin showed the opposite trend. Amylose content was lower for collar starch (12.6–23.2% vs. 16.3–27.2% for remnant starch). Amylose Mw and Rz followed the same trend as amylopectin. Cypress, the cultivar with lowest alkali spreading score, had the highest amylopectin Mw, Rz, and average chain length. Hence, starch molecular weight and branch chain profiles have an important bearing on the alkali digestibility of rice kernels.

P-262
Structural changes of wheat flour starch and gluten during heating and shear stress conditions using farinograph-E, Viscograph-E and light microscope. J. DREISÖRNER (1), S. Iaquez (2). (1) Brabender GmbH & Co. KG, Duisburg, Germany; (2) C.W. Brabender Instruments, Inc., South Hackensack, NJ, USA.

Cereals and bread based food systems consist of protein and starch, as well as water. The information and data gathered concerning function, functionality and interaction ability of these three components during mixing, ripening, heating (baking) and storage of the final product are vital in determining the base for constant product quality. Through the use of a Farinograph®, and following the protocol of AACC/ICC methods, information about the mixing stage of bread making water uptake, protein strength, and kneading performance can be obtained. Furthermore, when following standard procedures and guidelines described by the AACC/ICC, the Amylograph E and the Viscograph E, respectively, are used to determine the gelatinization properties of flour and starch and products containing starch. Both methods in combination enable the user to evaluate flours or whole meal samples and to estimate the values of the raw materials. In addition to the AACC/ICC standard procedures, the software of the Farinograph® E allows the

operator to create individually defined speed ramps (0–200 rpm) and to set temperature ramps. In this study the well-known Farinograph® Sigma Blade S 50 mixer is closed after the standard test procedure (AACC, ICC) with a spherical lid; the speed is changed and heated to a temperature of 90°C. By using the additional options of the Farinograph® E, within one single experiment the results in respect to the standard procedures (standard S 50 mixer; water uptake, stability, quality number, degree of softening) can be obtained --as well as additional information about the gelling properties under shear stress conditions.

P-263

Structure and properties of corn, rice, wheat and potato starch dispersed in the ionic liquid, 1-butyl-3-methylimidazolium chloride. D. G. STEVENSON (1), A. Biswas (3), J. Jane (2), G. E. Inglett (1). (1) Cereal Products & Food Science Research Unit, NCAUR/ARS/USDA, Peoria, IL, USA; (2) Department of Food Science & Human Nutrition, Iowa State University, Ames, IA, USA; (3) Plant Polymer Research Unit, NCAUR/ARS/USDA, Peoria, IL, USA.

Ionic liquid (IL) has gained industry attention, especially in green chemistry. Researchers have utilized IL for dispersing cellulose, but no report using IL for other polysaccharides. In this study, corn, rice, wheat and potato starches were dispersed in hot water (DIHW) or heat-dispersed in IL, 1-butyl-3-methylimidazolium chloride (HDIIL) and morphology, amylopectin molecular weight (APM_w) and thermal properties (TP) were analyzed. For starch DIHW, corn and potato had gelatinized aggregates, whereas rice and wheat had granular clumps. Starch HDIIL had clumps composed of <1 micrometer diameter particles. Starch DIHW had slight decrease in APM_w of corn and rice starch, but not for wheat or potato starch. Cereal starches had APM_w greatly reduced by HDIIL (4–6 peaks observed). Potato amylopectin was degraded less by IL (two peaks) probably because negatively-charged phosphomonoesters covalently bonded to positively-charged imidazolium rings or repelled by IL chloride ions. Larger potato starch granule size may impede IL penetration, reducing reaction efficiency. TP showed potato starch incompletely gelatinized by HDIIL whereas cereal starches were completely gelatinized. Results suggest IL applications involving starch may be limited unless alternative, less destructive, IL can be found.

P-264

Studies on the physicochemical properties of starches from different areas of kudzu. S. LIN (1), W. Shih (1), J. Chen (1). (1) Graduate Institute of Applied Science of Living, Chinese Culture University, Taipei, Taiwan.

Kudzu (*Pueraria lobata*) is a wild vine that grows in Asia. The starch is highly prized in traditional confectionery, the manufacture of a kind of noodle, and cooking. The purposes of this study were to investigate the physicochemical properties of starches and their gels from different areas of kudzu. During the investigation, differential scanning calorimetry (DSC), Brabender viscoamylography, texture profile analysis (TPA), X-ray diffractometry and scanning electron microscopy (SEM) were applied. The results showed Japanese kudzu starch with low amylose content (19.44%) was found to have low gelatinization temperature (62.24°C), which had the highest amylose content (24.34%) of Taiwanese kudzu starch have highest gelatinization temperature (74.21°C). The Brabender viscosity showed high viscosity (549 B.U.) of Taiwanese kudzu starch, low viscosity (338 B.U.) of Chinese kudzu starch. Photomicrograph shows from different areas of kudzu starches are spherical, hemispherical, and polygonal starch granules. The transmittance of 1% Japanese kudzu starch showed the highest, Taiwanese kudzu starch showed the lowest. The gels resulted in low hardness (127.36 g) and gumminess (91.14 g) of Chinese kudzu starch, the chewiness was between these two mentioned above. The X-ray diffraction pattern of different areas kudzu starches were the Ca crystalline type.

P-265

LC-MS analysis of phenolic acid antioxidants in select botanical parts of wheat. E. S. BONWELL (1), H. Koc (1), D. L. Wetzel (1). (1) Microbeam Molecular Spectroscopy Laboratory, Grain Science Department, Kansas State University, Manhattan, KS, USA.

In our laboratory the aleurone phenolic acid (ferulic acid) and germ apigenin-based C-glycosylflavones have been determined routinely in hard wheat milling fractions from the KSU pilot mill. The highly localized chemical distinction between botanical parts we have also revealed by in situ infrared microspectroscopy of single kernel frozen sections. Our current study is concerned with the localized antioxidant content in select botanical parts of wheat kernels. To achieve this goal the high sensitivity and selectivity of mass spectrometric detection coupled with LC enables working with small quantities of plant material obtained by dissection of the tissue of interest. The LC process separate compounds within the phenolic class and separates them from flavonoids. Light microscopy is used to assure purity of the specimens with respect to adjacent tissue in the seed. Small scale extraction and sample handling was developed to support this study. Resulting analyses localize of various antioxidants to their botanical point of origin.

P-266

Technological quality evaluation in new varieties of chickpeas *Cicer arietinum* L. grown on different soil types in the northwest of Mexico. G. A. YAÑEZ-FARÍAS (2), A. G. Cota-Gastélum (2), M. R. Falcón-Villa (2), R. Anduaga-Cota (2), A. L. Romero-Baranzini (2), J. A. Morales-Gómez (1), J. M. Barrón-Hoyos (2). (1) I.N.I.F.A.P., Hermosillo, Sonora, Mexico; (2) Universidad de Sonora, Hermosillo, Sonora, México.

An advanced line (HOGA-012) and two new chickpea varieties (Suprema and Costa), recently released in the northwest of Mexico, were grown under similar environmental conditions but different soil type (medium and heavy), in order to evaluate the influence of different soil conditions on the technological qualities (soaking and cooking characteristics) of chickpeas. A commercial variety Blanco Sinaloa was used as a control. A factorial experimental design 4 × 2 was used to determine significant differences among line and varieties. Results showed that soaking times were significantly different among varieties, where Blanco Sinaloa had the highest value, followed by HOGA-012, Costa, and Suprema consecutively, but no differences were observed among soil types. A significant influence of soil type on the cooking quality characteristics of chickpeas was observed. This effect

was found for both advanced lines and varieties. Chickpeas grown in medium soil showed higher cooking times than those grown in heavy soil. The variety Costa had the highest cooking time followed by HOGA-012, Blanco Sinaloa, and Suprema consecutively. In general terms soil conditions had a significant influence on the cooking quality of chickpeas, where heavy soil type favors shorter cooking times.

P-267

The environmental impact on starch size distribution in developing hard red winter wheat. J. D. WILSON (1), R. C. Kaufman (1), S. Park (1). (1) USDA/ARS/GMPRC, Manhattan, KS, USA.

Starch constitutes the greatest weight portion of the wheat endosperm (65–75%) and contributes its own unique functional qualities such as texture, volume, consistency, aesthetics, moisture, and shelf stability to various baked products. Particle size has long been recognized as an important variable in the efficiency of a range of processes including predicting rheology and flow behavior. While genetics is the dominant determinant in caryopsis development the environment also has a critical role in quality variability. The objective of this work is to study starch size distribution in identical varieties of developing hard red winter wheat grown in the same location over at least 5 consecutive years and correlate differences to various environmental factors. The samples were collected from the Kansas State University Agronomy field plots in Manhattan, KS. The heads were tagged as to flowering dates and samples were collected starting at 7 days-after-flowering (DAF) and regularly sampled until harvest. The starch was isolated, then freeze-dried and starch size distribution was analyzed on a laser diffraction particle size analyzer. Trends were observed within varieties between starch size distribution and temperature as well as total precipitation in 10, 17, 28 DAF and just prior to harvest. These trends included total volume fluctuations and shifts in peak diameters of 10–20% of the A-type granules. Studying starch size distribution during development of the wheat caryopsis may provide needed insight into critical environmental growth phases.

P-268

The use of DSC and FTIR to probe the miscibility in dextrans as model carbohydrate systems. D. Icoz (1), J. L. KOKINI (1). (1) Rutgers University.

Miscibility of carbohydrate polymers consisting of mixtures of chemically derivatized dextrans with charged side chains (DS500 and DEAE500) were studied as model systems. The effect of total polymer concentration and added salt amount on miscibility was investigated using DSC and FTIR spectroscopy. Mixed systems at 30% and 70% polymer concentrations without any added NaCl, and at 70% polymer concentration with 1M NaCl added resulted in a single Tg in DSC, indicating miscible systems. At 30% polymer concentration with 1M NaCl, two separate Tgs were observed in DSC thermograms, indicating immiscible systems. FTIR spectra of pure DEAE500 showed a broad band around 3286 cm^{-1} due to high number of hydrogen bonded OH groups in the form of multimers. IR spectra of DS500 showed a shoulder at 3250 cm^{-1} due to a number of hydrogen bonded OH groups in the form of multimers; a broad band at 3450 cm^{-1} due to hydrogen bonded OH in the form of dimmers; and a shoulder around 3600 cm^{-1} due to free OH groups. In mixed systems that showed 1 Tg by DSC, the shoulder of DS500 around 3600 cm^{-1} disappeared as DEAE was introduced, because the free OH groups participated in H-bonding with DEAE. The shoulder of DS500 at 3250 cm^{-1} was still present in mixtures although its intensity got less. The broad band of DS500 at 3450 cm^{-1} and the broad band of DEAE at 3286 cm^{-1} shifted towards each other in mixtures, showing that the components were participating in inter-molecular H-bonds. In the FTIR spectra of the system that showed two Tgs by DSC, there were no clear shifts of the bands. Mixture IR bands got broader as if DS500 and DEAE500 bands were appropriately summed indicating no significant hydrogen bond formation between the components.

P-269

Thermal behavior of resistant starches. W. S. RATNAYAKE (1), D. S. Jackson (1). (1) Department of Food Science & Technology, University of Nebraska, Lincoln, NE, USA.

The thermal behaviors of three resistant starches (types RS 2, RS 3, and RS 4) were investigated. Starch samples were heated in excess water to specific temperatures, from 35 to 85°C at 5°C intervals, filtered, and freeze-dried. The treated samples were analyzed using light microscopy, scanning electron microscopy (SEM), differential scanning calorimetry (DSC), X-ray diffraction (XRD), and high-performance size-exclusion chromatography (HPSEC) to characterize granular and molecular level structural changes. Although the resistant starches did not show significant morphological changes, as revealed by microscopy, they did undergo internal structural changes at low temperatures before complete phase transition occurred. The structural changes were less in RS 2, compared to RS 3 and RS 4 samples. The non-granular RS 3 material showed microscopically visible changes at >80°C, while crystallinity decreased gradually from 35 to 85°C. Cross-linking might have prevented RS 4 from becoming completely amorphous within the temperature range (35–85°C) tested. The extent of structural changes depended on treatment temperature and RS type.

P-270

Type and concentration of acid on the degradation of acid-methanol treated rice starches. J. Lin (1), C. Pan (1), Y. CHANG (1). (1) Department of Food & Nutrition, Providence University, Shalu, Taiwan.

Rice starches (TKW1, TNG67 and TCS17) were treated by different types (HCl, HNO_3, H_2SO_4) and concentrations (25~100 mN) of acid in methanol at 45°C for 1 h. The weight-average degree of polymerization (DPw) of starch was determined by high performance size exclusion chromatography. After acid-methanol treated, more than 95% starch granules were recovered. The DPw of acid-methanol treated rice starches obviously decreased with increasing concentration of acid, especially for HCl-methanol treated starch. At the same acid concentration, the DPw of HCl-methanol treated starches were obviously lower than that of starches treated with other acids. As the reciprocal of DPw of acid-methanol treated starch was plotted against the hydrogen ion concentration in methanol, a negatively linear correlation ($r^2 > 0.81$, $P < 0.001$) was observed for the same rice variety in spite of acid type. The slope of the regression line for TKW1 (0.73E-6) starch (waxy starch) was obviously lower

than that of TNG67 (1.17E-6) and TCS17 (1.13E-6) starch (both are non-waxy starches). This suggests the hydrogen ion concentration in methanol could be used as an index on estimating the DPw of rice starch treated with different acids in methanol.

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Antioxidant activity in sorghum bran diets and their effect on colon carcinogenesis. C. M. MCDONOUGH (1), L. Dykes (1), R. J. Carroll (3), L. W. Rooney (1), N. D. Turner (2). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA; (2) Nutrition and Food Sciences, Texas A&M University, College Station, TX, USA; (3) Statistics Department, Texas A&M University, College Station, TX, USA.

Oxidative stress from inflammation may induce colon cancer. Black and brown sorghum bran has in vitro antioxidant activity that may reduce in vivo oxidative damage. Sprague Dawley rats ate diets containing 6% dietary fiber from cellulose, or white, black (contains anthocyanins) or brown sorghum (contains tannins) bran to determine whether sorghum bran would confer protection against colon cancer in vivo. The rats were injected with azoxymethane to induce colon cancer. The diet was analyzed for tannins, phenols, and ABTS activity three times. Aberrant crypts were determined at wk 10. Over time, tannin levels did not change, phenol content declined slightly in white and black sorghum bran diets, and there was a 10% reduction in ABTS activity in the brown sorghum diet. ABTS activity averaged 0.93, 11.6, 84 and 228 µmol TE/g for cellulose, white, black and brown sorghum bran diets, respectively. The black sorghum diet caused a small reduction in intake ($P < 0.04$) by 10 wk, compared to the other sorghum diets, but there was no effect on weight gain or feed efficiency. Aberrant crypt number did not differ between the cellulose and white sorghum diets. Rats consuming brown (47%, $P < 0.006$) or black sorghum (29%, $P < 0.04$) bran diets had fewer aberrant crypts. The cellulose and bran pieces were relatively intact in the feces, yet bacterial fermentation of the bran pieces and testa cells suggests that the bioactive compounds in the black and brown sorghum may be released in the colon lumen, so particle size reduction of these cells may be important. Antioxidant activity provided by black and brown sorghum bran may reduce colon carcinogenesis in rats by reducing the oxidative stress. Funded by USDA 58-5430-5-339 and NIEHS P30-ES09106.

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Antioxidant activity of typical and mutant corn genotypes. W. Li (2), P. J. White (1), C. J. Bern (1), T. BETA (2). (1) Iowa State University; (2) University of Manitoba.

Consumption of fruits, vegetables and whole grains rich in antioxidative phytochemicals is associated with reduced risk of chronic diseases. Phenolic acids are among the main antioxidative phytochemicals in grains that have been shown to be beneficial to human health. Since corn is a major staple food in several parts of the world, total phenolic content (TPC), antioxidant activity and phenolic acid composition of typical and mutant genotypes [typical-1 (Pioneer 3335), waxy (Pioneer 33A63), typical-2 (B73XOh43), and high-amylose (B73aeXOh43ae)] were investigated. TPC ranged from 0.7 to 1.0 and from 0.9 to 2.2 mg ferulic acid equiv/g of corn in methanol and HCl/methanol (1/99, v/v) extracting solvent, respectively. TPC after alkaline hydrolysis ranged from 2.7 – 6.3 mg. ORAC values were 10.6 – 12.5 mg of Trolox equiv/g (TE) of corn in methanol extracting solvent, and 18.8 – 24.9 TE of corn in HCl/methanol (1/99, v/v) extracting solvent. ORAC values after alkaline hydrolysis ranged from 42.9 to 68.3 TE of corn. DPPH radical scavenging at 60 min was 34.4 – 44.5% in methanol and 60.4 – 67.3% in HCl/methanol (1/99, v/v). DPPH scavenging of all phenolic acids after alkaline hydrolysis ranged from 48.6 – 64.9%. Superoxide anion scavenging capacity showed that TE of corn were 0.4 – 0.8 in methanol and 0.8 – 1.6 in HCl/methanol (1/99, v/v). The composition of phenolic acids in corn (mg/kg) was p-hydroxybenzoic acid (5.1 – 10.6), vanillic acid (3.3 – 14.7), caffeic acid (2.3 –25.7), syringic acid (12.4 – 24.5), p-coumaric acid (97.9 – 211.0), ferulic acid (1552.5 – 2969.1), and o-coumaric acid (126.5 – 575.9). TPC and ferulic acid levels were significantly higher in mutants than in typical corn. High amylose and waxy genotypes showed higher antioxidant activity when compared to normal parents from which they were derived.

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Barley grains as a source of phenolic compounds. J. Klepacka (1), E. GUJSKA (1). (1) University of Warmia and Mazury, Olsztyn, Poland.

There is growing recognition that many phenolic secondary metabolites present in foodstuffs may possibly exert beneficial effects on human health. Barley grains contain a great number of phenolic compounds, such as proanthocyanidins, catechins, phenolic acids and coumarins. Although there are several studies on barley phenolic acids, the identification and quantitation of major phenolic compounds in different barley varieties have not been done methodically. Therefore, the objective of this study was to investigate and compare the content of some phenolic compounds in different barley varieties cultivated in Poland. The determination of total phenolic compounds in grain was done using extraction of phenolic compounds with methanol, evaporation of methanol, the addition of Folin-Denis reagent and sodium carbonate and then measurement the absorbance at the wavelength of 720 nm against the reference sample. The results were expressed as catechin equivalent with a reference curve plotted for D-catechin. The content of ferulic acid in grain was determined by HPLC method using acid and enzymatic hydrolysis to release ferulic acid from barley grains. The total phenolics in different varieties of barley ranged from 516,25 µg/g to 689,15 µg/g. Significant differences were found in phenolic compounds among analysed varieties. The content of ferulic acid varied between 159,57 µg/g to 314,17 µg/g. The results showed that the content of phenolic compounds (both total phenolics and ferulic acid) in the grain of the analysed varieties depends on the nature of variety. Due to a high consumption of cereal products as well as the content of their phenolics, these products may constitute a valuable source of phenolic compounds in human diet.

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Comparison of total phenol and antioxidant activity levels of lemon-yellow and red pericarp sorghums. L. DYKES (1), L. W. Rooney (1). (1) Texas A&M University, Cereal Quality Laboratory, College Station, TX, USA.

Total phenol and antioxidant activity of sorghum varieties can be influenced by their genotypes. The effect of pericarp

color on the total phenol and antioxidant activity levels of twenty non-tannin sorghums were evaluated using the Folin-Ciocalteu and 2,2′-azinobis (3-ethyl-benzothiazoline-6-sulfonic acid) (ABTS) assays. Sorghums with a white pericarp had the lowest total phenol (0.86–1.36 mg gallic acid equivalents (GAE)/g) and antioxidant activity (8.49–11.48 µmol Trolox equivalents (TE)/g) levels among the samples. Lemon-yellow pericarp sorghums had total phenol and antioxidant activity of 2.18–3.50 mg GAE/g and 23.65–49.67 µmol TE/g respectively. Red pericarp sorghums had total phenol and antioxidant activity levels of 1.84–4.48 mg GAE/g and 18.11–81.66 µmol TE/g respectively. There was a strong correlation between total phenol and antioxidant activity among the samples ($r = 0.93$, $P < 0.001$). Analysis of variance (ANOVA) showed that total phenol and antioxidant activity levels were not significantly different between lemon-yellow and red pericarp sorghums ($P > 0.05$). These results suggest that pericarp color does not affect total phenol and antioxidant activity levels of pigmented sorghums. This information can be useful to sorghum breeders in the production of non-tannin sorghums with increased antioxidants.

P-275
Effect of steeping and germination conditions on GABA production in barley. S. JANG (1), S. Lim (1). (1) Korea University, Seoul, South Korea.

The gamma-aminobutyric acid (GABA) is one of the vital health-promoting components in germinating cereals. Waxy hull-less barley was germinated in various steeping conditions, and the residual amount of GABA was determined by using a HPLC connected to a fluorescence detector. The barley grains were steeped in water for 8–24 h at different temperatures (5, 15 and 35°C), and then germinated at 15°C up to 72 h. Steeping raised the water content in the grains which could promote the subsequent germination. The optimum water content for the germination was in a range between 40 and 45%. Among the conditions tested, steepings for 16 h at 5°C and 8 h at 15°C reached this range of water content. When steeping at 5°C, however, a much longer time (16 h) was needed to reach the desired water content. The barley steeped for 16 h at 5°C produced the highest level (89.0%) of germination 3 days at 15°C among the germinated grains tested. After 3 days of germination, the GABA content at low steeping temperature (5°C) was 203 nmole/g, whereas it was more than double (474 nmole/g) at the high temperature (35°C). It suggested that the glutamate decarboxylase (GAD), the enzyme for gamma-aminobutyric acid synthesis, might be more activated at 35°C than at 5°C for steeping. The steeping temperature exhibited a positive relation to the GABA content, whereas the steeping time did not affect the GABA content. Overall data showed that steeping procedure rendered more significant effect on accumulation of GABA than did the germination. Germinated barley grains containing GABA could be optimally produced by controlling the steeping conditions, and the resulted barley products are utilized as biofunctional food materials.

P-276
In vitro digestibility of phytoglycogens extracted from sweet corn kernels. J. SHIN (1), Y. Yao (1). (1) Department of Food Science, Purdue University, West Lafayette, IN, USA.

Carbohydrate digestion is associated with obesity, diabetes, and cardiovascular disease. Various physicochemical factors affect the digestion rate of carbohydrates in foods. For alpha-D-glucans (e.g. starch and phytoglycogen), digestibility is related to their molecular structure. In this study, the objective was to investigate the digestibility of phytoglycogens from maize mutants, and to determine the relationship between branch structure and digestibility for alpha-D-glucans. In DBE (starch debranching enzyme)-deficient *su1* maize mutant, amylopectin is replaced by glycogen-like soluble alpha-glucan, phytoglycogen. Phytoglycogen is highly branched, with the ratio of alpha-(1, 6) to alpha-(1, 4) glucosidic linkages much higher than that of amylopectin. Alpha-(1, 6) linkages are generally less susceptible than alpha-(1, 4) linkages when subjected to intestinal maltase-glucoamylase, sucrase-isomaltase, and fungal amyloglucosidase. Therefore, we hypothesize that the digestibility of phytoglycogen is lower than that of normal and waxy corn starch. Phytoglycogens were extracted from a variety of commercial sweet corn containing *su1* gene, and analyzed for their molecular structure and in vitro digestibility. For structure analysis, the materials were debranched and characterized using high performance size-exclusion chromatography. The digestibility was determined by a modified Englyst assay. Our results indicated that phytoglycogens from *su1*-containing sweet corn contain a higher amount of short chains than normal and waxy corn starch. The digestibilities of phytoglycogens were as low as 80% of that of normal and waxy corn starch. The study indicated a relationship between in vitro digestibility and branch structure for alpha-D-glucans, as well as potential nutritional value of phytoglycogen and sweet corn.

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In vitro digestibility of microwaved amaranth and plantain starches. J. TOVAR (1), S. Silva (1), E. Perez (2). (1) Institute of Experimental Biology, Universidad Central de Venezuela; (2) Institute of Food Science and Technology, Universidad Central de Venezuela.

Modified starches have improved physicochemical properties and are widely used in the food industry. Studies on their digestibility are important for the rational exchange/substitution of ingredients. The objective of this investigation was to evaluate the impact of microwave treatment on the bioavailability of amaranth (*Amaranthus cruentus*) (A) and plantain (*Musa paradisiaca* cv. Harton) (P) starches. Starches were isolated at laboratory scale, adjusted to 25% moisture and microwaved at 325W for 6 min, with a constant temperature (85°C). Microwaving reduced the enzymatically available starch content of A by 9%, but no significant effect was observed for P sample. Gel permeation chromatography revealed minor changes in the apparent molecular weight of amylose and amylopectin, which may be related to the altered digestibility of irradiated A starch. The microwave-treated P sample exhibited lower total resistant starch content than the native preparation (35% to 17%, respectively, dmb). A similar tendency was recorded for A starch, although absolute values were remarkably smaller (1–0.6). Only minor retrograded resistant starch levels (0.6–0.8%) were detected, with no

significant difference between treated and native samples. Microwave treatment induced slight increases in the alfa-amylolysis rate of both starches, but it did not reach those of fully gelatinized (boiled) samples. Thus, microwaving under limited moisture conditions increases the overall digestibility of P and A starches. Major changes relate to augmented susceptibility to digestion by pancreatic amylase and decreased enzyme resistant fractions, particularly in P starch.

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Knowledge and attitudes surrounding whole grain foods among school foodservice personnel. K. M. ANDERSON (1), M. M. Reicks (1), Z. M. Vickers (1), L. Marquart (1). (1) University of Minnesota, Saint Paul, MN, USA.

The purpose of this study was to assess attitudes and practices of school foodservice personnel regarding whole grain foods because these attitudes and practices influence the delivery of whole grain foods through school meals. Staff responsible for administration, management, food preparation or service were surveyed (n = 245). Most respondents believed that students did not eat enough whole grain foods and that recommended whole grain servings were 3–6/day. Common practices involved learning about and recommending whole grain foods but less common were ordering, writing menus, discussing and preparing whole grain foods. Most agreed that serving whole grain foods improves student's health, helps meet recommendations, is positively perceived and supported by scientific evidence. They disagreed that serving whole grains costs too much, requires costly equipment and training and these foods are hard to source. They were undecided about whether whole grain foods taste bad, are the wrong color, are hard to identify and spoil too fast. Overall, participants' attitudes about serving whole grain foods in school meals were positive, but many did not commonly procure or serve these foods. School foodservice staff may be open to whole grain foods that are reasonably priced and easily served, but may need further training to include in school meals.

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Nutraceutical content of maltodextrin spray dried with blueberry byproducts. K. MA (1), K. D. Dolan (1). (1) Michigan State University.

Maltodextrin, made from cornstarch, is commonly used in the spray dry industry. There are roughly 1 million pounds of cull blueberries in Michigan that are discarded each year. These byproducts contain valuable anthocyanins and antioxidants which have numerous health benefits. Anthocyanins and antioxidants were extracted from these byproducts at 100°C for 30 minutes with a 1:3 ratio of fresh cull blueberries to water. Maltodextrin was then mixed into the extract at 95:5, 90:10 and 70:30 ratio of maltodextrin to fruit solids, and then spray dried. Samples were collected before and after spray drying for the analysis of antioxidant capacity using the oxygen radical absorbance capacity (ORACFL), total phenolics using the Folin-Ciocalteu's method and total anthocyanins, which were characterized by an HPLC system coupled with a UV detector. Initial ORACFL and total phenolics values of the cull blueberry extract before spray-drying were 24.14 ± 4.53 µmol Trolox equivalents/g dry blueberry solids and 45.74 ± 6.71 mg Gallic acid equivalents/g dry blueberry solids, respectively. Blueberry samples that contained 95:5, 90:10 and 70:30 maltodextrin:blueberry solids showed a decrease in ORACFL value of 10%, 9% and 25%, respectively. Total phenolics showed a decrease of 40%, 48% and 55%. There was a 20%, 58%, and 79% reduction of total anthocyanins, respectively. These trends indicated that maltodextrin provided a protective effect for nutraceutical components during spray drying.

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Processing effects on the antioxidant activity of amaranth and quinoa. K. E. PETROFSKY (2), M. E. Chevrel (2), K. A. Evenson (2), F. Rigelhof (2), R. Fulcher (1), L. Marquart (2). (1) University of Manitoba, Department of Food Science, Winnipeg, MB, Canada; (2) University of Minnesota, Department of Food Science and Nutrition, St. Paul, MN, USA.

Processing wheat and other common grains increases the natural antioxidant activity of phenolics and creates new activities through formation of Maillard reaction products (MRP). The effect of processing on uncommon grains including amaranth and quinoa is unknown. We examined the effects of processing on antioxidant activity using an extrusion model system simulating a puffed whole grain cereal or snack piece. Ground amaranth and quinoa grains were extruded using different water (steam) feed rates and barrel temperatures. The products were dried to target moistures and samples were taken from the starting material, extrudate, and dried final products. A whole white wheat control was also processed for comparison. Total antioxidant activity was measured by reacting prepared samples in methanol solution with 2,2-diphenyl-1-picrylhydrazyl (DPPH) and expressed as Trolox equivalents/100 grams (TE). Antioxidant activities in the extruded samples increased with increasing barrel temperature for all grains. Drying and toasting the extrudate to the same target moisture at low and high temperatures also showed an effect on MRP. The effect of water feed rate on antioxidant activity was not consistent and may have been influenced by grain composition and the influence of water on the rate of Maillard browning. Differences in amino acid and sugar composition and concentrations may also have contributed to differences in MRP related antioxidant activity.

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Stabilized rice bran – A functional food for the 21st century. R. M. PATEL (1). (1) Nutracea, El Dorado Hills, CA.

Rice bran an excellent source of fiber is very nutritious. Within hours of milling it turns rancid due to the enzyme lipase. NutraCea has a patented proprietary process to deactivate this enzyme. This stabilized rice bran (SRB) retains all nutrients naturally present. Table 1 compares the nutritional value of corn, oat, and wheat and rice bran. It is higher in fat (20.5%) lower in carbohydrates (51%) and starch (14%). SRB has a low glycemic index (47%) and contains both insoluble and soluble fiber. Supplementation with SRB in diabetics show lower fasting blood glucose both in insulin dependent ($P < 0.01$) and non insulin dependent subjects ($P < 0.001$). SRB also decreased hyperlipidemia ($P < 0.05$) and glycosylated hemoglobin. Wheat bran does not. SRB protein is hypoallergenic easily digestible with all essential amino acids and is high in lysine (promotes growth). Our study in Guatemalan children shows in 90 days children with Grade II and Grade III malnutrition recovered. Gamma oryzanol exclusive to rice increases muscle mass and promotes growth

and prevents atopic dermatitis in children. Patients with irritable bowel syndrome show a significant improvement in symptoms. (Pecha et al 2003). It improves immunity in the elderly, and prevents urinary stone formation. It is a good source of B complex vitamins and high in Niacin (47 mg/100 g). It is rich in tocopherols and tocotrienols. Tocotrienols lower blood pressure and oxidative stress (Ardiansyah 2006). Stabilized rice bran is thus a functional food with a tremendous potential for use in the food industry. Currently it is being incorporated into cereals, pizza dough, soups and sauces, salad dressings, muffins, breads, crackers, nutritional bars and beverages for human consumption. It is also being used in the pet and equine industry for its health benefits.

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Total phenol content and antioxidant activity of canola grown in North Central USA. P. G. KRISHNAN (1), C. Dwivedi (1). (1) South Dakota State University, Brookings, SD.

The North Central growing region produces over 90% of canola in the US with 6.5 million acres devoted to this crop. The objectives of the study included the determination of canola phenolic content and measurement of its functionality (antioxidant activity) in food systems. Further objectives included the isolation of bioactive canola components for use in enhancing the shelf life of canola oils. We are also pursuing new information that indicates that antioxidant activity is imparted by roasting of canola at 80 to 100C prior to oil extraction. In addition, feeding trials are being conducted to demonstrate the effectiveness of processed (roasted and unroasted) canola meal in tumor reduction in laboratory mice. Phenol content was highly correlated with antioxidant activity. Correlation coefficients (r) varied from 0.85 to 0.9763 for 2003 year crop. Phenolic compounds were responsible for most of the antioxidant activity. The major phenolic compound in canola meal, sinapine, was measured by HPLC. Correlation coefficient between total phenolic content and sinapine content was 0.94. Sinapine shows potential for use as a single predictor of total phenolic content in canola seeds. Extraction strategies that preserve the bioactivity of canola phenolics will be reported. We are attempting to optimize increases in canola constituent functionality in food stuffs while preserving taste and other features.

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Use of polymer encapsulated starches as a novel method to make low glycemic foods. M. VENKATACHALAM (1), G. Zhang (1), B. R. Hamaker (1). (1) Purdue University, Department of Food Science, West Lafayette, IN.

Recently, there is interest in the potential use of low glycemic response foods in the management of diabetes, obesity and cardiovascular diseases. Starch, being the important contributor to the glycemic response of foods, has been categorized into rapid digestible starch (RDS), slowly digestible starch (SDS), and resistant starch (RS). While the glycemic response in humans has been specifically correlated to the amount of RDS in foods, the role of SDS and RS in hunger satiation, energy expenditure and benefits derived from slow release of insulin are also being considered. Therefore, food preparations with low glycemic profiles and higher amounts of SDS or RS are important targets for some in the food industry. The use of polymer-encapsulated starches as an ingredient with moderated starch digestion has been explored in the present study. Starch encapsulated spheres were prepared by dropping (or atomizing) a homogenous mixture of polymer(s) and a suitable starch into a $CaCl_2$ solution, washed and then dried (12 h, 45°C). In vitro starch digestibility (RDS, SDS & RS) of cooked (100°C, 20 min) spheres was evaluated using the Englyst assay. Results indicate that polymer encapsulation can significantly alter starch digestibility. Various factors including type of polymer, polymer concentration, and sphere size influence starch digestion rate. Scanning electron microscopy (SEM) pictures of the digested spheres suggest amylase digestion of gelatinized and compacted starch in the polymer spheres to be from the periphery to the center of the spheres.

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Characterization of native manioc starch composite films and their application as coating in pakan pears preservation. F. M. FAKHOURI (1), F. P. Collares (1). (1) State University of Campinas-UNICAMP, Department of Food Technology, Campinas, SP, Brazil.

Edible films and coatings have been increasingly used as alternatives to traditional packaging. The objective of this study was developing and characterizing gelatin and native manioc starch composite films with respect to their physical, barrier and mechanical properties. The filmogenic solutions were prepared separately: (i) 10 g gelatin in 100 mL of water and 5% sorbitol (in relation to the solids content) and (ii) 3 g of manioc starch in 100 mL of distilled water, 10% plasticizer; by heating at 85°C for 10 and 15 minutes, respectively, being then mixed in the proportion 4:1, 1:1, 1:4. One manioc starch simple coating and three composite coatings containing 3% manioc starch and gelatin were then applied on Pakan pears in natura, in the different proportions studied. The pears were covered using the immersion technique and stored alongside the control lot without coating for 28 days at 10°C and 42% UR, to evaluate weight loss. The increase in gelatin concentration caused an increase in the biofilms thickness and permeability to water vapor. Greater variations for the film containing 3% manioc starch was observed, where thickness increased 88% and permeability to water increased from 3.91 to 7.08 gmm/m^2dkPa. Furthermore, the increase in protein quantity also caused elevation in resistance to traction, and in solubility in water of composite films. No significant difference was observed in relation to the increase in starch concentration of biofilms which led to the choice of the lowest concentration of manioc starch for obtaining the coatings. The application of coatings helped reduce the weight loss of pears. Whereas the control sample lost 4.27%, the coated samples lost from 3.02 (composite films) to 3.56% (simple films), demonstrating that the coatings studied were effective in extending the shelf-life of pears in natura, stored under refrigeration.

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Comparison of different methods for pre-harvest sprouting phenotyping in bread wheat (*Triticum aestivum* L.). R. SINGH (1), M. Matus-Cadiz (1), M. Baga (1), P. Hucl (1), R. N. Chibbar (1). (1) Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK, Canada.

Pre-harvest sprouting (PHS) is in-spike germination of physiological mature grain and causes yield loss due to a diminution of grain weight and severely affect the breads

and noodles quality. To develop a precise method for PHS determination, 40 doubled haploid lines derived from cross between two spring wheat (*Triticum aestivum* L.) cultivars ND690 (non-dormant) and W98616 (dormant) were studied for the germination percentage, falling number, and alpha-amylase activity in dry and imbibed seeds. The dormant genotype (W98616) and non-dormant genotype showed no difference in alpha-amylase activity in dry harvested seeds However, after imbibing the seeds in water for two days, ND690 showed a 5–9 fold increase in enzyme activity compared to W98616. The doubled haploid lines used in this study showed no significant difference in the alpha-amylase activity in the dry harvested seeds. The significant correlation (r = 0.60) was detected between germination and alpha-amylase (imbibed seeds). No significant correlation was observed between germination and falling number, germination and alpha-amylase (dry seeds), and falling number and alpha-amylase (imbibed seeds). A strong significant correlation (r = –0.83) was observed between falling number and alpha-amylase (dry seeds). Thus, germination test is a better method for phenotyping for PHS resistance.

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Composite films elaborated from native, waxy or modified waxy corn starches and gelatin – Visual aspect and opacity. F. M. FAKHOURI (1), F. P. Collares (1). (1) State University of Campinas-UNICAMP, Department of Food Technology, Campinas, SP, Brazil.

The interest in the development of edible and biologically degradable biofilms has grown significantly in the last years due to the search for high quality foods and materials whose residues have minimum environmental impact. The objective of the present study was to elaborate native, waxy and modified waxy starch and gelatin composite biofilms, plasticized with sorbitol or glycerol, and characterize them with respect to visual aspect and opacity, which constitute very important properties as they greatly influence the acceptability of the product by the consumer. The transparency of flexible films gives the consumer the exact idea of the product to be purchased. The solutions were prepared separately: (i) 10 g gelatin and 5% plasticizer in relation to the weight of the macromolecule in 100 mL of distilled water, heating at 70°C for 10 minutes, (ii) 3 g or 5 g of corn starch with 10% plasticizer in 100 mL of distilled water, heating at 75°C for 5 minutes. The solutions were then mixed in the proportions 1:1, 1:4 and 4:1. The opacity of the films was determined using HunterLab colorimeter. All of the films were visually transparent and homogeneous. The addition of gelatin caused, for all the starches studied (in concentrations 3 and 5%), a decrease in the opacity of biofilms, regardless of the plasticizer used. Greater difference was observed for films containing 5% of waxy corn starch plasticized with glycerol, where opacity went from approximately 37.5 to 2.5% with the addition of gelatin. The films containing 5% of starch presented greater opacity than the films with 3% of starch and in general. The chemical conversion of waxy corn starch also contributed to decrease opacity. Between the two plasticizers studied, films elaborated from sorbitol had a lower value of opacity, being approximately 5% lower for waxy corn starch films in proportion 4:1.

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Elucidation of starch granule surface composition and reactivity aided by gel permeation chromatography coupled with fluorescence detection. J. HIGLEY (1), H. Kim (2), K. Huber (2). (1) TIC Gums; (2) University of Idaho.

A fluorescent probe, confocal laser scanning microscopy (CLSM), and gel permeation chromatography (GPC) were used to probe amylose and amylopectin locale and structure within native starch granules. Potato, tapioca, and wheat starches were derivatized with a fluorescent dye in both the non-hydrated and hydrated states. Optical CLSM sections of derivatized starches revealed that derivatization of non-hydrated starches was effectively confined to external granule surfaces (i.e. surface-derivatization only), while that of hydrated starches occurred throughout the granule matrix or interior. Native and isoamylase-debranched starch derivatives of non-hydrated and hydrated reactions were fractionated by GPC, and analyzed for fluorescence intensity. For surface-derivatized starches, both amylose and amylopectin fractions were labeled by the fluorescent probe, indicating the presence of both molecules at granule surfaces. However, the proportion of fluorescent-labeled amylose at the granule surface (non-hydrated reaction) was substantially lower than that of the entire granule (hydrated reaction). On strictly an anhydroglucose basis (reaction density), amylose was more heavily derivatized than amylopectin. Nevertheless, amylopectin long (likely extending into or passing through amorphous regions) and short (unable to participate in double helices) chains were at least as densely reacted as amylose. Medium-length chains (involved in double helices) generally possessed the lowest reaction densities of all fractions evaluated, reflecting the semi-crystalline nature of amylopectin within the starch granule. This experimental approach holds future promise for further bridging the gap between starch granular and molecular structural regimes to better understand starch behavior.

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Evaluation of legume cooking characteristics using a rapid screening method. H. YEUNG (2), R. W. Waniska (2), J. Ehlers (1). (1) Botany and Plant Sciences, University of California at Riverside, CA, USA; (2) Cereal Quality Laboratory, Texas A&M University, College Station, TX, USA.

Continuous growth of improved legume varieties exists to overcome the challenges of new diseases and achieve goals for higher yield. While most legumes are consumed as cooked seeds, consumer preferences for legume products should also be considered and at an earlier stage in the breeding process. Currently used, is the Mattson cooker apparatus, which measures cooking time using weighted plungers. The method, however, requires constant attention and can be difficult for the operator to take accurate notes if several seeds reach the cooked state at the same time. It is important to develop an effective and low-cost method to analyze the cooking quality attributes of new varieties, in order to advance breeding lines. The objective is to use a rapid screening method to evaluate the cooking quality attributes of several cowpea (*Vigna unguiculata*) varieties grown in the same environment and relate physicochemical characteristics with sensory attributes. Samples of five grams were taken from 24 cowpea varieties and boiled in plastic bags until the majority of the seeds were fully cooked. Broth was drained and the seeds and their broth

were separated into dishes. Samples were rated for aroma intensity, the number of split seed coats and cotyledons, turbidity of the broth, cooked doneness, and hardness. Textural properties of cooked samples were determined by Kramer-shear test using the TA.XT2 texture analyzer. Cowpea cultivars grown in the same environment varied in their physicochemical characteristics. This methodology allows observation of distinguishable characteristics between legume varieties. Legumes can then be differentiated into preferred and less preferred categories due to specific requirements of the food processor or consumer.

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Extrusion of starch-based foams in a single screw extruder. G. SURESH BABU (1), H. A. Pushpadass (1), R. W. Webber (1), M. A. Hanna (1). (1) Industrial Agricultural Products Center, University of Nebraska-Lincoln, Lincoln, NE, USA.

Biodegradable starch-based packaging peanut foams were extruded in a single-screw Brabender laboratory scale extruder. Starch was blended with polystyrene in the ratio of 70:30, and extruded in the presence of nucleating and blowing agents. Extrusions were carried out at 16, 18 and 20% moisture content, and at two temperatures. The temperature of the mixing, kneading, and die sections of the barrel were maintained at 50-140-140°C or at 50-160-160°C. Talc at 0, 1, and 3% levels was used as nucleating agent while polycarbonate at 0 and 1% was added to enhance expansion. The influences of extrusion variables like temperature, feed moisture, and nucleating agent on expansion of foams were investigated. The experiment was laid out in the split plot design. It was observed that the bulk density of the foams increased as the temperature decreased. Addition of talc resulted in foams with smoother surface texture, but higher density. It also resulted in smaller sized cells with less expansion of the foam melt. Polycarbonate addition, however, had a positive impact on expansion of the foams. The influence of moisture content on expansion of foams was found to be critical. The expansion ratio, bulk density, compressive shear strength, water absorption index, water solubility index, electrostatic property, and thermal behavior of the foams were determined.

P-290

Influence of gelatin addition in the opacity of native and modified manioc starch composite biofilms. F. M. FAKHOURI (1), F. P. Collares (1). (1) State University of Campinas-UNICAMP, Department of Food Technology, Campinas, SP, Brazil.

One of the functions of packaging is allowing the consumer to visualize the characteristics of the product he is buying as well as its exact volume, presenting the product in a more appealing way, as it happens when flexible polyethylene tereftalate and polypropylene films are used. The objective of this study was to evaluate the effect of gelatin addition in the visual aspect and opacity of native and modified manioc starch composite biofilms, plasticized with sorbitol or glycerol. The filmogenic solutions were obtained separately: (i) 10 g gelatin and 5% plasticizer in relation to the weight of the macromolecule in 100 mL of distilled water, heating at 70°C for 10 minutes, (ii) 3 g or 5 g of manioc starch (native or modified) with 10% plasticizer in 100 mL of distilled water, heating at 85% for 15 minutes. The solutions were then mixed in the proportions 1:1, 1:4 and 4:1. The opacity of films was determined using HunterLab colorimeter. The films obtained were visually transparent and homogeneous. The addition of gelatin decreased the opacity of biofilms elaborated from native and modified manioc starch, in concentrations 3 and 5%, for both plasticizers studied. For films elaborated both from sorbitol and glycerol, greater difference in opacity was observed with the addition of the amount of gelatin for films containing 5% of native manioc starch; this value went from approximately 27.5 to 7% when sorbitol was used. Films with 5% native manioc starch presented greater values of opacity compared to the films elaborated with 3%. The use of modified manioc starch also produces films with lower opacity values, greater difference was also observed for films containing 5% of starch, where the decrease was of approximately 15%, for both plasticizers studied.

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Modified manioc fecula edible films and their application in strawberry coating. F. M. FAKHOURI (1), F. P. Collares (1). (1) State University of Campinas-UNICAMP, Department of Food Technology, Campinas, SP, Brazil.

The growing concerns about ecological and environmental conditions have led to the search for alternatives to traditional packaging such as the use of edible films and coatings. In the present study, edible films prepared from modified manioc fecula and gelatin were developed and characterized with regards to thickness, permeability to water vapor, solubility in water, mechanical properties. Afterwards, the filmogenic solutions chosen were applied on strawberries, using the immersion technique and dried at 25°C for 12 hours, with the objective of evaluating their acceptance as to sensorial properties. The solutions were prepared separately: (i) 10 g gelatin in 100 mL of water and 5% sorbitol (in relation to the solids content) and (ii) 3 g and 5 g fecula in 100 mL distilled water and 10% plasticizer; heated at 85°C for 10 and 15 minutes, respectively. These solutions were then mixed in proportions 4:1, 1:1 and 1:4. The films were thicker and with greater values of permeability to water vapor with the increase in of gelatin concentration in the mixture. This addition of gelatin also caused elevation in tensile strength and solubility in water of the films (24.8 – 38.03%). The increase in starch concentration in the biofilms from 3 to 5%, did not significantly influence the value of water vapor permeability, which led to the choice of the filmogenic solutions containing 3% of fecula for the elaboration of the coatings. In the sensory analysis, the coated samples obtained greater acceptance with regards to brightness, global appearance, color and buying intention than the control sample. The degustation showed that the coated samples did not differ from the control sample, which indicates that the coatings did not interfere with aroma, flavor and texture of the strawberries, therefore constituting potential alternatives for the extension of the shelf life of this fruit.

P-292

Study of moisture transport properties associated with field fissuring in rice grains – An approach to quantify potential genetic improvement in rice. P. JAT (2), S. G. Osborn (2), T. A. Elizabeth (1), S. R. Pinson (1). (1) USDA ARS, Beamont, TX, USA; (2) University of Arkansas, Fayetteville, AR, USA.

Rice kernel cracking due to field fissuring is one of the major

causes of reduced head rice yield. Breeders want to develop new, improved fissure resistant varieties, but a progress is severely limited by fact that present methods for evaluating fissure resistance require large time and labor. Post-harvest fissuring during drying have identified a multitude of kernel components, such as hull and bran thickness and endosperm shape, as affecting fissure rates. Fissuring is triggered by moisture gradient (MG) formation due to moisture re-adsorption into dried kernel. Modeling of kernel components role in MG formation may help for developing genetic marker associated with MG. Markers can be used by breeder as a tool to improve the milling quality. Four rice cultivars were used in this study: Cypress, LaGrue, Lemont, and Teqing. Experiments were conducted at 22 and 35°C temperature at 97% relative humidity with initial moisture content of 15% (wb) rice grains. Endosperm diffusivity, hull and bran moisture resistance, and max MG are predicted and compared using a three dimensional mass diffusion model. Highest hull and bran moisture resistance and lowest maximum MG has been observed in Cypress while lowest moisture resistance and highest max MG in Tqing, it indicates that Cypress is more resistant than Teqing which is in agreement with observed fissuring in field. Model found that moderate increase in thickness may further increase the fissure resistance in Cypress.

P-293

Composite biofilms manufactured with gluten, gelatin and manioc starch or corn starch (native or modified). L. C. Bertan (2), T. G. Kieckbusch (1), F. P. COLLARES (2). (1) State University of Campinas, School of Chemical Engineering, Campinas, SP, Brazil; (2) State University of Campinas, School of Food Technology, Department of Food Technology, Campinas, SP, Brazil.

Studies involving biofilms stemmed from the need of alternatives to substitute synthetic packaging. The objective of this study was to develop composite films containing starches, gluten and gelatin, at a proportions 1:1:1 and characterize them with respect to permeability to water vapor, solubility in water, tensile strength and elongation. Starch filmogenic solutions were prepared using native or modified waxy corn starch or manioc starches (2 and 4%), water (100 mL) and 10% glycerol (w/w) at 75°C/15 minutes and 85°C/5 minutes, respectively. The gluten filmogenic solution, containing 5 g gluten, 32.5 mL of ethanol in 67.5 mL of water and 20% glycerol and was heated at 75°C/5 minutes The solution was then centrifuged at 5000 rpm/20 minutes and afterwards, 5% glycerol was incorporated. The gelatin filmogenic solution (10 g/100 mL of solution) was prepared at 55°C for 10 minutes, and 5% of glycerol (w/w) was added. The solutions were mixed and the films were made by casting. The permeability to water vapor ranged from 3.22 to 4.48 g.mm/m2d.kPa, differing significantly only between the films composed by 4% native manioc starch and the films composed of 2% modified manioc starch. Solubility in water ranged from 21.54 to 32.35%. An increase in waxy corn starch concentration caused a 25% decrease in resistance to tension. The percentage of elongation ranged from 3.38 to 4.46% and did not present significant differences among all of the films studied. The composite films containing 2% modified manioc starch presented the best water vapor barrier properties and higher resistance to tension. We thank FAPESP for the granting of a doctorate scholarship to student Larissa Canhadas Bertan.

P-294

Cooking time of white corn and its effect on grain hardness and water uptake. A. R. ISLAS-RUBIO (1), L. E. Molina-Jacott (1), B. Silva-Espinoza (1), M. Granados-Nevárez (1), F. Vásquez-Lara (1). (1) CIAD, A.C., Hermosillo, Sonora, México.

The cooking properties of corn are relevant for determining the end-use of this grain. The nixtamalization process involves cooking of corn in water plus lime. During this process, the grain uptakes water to some extent, depending on raw grain hardness and duration of cooking. The aim of this study was to evaluate the effect of cooking time on cooked corn (nixtamal) hardness and water uptake (WU). A white corn grown in Sinaloa, Mexico, during the 2005 cycle was subjected to lime-cooking (1% lime, w/w) in jute bags. After 15, 30, 45, and 60 min of cooking, the nixtamal was removed from the kettle, drained and allowed to cool at room temperature for 10 min. The cooled nixtamal was transferred to polyethylene bags to avoid dehydration while moisture and hardness measurements were taken. Nixtamal hardness (force required to penetrate the grain 2 mm) in three different positions of the grain (ten grains per each cooking time) was determined with the texture analyzer TA-XT2 using a conical probe (45° angle) and a test speed of 0.5 mm/sec. The nixtamal hardness depended on the position where the measurement was taken and was inversely related to cooking time up to 45 min. Hardness of nixtamal cooked for 60 min was not different from that of nixtamal cooked 45 min. Nixtamal water uptake increased with cooking time. A difference of 12% in WU was observed between the nixtamal cooked for 60-min and 15-min. In general, lower hardness values were obtained when measurements were taken from the central upper part of the grain (tip cap down). However, the other two positions (central left side and central right side) provided a more reproducible hardness measurements.

P-295

Developing quick methods to cook sorghum for different food applications. V. R. CALDERON (1), L. W. Rooney (1), C. M. McDonough (1). (1) Cereal Quality Lab, Texas A&M University, College Station, TX, USA.

Utilization of whole sorghum provides the opportunity to increase consumption of bioactive compounds significantly. Whole sorghum depending on variety, kernel size and hardness, requires from 30 to 45 min of steaming. A quick cooking sorghum with a 5 to 15 min cook time would be useful. The objective of this study was to evaluate the use of quick cooking methods applied to cook four specialty sorghum varieties: white food-type, two types containing condensed tannins and a black high anthocyanin sorghum. Two dry heat treatments, a microwave treatment and a combination of these methods were used to pretreat the whole grains. Subsequent cooking time, dry matter losses, color and texture of the grains were determined and they were evaluated using an hedonic scale. The best treatment to reduce cooking time was a combination method which reduced cooking significantly for all the varieties. Dry matter losses increased with the expanded and dry heat treatments for the tannin sorghum (1.40%), because more pigments leached into the cooking water. The tannin sorghums produced the most intense color in the broth which had a strong aroma. The cooked grains varied in color, texture, taste and some were

excellent sources of bioactive compound. Cooking in limited water retained the bioactive compounds and improved color.

P-296
Effect of pearling on free radical scavenging properties of hulled and hull-less barley. C. F. ROSA (1), G. Fulcher (1), T. Beta (1). (1) University of Manitoba.

Free radicals are responsible for a multitude of diseases including chronic disorders associated with aging. Cereal grains contain various levels of antioxidants that can combat excessive free radicals produced in the body. Hulled (CI 4325) and hull-less (Shigah Waseh) barley grains were used for the investigation. Barley fractions were obtained by dehulling and pearling whole grains for 0, 1.0, 1.5, 2.0, 2.5 and 3.0 min. Free radical scavenging properties in whole and pearled barley were determined using photochemiluminescence (PCL) and spectrophotometry. Both lipid and water soluble antioxidants were measured using PCL. Water-soluble antioxidants expressed in ascorbic acid equivalents were five times higher than lipid soluble ones. The latter were expressed in Trolox equivalents. Hulled barley contained higher levels of phenolic antioxidants than the dehulled grain and pearled fractions. Only half the original amount of antioxidants was left after pearling for 2 min to remove 15% of the kernel. Results obtained from spectrophotometry using the free radical 2,2 diphenyl-1-picrylhydrazyl (DPPH) showed similar trends; however, free radical scavenging ability was significantly reduced after 1 min of pearling when 91% of the original sample remained. The significance of the findings implies the need to optimize methods of barley pearling to minimize against excessive losses of antioxidants available in whole grains.

P-297
Effect of soaking conditions on color characteristics of soaked and parboiled rice. L. LAMBERTS (1), K. Brijs (1), W. De Man (2), J. A. Delcour (1). (1) Laboratory of Food Chemistry, KU Leuven, Heverlee, Belgium; (2) Masterfoods, Olen, Belgium.

Parboiling is a three step hydrothermal treatment consisting of soaking, steaming and drying. The color of rice changes from white to amber during parboiling. Many hypotheses about color changes of rice during parboiling are found in literature, but the exact mechanisms are still not completely understood. Brown long-grain rice (varieties Puntal and Gladio) was soaked at different temperatures (24 – 60°C) for different times (1 – 24 h) both in excess water and under total water absorption conditions. Soaked brown rice was steamed, dried and milled to obtain milled parboiled rice. The contribution of leaching of pigments in the soaking water under excess water conditions and migration of bran pigments into endosperm to brown rice color were determined. During soaking, polyphenoloxidase activities were monitored. Furthermore, the effect of soaking conditions on levels of Maillard precursors (i.e. reducing sugars and free epsilon-amino nitrogen) was determined. Brown and milled parboiled (i.e. soaked and steamed) rice color was measured and the levels of furosine, 5-hydroxymethyl-2-furfuraldehyde and lysine were analysed.

P-298
Effect of variety and crude protein content on dehulling characteristics of red lentils (*Lens culinaris*). N. WANG (1), M. McKinley (1), R. Toews (1). (1) Canadian Grain Commission, Grain Research Laboratory, Winnipeg, MB, Canada.

Red lentils (*Lens culinaris*) are mainly processed into dehulled and split forms before human consumption and characteristics such as dehulling efficiency (DE) are important to lentil breeders, processors and exporters. The objectives of this study were to study the effect of variety and crude protein content on dehulling characteristics of red lentils and to determine the relationship between seed composition and dehulling characteristics. Four red lentil varieties, each with two levels of crude protein content, were used in this study. Lentils were dehulled on a Satake grain testing mill TM05 (Satake Engineering Co. Ltd., Japan). After dehulling, the product was separated into whole seeds, split seeds, broken seeds and hulls using a dockage tester. Protein, starch and fiber content were determined according to the standard methods. Analysis of variance showed that both variety and crude protein content had a significant effect on dehulling efficiency (DE), the amount of undehulled seeds, powder and broken fractions. DE was negatively correlated with protein and fiber content but positively related with starch content. The amount of undehulled seeds was positively correlated with protein and fiber content but negatively correlated with starch content.

P-299
Effective communications make the difference: Tracking consumer attitudes toward food biotechnology. A. P. BENSON (1). (1) International Food Information Council, Washington, DC, USA.

The level of trust in food safety is consistently high in the USA, and expectations toward new developments in food production, such as food biotechnology, are generally positive. Is there a connection? 70% of US consumers have heard "something, a lot, or a little" about food biotechnology, and over 60% of US consumers expect positive benefits within the next five years. Is there a connection? Over 80% of Europeans feel they are inadequately informed about biotechnology, and their expectations are negative or neutral, at best. Is there a connection? The International Food Information Council has conducted the longest running research into US consumers' attitudes toward food biotechnology and will present the results of its very latest 2006 survey. Information from Europe's Eurobarometer survey and from consumer research in other world regions will be presented for comparison purposes, and IFIC will elaborate on "best practices" in communications.

P-300
Effects of native lipid content on the gel properties and spherulite formation of jet cooked cornstarch. S. C. PETERSON (1), F. J. Eller (1), G. F. Fanta (1), F. C. Felker (1). (1) NCAUR, ARS, USDA, Peoria, IL, USA.

Steam jet cooking is a process that has been used for many years to prepare aqueous starch dispersions for both food and industrial applications. In this process, gel properties of the final starch dispersion are dependent on several variables,

including starch concentration, steam pressure, stirring and cooling conditions, and the native lipid content of the starch. Jet cooked cornstarch dispersions, when slowly cooled, have also been shown to form spherulites with varying morphologies that are also greatly influenced by the presence of native lipids, i.e., they will not form using defatted starch. Recent studies using critical fluid extraction of cornstarch have shown that partial, non-specific extraction of the native lipids from cornstarch can be obtained quickly and without the use of large amounts of potentially toxic solvents. Thus, cornstarch samples with a range of native lipid content were subjected to jet cooking in order to determine the role of native lipid content on gel properties and spherulite formation in jet cooked cornstarch.

P-301

Evaluation of preprocessing methods in the development of near-infrared models for triticale protein and moisture. B. IGNE (1), L. R. Gibson (2), G. R. Rippke (1), C. R. Hurburgh (1). (1) Iowa State University, Department of Agricultural and Biosystems Engineering, Ames, IA, USA; (2) Iowa State University, Department of Agronomy, Ames, IA, USA.

Triticale, a species resulting from the intergeneric crossing of wheat and rye, has the potential to introduce valuable economic and environmental benefits to grain production systems. Efficient utilization and trading of triticale requires rapid determination of its end-use properties. Protein and moisture contents were measured using near-infrared (NIR) spectroscopy on four consecutive years of variety trials. Partial least squares calibration models were developed on two reflectance and two transmittance NIR systems. The effect of spectral data preprocessing methods on predictive ability of calibrations was evaluated. Onboard instrument software in each of the models allows mean centering and autoscaling whereas instrument-independent software packages permit the use of advanced methods such as nth derivative, multiplicative scatter correction, and standard normal variate. Preliminary results show that better accuracy was obtained for protein prediction using adaptive preprocessing methods ($r^2 = 0.96$) than with conventional methods ($r^2 = 0.94$) on transmittance instruments. Equivalent results were obtained using reflectance instruments. For moisture prediction models, the same observations were made ($r^2 = 0.93$ using adaptive methods against $r^2 = 0.90$ with conventional methods) for all brands and both categories of instruments. Although triticale moisture and protein contents can be accurately predicted by NIR spectroscopy, the disparity among pretreatment methods could be resolved by more flexibility in the onboard software.

P-302

Extrusion on Goami2 rice – A variety high in indigestible carbohydrates. I. CHOI (3), K. Kim (3), J. Son (3), G. Ryu (2), H. Jeong (1). (1) Department of Food Science & Technology, Chungbuk National University, Cheongju, Republic of Korea; (2) Department of Food Science & Technology, Kongju National University, Kongju, Republic of Korea; (3) Post-Harvest Technology Division, National Institute of Crop Science, RDA, Suwon, Republic of Korea.

Goami2 (G2) developed by mutation breeding via N-methyl-N-nitrosourea treatment to Ilpum (IP), a high quality japonica rice, is high in amylose, fat, protein and indigestible carbohydrate (IDC) contents. The objective was to observe extrusion effects on physico-chemical properties of G2 extrudates. Milled G2 was grounded and extruded in a co-rotating twin-screw extruder equipped with a 20:1 barrel length to diameter ratio. Twelve extrudates were produced at dough moisture (MC:20,25%), screw speed (SS:200,300rpm) and barrel temperature (BT:110,120,130°). Expansion ratio (ER) was calculated by the ratio of extrudate diameter and die diameter (3.0 mm). Bulk density (BD, g/cm^3) was measured dividing the mass of extrudate in length (6 cm) by the length multiplied by its diameter. Breaking strength (BS, g) was measured as the resistance of extrudate by a three-point bending test. IDC contents were measured by total dietary fiber analysis (AOAC 991.43). Duncan's test and response surface methodology (RSM) were used for data analysis. Decreasing MC decreased BD and BS, but increased ER. The lowest BD (0.074) but highest ER (3.410) was found in 20MC, 300SS, 130BT of which BS was also very low (161.015). Considering TDF content (4.8–5.2 g/100 g) in raw G2 rice, some variations were found in IDC depending on extrusion conditions, showing relatively lower IDC (3.85 ± 0.47) with 20MC at 130BT, but higher IDC (6.07 ± 0.75) with 20MC at 110BT. ANOVA also indicated that significant effects of MC, SS and BT on G2 extrudates. From the coefficient magnitude of regression models, MC and BT were the major factors to affect G2 extrudate qualities. Although G2 rice has poor cooking quality for ordinary cooked rice, Goami2 can be processed into value-added products or utilized as ingredients for processed foods.

P-303

Gluten biofilms plasticized with glycerol – Formulation optimization by response surface methodology. L. C. Bertan (2), T. G. Kieckbusch (1), F. P. COLLARES (2). (1) State University of Campinas, School of Chemical Engineering, Campinas, SP, Brazil; (2) State University of Campinas, School of Food Technology, Department of Food Technology, Campinas, SP, Brazil.

Biopolymers films have been considered a sustainable alternative to synthetic packaging The objective of this study was to optimize the formulation of gluten biofilms plasticized with glycerol, using response surface methodology (MSR). A 2^3 complete factorial design with 6 axial points and 3 central points was used, considering the following independent variables: (i) wheat gluten concentration (2.5; 5.0; 7.5 and 12.5 g/100 mL), (ii) ethanol concentration (20; 32.5; 45; 57.5 and 70 mL/100 mL); (iii) pH (2, 3, 4, 5 and 6). The film forming solution was produced by mixing different amounts of gluten and ethanol, adding 20% of glycerol (w/w) and heating the solution to 75°C/5 minutes. The solution was then centrifuged at 5000rpm/20 minutes and the films made by casting. The dependent variables were: (i) water vapor permeability (WVP); (ii) solubility in water; (iii) tensile strength and (iv) percentage of elongation. ANOVA analysis indicated that the model was statistically significant for all responses studied. The increase of gluten concentration (2.5 to 12.5 g/mL) caused an increase in WVP, which varied from 5.44 to 12.72 g.mm/m^2.day.kPa. The gluten concentration was the only significant variable ($P < 0.05$) affecting the solubility in water and an increase in gluten caused a decrease in solubility. Resistance to tension varied from 0.36 to 1.35 MPa, producing high resistance at the maximum protein concentration. The analysis also indicated that all range of pH values studied (2 to 6) could be used to obtain films

with high elongation if the gluten concentration is above 7.5%. The films with the best attributes with respect to WVP and resistance to tension were obtained with 5% gluten, 32.5 mL ethanol and pH 5. We thank FAPESP for granting a scholarship to L. C. Bertan.

P-304

Grain quality analysis of sorghum samples from El Salvador. V. R. CALDERON (2), L. Sandoval (1), L. W. Rooney (2), S. Mason (3). (1) CENTA, San Salvador, El Salvador; (2) Cereal Quality Lab, Texas A&M University, College Station, TX, USA; (3) Department of Agronomy, University of Nebraska, Lincoln, NE.

Relations among grain quality factors (proximate composition and physical properties) of fourteen sorghum cultivars grown in different locations of El Salvador using two fertilization levels (0–20 Kg/ha^{-1} of nitrogen) were evaluated. The objective was to determine the effect of nitrogen application on yield response and quality sorghum grain. Grain from each cultivar was analyzed for starch, protein, test weight, true density and color, hardness, kernel weight diameter and dehulling properties. Significant positive and negative correlations were found between protein and yield (r = –0.36) starch and protein (r = –0.91), hardness and dehulling properties (r = 0.45), true density and dehulling properties (r = 0.32), and bulk density and hardness (r = 0.47). Differences among varieties by locations were significant. Environmental conditions at each location affected protein, starch, bulk density, color, kernel size and weight. Grain yield and true density were significantly affected by nitrogen application for all locations; the effect on the overall quality grain was minimal. Many of these varieties have excellent potential for food processing including nixtamalization. The varieties had excellent milling properties and could be used for human consumption in a wide variety of applications.

P-305

Grain sorghum dry grind unit operation influence on lipid content of process streams. E. C. NEWGARD (1), C. L. Weller (1). (1) Department of Biological Systems Engineering, University of Nebraska-Lincoln.

Lipid levels were monitored at various points in a grain sorghum dry grind ethanol process. The points of interest were: ground grain sorghum, mash solids after saccharification, mash solubles after saccharification, wet grains, thin stillage, and distillers' dry grains and solubles (DDGS). Fractions to provide the various points were generated through parallel flask fermentations (100 g ground grain sorghum in 400 g water). After saccharification, one flask fraction was collected and dried. After fermentation was complete, a second flask fraction was collected and dried. Two remaining flask fractions were centrifuged to separate wet grains from thin stillage and then dried. The drying was completed in 24 hours using a recirculated air oven set at 90°C. Lipid contents were determined using a Soxhlet extractor at 70°C with 33.0 g of hexane with a boiling time of 1 hr and a rinsing time of 1.5 hours. The lipid contents were: 0.0905 g lipid/g ground sorghum, 0.1036 g lipid/g mash solids, 0.0110 g lipid/g mash solubles, 0.2462 g lipid/g WG, 0.0299 g lipid/g TSS, and 0.2411 g lipid/g DDGS. Ground grain sorghum samples with an average moisture content (w.b.) of 0.08 contained 8.326 g lipid material. Mash contained 4.972 g of lipid with 4.454 g in the mash solids and 0.518 g in the mash solubles. Wet grains contained 5.496 g lipid material and thin stillage contained 0.121 g lipid material. DDGS contained 6.528 g lipid material.

P-306

Identification of barley varieties to suit the needs of industry. S. UTHAYAKUMARAN (1), I. Batey (1), N. Barker (2), C. Wrigley (1). (1) Food Science Australia/Value Added Wheat CRC, North Ryde, NSW, Australia; (2) Grain Corp., Marong, VIC, Australia.

Variety declaration is the basis of quality control or segregation of barley varieties for malting and for feed. Barley varieties are normally identified using visual examination which requires well trained operators. Alternative DNA methods have been developed but they are not rapid or cost effective. A fast method for identification of wheat (*Triticum aestivum* L.) varieties has previously been developed using lab-on-a-chip analysis. This involves identification based on protein composition, with automatic interpretation, using the Agilent BioAnalyzer with the Protein 230 kit. The capillary electrophoresis run for each extract takes only 50 seconds. We applied a similar method for the identification of barley varieties, examining barley varieties from around the world, but concentrating on Australian varieties. Authentic samples of 27 varieties were provided by the Australian Winter Cereals Collection. Unambiguous differentiation of 16 of these was achieved with this system. The 27 varieties tested were classified into 20 groups, 16 containing an individual variety, 3 groups with a pair of varieties, and 1 group of five. Representative electrophoretograms of each variety have been placed into files which will serve as a reference library, as a basis of comparison for the identification of harvest samples. The lab-chip system has been trialed successfully for use at grain-receival stations (silos) during harvest as a means of checking varietal identity on-the-spot "in real time".

P-307

Kinetic parameters and degree of hydrolysis of wheat gluten affected by trypsin from tropical fish pyloric ceca. F. Cabrera-Chavez (1), J. R. Herrera-Urbina (1), J. M. Ezquerra-Brauer (1), O. ROUZAUD-SÁNDEZ (1). (1) Universidad de Sonora, Hermosillo, Sonora, México.

Enzymes are good tool to modify wheat gluten to enlarger the field application. In this study, gluten and their fractions gliadins and glutenins from durum (Jupare) and bread (Rayon) wheat varieties were treated by trypsin isolated from sierra (*Scomberomorus concolor*) pyloric ceca extracts. Km and Vmax were determined to establish the kinetic reaction status. The degree of hydrolysis was based on the reaction of primary amino groups with o-phthaldialdehyde (OPA). Isoelectric point was measured by intersection on potential zeta zero from electrokinetic potential versus pH. The values of Km and Vmax showed a higher affinity by glutenins fraction than that of the gliadin fraction, and that the gluten inclusively. Trypsin demonstrated has a different efficiency of hydrolysis of gluten and their fractions with the degree of hydrolysis values obtained in this study. The effect of hydrolysis on the isoelectric point was more in durum that bread wheat. Trypsin extracts from sierra pyloric ceca has the ability to modify the gluten and their fractions from two wheat cultivars.

P-308

Monitoring milling fractions while the mill is running with a commercial acousto-optic tunable filter spectrometer. H. KOC (1), D. L. Wetzel (1). (1) Microbeam Molecular Spectroscopy Lab., Grain Science Department, Kansas State University, Manhattan, KS, USA.

On-line monitoring of intermediate product KSU pilot millstreams has previously been demonstrated to provide an advantage that can benefit control action. Our previous near-IR monitoring systems used filter technology with the optical unit in the mill more than 100 ft. away from the external host instrument and computer. An acousto-optical tunable filter spectrometer enables either full spectrum scanning or rapid random wavelength access by the process of electronic wavelength switching. This type of spectrometer that has no moving parts is readily adapted to an industrial environment. Unlike the KSU research model acousto-optical tunable filter spectrometer, the commercial instrument by Brimrose (Baltimore, CT) is compact, rugged and is equipped with a hand-held probe that has pre-focused optics set for a convenient length in front of the probe. The hand-held unit is tethered electrically to a portable power supply that can be battery operated. This commercial model possesses several features that make it more user-friendly and convenient than our custom instrument. In the KSU pilot flour mill a modified commercial filter instrument was previously installed and run successfully over an extended period of time involving many different milling operations. For the experimentation reported here in addition to continuous operation at a single test point of the mill, the portable unit was applied to a series of fractions collected simultaneously enabling a multistream content profile of the mill at any point in time. By use of the scanning feature, drastic optical changes that are a function of flow or reflective characteristics inside the spouting are readily identified. In this way, false conclusions that can be drawn in examining only the wavelength of interest are avoided.

P-309

Production and use of a soluble arabinoxylan containing concentrate from wheat starch plant process water. F. MEUSER (1), J. Dorfer (1), N. Lochow (1). (1) Technical University, Berlin, Germany.

We have developed a biotechnological process for the production of a water soluble dietary fibre concentrate (SCC) from the process water of a particular wheat starch plant by submitting the process water to mechanical, enzymatic and fermentative treatments. The process water of this plant has a dry matter concentration of about 10%. This dry matter consists to a large extent of soluble dietary fibre among which arabinoxylans predominate. As it is already known that arabinoxylans contribute to the health beneficial effects of soluble dietary fibre products, it was our aim to recover from the SCC its arabinoxylan fraction as an arabinoxylan concentrate (AXC). For this the SCC was diluted with water and then fractionated by precipitating its arabinoxylan content with ethanol. The precipitate was further purified by washing it out with aqueous ethanol. The wet precipitate was drum-dried and pulverized by milling. The resulting powder was characterized according to its chemical composition and physicochemical properties. The total dietary fibre content of the AXC was 77% (d.m.b.) of which 93% formed the nutritionally preferred soluble dietary fibre fraction. The arabinoxylan content of the AXC was 62% (d.m.b.). The mean molecular weight of the carbohydrate fraction of the AXC ranged from 20 to 40 kD. The intrinsic viscosity of the AXC amounted to about 80 mL/g. The AXC was used as a recipe component of rolls, each roll containing 5 g AXC. The sensory quality characteristics of the rolls were equal to those of rolls which did not contain the AXC. The taste of the former differed from that of the latter by a slight nut-like nuance. It can be concluded from the baking experiments that the AXC can be successfully applied to dietary fibre enrichment of baked goods.

P-310

Properties of defatted and pin-milled oat bran concentrate fractions separated by air classification. D. G. STEVENSON (1), F. J. Eller (3), J. Jane (2), G. E. Inglett (1). (1) Cereal Products & Food Science Research Unit, NCAUR/ARS/USDA, Peoria, IL, USA; (2) Department of Food Science & Human Nutrition, Iowa State University, Ames, IA, USA; (3) New Crops Products Research Unit, NCAUR/ARS/USDA, Peoria, IL, USA.

Oats contain health beneficial beta-glucans. To incorporate into foods, industries seek beta-glucan ingredients with broader functionality. This study investigated the potential for air classification to produce fractionated oat bran products with novel properties. Oat bran concentrate (OBC) was defatted by supercritical carbon dioxide, pin-milled and air classified into five fractions (< 15, 15–18, 18–24, 24–30 and > 30 micrometer particle diameter). Beta-glucan content (% dry weight) of defatted OBC, its subsequent pin-milling and the air classified fractions in ascending particle size was 14.3, 17.0, 4.3, 5.8, 12.6, 14.7 and 22.4, respectively. High-performance size-exclusion chromatography equipped with multi-angle laser-light scattering and refractive index detectors showed amylopectin was predominant molecule present in all OBC powders, with higher concentrations in fractions collected that were <24 micrometer. Fractions >24 micrometer, which had highest beta-glucan contents, had higher starch gelatinization temperatures (measured using differential scanning calorimeter), and had substantially higher peak, breakdown, final and setback paste viscosity (measured using RVA) compared with the other lower-beta-glucan containing fractions. No differences in water retention of 25% (w/w) oat powders in water (measured using thermogravimetric analyzer) were observed among defatted OBC, its subsequent pin-milling and five fractions separated by air classification. Differences in pasting properties show defatted, pin-milled OBC fractionated by air classification will have different food applications depending on particle size.

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Recovery and characterization of lipids from ten grain sorghum parent lines. K. L. CHRISTIANSEN (1), C. Weller (1), V. Schlegel (2). (1) Department of Biological Systems Engineering, University of Nebraska-Lincoln, Lincoln, NE, USA; (2) Food Science and Technology, University of Nebraska-Lincoln, Lincoln, NE, USA.

Several studies have been conducted to determine the lipid composition of grain sorghum kernels (whole, milled and spent). A study identifying and comparing the lipids found in the stalks, leaves, and kernels of sorghum has yet to be reported. Lipids extracted from grain sorghum have been

shown to improve blood health in hamsters and therefore could potentially benefit human health. This study sets out to identify and quantify lipid classes extracted from stalks, leaves, and whole kernels from ten different sorghum parent lines. All extractions were performed in a soxhlet system with n-hexanes as the extracting solvent. Thin layer chromatography and densitometry were performed on all samples. Lipid classes including phytosterols, tocopherols, free fatty acids, aldehydes, alcohols, and triacylglycrides were quantified. Leaf extracts had higher amounts of soluble matter, overall. Leaf extracts also contained more alcohol and sterol classes. Stalk extracts contained more free fatty acids while the kernel extracts contained more aldehydes than the others. Trace amounts tocopherols were observed by HPLC in all 29 samples. The tocopherols isomers present in the kernels, leaves, and stalks varied between sorghum lines and botanical parts. Differences in the lipid profiles were observed between botanical parts of sorghum and between sorghum lines.

P-312

Relationships of single kernel characterization system variables and milling quality in hard and soft white winter wheats. J. OHM (2), A. S. Ross (2), J. Peterson (2), M. Beilstein (1). (1) Corvallis, OR, USA; (2) Crop & Soil Science, Oregon State University, Corvallis, OR, USA.

Single kernel characterization system (SKCS) was used to analyze 128 wheats which included 66 hard white winter and 62 soft white winter wheats grown in Oregon. Crushing force (740 data points), Dy-histogram (101 data points), and conductance profile (147 data points) were obtained from SKCS for each wheat and simple linear correlation coefficients were calculated with flour yield (FY), break flour yield (BFY), and flour protein contents (FPC) to investigate their relationships. Among SKCS characteristics, hardness index had significant correlations with FY (r = 0.576 $P < 0.001$), BFY (r = –724, $P < 0.001$), and FPC (r = 0.640, $P < 0.001$). Among crushing force data points, FY had a highest correlation with 227th point (r = 0.524 $P < 0.001$), BFY with 270th point (r = –0.741 $P < 0.001$), and FPC with 237th point (r = 0.552 $P < 0.001$). Some Dy-histogram data points were also significantly correlated with these variables, showing highest coefficient between 44th point and FY (r = –0.605 $P < 0.001$), 40th point and BFY (r = 0.719 $P < 0.001$), and 48th point and FPC (r = 0.673 $P < 0.001$). Multivariate analyses were applied to develop prediction models of FY, BFY, and FPC, using SKCS variables. Calibration model showed R-square values of 0.593, 0.669, and 0.593 for FY, BFY, and FPC, respectively. Cross validation showed R-square values of 0.545, 0.620, and 0.549 for the same quality characteristics.

P-313

Rheological characterization of zein-oleic acid doughs as a function of moisture content and mixing time. M. K. Lau (1), H. DOGAN (1), J. L. Kokini (1). (1) Rutgers University.

The objective of this research was to study the effect of moisture content and mechanical energy input during kneading of zein-oleic acid dough using rheological properties. Two different mixing methods, farinograph (Brabender Instruments Inc.) and a single screw extruder (Brabender Instruments Inc.), were compared. Farinograph was useful to single out the effect of dough moisture content and mixing energy during kneading. Doughs with 26, 31 and 35% moisture were subjected to three mixing levels: one at the development peak level of the farinogram and two levels at which specific mechanical energy (SME) levels of 40 and 120 kJ/kg were reached. Dough was kneaded by passing 2, 4 and 8 times in the extruder (35, 70 and 140 kJ/kg). Small amplitude oscillatory and stress relaxation tests were conducted in all zein-oleic acid doughs to characterize the network formation. Dough at 26% moisture content mixed in the farinograph had higher G′ and lower slope of G′ vs log frequency compared to doughs with 31% and 35% moisture. The highest value of G′ and lowest slope of log G′ vs. log frequency were found at the peak level with 26% moisture with a slow decay of damping function. Highest magnitude of G′ and smallest slope of the frequency sweep curve for doughs with 31% and 35% moisture were found at a 120 kJ/kg. Increment of moisture in control doughs showed exponential decrease of values of G′ ($R^2 = 0.99$). In the extruder method, the magnitude of G′ increased as number of passes increased. Exponential equations found in the moisture study helped to calculate the contribution of moisture into the dough during extrusion and mixing energy as well. Experimental results indicated that the dough moisture content together with the mixing level is important factor that affect the rheological properties of the zein-oleic acid dough.

P-314

Selective formation and yield enhancement of spherulites in jet-cooked high-amylose cornstarch dispersions. F. C. FELKER (1), G. F. Fanta (1). (1) USDA, ARS, NCAUR, Peoria, IL, USA.

Previous studies of spherulite formation during slow cooling of excess steam jet-cooked cornstarch dispersions have revealed a diversity of spherulite morphology under different experimental conditions, including different fatty acid species. Those experiments were conducted using stainless steel dewar flasks. We have now observed that a polyethylene liner in the cooling container produces different results, possibly due to the smoother or more hydrophobic surface. As the dispersion cools, relatively large, lobed or spherical spherulites form first at the highest temperature, while smaller toroidal spherulites form at a lower temperature. If the formation of those types of spherulites is minimized by either rapid cooling or by altering the surface of the container, very small spherulites (less than one micron in diameter) predominate. Experiments indicate that temperature during spherulite formation, as well as the fatty acid species present, has an influence on spherulite morphology. The abundant submicron particles formed at lower temperature are being examined as possible nanoparticles for such applications as fillers in plastics, etc.

P-315

Separation of vital wheat gluten to gliadin-rich and glutenin-rich fractions. T. MCCANN (2), C. Dela Cruz (2), L. Day (1). (1) Food Science Australia, Werribee, VIC, Australia; (2) RMIT University, Melbourne, VIC, Australia.

Vital wheat gluten, produced by a water washing process of wheat flour dough, is an important food protein ingredient. The two major protein fractions in gluten, gliadins and glutenins, have different roles in determining the overall viscoelastic behavior of gluten. Glutenin, capable of forming large protein networks upon gluten rehydration, brings the high viscosity and elastic behavior to gluten; whilst gliadin,

the monomeric proteins, provide the plasticising properties. The surface properties of these two protein fractions are also very different, gliadin being more surface-active than glutenin. Therefore the fractionation of gluten to more specific gliadin-rich and gluten-rich proteins could add value to current gluten ingredients and make new protein ingredients with differentiated functional properties. In this study, the process feasibility for gluten fractionation was investigated. Two approaches, ethanol and mild acid (0.01M acetic acid) were used to separate gluten into soluble (gliadin-rich) and insoluble (glutenin-rich) fractions. Further treatment was carried out to recover soluble proteins and dry the fractions. The yield of the gliadin-rich fraction was similar for both ethanol (27.6%) and acetic acid (27.3%) treatment. The purity of gliadin-rich and glutenin-rich protein powders was examined using SDS-PAGE and SE-HPLC. The results showed that fractionation using ethanol treatment produced a gliadin-rich fraction with higher purity than that obtained using acetic acid.

P-316

The effect of irradiation temperature on the retardation of non-enzymatic browning reaction of cooked rice occurred by gamma-irradiation. K. JAE-HUN (2), O. Sang-Hee (2), L. Ju-Woon (2), R. Gi-Hyung (1), B. Myung-Woo (2). (1) Kongju National University, Yesaneup, Chungnam, Korea; (2) Korea Atomic Energy Research Institute, Jeongeup, Chunbuk, Korea.

The effect of an irradiation temperature on the non-enzymatic browning reaction occurred by gamma-irradiation in sugar-glycine solution and cooked rice was evaluated in the present study. When the sugar-glycine solution and cooked rice were irradiated at room temperature, the browning was dramatically increased during a post-irradiation period. In the case of an irradiation at below a freezing point, the browning by an irradiation was retarded during not only irradiation but also a post-irradiation period. The change of the sugar profile such as a sugar loss or a reducing power of the irradiated sugar-glycine solution and the ESR signal intensity of the irradiated cooked rice were also decreased with a low temperature. The present results may suggest that the production of free radical and a radiolysis product is inhibited during a gamma-irradiation in a frozen state and it may prevent the browning reaction occurred by gamma-irradiation.

P-317

The effect of storage temperature of paddy on willingness to pay by consumers. S. S. KIM (1), H. Kim (1), D. C. Kim (1), S. E. Lee (1), O. W. Kim (1). (1) Korea Food Research Institute, Songnam-si, Kyunggi-do, Republic of Korea.

The effect of storage temperature (ST, 5, 15, 25°C) of paddy on willingness to pay (WTP) by 108 consumers was investigated by tasting cooked rices prepared with six major rice cultivars (Ilmie, Chuchung, Ilpum, Hwayoung, Nampyong, Odae) in Korea after 12 months of storage. Also physicochemical characteristics of milled rice and sensory quality of cooked rice by trained panel were measured during storage at 1 month interval. At each ST, significant differences among cultivars in WTP was found. While Odae and Ilpum was the highest in WTP, Chuchung and Nampyung was the lowest in 25°C and 15°C stored samples. The average WTP for rice stored at 5°C for 12 month was 47,277 won/20 kg, while those for rice stored at 15°C and 25°C were 45,740 won/20 kg and 43,331 won/20 kg respectively. The significant differences among three ST of paddy was noted for germination rate, color b value and fatty acidity of milled rice and overall sensory quality of cooked rice during 12 months of storage. While the germination rate was constant during 12 months of storage at 5°C, significant decrease of germination rate was noted for all six cultivars within 12 months of storage at 25°C implying importance of ST on grain quality and product value by consumers.

P-318

The milling ratio effects on physicochemical characteristics of milled rice and sensory quality of cooked rice depending on rice cultivars. E. JANG (1), S. Kim (1), S. Lim (2), H. Kim (1), O. Kim (1). (1) Korea Food Research Institute, Songnam-si, Kyunggi-do, Republic of Korea; (2) Korea University, Seoul, Korea.

The effects of milling ratios (8.0, 9.5, 11, 12.5, 14%) on physicochemical characteristics of milled rice and sensory quality of cooked rice were investigated with major cultivars (Ilmie, Chuchung, Ilpum, Hwayoung, Nampyong and Odae) in Korea. The yield of brown rice for Hwayoung and Odae were higher than other cultivars while that for Ilmie was the lowest. The protein content, and colour b value of milled and cooked rice were decreased while whiteness, and amylose content were increased with milling ratio. The result of image analysis showed significant difference in area, aspect ratio, maximum diameter, minimum diameter, perimeter, and roundness of rice kernels among six cultivars and among five different milling ratios. Generally Odae was larger and Nampyung was smaller in perimeter and area of rice kernels among six cultivars regardless of milling ratio. As the milling ratio was increased, Hwayoung become rounder than other cultivars. Except 8% milling ratio, cultivar Odae and Hwayong were higher in overall sensory quality, while cultivars Ilmie and Chuchung were lower than others. The high correlation coefficients were found between overall sensory quality and milling ratio ($r = 0.77 \sim 0.83$), color L ($r = 0.80 \sim 0.85$), color a ($r = -0.71 \sim -0.78$), and color b value of milled rice ($r = -0.81 \sim -0.87$), amylose ($0.79 \sim 0.87$), whiteness ($r = 0.89 \sim 0.90$) and b value of cooked rice ($r = -0.94 \sim -0.96$) for six rice cultivars.

P-319

The role of cellular structure and phase behavior on the texture of extruded solid foams. L. Samuel (1), H. Dogan (1), J. L. KOKINI (1). (1) Rutgers University, New Brunswick, NJ, USA.

Understanding the impact of cellularity and phase behavior on texture of extrudates can result in rules to design the product better by configuring the extrusion process to obtain the desired level of crystalline to amorphous ratio and also to obtain the needed level of cellularity. The objective of this study was to investigate the effect of processing conditions on the formation of cellular structure and, the impact of cellularity and phase behavior on the texture of extrudates. 50:50 corn-wheat blend along with poultry meal was extruded under varying processing conditions to obtain extrudates of wide range of cellularity. Cross-sectional images of extrudates were obtained using X-ray microtomography and subjected to image analysis techniques to measure average cell size and cell size distribution, cell density, cell wall thickness

and cell wall thickness-to cell radius ratio (t/R). Volumetric displacement techniques were used to quantify bulk and solid densities. Differential scanning calorimetry and wide-angle x-ray diffraction were used to determine glass transition temperatures (Tg) and crystalline to amorphous ratios respectively. Uniaxial compression was used for textural characterization. Average cell wall thickness of the extrudates decreased with decreasing ratios of specific thermal energy to specific mechanical energy (R^2 = 0.87). Fracture stress increased as a power function of bulk density (R^2 = 0.77). Number of peaks decreased with increasing t/R ratios (R^2 = 0.55). X-ray diffraction patterns revealed a predominantly amorphous starch phase with relatively low crystalline to amorphous ratio (0.9–5.7%), attributed to the crystallization of amylose-lipid complexes during extrusion. Fracture stress decreased exponentially with increase in relative crystallinity (R^2 = 0.67) and increased as distance from Tg increased (R^2 = 0.64).

P-320
Time of extraction influence on level of phytosterols and policosanols extracted from grain sorghum DDG's. C. LEGUIZAMON S. (1), C. Weller (2), V. Schlegel (1), T. Carr (3). (1) Department of Food Science and Technology, University of Nebraska, Lincoln, NE, USA; (2) Department of Biological Systems Engineering, University of Nebraska, Lincoln, NE, USA; (3) Department of Nutrition & Health Sciences, University of Nebraska, Lincoln, NE, USA.

Lately, phytosterols and policosanols have gained importance because of their lowering-cholesterol properties. New sources of these compounds need to be identified. Several phytosterols and policosanols compounds have been found in lipid extracts from grain sorghum and sorghum dried distillers grains (DDG, a by-product of ethanol production from grain sorghum). Extraction of DDG with hexane at different times was carried out. The effect of the time of extraction on the amount and composition of phytosterols and policosanols in the extracts was determined. The method for extraction used was refluxing with hexane (3:1) at 64°C for a time of 30 min, 1 hr, 2 hr, 4 hr or 6 hr. Following extract filtering and solvent vaporization at low pressure, composition of phytosterols and policosanols for each extract was determined using TLC and GC analysis. Amount of phytosterols and policosanols extracted increased with extraction time. Sitosterol, stigmasterol, campesterol, octacosanol and triacontanol recovery levels varied with time.

P-321
Understanding organics and the regulations governing this market. B. A. RUSH (1). (1) Briess Malt & Ingredients Company, Chilton, WI, USA.

Once available only through specialty outlets, organic products are fast becoming part of mainstream. While organics represent a small and relatively less tracked market than well established conventional markets, this young but rapidly growing market offers almost unlimited opportunities. The organic industry grew 20% to reach $10.8 billion in consumer sales in 2003. Organic foods, by far the largest and most clearly defined part of the organic industry, grew 20.4% and accounted for the majority of organic sales. Sales of organic foods have nearly tripled since 1997, and growth rates of 17% to 21% since 1997 are expected to continue in coming years. In order to help growers, producers and handlers understand what is required to enter and be successful in this new market, this presentation will better define the laws and processes that must be complied with in order to maintain a certified organic operation. It will explain the USDA National Organic Program and how to comply with current regulations. We will discuss requirements to become certified organic, labeling requirements for organic products, and organic certifying agencies. This presentation will also discuss audit trails that are required for full traceability of organic materials from the farm to the finished product.

P-322
Wet milling: An efficient process to recover a recombinant LTB-rich fraction from corn. N. VIGNAUX (2), L. A. Johnson (1). (1) Center for Crops Utilization Research; (2) Iowa State University.

Recombinant protein extraction and purification from ground whole corn kernels is expensive because of low concentrations of target protein and high amount of contaminating proteins and lipids. One strategy to reduce that cost is to achieve an initial enrichment of the protein of interest prior to extraction. We envisioned taking advantage of targeted expression of recombinant protein into specific kernel tissues to use wet milling and recover a fraction high in target protein concentration. An *E. coli* enterotoxin B subunit protein (LT-B) targeted in corn endosperm was used because LT-B is heat resistant and wet milling involves steeping the kernel at 50°C. LT-B is a candidate vaccine against *E. coli* induced diarrhea. Steeping conditions (presence/absence of sulfur dioxide and lactic acid) were tested using a traditional wet-milling procedure. Solids mass and LT-B yield were measured in each fraction. The best results were obtained when LT-B corn was steeped in water with no added sulfur dioxide and lactic acid for 40 hr. It was possible to recover 95% of the extractable LT-B after milling. While previous evidence indicated LT-B was entrapped within starch granules, about 70% of the total LTB was recovered in the fine and coarse fiber fraction, which accounted for 18% of the total kernel mass. Only traces of LT-B were found in the starch fraction, and the rest was recovered in the steepwater and in the gluten fraction. One explanation for the high concentration of LT-B in the fiber fractions is the possible binding of LT-B to cell walls. Our results suggest that wet milling is an efficient way to produce a LT-B-rich fraction low in lipids and water-soluble proteins.

P-323
Comparative analysis of wheat classification systems in selected wheat exporting countries. A. Rosenberg (1), J. Kohler (1), T. ASKIN (1). (1) Agriculture and Agri-Food Canada, Winnipeg, MB, Canada.

The wheat classification systems of Canada, the United States, Australia, the United Kingdom, Argentina, France, and Ukraine are compared. The objective of this paper is to identify areas where Canada should consider adjustments to its wheat classification system to enhance its competitive position in the world wheat market. Wheat classification is defined as the method of segregating wheat into packages of end-use and quality information through classes, grades, and variety evaluation. The specifics of each country's system are described, including the functions of wheat classes and grades, the level of regulation present, recent changes to the system,

and how the system relates to end-use. The profiles consist of information obtained from official documents, as well as the input of representatives from most of the countries. The paper concludes that Canada's near-term competition may not necessarily come from non-traditional wheat exporting nations such as the Ukraine, as they lack an effective system to ensure consistency throughout shipments. Instead, the greater challenge may come from countries such as Argentina that have built upon a basic but well-rounded classification system as part of a strategy to improve overall wheat quality.

P-324

Degradation modelling of pyrethroid residues in raw and processed stored wheat. A. Calderon-Flores (2), M. Aldana-Madrid (2), M. SILVEIRA (2), P. Grajeda-Cota (1), M. Salazar-Garcia (2). (1) CIAD, A.C., Hermosillo, Sonora, Mexico; (2) Universidad de Sonora, Hermosillo, Sonora, Mexico.

This study evaluates different modeling techniques to estimate the pyrethroid degradation process in stored wheat grain and its processed products. One ppm of deltamethrin was applied to four replicates of 20 kg wheat grain, stored at room temperature (T) and relative humidity (RH). Grain samples were extracted at seven days intervals until 42 days. Deltamethrin content was determined using gas chromatography on the raw grain, flour and bread from each sample. Several statistical models and lifetime techniques were applied to determine the degradation behaviour related to time, storage T, and RH. After 42 days of storage, whole wheat grain residues of deltamethrin decreased 93%. White flour contained 26.8% of the whole grain, and bread 7.22%. Although linear, quadratic and logarithmic models seems to fit adequately on the time decrease for the whole grain (r = 0.79, 0.92, and 0.87, respectively), the effects of temperature and relative humidity as well as a lifetime analysis suggested the logarithmic model as the best fit (r = 0.98, $P < 0.001$). Estimated time of complete degradation corrected by average RH (55%) was 32 days ($P < 0.001$). RH increases significantly degradation time ($P < 0.02$), whereas temperature reduces it ($P < 0.15$). To assure complete degradation of pyrethroid insecticides it is recommended to wait at least 30 days after application, sifting and aerating the grain lot.

P-325

Determining corn hardness from grinding time, grinding energy and near-infrared spectroscopy of whole kernel and ground material. P. R. ARMSTRONG (1), J. Lingenfelser (2). (1) GMPRC USDA-ARS; (2) Kansas State University.

The Stenvert hardness test was used to determine the grinding time and energy of 121 food-grade corn hybrids at different moisture content (MC) levels. Grinding parameters were found to be significantly different between 10% MCwb to 14% MCwb. Lower moisture corn required less grinding time and energy. Equations were developed to correct grinding time and energy to a common moisture level in order to minimize moisture effects on corn hardness determination. Other findings show the grinding energy was found to be more repeatable than grinding times and the effect of mill grinding speed significantly affected grinding parameters. Near infrared reflectance (NIR) spectroscopy was concurrently evaluated as a method to measure corn hardness. Good predictive models, using PLS regression, were not obtainable using spectra (500–1700 nm) of whole kernel and ground samples. The moisture correction equations developed in this work allow samples of corn to be tested over a broader range of MC. This provides more convenience and greater confidence in using grinding parameters as a corn hardness measurement. Mill speed effects, although significant on grinding parameters, can be controlled more easily than corn MC.

P-326

Geographical diagnostics of polished rice based on C, N contents and C, N, O stable isotope analyses. Y. SUZUKI (1), Y. Chikaraishi (2), N. O. Ogawa (2), N. Ohkouchi (2), T. Korenaga (1). (1) Department of Chemistry, Tokyo Metropolitan University, Hachioji, Japan; (2) Institute for Research on Earth Evolution, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan.

Elemental and stable isotopic compositions of food materials are potentially available for identification of their geographical origin. The recent spread of elemental analyzer/isotope ratio mass spectrometry (EA/IRMS) allows the elemental and stable isotopic compositions of organic materials to be determined rapidly and routinely. Therefore, we determined carbon (C) and nitrogen (N) contents, and stable carbon (C), nitrogen (N) and oxygen (O) isotopic compositions of polished rice from various cultivated area, in order to develop a simple method to discriminate its geographical origin. As a first approach, we examined a single cultivar: Koshihikari rice from 14 different cultivated areas (USA, Australia and Japan). For all samples, C and N contents and the C, N, O isotopic compositions are consistent with those of general plant materials, being 37.2 to 40.0%, 0.9 to 1.4%, −27.1 to −25.8‰, +0.4 to +9.0‰ and +18.9 to +22.9‰, respectively. However, its cultivated area is clearly distinguished by a pentagonal radar plot based on the elemental and isotopic compositions, which probably depends growth environments. For example, American and Australian rice is characterized by relatively higher oxygen (by ∼3‰) and nitrogen (by ∼4‰) isotopic compositions than Japanese rice, respectively. Moreover, diagnostic difference is observed within Japanese rice from different locations. Thus, the radar plot based on C and N contents and C, N, O isotopic compositions will become a useful method for rapid and routine discrimination of geographical origin of polished rice.

P-327

Global grain tracing and recall system: Sampling strategy. K. LEE (1), T. J. Herrman (2). (1) Department of Soil and Crop Sciences, Texas A&M University, College Station, TX; (2) Office of the Texas State Chemist, Texas A&M University, College Station, TX.

Proof-of-concept research exploring the feasibility of a grain tracing and recall system using bar coded caplets to identify the field(s) of origin of commingled grain received support by USDA Plant Biosecurity Program within CSREES. An important component of this work involved developing a sampling scheme for different points in the marketing system. The application of bi- and multinomial statistics enabled researchers to develop sampling schemes for field delivered grain and commingled grain moving between grain elevators, respectively. The inclusion rate of 1 tracer/1 kg grain at the field appeared to require 79 kg and 298 kg wheat for 10 and 30 fields at country elevator, respectively. The computed number of rail cars to ship wheat grains to the next delivery

point was 6 for 10 fields and 18 for 30 fields, assuming 600 and 1800 tons of grain, respectively. Appropriate sampling size at a rail car was 13.2 kg for 10 field and 16.5 kg for 30 fields before leaving a country elevator or on a receiving point of the next point. At the inland-terminal elevator, sample sizes for the identification of the increased number of fields, 60 and 90 fields, were 672 kg and 1072 kg wheat, respectively. The required number of rail cars and sample size at each rail car were 36 cars and 18.7 kg for 60 fields, and 54 cars and 19.9 kg for 90 fields. Additional sampling required for the identification of the elevator ID was not necessary if the inclusion rate is less than 1 tracer per 50 kg of grains at the elevator since sample size for the field identification is greater than that for the elevator identification.

P-328

In-house validation of real-time PCR assay for the detection of GT73/RT73 canola GM event. T. DEMEKE (1), I. Ratnayaka (1). (1) Canadian Grain Commission.

Adventitious presence (AP) of genetically modified (GM) materials in non-GM grain is one of the most important concerns in international grain trade. In Canada, the two major canola GM events are GT73/RT73 (Roundup Ready®) and MS8xRF3 (Liberty Link®). About 50% of the canola acres in Canada are planted with cultivars that had the GT73 event. Event-specific primer set for the target DNA and two primer sets for reference DNA were used for PCR amplification of GT73 canola samples. TaqMan® probes labeled with FAM as the reporter dye at 5′ end and TAMRA as the quencher dye at the 3′ end were used for the detection and quantification. The real-time PCR assay was successfully used to quantify DNA samples consisting of 5, 1, 0.5 and 0.1% GT73 canola. Reproducible and accurate results were obtained for the experiments conducted. The amplification efficiency, linearity and coefficient of variation were within the acceptable and recommended range. Based on our observation, the quantitative real-time PCR assay can be used to detect and quantify as low as 0.1% Roundup Ready® content in canola samples.

P-329

Quantification of food-grade corn density variance components. K. LEE (3), T. J. Herrman (4), T. M. Loughin (1), J. Lingenfelser (2). (1) Department of Statistics, Kansas State University, Manhattan, KS; (2) Department of Grain Science and Industry, Kansas State University, Manhattan, KS; (3) Department of Soil and Crop Sciences, Texas A&M University, College Station, TX; (4) Office of the Texas State Chemist, Texas A&M University, College Station, TX.

Variance structure of corn kernel density for commercial corn (*Zea mays* L.) hybrids grown across four locations during two growing seasons was quantified within a hierarchical scheme: field, repetition (repetitions within a field), row (inside and outside row within a repetition), plant (plants within a row), and earloc (kernels at the top, middle, bottom on the ear). Kernel density for 1440 samples during 2002 and 612 samples during 2003 was measured using a gas pycnometer. Significant source of variation occurred in the plant for all hybrids during 2002 ($P < 0.01$). In both growing seasons, higher sampling levels including field and repetition were more significant source of variation than lower sampling levels except plant. Partitioned variance estimates for kernel density were great for field and plant in year 1, and for field and repetition in year 2. Corn density variance structure, to a great extent, varied among hybrids and between years. With respect to fixed effects, least square mean (LSM) difference between inside and outside rows within a repetition was not significant ($P > 0.05$), but mean kernel density increased toward the bottom-most kernels on the ear for all hybrids in year 1. Variance structure for the tangential abrasive dehulling device (TADD) and dry-milled grit yield within a hierarchical scheme with reduced sampling levels was similar to that for kernel density, but the magnitude and direction of the variance estimate differed from those of kernel density variance estimates. Better knowledge and insight of the variation in kernel density within and between fields may allow to improve grain quality consistency and to facilitate the development of segregation and classification system for corn samples at collecting point, resulting in optimization of end-use performance and maximizing economical benefits for people in corn industry.

P-330

Susceptibility of sorghum for lesser grain borer and their influence on the physicochemical properties of sorghum kernel and flour. S. PARK (1), F. H. Arthur (1), S. R. Bean (1), T. Schober (1), B. Ioerger (1). (1) USDA-ARS GMPRC, Manhattan, KS, USA.

There is increased interest in sorghum as a human food because it is gluten-free, which is critical for those who suffer from celiac disease, and it has a high content of antioxidants. The storage of sorghum is anticipated to increase as the demand grows for sorghum as a substitute for gluten-based products. The lesser grain borer (LGB) (*Rhyzopertha dominica* F.) is a major economic insect pest of many stored grains, and can also infest sorghum. However, there are few studies which show the susceptibility of sorghum to the LGB and effects of insect population and resulting damage on the physicochemical properties of sorghum kernel and flour. We established LGB colonies on sorghum, and placed mixed-sex 1–2 week old adults in jars filled with sorghum at population levels of 0, 10, 20, 40, and 80; at 27 and 32°C. We found significant differences ($P < 0.01$) for main effects initial population level, temperature, and the interaction on F1 progeny, % insect-damaged kernels (IDK), and frass weight. Positive correlations were found among all main effects, and there were correlations between insect population levels and quality characteristics of milled sorghum including peak viscosity (r = 0.68), peak time (r = 0.63, $P < 0.01$), holding strength (r = 0.78), set back (r = 0.82) and final viscosity (r = 0.83).

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The study on sanitation and safety management of rice flour noodles in Taiwan. S. LIN (2), W. Kuo (2), Y. Chiang (1). (1) Department of Human Development and Family Studies, National Taiwan Normal University, Taipei, Taiwan; (2) Graduate Institute of Applied Science of Living, Chinese Culture University, Taipei, Taiwan.

In this study, the sanitation and safety management of rice flour noodle process in Taiwan was investigated. The research was conducted by survey method and made use of convenience sampling method to choose seven from fourteen rice flour noodle factories. The tools of this research were “factory environment and establishment scale”, “machine

equipment scale", "organization personnel scale", "sanitation management system and personnel sanitation scale", "manufacture process scale", and "quality control scale". The available data was collected from seven items and one hundred and sixteen questions. The results indicated: 1) to research and develop automatic machines, 2) to control the pollution medium, 3) to reduce the injurious factors, and 4) to accept the identification of GMP (good manufacture practice), and HACCP (hazard analysis critical control point) to improve the quality.

P-332

The use of a very low cost extruder on the inactivation of phytohemagglutinin activity in red kidney beans (*Phaseolus vulgaris* L.). G. NYOMBAIRE (1). (1) Michigan State University.

A significant part of the world relies on dry beans as a staple food for subsistence, particularly in combination with cereals. However, beans contain phytohemagglutinins (PHA), protease inhibitors and amylase inhibitors. These antinutrients must be inactivated, the starch must be gelatinized, and the beans must be ground or softened before consumption. Lack of fuel wood for cooking dry beans is a major problem facing over-populated developing countries and continued deforestation alters local and global climate. The existing extrusion equipment is not suited to the context of countries with low income, as it requires considerable financial investment. The objective of this study was to test the performance of a very low cost extruder on the inactivation of phytohemagglutinin activity in red kidney beans. Extrusion of raw ground red kidney beans was accomplished using a low cost laboratory co-rotating twin-screw extruder model JS30A manufactured in China by Qitong Chemical Industry Equipment Co., Ltd. The screws are 30 mm in diameter and the barrel has a L/D of 16. Red kidney bean flour was extruded at 25% and 36% moisture content wet basis; screw speed was 118, 194 and 255 r.p.m; feed rate was 85 and 120 g/min and extrusion barrel temperature was 105 and 125°C (die end). Phytohemagglutinin activity in the extruded samples was determined in triplicate by enzyme-linked immunosorbent assay (ELISA). Significant reduction (more than 90%) of PHA was observed in samples extruded under 25% moisture. The very low cost extruder manufactured in China can be used by both developed and developing countries in the production of safe and low cost nutritional bean products such as infant flours and bean snacks.

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Characteristics of starches of Mexican durum wheat cultivars. B. MONTAÑO-LEYVA (2), P. Torres (2), C. Medina-Rodriguez (2), B. Ramirez-Wong (2), F. Martínez-Bustos (1), R. Ramirez-Bon (1), J. Wilson (3). (1) CINVESTAV, Unidad Querétaro, Mexico; (2) Departamento de Investigación y Posgrado en Alimentos, Universidad de Sonora, Hermosillo, Sonora, Mexico; (3) USDA, Manhattan, KS, USA.

Starches extracted from five different durum wheat cultivars were analyzed and compared to starches from soft and hard wheats, respectively. Starches were evaluated using differential scanning calorimetry (DSC), X ray diffraction analysis, laser diffraction sizing and rapid viscoamilograms. Crystallinity percentages were higher for durum wheat, when compared to soft and hard wheat starches. Granule size distribution showed differences. Separation between the two populations of A and B granules were less differentiated for durum wheat starches than the populations of granules of the hard wheat starch. The endothermal transition corresponding to gelatinization showed amplitude of 10°C and a peak at 60°C, with small differences between durum wheat starches, and being lower for durum than hard and soft wheats. There were significant differences ($P < 0.05$) in pasting and gelatinization viscosities. Durum wheat starches produced the highest viscosities. The groups of techniques differentiated starches from tetraploid and hexaploid wheats, and they also detected differences due to environmental effects.

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Chemical characteristics of spaghetti fabricated with different levels of plantain starch addition. R. G. HERNANDEZ-NAVA (1), L. A. Bello-Perez (1), J. J. Berrios (2), J. Pan (2). (1) CEPROBI-IPN, Yautepec, Morelos, Mexico; (2) U.S. Department of Agriculture, WRRC, Albany, CA.

Plantain starch contain high concentration of resistant starch (RS), which is consider a functional ingredient with the same beneficial effect on human health as those from dietary fibers. The chemical composition of spaghetti fabricated with 5, 10, 15 and 20% of plantain starch addition was studied. Plantain starch was isolated in house; while semolina was from a commercial source. Spaghetti with 100% semolina was used as control sample. Spaghetti products were processed following standard procedures used by the California Wheat Commission. Different chemical analyses of the spaghetti products were determined using standard AACC methods. The moisture content of the spaghetti was not affected by the process or the different levels of plantain starch addition. However, the concentration of protein, crude fat and ash decreased significantly ($P < 0.05$) as the level plantain starch increased in the spaghetti. Conversely, the concentration of RS increased significantly ($P < 0.05$) with an increase in the level of plantain starch, in substitution of semolina, in the spaghetti. The result of this study demonstrated the feasibility of fabricating spaghetti, as a functional food, with high concentration of plantain-RS.

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Effects of added ash on the pasting and noodle making properties of wheat flour. H. GUJRAL (1), B. Baik (1). (1) Washington State University, Pullman, WA, USA.

Ash content serves as an index of wheat flour quality to flour millers and food manufacturers, who prefer flour of low ash content even though its significance in functional properties of wheat flour is not well understood. We explored if ash has any influence on the processing properties of wheat flour and product quality. Ash obtained by incinerating wheat bran was incorporated into two hard white spring wheat flours having ash content of 0.46 and 0.45% to raise the total ash content to 1, 1.5 or 2%. Increasing ash to 2% increased the RVA peak viscosity of the flours by 7–15%, but lowered the peak viscosity of the isolated starch. The pH of the flour water slurries was increased from 6.0 to 7.8 with ash at the 2% level. The peak viscosity of the starch increased with the addition of gluten and further increased by the subsequent addition to 1% ash, possibly by promoting electrostatic interactions in protein molecules. Incorporation of ash up to 2% reduced the sheet length of white salted noodles by 7–16%, resulting

in thicker noodles. With the addition of ash to 2%, water retention of cooked noodles decreased and firmness increased. The viscosities of wheat flours were >7% higher with ash added to 2%, even when the pH was kept constant by using a buffer solution. The peak viscosity temperature of flours decreased by about 10°C by ash addition to1%. Viscosity of starch in buffer solution increased by addition of ash to 2%, but it did not lower the pasting temperature of the starch.

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Evaluation of U.S. durum wheat quality with mixolab.

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Mixolab is a quality control device which can be used to determine the rheological, gelatinization and enzymatic properties of flour and semolina. The objective of this study is to evaluate the rheological and gelatinization properties of durum wheat grown in US with mixolab. Alamo, Ben, Belzer and Rubgy cultivars were used. Cultivars were held at 30, 45 and 60 C bowl temperatures and showed significant differences ($P < 0.05$) in terms of protein quality. Alamo gave the highest hydration (C1) and stability scores compared to Belzer and Ben, which showed similar results. Rugby gave the lowest C1 score and was significantly different ($P < 0.05$) than other cultivars. High temperature (45–60°C) mixing decreased C1 and C2 scores of all cultivars and C1, C2 and stability scores were significantly lower compared to 30 C tests. Gelatinization properties varied, however Ben gave the highest torque score (C3) slightly higher than Alamo, whereas Rugby was the lowest. Belzer gave the highest C5 score, whereas Rugby the lowest. Alamo and Ben showed similar C5 scores. Gelatinization properties were significantly altered by higher bowl temperatures, which showed higher torque scores (C3 and C5) for all cultivars. Final torque results (C5) were higher at 45 and 60 C bowl temperatures. The results showed variability due to protein quality and starch pasting properties, which indicated that mixolab could be used to determine U.S. durum wheat quality.

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Fortification of spaghetti with *Lupinus mutabilis* derivatives and rheological, processing, and quality evaluation studies.

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The aim of the present work was fortified with *L. mutabilis* derivatives durum wheat semolina. Protein (N × 6.25; method 955.04), lipids (method 920.39), crude fibre (method 962.09) and ash (method 923.03) were determined according to AACC 1995. Spaghetti was prepared from durum wheat semolina, fortified with 0, 5, 10, 15 and 20% of lupin flour (LF), 3, 5, 8 and 10% of lupin protein concentrate (LPC) and 0.5, 1, 2, 3 and 4% of lupin protein isolate (LPI) to increase protein. Later the rheological analyses (TPA and adhesiveness) were performed by using a TA.XT2i texture analyzer (Stable MicroSystems Ltd., Surrey, UK) in a compression mode. Supplementing semolina with LF, LPC and LPI caused an decrease in hardness and cohesivity of the dough except for blends containing 15 and 20% of LF, in the case of adhesivity, the fortification increase this property. For the extensibility and adhesivity force diminish between 15–20% of LF and 8–10% of LPC. Firmness scores of the fortified spaghetti increased with the level of fortification. Taste panel evaluation showed that spaghetti supplemented with 3% of LPI was acceptable. A beany taste and hardness was reported for this spaghetti with respect to the commercial.

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Glutenin macropolymer from salt and alkaline noodles.

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Interactions between glutenins and gliadins provide the unique visco-elasticity of wheat flour dough. The glutenin fraction of wheat gluten that forms an insoluble gel layer after being centrifuged in 1.5% SDS is known as glutenin macro polymer (GMP). Using a modified method from Don et al (2003a) we were able to isolate GMP from both salt and alkaline noodle samples. Samples (10 ± 0.05 g) were removed from 6 stages during noodle processing. After sampling noodle doughs were frozen immediately in liquid nitrogen, freeze-dried, and then ground to pass a 0.212 mm sieve. The ground samples (1.55 ± 0.005 g) were then mixed with 22 ml of 1.5% (w/v) SDS and centrifuged at 39,000 g for 60 min at 20°C. The amounts of GMP isolated from both the salt and alkaline noodles were similar at all stages of processing, except after resting for 24 hr, where the amount of alkaline GMP isolate was higher. The GMP from both salt and alkaline noodle doughs was stickier when isolated after the compounding stage compared to GMPs isolated from flour or the mixed dough before compounding. Generally the GMP isolated from alkaline noodle doughs exhibited more evident stickiness at all stages, when compared with the GMP isolated from salt noodle doughs. Dynamic rheology indicated that the alkaline GMP isolate was more variable in physical properties compared to salt GMP isolate. For example for the salt noodle GMP, phase angle varied from 23 to 25°, whereas, for alkaline noodle GMP, phase angle varied much more, from 20 to 38°. Particle size analysis indicated that both GMP isolates were bimodal and that there was a difference between the alkaline and salt GMP isolate distributions.

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Possibility of use of instrument MOM color 100 for objective evaluation of spaghetti color.

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Bright yellow colour is an important factor in the use of pasta for food production, particularly to make good-quality pasta product. This colour is the result of the natural carotenoide pigments present in the seed, of the residual contents after storage of grain or semolina and after milling, of their oxidative degradation by enzymes during pasta processing, and of processing conditions. Experimental pasta-making followed by a proper assessment of the finished product, such as by a panel test, provide the most reliable evaluation, but color quality can be empirically predicted by objective experiments. The relation between visual and photoelectric measurements of spaghetti color was studied. Color measurement was performed on spaghetti present on Serbian market, using three-stimulus photoelectric colorimeter

MOM color 100. Using the CEI system, reflectance data were converted to trichromatic coordinates, as well as another color measurement expressed by CIELab, ANLAB and Hunter systems and related to visual spaghetti color scores. Statistical analysis showed a high correlation between visual and reflectance measurements of colors.

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Protein extractability of wheat flour and noodle dough as a protein quality index for making Asian noodles. S. YOON (1), B. Baik (1). (1) Washington State University, Pullman, WA, USA.

Functional properties of wheat flour protein suitable for making noodles may differ substantially from those for making bread. While full development of gluten occurs during bread dough mixing, there is limited gluten development in noodle dough. Our understanding of functional properties of protein required for making noodles and their evaluation are inadequate for effective screening of noodle wheat genotypes. We determined the proportions of salt, alcohol and acid soluble proteins of wheat flour as indexes of protein quality and their changes during dough mixing and sheeting process to identify the protein quality profile suitable for making noodles. Wheat flours of varying protein content, milled from two hard white and two soft white wheat varieties, and three commercial noodle wheat flours were prepared into noodle dough and sheet. Protein content ranged from 7.6 to 12.5% in soft, from 13.5 to 15.3% in hard and from 8.0 to 10.5% in commercial wheat flours. SDS sedimentation volume (SV) of flour based on 10% protein content was greater than 54.0 mL in hard, but was lower than 33.8 mL in soft wheat flours. Three commercial noodle flours exhibited much higher SDS SV than soft wheat flours. Proportion of salt soluble protein ranged from 16.5 to 20.9% in hard and commercial noodle wheat flours and from 22.1 to 30.7% in soft wheat flours. Variations in the proportion of salt soluble protein among wheat flours of varying protein content in each variety were evident but smaller than variations among wheat varieties. While the proportion of salt soluble protein significantly decreased during dough mixing, no further decrease in the proportion of salt soluble protein was observed by the subsequent sheeting process.

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Characteristics of buckwheat flours obtained from gradual milling system and their application for noodle making. P. V. HUNG (2), S. Yamamoto (2), K. Miyake (2), T. Maeda (1), N. Morita (2). (1) Department of Life and Health Sciences, Hyogo University of Teacher Education, Hyogo, Japan; (2) Laboratory of Food Chemistry, Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Osaka, Japan.

Soba noodles are native Japanese noodles made of buckwheat flour and wheat flour with high nutritious quality. However, refined buckwheat flour was milled with removal of most portions of fiber, mineral and phenolic compound in bran and germ. Therefore, a gradual reduction milling system has been developed to improve the nutritious constituents in flour. In this study, four fractions (3M, 2MA, 1MA and 1SA), which were fractionated from whole buckwheat grain from outer to inner part using the gradual reduction milling method are characterized and applied for noodle making. Fraction 3M which is nearly outer part had significantly high amounts of dietary fiber, mineral and rutin contents, whereas 2M had the highest protein content than the other fractions. In contrast, fraction 1SA which is nearly inner part had the highest starch and the lowest protein, lipid, ash and rutin contents. The fraction 1SA showed significantly higher viscosity, whereas 3M showed significantly lower viscosity than the others. Amylose contents of all fractions were not significantly different. All fractions were used to substitute for 10, 20 and 40% of a strong wheat flour (1CW) for noodle making. Substitution with fraction 3M decreased the lightness (L*) value, but increased the chromaticity (a* and b*) values of noodle, whereas substitutions with 2MA, 1MA and 1SA increased the whiteness of noodle both before and after boiling. The noodles substituted with buckwheat flour fractions had higher firmness and stretching stress than the control (100% 1CW). However, the noodle made from 40% substitution of buckwheat flour fraction for 1CW had lower firmness than those with 10 or 20% substitution. As a result, the different buckwheat fractions could be used for noodle making because they have different impact on the nutritious quality of noodles.

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Effect of bran on durum wheat pasta drying. S. VILLENEUVE (1), P. Gélinas (1). (1) Food Research and Development Centre, Agriculture and Agri-Food Canada, Saint-Hyacinthe, QC, Canada.

Pasta made from whole durum wheat semolina is a growing market but little information is available on its optimal drying conditions. The aim of this study was to determine the effect of wheat bran on pasta drying. Bran-free pasta (100% roller-milled durum wheat semolina) and bran-rich pasta (semolina supplemented with 15% wheat bran previously ground with a centrifugal mill with 0.2 mm aperture openings) were extruded through a 2.0-mm die and dried for 20 h in an environmental chamber at 40, 60 or 80°C, and 65, 75 or 85% relative humidity. Pasta was weighed online with a 5-kg load cell connected to a data acquisition system. Bran changed the course of pasta drying, depending on temperature and relative humidity conditions. Effective moisture diffusivity of bran-rich pasta decreased when relative humidity was higher than 75% but, below 75%, the reverse was observed. Above 76°C, equilibrium moisture content of bran-rich pasta was higher than bran-free pasta. In conclusion, optimal drying conditions for bran-rich pasta would be different than bran-free pasta.

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High speed dough tests of semolina using the Newport Scientific doughLAB. J. Dang (2), M. L. BASON (2), M. J. Sissons (1). (1) NSW Department of Primary Industries, Tamworth Agricultural Institute, Calala, NSW, Australia; (2) Newport Scientific Pty. Ltd., Warriewood, NSW, Australia.

The Newport Scientific doughLAB is a z-arm, variable speed (up to 200 rpm) dough mixer that tests the characteristics of doughs, and provides results that are comparable with those obtained from the Brabender farinograph at standard speed. High energy (high speed) mixing is especially useful for samples that are difficult to develop. The objectives of this study were to compare results from the doughLAB and farinograph on semolina doughs, and assess the capability and repeatability of the doughLAB in performing accelerated

tests. Twenty semolina samples, with accompanying farinograph water absorption (WA) data, were tested on the doughLAB using a 50-g bowl at standard and accelerated speeds. WA values for these samples ranged from 55.4% to 65.6%. Increasing mixing speed resulted in higher torques, better peak resolution and more rapid dough development times. Results were generally more repeatable at higher speeds. In some cases, a second peak was detected, which suggests that testing semolina or any difficult-to-develop samples at standard speed would bias results to detect only the first peak. Good correlations (r^2 = 0.977) were observed between farinograph and doughLAB WAs at standard mixing speed. WA values from doughLAB tests at higher speeds were also well correlated (r^2 = 0.977 and 0.999 at 120 rpm and 180 rpm, respectively) with those from farinograph standard speed test, and the slopes of the fitted lines were parallel. Consequently, tests at higher speeds could be used to estimate flour WA, reducing test time and giving a better indication of dough stability.

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Influence of hydration level and mixing time on rheological and structural properties of common and durum wheat milling fractions. V. LANDILLON (1), D. Cassan (1), M. Morel (1), B. Cuq (1). (1) Agro.M-INRA UMR IATE, Montpellier, France.

The aim of this work is to study the agglomeration mechanism of wheat milling fractions occurring at intermediate hydration levels (12–35%) and two mixing times (10 and 30 min). Two common wheat flours (55 and 110% extraction rates), one durum wheat groat and one durum wheat semolina are selected from different physical and biochemical characteristics. The cohesion properties and the morphology of the wheat millings before and after mixing with water were determined using the powder flow analyser under compaction and shearing stresses and the environmental scanning electron microscopy (ESEM). Different agglomeration products, in terms of size and cohesion, were observed in relation with the physical and biochemical characteristics of wheat millings. Under our experimental conditions, no dough formation occurred. Short mixing time and intermediate water contents induced heterogeneous particles hydration. Slightly swollen starch granules were observed while many others appeared unchanged. Low water contents (<20%) lead to weak but discriminative cohesion for the different wheat milling particles. Under compaction, common flours and durum groat were cohesive contrary to durum semolina (higher particle size). After shearing, only the durum groat remained cohesive, probably due to biochemical composition even if no relationship was clearly found. At higher water contents (>20%), the cohesion properties were similar for all the wheat millings. This was probably associated to the reactivity of particles that tended to form cohesive interactions such as liquid bridges and hydrogen bondings. Moreover, drastic cohesion changes associated to a critical reactivity threshold were observed for all wheat millings between 25 and 30% water content.

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Manipulation of starch composition in wheat breeding in Italy. E. DE AMBROGIO (2), G. Ferrazzano (2), R. Ranieri (1), M. Silvestri (1), F. Sestili (3), A. Saliola Bucelli (3), D. Lafiandra (3). (1) Barilla G. e R. Fratelli S.p.A., Parma, Italy; (2) Società Produttori Sementi S.p.A., Bologna, Italy; (3) Università della Tuscia, Viterbo, Italy.

Starch, which accounts for 65–75% of wheat grain dry weight, is the major constituent of flour and semolina and it is composed of two types of polymers, amylose and amylopectin. The physical and chemical properties of starch and consequently the quality of end products are dependent on the relative amounts of amylose and amylopectin. In bread wheat, at least four kinds of proteins, waxy protein (GBSS) and three starch granule proteins (SGP-1, -2, -3), are responsible for starch synthesis. The waxy protein is a granule-bound starch synthase (GBSS) responsible for amylose synthesis and three proteins are present in bread wheat, which are encoded by three genes designated Wx-A1, Wx-D1 and Wx-B1, located on chromosome arms 7AS (Wx-A1), 7DS (Wx-D1) and 4AL (Wx-B1). The starch granule protein SGP-1, is involved in amylopectin synthesis, and as in the case of waxy proteins three proteins are present in bread wheat, SGP-A1, SGP-B1 and SGP–D1, whose genes (Sgp-A1, Sgp-B1 and Sgp-D1) are localised on the short arm of the homoeologous group 7 chromosomes. Extensive electrophoretic analyses of bread and durum wheat have led to the identification of partial waxy mutant lines, lacking one waxy protein. Crossing these materials has permitted the combination of the different null alleles detected, both in a bread wheat line (N11) and in the durum wheat cultivar Svevo, with the production of the entire set of partial waxy lines along with the total waxy. Similarly, mutant lines lacking one of the three possible SGP-1 proteins identified by Yamamori and Endo (1996) have been used to produce bread and durum wheat lines lacking simultaneously all the SGP-1 proteins. Expression profiling of waxy genes has been carried out on developing kernels of partial waxy lines and normal durum wheat. The use of these materials in food and non food uses will be presented.

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Noodle quality affected by different cereal starches. Y. Huang (1), H. LAI (1). (1) Dept. Agric. Chem., National Taiwan University.

Different sources of cereal starches, including rice, wheat and corn, were used as the substituted starches of reconstituted flour for udon noodle making. The effects of starch properties on the noodle making and its eating and storage qualities were evaluated. The dough sheets made from reconstituted flours had similar initial stress of wheat dough which was prepared by adjusting the water absorption of flour. The results show that dough sheet made from rice starch was the most compact and the least thickness, while their percentage of relaxation increased compared to others. The optimal cooking time was much shorter for noodle made from rice starches than other samples. The low cooking loss of noodle made from rice starches was attributed to the short cooking time, while the short cooking time resulted in low moisture content and low swelling index of boiled noodle. The noodle made from waxy rice and waxy corn starches had good storage quality up to 1 day storage at 4 °C. which show low cutting force of noodles. The cutting force increased significantly for noodles made from rice starches than others after 5 days of storage.

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Processing and assessment of udon noodles: Evaluation of ANW, APW and ASW for the quality properties of udon noodles. L. CATO (1). (1) AWB Ltd., Melbourne, VIC, Australia.

Udon noodles (white salted noodles) are a popular choice of food in many Asian countries and one of the most popular noodle types in Japan. These types of noodles in Japan are typically made of softer wheat flours of medium protein content (about 9–10.5%) and low extraction rates (50%) and are made from a mixture of flour (100 parts), water 32–35 parts) and salt (3%). Bright and creamy, slightly yellow colour is preferred, free of specks, while soft but with a note of firmness attached textural characteristics are required. The aim of this study has been to evaluate Australian wheat grades of different wheat and flour properties for processing of udon noodles. Texture was measured using the Lloyd texture analyzer, while the colour was measured using the Minolta Chroma Meter (CR300). The samples evaluated included: Australian noodle wheat (ANW), Australian Premium White (APW) and Australian Standard White (ASW) grown in Western Australian (WA). The samples had protein content in the range of 8.2–9.4% while ash content ranged from 0.37–0.43%. ANW resulted in excellent noodle colour (bright and creamy) and good textural characteristics (good balance of hardness and softness). ASW resulted in udon noodles of acceptable quality, while noodles made from APW were bright in appearance but had firmer textural properties. The differences seen will be discussed in relation to the grain hardness, starch and protein properties.

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Rapid spectrophotometric method for determination of phosphine in wheat. F. Longobardi (2), M. PASCALE (2), M. Silvestri (1), R. Ranieri (1), A. Visconti (2). (1) Barilla G. e R. Fratelli S.p.A., Parma, Italy; (2) Institute of Sciences of Food Production (ISPA), National Research Council, Bari, Italy.

Phosphine (PH_3) is a fumigant used worldwide to disinfest stored products, including cereals. Many pest control procedures using PH_3 start with metal phosphides, which decompose to liberate PH_3. The FAO/WHO tolerance level for PH_3 in raw cereals, i.e. 0.1 mg/kg, is based on measurement of PH_3 as total PH_3 deriving from both residual phosphides and physically bound PH_3. A spectrophotometric method for rapid determination of PH_3 residues in wheat has been developed. Phosphine-fumigated wheat kernels were added with an aqueous solution of H_2SO_4 in a gas-tight flask and PH_3 was released into the headspace by microwave irradiation. An aliquot of headspace was transferred by gas-tight syringe into a vial containing a solution of $AgNO_3$. Absorbance of resulting solution was measured at 400 nm. A good linearity response ($r = 0.9965$) was observed in the range 0.035–0.230 mg/kg between absorbance values and PH_3 concentrations with a detection limit of 0.026 mg/kg. The total time of analysis was 10 minutes. A good correlation ($r = 0.9940$) was found between results obtained by analysis of samples containing unknown PH_3 residue with spectrophotometric and GC-NPD methods.

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The enzyme assays of Australian white wheat flours and Asian noodles: The colour and textural properties of white salted noodles. L. CATO (1), A. L. Halmos (2), D. M. Small (2). (1) AWB Ltd., Melbourne, VIC, Australia; (2) RMIT University, Melbourne, VIC, Australia.

White salted noodles are a popular food worldwide and a bright uniform appearance along with the texture are important attributes of these products. It is known that milling of the wheat as well as the starch and protein characteristics are important. Whereas the significance of enzymes in baking of wheat flour is well recognized, less is known of their significance and potential in noodlemaking. Wheat flour contains low levels of some enzymes and it is also known that enzymatic activities may vary for different genetic varieties. Many enzymes that are naturally present in flour may have a significant impact on product characteristics of white salted noodles. The aim of this project has been to evaluate the activity of various enzymes naturally present in white wheat flours and their impact on the quality of white salted noodles. Enzymes assayed included ascorbic acid oxidase (EC 1.10.3.3), lipase (EC 3.1.1.3), lipoxygenase (EC 1.13.11.12), peroxidase (EC 1.11.1.7) and alpha-amylase (EC 3.2.1.1). Some variations in levels of enzymes have been found in a series of flours. The significance of these enzymes to the quality (product appearance and eating quality) indicates that there may also be potential for addition of enzymes during formulation of white salted noodles, particularly ascorbic acid oxidase and lipoxygenase. The addition of these two enzymes resulted in improved textural properties and brighter noodle sheets. Peroxidase and wheat germ lipase adversely affected the colour properties of white salted noodles, the addition of peroxidase also resulted in slightly firmer noodles while lipases had only minor effect on textural properties of white slated noodles. Bacterial alpha-amylase adversely affected firmness of white slated noodles.

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Evaluation of commercial spaghetti texture at different cooking and resting times. A. COTA-GASTÉLUM (2), M. Salazar-García (2), A. Islas-Rubio (1). (1) Centro de Investigación en Alimentación y Desarrollo. Hermosillo, Sonora, México; (2) D.I.P.A.Universidad de Sonora, Hermosillo, Sonora, México.

Texture is generally accepted as the main criteria to evaluate the quality of cooked pasta. Commercial spaghetti was cooked at different cooking times (9.5, 12.5, and 15.5 min) and allowed to rest for 2 and 5 h. The effect of cooking and resting times on texture and physicochemical parameters such as water absorption index, total solids, amylose content and total organic matter of cooked spaghetti were evaluated. Spaghetti firmness (as maximum force) and work of deformation (as area under the curve) were determined using the texture analyzer TA-XT2. Spaghetti firmness was significantly affected by cooking and resting times. On the other hand, cooking time showed a significant effect on the physicochemical parameters evaluated; in addition, significant correlations between these parameters and maximum force and work of deformation were found. This suggests that maximum force provides a good estimate of the texture of cooked spaghetti.

P-351

Fluorescence polarization immunoassay for rapid screening of deoxynivalenol in wheat-based products. V. Lippolis (2), M. PASCALE (2), A. D'Alessandro (1), R. Ranieri (1), A. Visconti (2). (1) Barilla G. e R. Fratelli S.p.A., Parma, Italy; (2) Institute of Sciences of Food Production (ISPA), National Research Council, Bari, Italy.

Deoxynivalenol (DON), also known as vomitoxin, is a tricothecene mycotoxin produced by *Fusarium culmorum* and *F. graminearum*, plant pathogenic fungi frequently occurring in cereals worldwide. DON has been shown to induce several toxic effects in various animal species. Recently, the European Commission has established maximum permissible levels of DON in wheat and wheat-based products. A rapid fluorescence polarization (FP) immunoassay was developed in our laboratory for determination of DON in soft wheat, durum wheat, semolina and pasta. It consisted of a rapid extraction with phosphate buffered saline (PBS), followed by filtration and FP immunoassay quantification based on the competition for a DON specific monoclonal antibody between DON and a DON-fluorescent tracer. The total time of analysis was less than 15 min. Average recoveries from samples spiked with DON at levels from 0.25 to 1.75 µg/g were higher than 98% with relative standard deviation lower than 5%. The limit of detection was 0.08 µg/g DON for all matrices. Comparative analyses of naturally contaminated samples performed by the FP immunoassay method and HPLC/immunoaffinity clean-up showed a good correlation between DON concentrations ($r > 0.995$). The FP immunoassay is suitable for rapid quantitative determination of DON in soft wheat, durum wheat, semolina and pasta at levels foreseen by international regulations, and showed better accuracy and precision with respect to the HPLC/immunoaffinity method.

P-352

Improving dough color stability through the isolation and sequence analysis of polyphenol oxidase (PPO) genes in wheat and its wild relatives. B. BEECHER (1). (1) USDA-ARS.

Polyphenol oxidase (PPO, EC 1.10.31), also known as tyrosinase, catecholase and catechol oxidase, is an enzyme that occurs in many tissues of the wheat plant, including the outer layers of wheat kernels. High levels of wheat grain polyphenol oxidase can lead to high concentrations in derived flour products. In the presence of oxygen, flour PPO will catalyze the oxidation of a number of phenolic substrates to produce dark pigmented products. This, in turn, leads to discoloration, and diminished product quality. High levels of grain PPO have been associated with diminished end-product color and brightness in a variety of Asian noodle products. Recent observations suggest that wheat contains multiple PPO genes, some of which are expressed in the developing seed. The exact number of PPO genes in wheat is unknown. Likewise nothing has been reported concerning the PPO genes' structure and regulatory sequences controlling PPO expression. The answers to these questions are necessary if we are to further improve the color stability of wheat flour products. In this study, we have identified, isolated and sequenced the complete genomic (regulatory) sequences of PPO genes from wheat and wheat relatives. Interestingly, the number of PPO gene sequences appears to be highly variable among wheat genotypes, and can be quite large. For example, we present six distinct and

complete PPO coding and regulatory sequences isolated from the diploid wheat relative *Triticum monococcum*.

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Pasting and cooking properties of pasta products. C. BRUNEEL (1), B. Pareyt (1), H. Goesaert (1), J. Delcour (1). (1) Katholieke Universiteit Leuven, Leuven, Belgium.

Protein, starch and the ultrastructure of pasta products play an important role in determining pasta quality. During industrial pasta production and the subsequent cooking, the protein forms a network, which is impacted by starch swelling. So far, there is still little information about the properties of a strong protein network needed for high quality pasta. The purpose of this study was to characterise 17 different spaghetti products and to increase insight in the role of proteins on their pasting and cooking properties by studying the effects of the reducing agent dithiothreitol (DTT). In the exercise, durum wheat semolina served as control. The compositions (levels and characteristics of starch, protein, ash, lipid, nonstarch polysaccharides) and cooking quality parameters (water absorption, cooking losses, ...) of the investigated pasta products were analysed with AACC methods. The level of SDS (2% w/v)-unextractable protein varied widely, and may be related to differences in process and drying conditions. Starch and amylose contents correlated with cooking quality as did the increases in levels of said SDS (2% w/v)-unextractable protein. In addition, protein had a substantial impact on the rapid visco analyser (RVA, 12% dry matter, run consisting of 1 min at 50°C, 6.5°C/min to 95°C, 8 min at 95°C, 7.5°C/min to 50°C) pasting and cooking properties. Addition of DTT (0.15%) in RVA demonstrated that the protein barrier restricts the heat-induced swelling of starch and its leaching behaviour in the above temperature profile and that the protein barrier has a positive impact on the rigidity of the starch granules during cooking of milled pasta. Overall, the results of this study provide evidence for the existence of a protein barrier, consisting of disulfide linked protein, affecting starch swelling, and the rheological and cooking properties of pasta products.

P-354

Polyphenol oxidase (PPO) in wheat and wild relatives: Evidence for a complex multigene family. A. N. MASSA (2), B. Beecher (1), C. F. Morris (1). (1) USDA ARS Western Wheat Quality Laboratory, Pullman, WA, USA; (2) Washington State University - USDA ARS Western Wheat Quality Laboratory, Pullman, WA, USA.

Polyphenol oxidase (PPO), a copper-containing oxidase, is responsible for browning reactions that discolor Asian noodles and other wheat products. In this study, the A, B, and D genomes from the diploid (*Triticum monococcum*, *T. urartu*, *Aegilops tauschii* and *Ae. speltoides*), tetraploid (*T. turgidum*, subspecies *dicoccoides* and *durum*) and hexaploid (*Triticum aestivum* cultivars Klasic and ID377s) members of the wheat gene pool were screened for detection of PPO genes. The objective was to characterize novel PPO sequences, particularly those expressed in seed tissues, and to gain a better understanding of the structure and organization of this multigene family. Based on regions with relatively high variability bordered by conserved sequences, we designed primers to amplify partial but discriminative PPO sequences. We identified and characterized 22 DNA sequence variants from seven *Triticum*/*Aegilops* taxa, and detected five PPO groups with distinct patterns of nucleotide and structural diversity. Putative orthologous/paralogous relationships are discussed on the basis of an evolutionary hypothesis.

P-355

Resistant starch of white salted noodles with different amylose content. T. SASAKI (1), K. Kohyama (1). (1) National Food Research Institute Ibaraki, Japan.

Resistant starch (RS) is known to be a portion of starch not digested in the small intestine and have beneficial effects similar to dietary fiber. White salted noodles are referred to as udon and popular wheat food in Japan. Starch is the main component of wheat flour and its properties are important to the quality of white salted noodles. The objective of this study was to estimate the RS content of white salted noodles from wheat lines with different amylose content and to classify physically inaccessible starch (type 1 RS) using in vitro procedure. Noodles were made from three wheat lines, Eradu (amylose content 27.7%), Ayahikari (22.8%), and Akebonomochi (1.7%). RS content was determined by enzymic hydrolysis with or without homogenizing after cutting into small pieces and measurement of the released glucose. When using homogenized sample, noodles made from low amylose line showed the highest resistance to hydrolysis. Eradu noodles showed significantly lower resistance to hydrolysis after short and long incubation than low amylose and waxy lines. Type 1 RS content was determined by calculation of RS content with or without homogenizing. Eradu noodles had a higher type 1 RS than other lines. Noodles made from waxy wheat line showed higher resistance to hydrolysis than other lines with higher amylose content despite the starch consisting of almost entirely amylopectin. The relationships between amylose content and RS or type 1 RS content of white salted noodles were not observed, which suggests that other characteristics of noodles may affect RS and type 1 RS content.

P-356

Teflon and bronze shaped pasta: Is it only a matter of surface appearance? M. LUCISANO (1), M. Pagani (1), M. Mariotti (1), D. Locatelli (2). (1) DiSTAM (Department of Food Science and Microbiology), University of Milan, Milan, Italy; (2) Institute of Entomology, University of Milan, Milan, Italy.

Pasta dough that is formed in the kneading machine and then driven by the extrusion screw towards the head of the press is forced through the die whose characteristics strongly affects the appearance of the pasta surface. Traditional dies made entirely of bronze make the pasta surface rough, which helps to capture the sauce, whereas the Teflon insert gives the product an even surface and a smoother texture. To find out if other quality characteristics could be affected by die materials, pasta was prepared with semolina using two different size distributions and extruded through Teflon and bronze dies. Samples were dried at both high (maximum temperature: 90°C) and medium temperatures (maximum temperature: 70°C). The dried spaghetti was evaluated for its mechanical strength (bending test with an Instron Machine), porosity in terms of pore volume, size and distribution (Pascal 240 high pressure porosimeter), susceptibility to the infestation with *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) and SEM ultrastructure of pasta surface before and during insect

infestation. Results showed that pasta extruded through the bronze die presented a higher porosity (4.2% for fine semolina and 3.7% for coarse semolina versus 2.2% for samples extruded through the Teflon die) due to a higher number of pores larger than 1 µm. This characteristic caused a 20–30% reduction in the spaghetti breaking strength and a higher development of the insects as the surface of pasta made the deposition of eggs easier as demonstrated by SEM images that show an uneven and rough surface presenting numerous tiny pits. The size distribution of the semolina and the drying cycle influenced the spaghetti's breaking strength and insect development, to a lesser extent.

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Application of time-domain nuclear magnetic resonance to quantify oil content in starch-oil composites prepared by excess steam jet-cooking. J. A. KENAR (1), M. Singh (1). (1) NCAUR/ARS/USDA, Peoria, IL, USA.

Stable dispersions of starch-oil composites can be obtained by excess steam jet-cooking aqueous slurries of starch and hydrophobic materials such as vegetable oils. These composites consist of uniformly suspended starch-coated oil droplets (1–10 µm in diameter) that can contain up to 50 wt % oil depending upon the formulation. The composites are routinely drum dried and then utilized in a broad range of food and non-food applications. The quality and performance of these composites in the end applications can depend, in part, on precise determination of the oil and moisture content within the starch-oil composites. Because some oil in the composite is tightly bound to the starch, a labor intensive process based on starch hydrolysis (chemical or enzymatic) followed by solvent extraction is currently utilized to determine the total oil content. The application of Time-Domain Nuclear Magnetic Resonance (TD-NMR) to quantify oil and moisture within these starch-oil composites represents a fast, accurate, and non-invasive technique based on NMR relaxation properties. This work examined TD-NMR to expediently quantify both the oil and water content in starch-oil composites and validate this method relative to conventional extraction procedures. The TD-NMR methodology was subsequently utilized to quantify oil and water content in low fat cookies prepared from starch-oil composites. Results of this study provided a basis upon which TD-NMR techniques can be applied to investigate starch-oil composites and improve the utilization and performance of these composites in various end applications.

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Effect of flour moisture level on biscuit flour functionality. W. CHUNG (1), N. Zhou (1), L. Haynes (1), T. Hansen (2). (1) Kraft Foods, East Hanover, NJ, USA; (2) Kraft Foods, Glenview, IL, USA.

Moisture level in biscuit flour and dough is important for baking functionality. Especially, flour moisture level can be one of the critical factors for a few characteristics such as enzyme activity and gluten development. The objective of this study was to determine the effect of moisture level in biscuit flour on dough rheology and baking functionality. White biscuit flour at three different flour moisture levels (low, medium, and high) were evaluated with AACC cookie test baking (10-53). Dough rheology of these flours was measured at the same time. The dough moisture content was controlled in the same level, by adjusting formula water. Results showed that the firmness and toughness of dough increased from 116 to 161 g and from 612 to 849 g.s, respectively with the increase of flour moisture. Meantime, the stickiness of dough also increased as the flour moisture level increased. Stress relaxation of these dough indicated that the relaxation time also increased with the flour moisture. All these results suggested that the dough could develop more network as the flour moisture increases. The baking test showed that the cookie spread more at lower flour moisture, the width and length ranged from 35.1 to 35.9 cm and from 34.9 to 35.7 cm as flour moisture decreases, indicating that cookie geometry or spreadability was affected by flour moisture level. In addition, cookie stack height increased with the flour moisture confirming the effect of flour moisture on cookie geometry. These results suggested that flour moisture level plays a critical role in biscuit flour functionality.

P-359

Effect of starch crystallinity on the mechanical properties of dry and hydrated baked cereal foams. E. LABAT (1). (1) Nestle Research Center, Lausanne, Switzerland.

Dry baked cereals foams with a crisp texture are highly appreciated by consumers. Moisture management in these products is essential for their shelf life. Our aim was to investigate the impact of starch crystallinity on the mechanical properties of baked foams as a function of water activity. Dry baked wheat flour foams were prepared using a hot plate oven, leading to a fully gelatinisation of the starch fraction. The foams were stored at different conditions to generate the crystallisation of amylopectin chains. Storage was performed under controlled conditions to achieve different moisture contents and different temperatures. After storage samples were dried under gentle conditions. Thermal analysis of the products after storage, revealed an endothermal transition between 60 and 90 °C, related to the melting of the amylopectin crystals. This endothermal transition varied according to the storage conditions, with enthalpies reaching up to 2.8 J/g starch. Moreover, the higher was the storage temperature, the higher was the melting point, indicating a change in crystal structure. Samples were rehydrated under controlled conditions of humidity and mechanical properties were assessed using a puncture test. The number of peaks (Nsr) with amplitude higher than 0.2 N was recorded. This method has previously been shown to correlate with sensory attributes. Irrespectively of the product, hydration induced a decrease in Nsr, which can be correlated to a loss of the product crispiness. The retrograded samples were characterised by higher Nsr than the control. The impact depends on the extend and crystal type formed during storage. The effect of crystalline amylopectin in modifying the mechanical properties of hydrated amorphous flour matrices has been demonstrated.

P-360

Exploration of sugar functionality in cookie and cake baking: Use of predictions from SRC, DSC, and RVA to enable a minimized experimental design. M. KWEON (2), L. Slade (1), H. Levine (1), E. Souza (2), R. Martin (2). (1) Food Polymer Science Consultancy, Morris Plains, NJ, USA; (2) USDA-ARS, Soft Wheat Quality Lab., Wooster, OH, USA.

Sugars are plasticizers of biopolymers, e.g. those of wheat flour. Dough plasticization is critical to mixing and baking, but concentrated sugar solutions act as anti-plasticizers compared to water, as seen in DSC and RVA. Thus, gluten development during mixing and starch gelatinization/pasting during baking are delayed or prevented. Sugar solutions are better solvents than water for biopolymers, as seen from SRC data for typical non-chlorinated cookie and chlorinated cake flours. Extensive chlorination causes decreased glutenin functionality (revealed by SRC lactic acid), but enables pasting in concentrated sugar solutions (which prevent pasting of non-chlorinated flours), without affecting gelatinization. Since differences in glass-forming ability modulate the generic role of sugars, xylose (X), glucose (G), fructose (F), and sucrose (Su) were used to explore the effects of sugar type on DSC, RVA, and baking. DSC showed retardation of gelatinization in 50% sugar solutions: X<F<G<Su, but RVA showed enhanced pasting: X>F>G>Su. Flour type, sugar concentration (%S), total solvent (TS), and baking method defined a core experimental design for baking with the 4 sugars. Using predictions from SRC, DSC, and RVA, a full 16 run design was cut to 2 extremes of the design space. Sugar-snap cookie baking with non-chlorinated flour, 73%S, and 80 g TS gave diameter: Su>F>G>X, but the reverse for height and moisture content, and snap-back for X (lowest Tg). Cake baking with chlorinated flour, 50%S, and 238 g TS gave height: Su>F>G>X, but a complex shape factor pattern: X>F=G=Su, due to expansion and collapse. Two crystal sizes confirmed the impact of gluten development and starch pasting on collapse: rapid Su dissolution gave greatest cookie surface crack and smallest cake shape factor.

P-361

Mapping QTL for soft wheat quality in multiple populations. C. Sneller (1), N. Smith (1), M. J. GUTTIERI (3), E. J. Souza (2). (1) Ohio State University; (2) USDA-ARS, Wooster OH; (3) University of Idaho.

Soft wheat is used to make a wide variety of products and thus variation for quality parameters is important to breed soft wheat cultivars suitable for different uses. Breeders need more knowledge about the genetics of soft wheat quality and systems for marker-assisted selection (MAS). MAS is best for loci and alleles that have positive effects on the trait over multiple genetic backgrounds. Progress has been limited in the past due to the cost of obtaining quality phenotype data and the paucity of suitable mapping populations. Recent development of solvent retention capacity (SRC) tests for quality and new funding for US wheat mapping efforts have removed these impediments. Our objective is to elucidate the genetics of soft wheat quality to better manage this variation and developed systems MAS. We will map soft wheat quality using seven biparental mapping populations, each with at least 150 RILs, 250 markers, and tested in four environments for eight quality parameters. The quality traits include SRC tests for pentosan, starch damage, gluten strength, and water absorption along with flour yield, flour protein, test weight, and softness equivalent. We will assess QTLs in each population and compare results over populations. A review of results from mapping in three populations using data from at least two environments will be presented.

P-362

Relationship between hardness and internal structure of high fiber content extruded snacks. R. E. Ferreira (1), Y. K. Chang (1), C. J. STEEL (1). (1) UNICAMP, Campinas, SP, Brazil.

The development of high fiber content extruded snacks is a means of supplying healthier products to consumers. The texture of extruded snacks has a great influence on the acceptability of the product and is related to the conditions used during the extrusion process. These conditions also affect the internal structure of the extrudates. The objective of this study was to evaluate the influence of raw material moisture content, process temperature and percentage of wheat bran on hardness values and to relate this parameter to the internal structure of the extrudates. Hardness was determined using a TAXT2 texture analyzer and internal structure was visualized through Scanning Electronic Microscopy (SEM). A central composite rotational design (CCRD) was used to evaluate the effect of the different variables. The independent variables studied were: moisture content (16.3–29.7%), third zone temperature (104.8–155.2°C) and bran content (0–24.6%). It was observed that the lowest moisture contents, the highest temperatures and the highest levels of wheat bran resulted in less hard snacks. Using SEM, it could be observed that high moisture contents resulted in snacks with a dense structure and poor cell formation; high temperatures contributed to the weakening of the structures; and high fiber contents lead to the formation of a great number of incomplete cells with thin walls, resulting in a fragile structure and a smoother texture. According to the results, it cannot always be affirmed that the addition of fibers, which results in a lower expansion, produces harder extrudates. It depends on the variables involved and their relationship.

P-363

Effect of incorporation of yacon (*Polymnia sonchifolia*) flour and oat in champurradas type cookies. A. L. Marangoni (1), F. P. COLLARES (1). (1) State University of Campinas, Department of Food Technology, Campinas, SP, Brazil.

Cookies are becoming a traditional and important kind of food in many countries. The variety of combined shapes and tastes, with a long shelf life and convenience, has perpetuated their acceptability. This work aims at responding to the demand for products with functional characteristics, and for this reason yacon flour from fresh tube roots was developed and the effect of its application was studied on physical and sensorial properties of champurradas cookies, containing oat flour. The yacon flour obtained presented 5.94% of moisture, 2.02% of protein, 0.11% of lipids, 4.12% of ashes and 83.87% of carbohydrates. Average diameter of particles from yacon flour, determined in vibratory sieves, was 0.55 mm. A rotating central composite response surface design for 2^2 for two independent variables considered, yacon flour level and oat level, was applied; and the effect of the two independent variables on the physical and sensorial properties of biscuits were studied. The dependent variables were moisture,

instrumental texture and color (HunterLab), dough density, specific volume, and sensorial evaluations as appearance, texture, flavour and acceptability. Only color parameter L* and sensorial acceptability presented a statistically valid model. The model developed for the L* parameter of color resulted in R^2 value of 0.87. Response surface indicated that L* parameter was maximum when yacon flour was 0.0% and oat level was 6.82%. The highest acceptance value was for yacon flour level of 3.45% and oat level of 1.18% and 6.82%. Aiming to obtain a functional product and considering the presented results, the recommended levels of yacon flour incorporated would be 3.45% and oat flour of 6.82%.

P-364

Effect of the addition of wheat bran to cakes according to the requirements of the Brazilian legislation for fiber claims. O. P. Almeida (1), V. C. Terezan (2), V. P. Godoy (2), C. C. Golineli (2), Y. K. Chang (3), C. J. STEEL (3). (1) AB Brasil, Jundiaí, SP, Brazil; (2) Emulzint, Jundiaí, SP, Brazil; (3) UNICAMP, Campinas, SP, Brazil.

The trend of dietary fiber addition to food is rising in Brazil. In breads, it is a reality, but in cakes, it is only beginning. The objective of this work was to study the effect of dietary fiber addition to cakes on physical and sensory parameters. Wheat bran (dietary fiber source) was added in levels that would permit the products to be labeled as "source" (3%) or "high content" (6%) of fiber, according to the Brazilian legislation. These cakes were compared with a sample with 0% added fiber. The cakes were prepared simulating the conditions of a typical Brazilian craft bakery and using commercial raw materials. Specific volume, modified volume index, pH and the rate of moisture reduction were inversely proportional to the fiber content of cakes. The "high content" sample was significantly firmer than the other two, which presented similar results. During the test period, the variation % of firmness was similar for all samples. An acceptance test with a nine-point hedonic scale showed a significant difference ($P < 0.05$) for the appearance of all samples. The results for the acceptance of appearance were inversely proportional to the fiber content. For the acceptance of texture and flavor, no differences were observed between samples. A second acceptance test, based on pre-defined quality parameters, showed a significant difference ($P < 0.05$) between global scores of all samples. These scores were inversely proportional to the fiber content. The purchase intention was also evaluated. The 0% and "source" samples presented similar results, over 80%, while the "high content" sample presented inferior results, between 70% and 80%. The results showed that it is possible to produce "source" and "high content" of fiber cakes using wheat bran.

P-365

Enhancing extrusion expansion of high fiber puffed products. O. A. BLAKE (1). (1) Purdue University.

Some of the most abundant sources of dietary fiber are obtained from agricultural by-products. However, many of these by-products, such as cereal bran, are underutilized sources of dietary fiber due to their limited functionality in food products. Therefore, the goal of this project was to improve the functionality of common dietary fibers, such as corn bran, by examining factors that affect extrusion expansion of model soluble and insoluble fibers, such as, carboxymethylcellulose (CMC), corn fiber gum (hemicellulose B), cellulose and corn bran. Extrusion puffing was used as the processing parameter because many breakfast cereals and some snacks marketed to children are puffed, using an extruder (direct or indirect puffing). The supramolecular structure of cellulose and corn bran significantly affected extrusion expansion of high fiber extrudates. The degree of crystallinity of cellulose had an inversely proportional relationship to extrusion expansion and modification of the supramolecular structure of corn bran significantly enhanced sectional expansion index of extrudates. Incorporation of 26% hemicellulose B of suitable molecular weight in cornmeal facilitated significant cross-sectional expansion of extrudates, such that their degree of expansion was similar to a control containing no added fiber. The molecular weight of soluble fibers played a significant role in determining the degree of extrusion expansion of extrudates; this was shown using corn fiber gum, CMC and arabinogalactan. An optimum number average molecular weight of 2.1 – 2.5 × 105 significantly improved sectional expansion index of extrudates containing CMC.

P-366

Sensory evaluation of graham crackers enriched with soluble fiber-rich whole barley flour. S. CHONGCHAM (1), N. Prasopsunwattana (1), P. Cooke (3), R. A. Flores (4), E. A. Arndt (2), M. B. Omary (1). (1) California State Polytechnic University, Pomona, CA, USA; (2) ConAgra Foods, Inc., Omaha, NE, USA; (3) Microscopic Imaging Group-USDA/ARS/ERRC, Wyndmoor, PA, USA; (4) University of Nebraska, Lincoln, NE, USA.

Studies have shown that most Americans consume insufficient daily amounts of whole grains and fiber. Low-fat, trans fat-free, viscous soluble fiber-rich graham cracker containing whole barley flour (WBF) rich in total dietary fiber and beta-glucan soluble fiber were developed. Ninety eight untrained students, faculty and staff tested the crackers for overall acceptability using a 9-point hedonic scale. Samples tested included four levels of WBF (0, 50, 75, and 100%) and two graham cracker commercial products (CP) used as controls. Data on water activity, CIELAB color, and three-point-bend texture were also collected. Beta-glucan content using the mixed linkage method, SEM and ultraviolet-induced fluorescence imaging of the doughs were also conducted. Hedonic scores decreased significantly ($P < 0.05$) as the level of replacement with WBF increased, with values ranging from 6.2 (control) to 4.6 (100% WBF). Water activity results were significantly lower for the control (0.243), as compared to the other treatments and CP (0.282). The control crackers were significantly lighter than the other products including CP, except for the 100% WBF (L = 63). Color a* and b* values showed no significant changes with an increase in WBF. Breaking forces for crackers containing WBF averaged (2.5 kg) but were significantly different ($P < 0.05$) from those of CP and the control (2.3 kg). Beta-glucan content per 30 g serving was 0.04 g for 0%, 0.5 g for 50%, 0.7 g for 75% and 0.8 g for 100%. Microstructure of the dough mixtures revealed evidence of more cell wall fragments as the amounts of WBF increased corresponding to an increase in the beta-glucan content that is mostly present in the cell walls and aleurone layer.

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Slowly digestible cookies prepared from resistant starch-rich lintnerized banana starch. L. A. BELLO-PEREZ (1), A. Aparicio-Saguilan (1), S. G. Sayago-Ayerdi (2), J. Tovar (3). (1) CEPROBI-IPN, Yautepec, Morelos, México; (2) Instituto Tecnológico de Acapulco, Calzada Instituto Tecnológico S/N, Acapulco, Guerrero, México; (3) Instituto de Biología Experimental, Universidad Central de Venezuela, Caracas Venezuela.

The development of new products is a strategic area of the food industry. Consumers are demanding foods showing two main properties: the first one deals with the traditional nutritional aspects of the food, whereas, as a second feature, additional health benefits are expected from its regular ingestion. The objective of this study was to evaluate starch digestibility and the in vitro predicted glycemic index of cookies prepared with banana RSRP preparation. Experimental cookies were formulated with a resistant starch rich-powder (RSRP) prepared from autoclave treated lintnerized banana starch. The products were studied regarding chemical composition, available starch (AS), resistant starch (RS) and rate of starch digestion in vitro. In order to evaluate the acceptance of RSRP-products, a first affective test was carried out on four cookie formulations containing different RSRP levels. The formulation chosen corresponded to a wheat flour:RRSP ratio of 15:85. Chemical composition of the cookies showed no difference in ash and lipid contents between control (100% wheat flour) and RSRP-cookies ($P < 0.05$). RSRP-cookies had higher AS and RS levels than control cookies, due to the addition of RSRP. HI-based predicted glycemic index for the RSRP-cookies was 60.53%, which was significantly lower than for control samples (77.62%), suggesting a "slow carbohydrate" feature for the RSRP-based goods. The second affective test indicated similar preference for RSRP-containing cookies and control samples. Results reveal RSRP from banana starch as a potential ingredient for bakery products containing slowly digestible carbohydrates.

P-368

Study of the application of yacon (*Polymnia sonchifolia*) flour and flaxseed flour in pound cake by surface of response methodology. A. L. Marangoni (1), F. P. COLLARES (1). (1) State University of Campinas, Department of Food Technology, Campinas, SP, Brazil.

Lately, the food market has shaped itself as a function of the food quality and nutritional value. Yacon is recognized as an important nutraceutical food, due to its functional properties related to its high level of fructo-oligosaccharides. This study assesses the application of yacon flour (obtained from raw roots) and flaxseed flour, which contains alpha-linoleic fatty acid, lignans and soluble an insoluble dietary fibers, to produce pound cakes with physiological functionality. A response surface methodology has been adopted to create 12 trials, including 4 axial points and 4 central points. The two independent variables could assume 5 different values each: yacon flour (X_1) and flaxseed flour contents (X_2). Dependent variables were physicochemical (moisture, instrumental texture and color, dough density and specific volume) and sensorial properties (global and crumb appearance, texture, flavor and acceptability). Experimental data were submitted to analysis of variance (ANOVA). Only the parameters, instrumental texture (hardness attribute); color (L*, C* and h*) and dough density generated valid statistical models. Generated surfaces suggest that yacon flour content range from 0.0% to 3.45% and flaxseed flour levels between 3.18% and 6.0% provided cakes with lower hardness. In relation to color parameters, minimum concentrations of yacon and flaxseed flours (0.0% and 3.18%, respectively) resulted in higher values for these parameters, that is, the cakes presented a clearer and more yellowish color. The dough density reached lower values when flaxseed flour level was 6.0%, but the yacon flour level had no influence. Thus, the addition of yacon and flaxseed flours, at concentrations of 3.45% and 6.0%, respectively, result in a cake with more desirable characteristics.

P-369

Withdrawn

P-370

Alternative milk drinks and tofu made from domestic pulses other than soy beans. G. ZWEYTICK (1), M. Jaksch (1), E. Berghofer (1). (1) University of Natural Resources and Applied Life Sciences, Department of Food Science and Technology, Vienna, Austria.

Domestic pulses, namely peas, lupines, faba beans and garden beans, and products made of these raw materials are themselves or in combination with cereals a good source of dietary fibres, minerals and vitamins and increase the biological valence of protein. Nevertheless, in Austria and in Central Europe the consumption of pulses is decreasing continuously. The aim of this study was therefore to investigate the possible use of pulses, other than soy beans, for beverages and tofu to develop palatable, convenient products with high nutritional value. Pulses were roughly cut and mixed with tap-water in 1:4, 1:7, 1:10 ratios, respectively. After partially saccharification with amylases at various periods (15 min; 45 min; 65 min), the obtained drinks were decanted and homogenized (15 min, 30 MPa). Depending on the objective, optimised products were as follows: For alternative milk drinks highest saccharification, thus most palatable taste, was obtained at a water:pulses ratio of 1:10. On the contrary, milk as intermediate for tofu production requires a high protein and dry weight content, which was achieved at low water ratios. A statistical design was used for tofu optimisation, varying the parameters (1) precipitation salt (Nigari), (2) temperature and (3) forming pressure. All three parameters correlated positively, where 2.5% (v/v) of Nigari, 95 °C and a forming pressure of 120 kg/m^2 were found as optimal conditions for the production of tofu with high dry weight and protein content, and thus, good texture. Except garden beans, all other tested pulses were suitable for tofu production, with pea tofu as the most favoured one.

P-371

Effect of amaranth flour addition on technological properties of standard and reduced fat pound cakes. E. L. Almeida (1), R. E. Ferreira (1), V. D. Capriles (2), Y. K. Chang (1), C. J. STEEL (1). (1) UNICAMP, Campinas, SP, Brazil; (2) USP, São Paulo, SP, Brazil.

In the last few years, increased attention has been given to amaranth in research, as it has been considered a grain with nutritional and functional benefits. However, its use is

still not widespread. To introduce new products, it is often necessary to develop formulations similar to those of habitual consumption. The aim of this work was to evaluate the effects of partial replacement of wheat flour and cornstarch by amaranth flour on technological properties of standard (S) and reduced fat (L) pound cakes. Wheat flour and cornstarch in cake formulations were replaced by 10, 20 and 30% amaranth flour. The technological properties evaluated were: batter specific gravity, according to AACC Method 72-10; cake specific volume by the volume/weight ratio; volume, symmetry and uniformity indexes, according AACC Method 10-90; and instrumental color of crust and crumb of cakes using the CIELab color system. As expected, an inverse relationship between batter specific gravity and cake specific volume was observed. Specific volumes of S and L cakes were similar. The replacement by amaranth flour in different levels did not alter volume and symmetry indexes of S and L cakes. However, the increase of the amaranth content resulted in a reduction of L values, showing that crumbs and crusts became darker. This work showed that the production of cakes with the replacement of 10–30% of wheat flour and cornstarch by amaranth flour is technologically viable, in both standard and reduced fat pound cakes.

P-372

Effect of biodegradable edible coatings on physical-chemical properties of chocolate pound cake. L. B. Fontes (1), C. C. Osawa (1), E. M. Walter (1), C. J. Steel (1), Y. K. CHANG (1). (1) UNICAMP, Campinas, SP, Brazil.

Biodegradable edible coatings are an alternative to replace synthetic packages that cause environmental concerns. This work evaluated the effect of edible coatings on physical-chemical properties of chocolate pound cake during storage, in comparison to cakes without coating (C) and cakes without coating packaged in polypropylene (CP). Chocolate flavored pre-mix was used to prepare the cakes. The following coatings were applied on the surface of the cakes after baking: 10% gelatin (GE), 10% gelatin and 10% stearic acid (SA), 18% "carnaúba" wax (CW), 10% modified starch (MS) and chocolate fudge (CF). The cakes were analyzed during 10 days storage at 28.2°C and 93.2% RH. The results were analyzed by ANOVA and the Tukey test ($P < 0.05$). CF and CP presented the lowest mass loss, while all other trials presented higher values than C. GE, SA and CP presented the lowest reduction of water activity, while CF and C presented the highest. The highest values for hardness and chewiness (TPA, probe P/100) were found for C and CW and the lowest were found for CP and GE. The surfaces of the coated cakes were harder (perforation, probe P/2) than C and CP. With respect to color (CIELab), SA was different to the remaining cakes, due to the presence of stearic acid that conferred a white color to the coating. The results indicated that the mass loss of the cakes could be mainly attributed to the loss of water from the coatings. The coatings evaluated may effectively prevent dryness of the cakes, maintaining them with desirable texture properties, except for CF. This may be attributed to the high concentration of sugar in the fudge that absorbed water from the cake.

P-373

Effect of the extrusion parameters and yacon (*Polymnia sonchifolia*) flour content on the quality of rice flour snacks. A. L. Marangoni (1), F. P. COLLARES (1). (1) State University of Campinas, Department of Food Technology, Campinas, SP, Brazil.

In this work, rice and yacon (*Polymnia sonchifolia*) flours were extruded for the production of snacks in a pilot single screw extruder INBRAMAQ (São Paulo, Brazil), model Labor PQ-30. The raw roots used to produce the yacon flour contain the following chemical composition: 88.38% moisture, 0.14% protein, 0.06 lipids, 0.03 ashes and 8.42% carbohydrates. The yacon flour obtained, in turn, presented 5.94% moisture, 2.02% protein, 0.11% lipids, 4.12% ashes and 83.87% carbohydrates. A response surface methodology has been adopted to create 12 trials, including 4 axial points and 4 central points. The three independent variables could assume 5 different values each: yacon flour concentration (X_1: 12, 15, 20, 25, and 28%), feed material moisture content (X_2: 17, 18, 20, 22 and 23%), and temperature of the 4th and 5th extruder zones (X_3: 103, 110, 120, 130, and 137°C). Dependent variables were physicochemical (texture and instrumental color, moisture, water absorption index and water solubility index, expansion rate) and sensory properties (appearance, texture, flavor and buying intention). The snacks produced with greater expansion rate values ($R^2 = 0.70$) were obtained at 120°C, with 17% material moisture content and 12% yacon flour content. For the sensory texture and buying intention, the R^2 was 0.87 and 0.72, respectively. The surfaces generated show that the maximum value for these last attributes occurred for the same conditions of temperature, moisture of raw material and yacon flour content as for expansion rate. The yacon flour content did not have, however, significant influence ($P < 0.05$) in buying intention.

P-374

Expanded *Amaranthus cruentus* seed – A novel raw material for special confectionery products. M. Bodroža-Solarov (1), B. Filipcev (1), O. Šimurina (1), M. POJIC (1). (1) Faculty of Technology, Novi Sad, Serbia and Montenegro.

Amaranthus cruentus, an ancient crop originating from America, can be used as a high protein grain. Chemical composition of *Amaranthus* sp. seed has properties similar to those of the cereal grains, but with higher mineral content (Fe, Ca). This paper describes a processing method and parameters of product quality. *A. cruentus* seed were popped at temperature 180–220°C. Expanded seeds were mixed with barley malt and dry roasted germ in a "Diosna" duplicator. After that, the mass was laminated and frozen at –20°C, and shaped in the form of small balls each weighting 5 g. Produced confectionery was packed using two different packaging materials (PA/PE, PP) and kept at two temperatures (+2°C, + 22°C). Sensory evaluation of *A. cruentus* confectionery showed that the product has a specific taste and pleasant aroma. Products based on expanded seeds of *Amaranthus cruentus* are intended for people suffering from celiac disease, anemia, and diabetes, as well as for healthy population.

P-375

Influence of flour chlorination and ingredient formulation on the quality attributes of pancakes. S. M. FINNIE (1), A. D. Bettge (1), C. F. Morris (1). (1) USDA-ARS WWQL, Pullman, WA.

Soft wheat flour is chlorinated in North America for the production of cakes and pancakes. The oxidative properties of chlorine gas cause chemical modifications to flour components that enhances processing and end-use functionality of the intended food products. The objectives of this study were first, to compare how untreated and chlorine-treated commercial soft wheat flour performs in a standard pancake formulation and second, to compare how the individual ingredients in a standard pancake formulation influence quality attributes of pancakes made with untreated as well as chlorine-treated commercial soft wheat flour. Two identical soft wheat flour samples, one chlorinated and the other unchlorinated, were used to study the flour chlorination effects on the quality attributes of pancakes, as determined by texture meter analysis and viscosity. Commercial pancake mixture ingredients were evaluated at different concentrations for their individual influence on quality attributes of pancakes. Differences (ANOVA) in means were used to evaluate the influence of the sources of pancake quality variation. The results indicate that flour chlorination had a significant influence on pancake batter viscosity, geometry and texture, with chlorinated flour unsurprisingly producing a consistently superior product. The evaluation of different ingredient concentrations indicated that no modification among pancake formula ingredients could wholly substitute for chlorination. Individual ingredients did dramatically influence pancake batter viscosity, geometry and texture (i.e. soy flour, dextrose, and the leavening agents). However, sucrose and shortening had insignificant influences on the end-use quality in both chlorinated and unchlorinated pancakes.

P-376

New developments in whole grain corn products. W. Duensing (1), R. PERRY (2). (1) Bunge Milling, Danville, IL, USA; (2) Bunge Milling, St. Louis, MO, USA.

Historically, the larger mills in the U.S. corn dry milling industry have utilized the "temper/degerming" method of corn dry milling to manufacture "degermed corn products" because of the food industry's requirements for high starch content, low oil content and long shelf life. Because these degermed corn products have most of the bran and germ removed, they do not meet the definition for "whole grains". However, products which exhibit good flavor stability and long shelf life are now available from the corn dry milling industry, including from Bunge Milling, which can be labeled as "whole grains" because they include the principal anatomical components - endosperm, germ and bran - in the same relative proportions as they exist in the intact kernel of corn. This paper will discuss some of the special processing challenges which were overcome in order to produce a whole grain corn meal with the flavor stability and shelf life which the customer demands. Additionally, this paper will discuss some of the potential applications in sweet and salty snacks for such a product.

P-377

Ozonation of cake flour as an alternative to chlorination. S. CHITTRAKORN (1), F. MacRitchie (1). (1) Department of Grain Science and Industry, Kansas State University, Manhattan, KS, USA.

Ozonation was studied as an alternative to chlorination for cake flour. Non chlorinated flour was treated with ozone at the rate of 0.06 L/min for 10 and 36 minute using 5 lb of flour. Ozonation of cake flour decreased pH and increased the lightness (L value) of flour comparable to chlorinated cake flour. As time of ozonation increased from 10 to 36 min, pH of flour decreased from 6.07 to 5.96 and 5.66 respectively. Baking studies using a high-ratio white layer cake formulation showed that cake batter viscosity increased as ozonation time increased and ozonated treatment of flour improved cake volume and increased brightness of cakes. As the time of ozonation increased from 10 to 36 min, the volume of cake significantly increased ($P < 0.05$) and the 10 min ozonation time gave similar volume to chlorinated cake flour. Cakes prepared with ozonated flour were significantly softer than chlorinated and non chlorinated flour ($P < 0.05$). The springiness and cohesiveness of cake from ozonated flour gave similar values to cake produced from chlorinated flour. Study of cake cell structure using C-Cell showed that cell brightness and number of cells of cake from ozonated flour exhibited similar values to those from chlorinated flour.

P-378

Particle size affects the physical and pasting characteristics of starch-lipid composites. M. SINGH (1). (1) USDA/ARS/NCAUR, Peoria, IL, USA.

Starch-lipid composites are used in baked products as partial replacement of fat. The cookies with higher than 30% fat replaced with starch-lipid composites are high in moisture and water activity. This increase is attributed to the water holding capacity of the composites. The effect of particle size of starch-lipid composites on their physical and pasting characteristics was studied. Milled starch-lipid composites ranged in particle size from 150 micrometers to 2 millimeters. The particle size distribution was measured and they were separated into different fractions, classified as fine, medium and coarse. The lightness of color (whiteness) increased with decrease in the particle size resulting in increased yellowness as denoted by increased values of b asterisk. The water holding capacity was affected by the increased particle size. The pasting characteristics of the different fractions are being studied using the rapid visco analyzer (RVA).

P-379

Reduction of acrylamide in low moisture bakery products. S. GROSSMANN (2), C. Alosco (1). (1) Budenheim USA, Plainview, NY; (2) Chemische Fabrik Budenheim, Budenheim, Germany.

Since the 2002 findings of acrylamide in food, several research studies have shown a significant amount of acrylamide in low moisture bakery products such as crackers, ginger bread, and cookies. Acrylamide has shown to be a carcinogen in laboratory animals exposed to high doses. These findings have initiated numerous studies to reduce the amount of acrylamide in these bakery products. One study conducted tested 3 formulations in triplicate using alternative leavening agents to replace the ammonium bicarbonate or ammonium

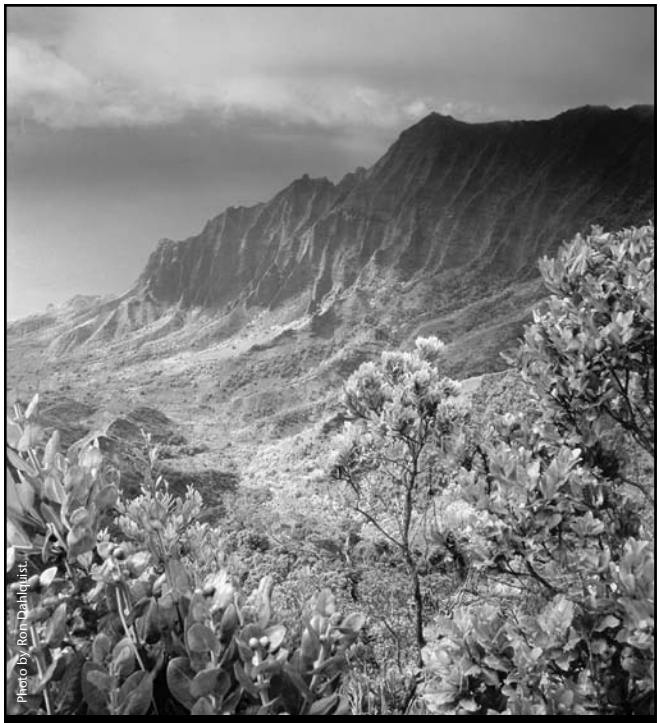
based compounds in gingerbread. The gingerbread was baked at 220 / 200C (top/bottom). Each product was then tested for acrylamide by HPLC and reported. The results showed the control gingerbread formulation with 2450 micrograms per kilogram, subsequent tests using the alternative leavening agents had levels as low as 135 ug/kg. The eating quality and appearance of the gingerbread were not adversely affected. This work has been submitted for patents and is patent pending.

P-380
The effect of pounding temperature on rheological characteristics of pre-cooked glutinous rice flour. S. Teo (1), A. YEH (1). (1) National Taiwan University, Taipei, Taiwan.

Glutinous rice cake (mochi) has unique viscoelastic properties and is a popular product in Asian area. During the preparation, pounding or agitation is required to yield the unique viscoelastic properties. Dynamic oscillatory rheometer and scanning electronic microscope (SEM) were employed to study the effects of pounding temperature (30, 50, 70°C) on the properties of glutinous rice products pre-cooked by using an electric pot. Pounding resulted in the decrease in G' for all the samples tested and an increase in the linear range by strain sweep. The pounding reduced the bulk density of the cooked glutinous rice cake. Both water content and pounding temperature affected the reduction in bulk density. For example, for the 55% moisture sample being pounded 450 times, there existed 14.3% reduction in bulk density at 30°C. Raising the pounding temperature to 70°C resulted in 11.9% reduction in bulk density. From the texture profile analysis, the hardness of sample was increased from 125.9 g to 168.3 g after being stored one day at –20°C. However, pounding 50 times at 30°C, the hardness of sample increased from 109.4 g to 128.5 g. The product with 55% water content exhibited slightly 3D structure with pores greater than 50 µm. Pounding at higher temperature (50°C) resulted in smaller pores. The data demonstrated that the pounding incorporated air into the matrix and softened the structure, which resulted in a soft but elastic product with unique texture.

P-381
Using non-contact ink jet technology to print high quality text, graphics, and other images directly onto foodstuffs. S. D. LINIGER (1). (1) Sensient Colors Inc., St. Louis, MO, USA.

From its initial developments, industrial ink jet technology has been used to improve manufacturing efficiencies, add value to products, and reduce operational costs. As the technology evolved, from primary coding applications for printing date, lot, and time codes onto products, to secondary coding applications for printing entire graphics, text, and bar codes onto shipping containers, new markets emerged. With recent developments in fluid technology, it is now feasible to use ink jet technology to print text and images directly onto a wide variety of food products. Printing variable, customized high-quality images directly onto food products without requiring the printing equipment to come into contact with the food presents a plethora of options for product enhancements, line extensions, promotional tie-ins, efficient in-and-outs, and many other opportunities where high speed variable imaging adds value to the product. The image quality available with today's print technology produces excellent results, and the high-speed printing capability means



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productivity is not compromised. With the well-established history of ink jet technology, coupled with ongoing product enhancements and developments, there are various equipment options, as well as ink formulations, that provide a range of coding solutions. Beyond ink jet technology lies laser technology, a technology that provides additional options for imaging a wide range of food products.

P-382
Utilization of a new oat beta-glucan rich hydrocolloid to reduce oil uptake in fried foods. S. LEE (1), G. Inglett (1). (1) USDA/ARS.

New batter coatings for fried foods were prepared with a new oat hydrocolloid and its oil-resisting effects were evaluated by the pasting and rheological properties. Oat bran concentrate was subjected to steam jet-cooking and fractionation, producing a new oat hydrocolloid containing 30% beta-glucan. When incorporated into batter formulations, the oat hydrocolloid affected significantly batter properties. The batters prepared with the oat hydrocolloid exhibited increased viscosity and elastic properties and their moisture retention during frying was improved. Furthermore, the oil uptake of fried batters was dramatically reduced, showing the potential of the new oat hydrocolloid as an effective oil barrier in frying foods. In addition to its oil-resisting properties, high content of beta-glucan provides more beneficial health effects beyond the traditional functions of batters.

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Ravindra N. Chibbar is a professor and Canada research chair in crop quality (molecular biology and genetics) at the University of Saskatchewan, Saskatoon, Canada. His research uses molecular biological strategies to modify grain carbohydrates and improve low-temperature tolerance in wheat and barley. Chibbar is a recipient of the CJ Bishop Award (1997) from the Canadian Horticultural Society and the Plant Biotechnology Institute Outstanding Achievement Award (1998). He was a founder and secretary-treasurer (1995–1998) of the AACC International Biotechnology Division and served as its chair from 1999 to 2001.

Domenico Lafiandra is a full professor and head of the Department of Agrobiology and Agrochemistry at the University of Tuscia, Italy. Lafiandra's scientific activities have mainly been dedicated to the following: genetic, biochemical, and molecular characterization of wheat storage proteins; the relationship between protein composition and quality characteristics of durum and bread wheat; and manipulation of starch composition. Lafiandra has participated in several research projects financed by national and international institutions and is actively involved in collaborative projects with scientists from different countries. Since 1994 Lafiandra has been a member of the editorial board of the *Journal of Cereal Science* and since 1997 he has been a regional editor for the same journal. Lafiandra is author or coauthor of 225 scientific publications, including papers in international referred journals, papers presented at international meetings, and book chapters.

Alsberg-French Schoch Memorial Award

The Alsberg-French-Schoch Award is sponsored by the Corn Refiners Association and is given in recognition of superior contributions to fundamental starch science. The award is given every two to four years and includes an honorarium and plaque. ***No award will be presented in 2006.***

Applied Research Award

Established in 2005, the AACC International Applied Research Award is presented for a significant body of distinguished contributions to the application of science in the cereals area. The award will consist of a $2,000 honorarium and a plaque and will be given to an individual scientist or a team of scientists. Recipients of the Applied Research Award are also accorded the status of AACC International Fellow for their contributions leading to this award. Awardees will have the opportunity to present a lecture during an annual meeting of the association. ***No award will be presented in 2006.***

C.W. Brabender Award

The Carl Wilhelm Brabender Award was established to honor the distinguished contributions to the application of rheology in milling and baking. Sponsored jointly by C.W. Brabender Instruments, Inc., South Hackensack, NJ, and Brabender OHG, Duisberg, Germany, the award is presented every three years and is administered alternately by AACC International and the Arbeitsgemeinshaft Getreideforschung, Detmold, Germany. The next AACC International-administered award will be in 2008. The award provides a plaque and a travel grant to enable the recipient to visit scientists and laboratories in other parts of the world. Recipients are professionally active in rheology.

Edith Christensen Award for Outstanding Contributions in Analytical Methods

Established in 2005, this award recognizes scientific and technical contributions that have advanced the grain science field. Recipients of the award have demonstrated excellence through their contributions to the development of new analytical technologies, the application of new analytical technologies to cereal grain products, and/or the application of existing analytical technologies to solving detection and measurements problems in the field of grain science. They have also demonstrated leadership in methods activity within AACC International.

Phil Williams graduated from the University of Wales at Aberystwyth with first class honors in chemistry in 1954. He obtained his Ph.D. degree in agricultural chemistry in 1957, specializing on the role of the phytate phosphorus in oats on phosphorus metabolism in the growing chick. It was during

his Ph.D. work that he became an analytical chemist and first became involved with the applied statistics associated with analytical chemistry.

Williams began his professional career at the Agricultural Research Institute, a wheat-breeding station, in Wagga Wagga, NSW, Australia, in 1958, which stimulated his career-long interest in wheat kernel texture and associated factors. In 1964 Williams obtained a National Research Council of Canada Post-doctoral Fellowship to work at the Canadian Grain Commission (then the Grain Research Laboratory [GRL]) in Winnipeg. In October 1965 he joined the staff of the GRL as head of the new Analytical Methods Development Section, a position he retained to the end of his career with the commission. He was appointed as the first chemist-in-charge of the Canadian Grain Commission's Protein Segregation Program for hard red spring (Canada Western Red Spring [CWRS]) wheat at its inception in 1970. This involved establishment of a network of macro-Kjeldahl laboratories in western Canada with an annual throughput of more than 600,000 tests.

Williams introduced near-infrared spectroscopy (NIRS) to the program early in 1972 and converted the entire program to NIRS testing between 1975 and 1977. He has maintained heavy involvement in the fields of both NIRS and wheat kernel texture. He spent the last six years of his professional career in the development of an electronic system for simultaneously testing and establishing grades of grains and seeds on the basis of texture and functionality.

Between 1975 and 1989 he found time to play a leading role in the establishment of the 50-laboratory complex of the International Center for Agricultural Research in Dry Areas (ICARDA), at Tel Hadya, near Aleppo, Syria.

During his career, Williams published more than 200 technical articles (81 in refereed journals), as well as more than 350 technical reports. He retired from the Canadian Grain Commission at the end of March 2002 and began a new career as educator and consultant in NIRS, grain technology and cereal chemistry.

Excellence in Teaching

The AACC International Excellence in Teaching Award is presented to a member and current teacher who has made significant contributions through teaching in the broad field of cereal science and technology. The award consists of an honorarium and plaque.

Jan A. Delcour, a citizen of Belgium, was a Youth for Understanding foreign exchange student in Marshall, MN (1974–1975). He obtained M.S. and Ph.D. degrees from the Katholieke Universiteit Leuven (Leuven, Belgium), where he heads the Laboratory of Food Chemistry. Delcour teaches food chemistry and cereal science courses. His research and that of his team focuses on basic aspects of starch, nonstarch polysaccharides, and storage and physiologically active protein constituents of cereals and aims to understand and improve cereal processing and final product quality. He is often cited for his clear presentations and his ability to reduce complex scientific matters to their essence. With members of his group, Delcour, an ISI highly cited researcher, has published about 225 research papers in peer-reviewed journals and filed patents grouped in 14 families. He has a track record that includes numerous long-term industrial collaborations and a significant role in EU research projects. Presently, he is a module leader in Healthgrain (www.healthgrain.org). Delcour, an incoming AACC International Board member, was technical program chair of the 1996 AACC Annual Meeting. He was associate editor for *Cereal Chemistry* from 2001 to 2005 and now serves as a senior editor for the journal.

Geddes Memorial Award

The William F. Geddes Memorial Award was created in 1961 to honor the zeal and unselfish industry of an individual member and to emphasize the importance of his or her contributions to the work of the society. Geddes served the association long and unselfishly as president (1938–1939), vice president (1937–1938), editor-in-chief of Cereal Chemistry *(1943–1961), active member, and committee member. Over the long span of his association with AACC International, Geddes influenced the organization in many ways, contributing to its work and progress, increasing its usefulness to its members, and boosting its reputation in the fields of fundamental and applied cereal science. The name of the recipient is kept secret until being unveiled during the Awards Ceremony.*

2005 Recipient:
Robert Cracknell, AWB Limited

Thomas Burr Osborne

The prestigious Osborne Medal, established in 1926 to recognize distinguished contributions in the field of cereal chemistry, was named after the outstanding protein chemist Thomas Burr Osborne. The medal is awarded in the form of a plaque and honorarium. Recipients of the Osborne Medal are accorded the status of AACC International Fellow. ***No award will be presented in 2006.***

Division Awards

Biotechnology Division Bruce Wasserman Young Investigator Award

Established in 1997 by the Biotechnology Division in an effort to encourage young scientists to pursue careers in cereal biotechnology research, the Bruce Wasserman Young Investigator Award recognizes the outstanding accomplishments of a young scientist whose research has contributed to enhanced knowledge of cereal functionality or improved cereal production or utilization. The award, sponsored by Monsanto, includes a commemorative plaque and honorarium.

2006 Recipient:

David Johnston is a research food technologist and lead scientist for the Crop Conversion Science and Engineering Research Unit at the USDA Agricultural Research Service's Eastern Regional Research Center in Wyndmoor, PA. Prior to joining the USDA in 1999, Johnston conducted doctoral and post-doctoral research in the Food Science Department at the University of California, Davis. Johnston holds an A.S. degree in biological sciences from Contra Costa College and a B.S. degree in microbiology and a Ph.D. degree in food biochemistry from the University of California, Davis. His current research projects are directed toward the use of enzyme-based technologies for milling grains and producing biobased products and fuels.

Engineering and Processing Division Stanley Watson Award

The Stanley Watson Award, established in 2001, is named in honor of an early corn wet-milling pioneer who started his research at the USDA during the early 1940s. Watson made substantial contributions in the improvement of the wet-milling process. The award recognizes outstanding AACC International members who, through the application of engineering principles, have made significant contributions in the area of cereal/grain processing. The award is presented biannually. ***No award will be presented in 2006.***

Protein Division Walter Bushuk Best Student Paper Award

The Protein Division selects the best protein chemistry paper presented by a student at the AACC International Annual Meeting each year. The award consists of an engraved plaque, honorarium, and recognition at the AACC International Annual Meeting.

2005 Recipient:
Baninder Sroan, Kansas State University
Rheology and Surface Activity in Bread Making

Protein Division Best Student Poster Award

The Protein Division selects the best protein chemistry paper presented by a student at the AACC International Annual Meeting each year. The award consists of an engraved plaque, honorarium, and recognition at the AACC International Annual Meeting. ***No award was presented in 2005.***

Rheology Division G. W. Scott Blair Award

The G. W. Scott Blair Award was established by the Rheology Division to honor individuals who have made outstanding contributions to the field of dough rheology or baked product texture and is named in honor of G. W. Scott Blair, who was the first person to do fundamental research on dough rheology. This award and the Rheology Division Young Scientist Award are is presented in alternate years. ***No award will be presented in 2006.***

Awards Presented by Related Organizations

Corn Refiners Association

The Corn Refiners Association, Inc. annually selects the best papers and posters concerning corn and corn-processing research from among those presented at the AACC International Annual Meeting. A committee considers presentations relating to better understanding of the corn wet-milling process, analysis of human nutrition issues facing the corn refining industry, innovative research approaches that encourage development of new uses of wet-milled corn, and scientific and technical projects that could increase the utilization and value of coproducts of the corn refining process or that improve energy utilization, environmental control, product quality, process equipment and analytical procedures, and equipment used in the corn refining industry. The paper and poster awards include a $500 honorarium.

2005 Paper Award Recipient:
Junjie Guan, University of Nebraska-Lincoln
Functional Properties of Starch Acetate Foams During Twin-Screw Extrusion

2005 Poster Award Recipient:
Wajira S. Ratnayake, University of Nebraska-Lincoln
New Insights into the Starch Gelatinization Process

Tortilla Industry Association

The purpose of this program is to encourage and recognize excellence in research related to the tortilla industry. Three honoraria are given each year for the best original papers describing research in any technical aspect of the formulation or production of corn or flour tortillas. There is a first prize award of $3,000 and two runner-up awards of $1,000 each.

AACC International Analytical Accuracy Awardees for 2005

Winners of AACC International's Analytical Accuracy awards, based on 2005 check sample results, have been announced. This is the eighth such set of awards to be made since the AACC International Check Sample Committee approved it eight years ago. Winners have received certificates suitable for posting and will be listed in the AACC International Annual Meeting program.

All subscribers to the various AACC International check sample series that include a proficiency testing option are eligible, whether or not they have elected the option, provided they have met the requirements for submission of results for the year involved. For each series, the award is made to the laboratory submitting the most accurate analyses. The statistical procedures used to select awardees are the same as those used to evaluate proficiency for other purposes. Awards are based primarily on the required analyses in each series. Analyses that are optional for proficiency test purposes are

continued

included if they improve the score to encourage subscribers to include the results of optional analyses in their reports. Series included in the 2005 awards are those shown in the list of awardees. Other AACC International check sample series for which the proficiency testing option is not now available may be added later as the number of subscribers and coefficient of variation of results warrant.

Formal entry for award competition is not necessary—all check sample subscribers to a given series are automatically eligible and entered provided they have submitted the required results on all samples for the award year. However, the same considerations apply to the Analytical Accuracy awards as to other achievement awards. Because there can be only one winner in any category and consideration is limited to those who have subscribed for the full year and submitted all required results, the results speak only to the performance of the awardees analyst or laboratory and not to that of many others who might be equally qualified.

Check sample subscribers or others who would like more information about AACC International Check Sample and Proficiency Testing Service are invited to visit: www.aaccnet.org/checksample.

Series A—Hard Wheat Flour, Monthly
USDA ARS, Fargo, ND

Series B—Hard Wheat Flour, Bimonthly
FFM Berhad, Port Klang Selangor, Malaysia

Series C—Soft Wheat Flour
Agricultural Research Centre, Harjumaa, Estonia

Series D—Feed Analyses
Ben King, The Quaker Oats Co., Cedar Rapids, IA

Series DF—Dietary Fiber
Food & Drug Analysis, Covance Laboratories, Madison, WI

Series HL and HS—Farinograph
Calvin Watson, McKee Foods Corp, Collegedale, TN

Series I—Amylograph
Bay State Milling Co., Indiantown, FL

Series J—Mixograph
ADM Milling Co., Mount Vernon, IN

Series K—Fat and Fatty Acids
Nestle Purina Analytical Laboratories, St. Louis, MO

Series MBA—Microbiological Analyses (Including Pathogens)
QA Lab, Minn-Dak Yeast Co., Wahpeton, ND

Series MBB—Microbiological Analyses
AFB International, O' Fallon, MO

Series SA—HPLC Sugar Analysis
Food & Drug Analysis, Covance Laboratories, Madison, WI

Series VMP—Vitamin Analyses
Food & Drug Analysis, Covance Laboratories, Madison, WI

Series VMP—Mineral Analyses
Novartis Nutrition Corp., Minneapolis, MN

Series VMP—Proximate and Mineral Analyses
Novartis Nutrition Corp., Minneapolis, MN

Series VMP—Proximate and Vitamin Analyses
Food & Drug Analysis, Covance Laboratories, Madison, WI

Series VMP—Vitamins, Minerals, and Proximate Analyses
Food & Drug Analysis, Covance Laboratories, Madison, WI

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Making a Difference

Volunteering to serve on an AACC International committee provides opportunities to gain skills and experience as well as the chance to give something back to the grains community. If you are interested in serving on a committee, please contact Susan Kohn at skohn@scisoc.org or at +1.651.454.7250 or visit www.aaccnet.org. AACC International thanks the following volunteers who serve on AACC International's committees, your dedication is deeply appreciated!

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Thank you MBAA Leaders!

MBAA is rich with members who enthusiastically take on new responsibilities and leadership roles in order to bring value to the Association.

MBAA's dedicated leadership generously volunteer their time and expertise in order to keep the Association strong. In addition to the Executive Committee and District Board of Governor Representatives, MBAA Committees work to guide MBAA's activities and serve as a channel of communication by actively soliciting member feedback. To contact these leaders, visit MBAA's online directory at http://interactive.mbaa.com.

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Fax: +1.651.454.0766
E-mail: aacc@scisoc.org
Website: www.aaccnet.org

AACC International-Europe Branch Office
Stanislas de Rijcklaan 60/22
BE-3001 Heverlee Belgium
Phone: +32 16 204035
Fax: +32 16 202535
E-mail: aacc@scisoceurope.org

Staff
The listing below provides the names of some key AACC International contacts.

Executive Vice President/Publisher ..... Steven C. Nelson
Vice President of Operations ..... Amy L. Hope
Vice President of Finance ..... Barbara Mock
Continuing Education ..... Betty Ford
Annual Meeting ..... Betty Ford
Annual Meeting Exhibit Sales ..... Debby Woodard
Advertising and Exhibit Sales Coordination .... Rhonda Wilkie
Member Services ..... Susan Kohn
Denise Kessler
Publications - Electronic ..... Steve Kronmiller
Publications - Marketing..... Greg Grahek
Linda Gold
Publications - Production ..... Karen Cummings
Phyllis Albertz
Cereal Foods World® ..... Dan Best
Cereal Foods World® Sponsorship .....Jan Kuhn
Cereal Chemistry® ..... R. Carl Hoseney
Approved Methods ..... Greg Grahek
Karen Cummings
Check Sample ..... Tim Moore
AACC International Foundation ..... Susan Kohn
AACC International Europe Office ..... Hilde Keunen

Future AACC International Annual Meetings

2007
October 7-10
San Antonio Convention Center
San Antonio, Texas

2008
September 21-24
Hawaii Convention Center
Honolulu, Hawaii

Master Brewers Association of the Americas Headquarters and Staff

MBAA
3340 Pilot Knob Road
St. Paul, MN 55121 U.S.A.
Phone: +1.651.454.7250
Fax: +1.651.454.0766
E-mail: mbaa@scisoc.org
Website: www.mbaa.com

Staff
The listing below provides the names of some key MBAA staff members at headquarters whom you may have the need to contact in the future.

Executive Vice President ..... Steven C. Nelson
Vice President of Operations ..... Amy L. Hope
Vice President of Finance ..... Barbara Mock
Director of Operations ..... Jody Grider
Annual Meeting ..... Ronda Thompson
Sue Casey
Continuing Education ..... Ronda Thompson
Member Services ..... Cheryl Sundquist
Marketing ..... Beth Elliott
Publications – Electronic ..... Steve Kronmiller
Publications – Marketing ..... Greg Grahek
Linda Gold
Publications – Production ..... Karen Cummings
Jordana Anker

Future MBAA Conventions

2007
October 26-28
Opryland
Nashville, Tennessee

2008
World Brewing Congress
August 3-6
Hawaii Convention Center
Honolulu, Hawaii

Thank You Members!

Thank you for helping us build a strong Association—an Association that enhances your career, gives you opportunities to make life-long professional friendships, and keeps you connected to the pulse of the industry.

As an AACC International member you have the unique opportunity to:

- Network with grain-based professionals worldwide
- Receive a subscription to CEREAL FOODS WORLD
- Receive print or online subscriptions to *Cereal Chemistry* at greatly reduced member rates
- Keep up-to-date through member e-mail newsletters
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- Publish and present your research
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- Participate in section and division activities
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- Monitor your laboratory's accuracy though the check sample service
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Questions? Stop by the membership table or contact Denise Kessler at +1.651.454.7250 or via e-mail dkessler@scisoc.org.

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MBAA membership offers a terrific opportunity to interact with other industry professionals as well as gain practical solutions, resourceful safeguards, and innovative technologies to strengthen your ability to succeed.

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- Subscription to the MBAA *Technical Quarterly,* which includes *The MBAA Communicator*
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- Participate in continuing education courses at a special member rate
- Attend District meetings and technical conferences
- Consult MBAA for technical support
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Annual Meeting
October 7-10
San Antonio, Texas
2007

AACC International Annual Meeting
San Antonio Convention Center
October 7-10 • San Antonio, Texas

Photos courtesy of Texas Tourism.

MBAA Will Be There…Will You?

2007

Music City USA

120th Anniversary Convention of the Master Brewers Association of the Americas

October 26–28, 2007
Opryland Hotel
Nashville, Tennessee

➤ *Abstract Submissions Open February 2007*

http://meeting.mbaa.com

Photo by Barry M. Winiker, courtesy of the Nashville CVB.

Photo courtesy of Hawaii Tourism Japan

2008

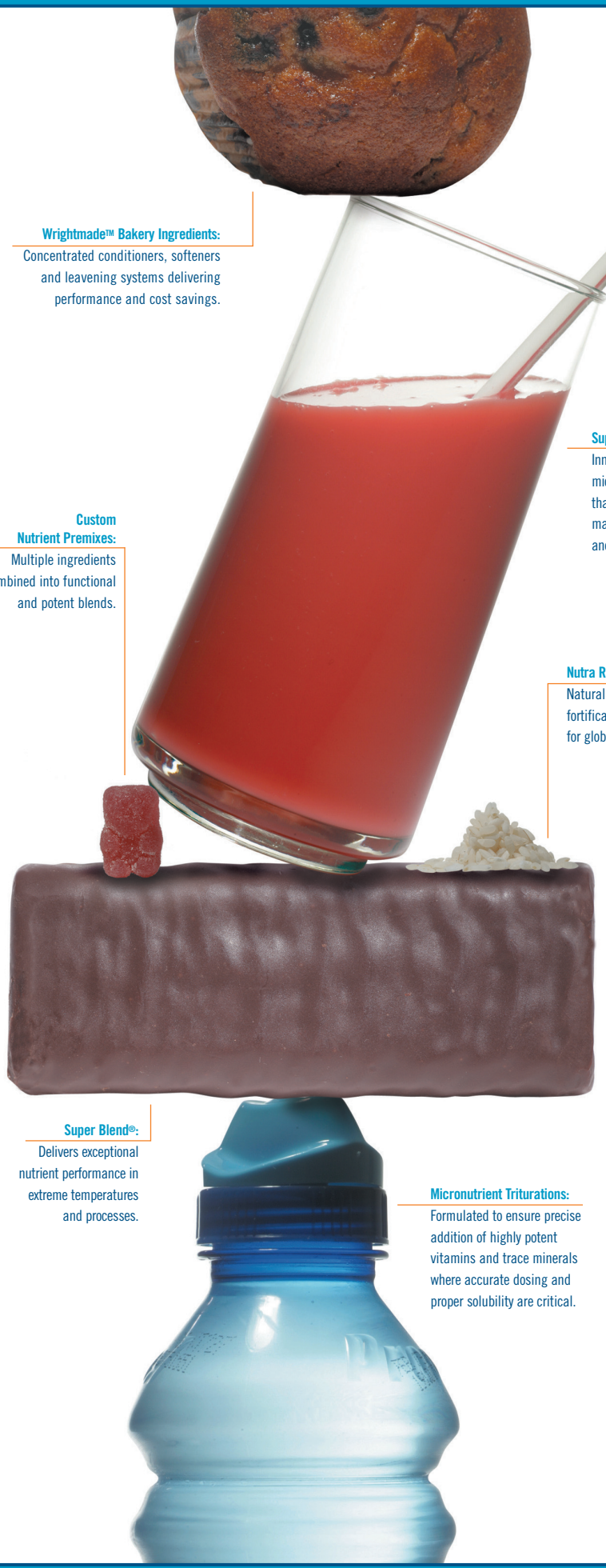
Aloha Hawaii

Business Will Be Brewing in Honolulu at the 2008 World Brewing Congress

August 3–6, 2008
Hawaii Convention Center
Honolulu, Hawaii

Co-hosted by the Master Brewers Association of the Americas and American Society of Brewing Chemists with active participation by the Brewery Convention of Japan, the European Brewery Convention, and the Institute of Brewing & Distilling.

www.worldbrewingcongress.org



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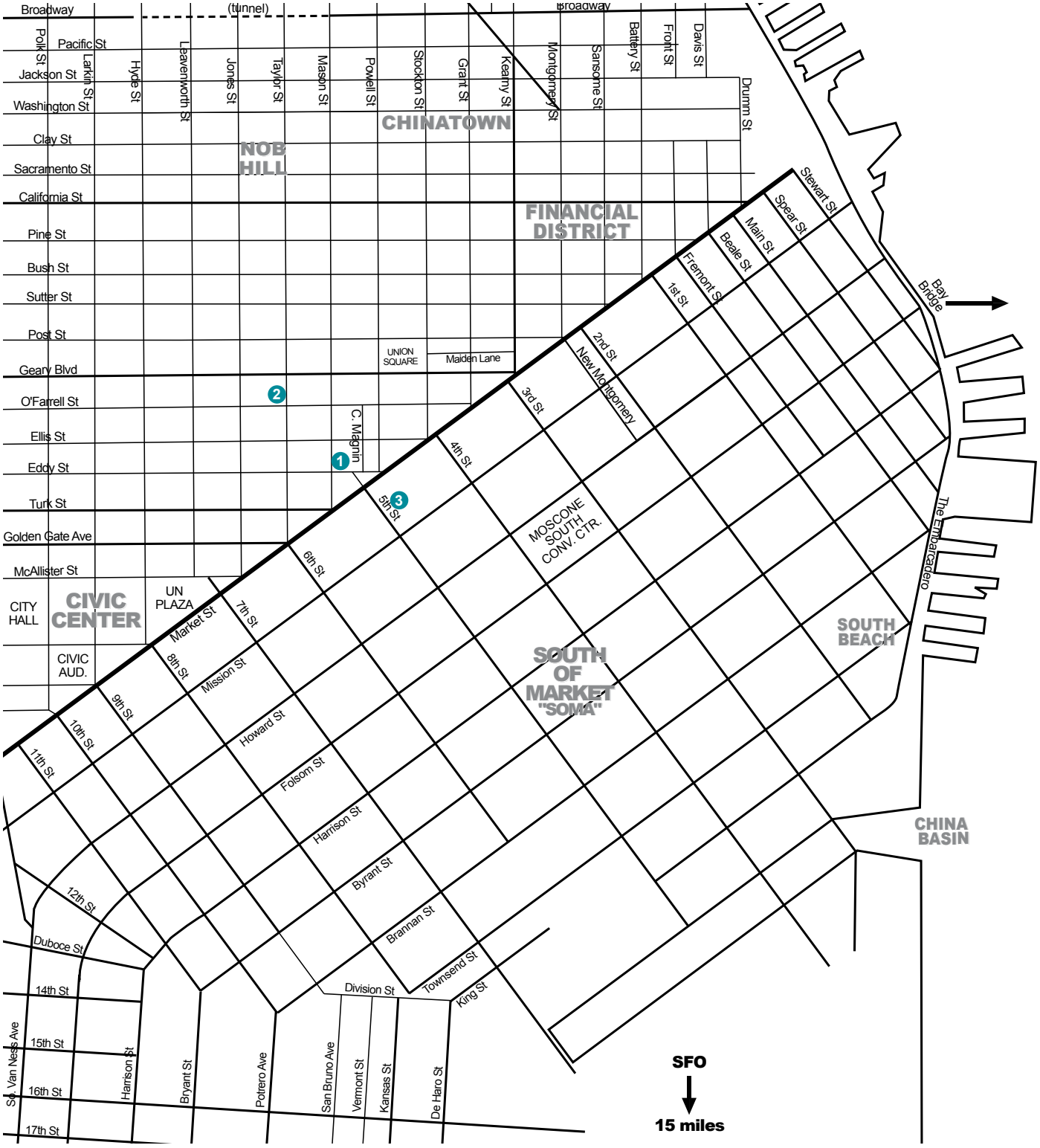
415.974.4000

❶ Renaissance Parc 55 Hotel
55 Cyril Magnin Street
San Francisco, CA 94102
415.392.8000

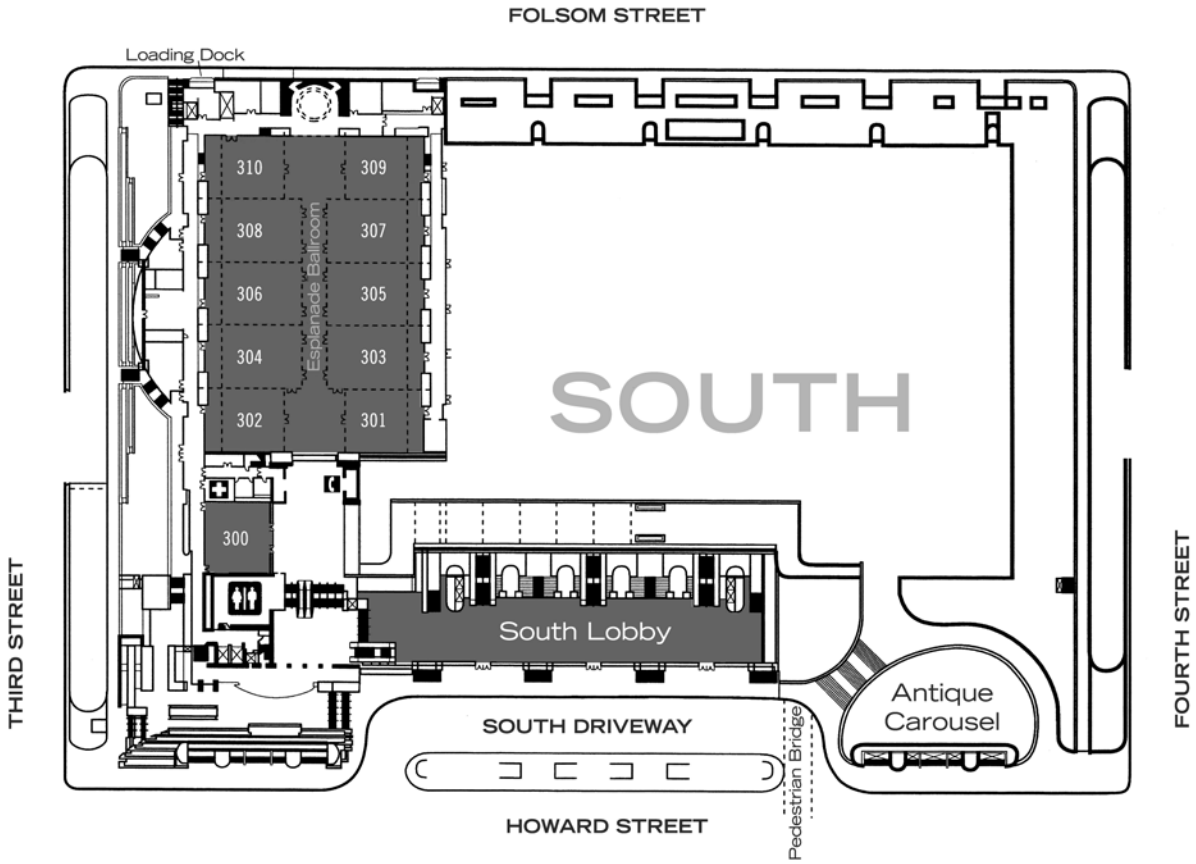
❷ Serrano Hotel
405 Taylor Street
San Francisco, CA 94102
415.885.2500

❸ Hotel Milano
55 5th Street
San Francisco, CA 94103
415.543.8555



Moscone Convention Center South

Esplanade Level



Exhibition

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Mezzanine Level

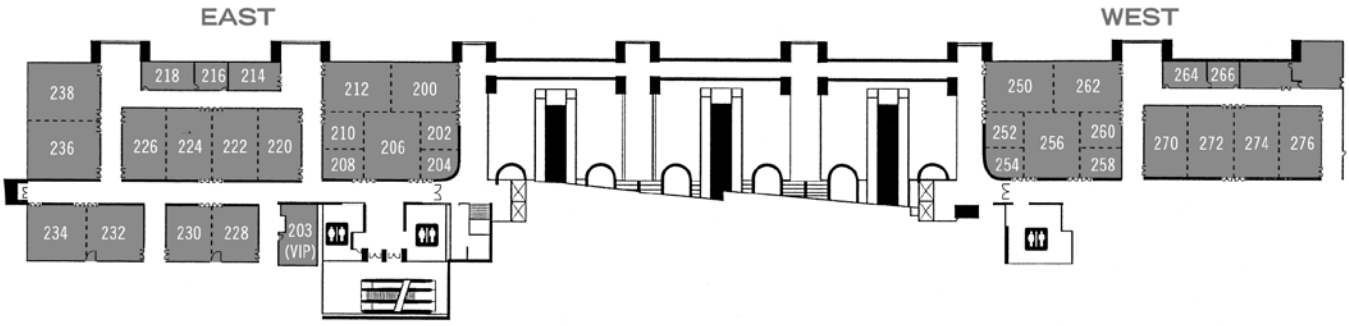
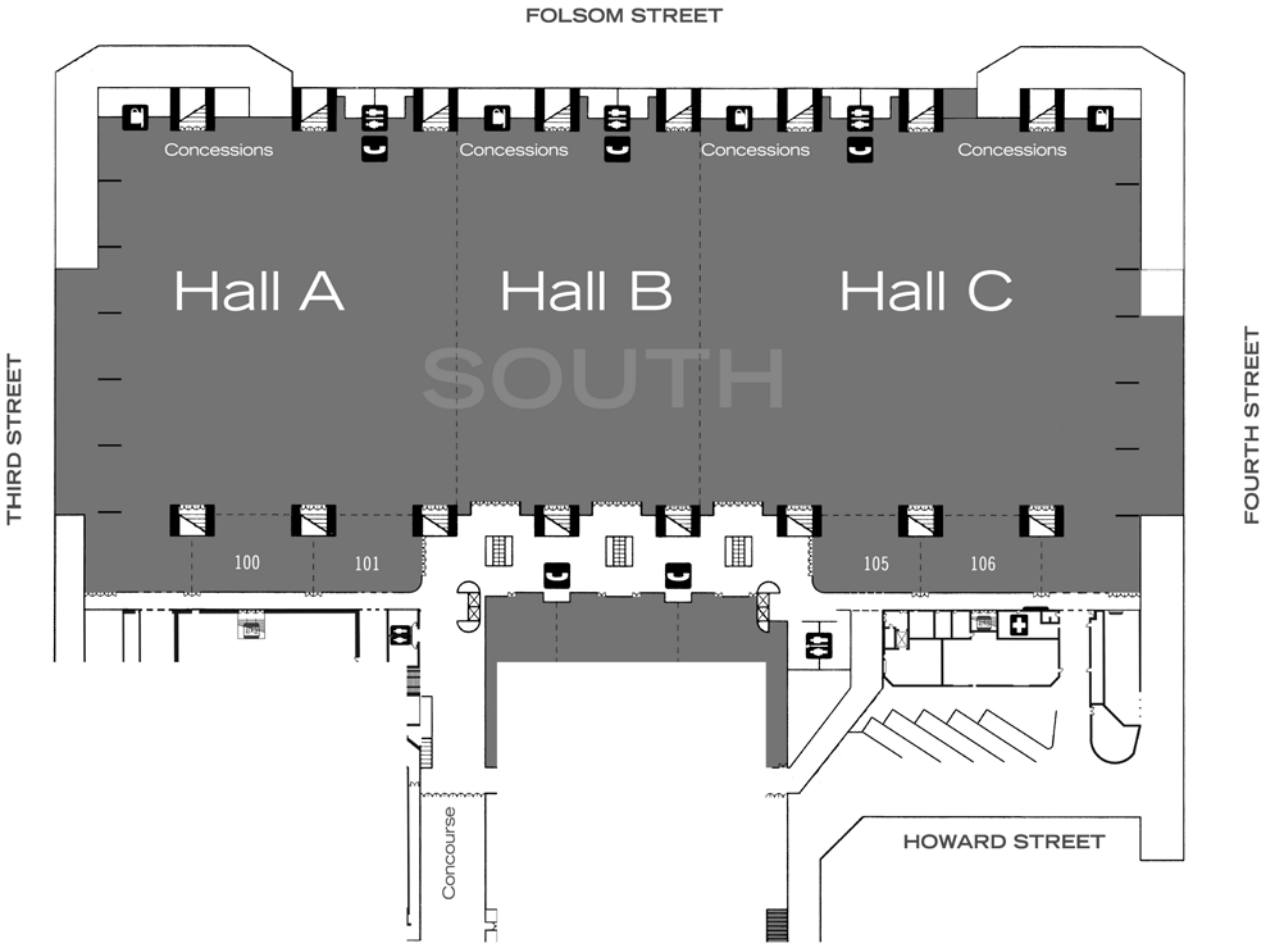
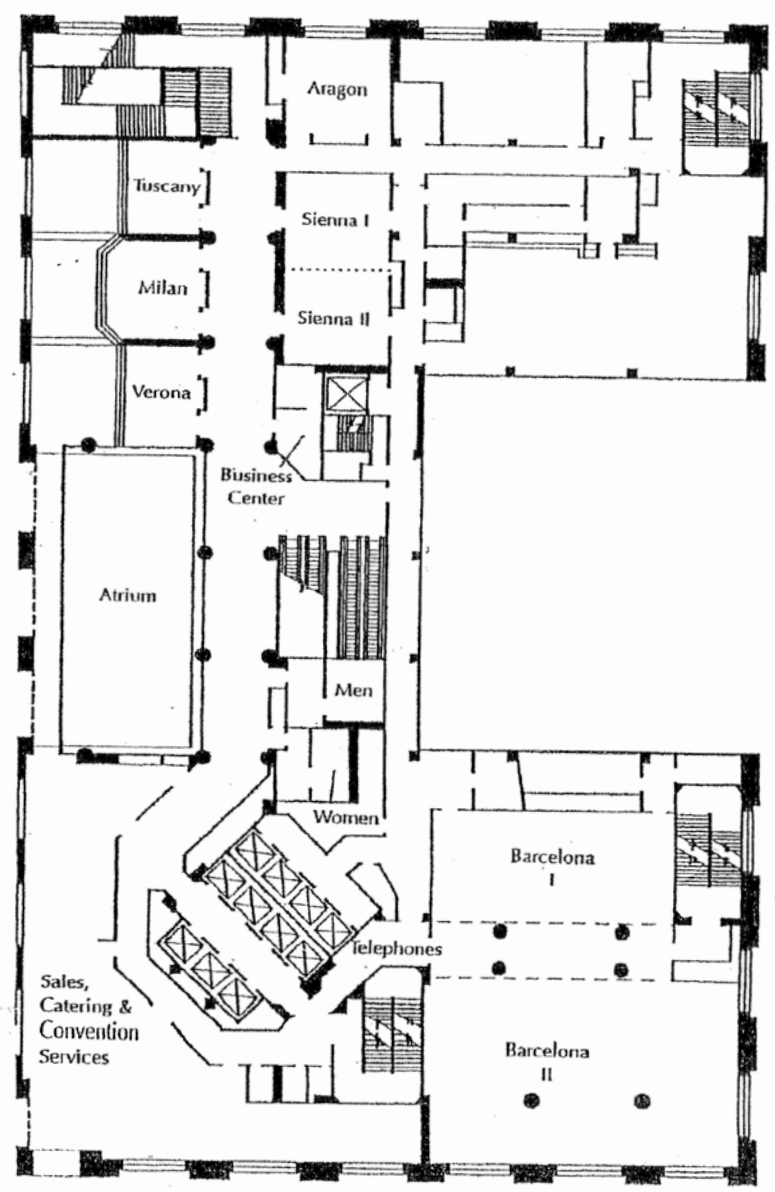


Exhibit Level

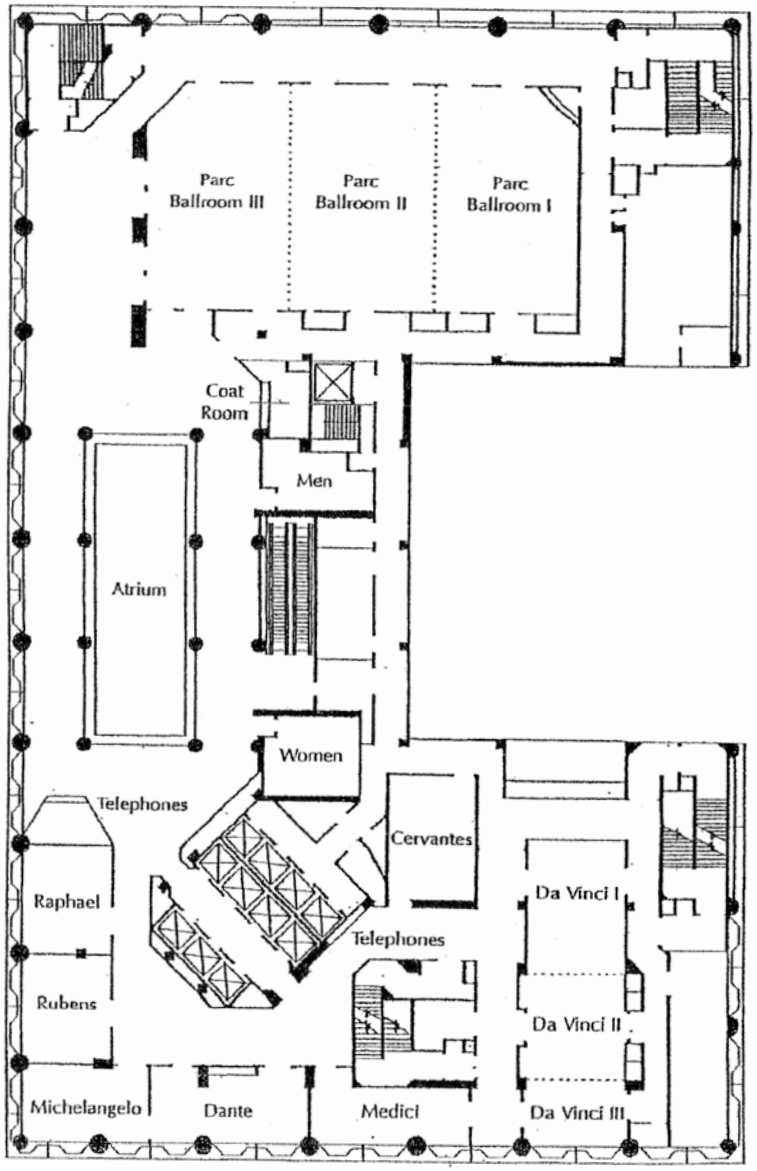


Renaissance Parc 55

Third Floor Level

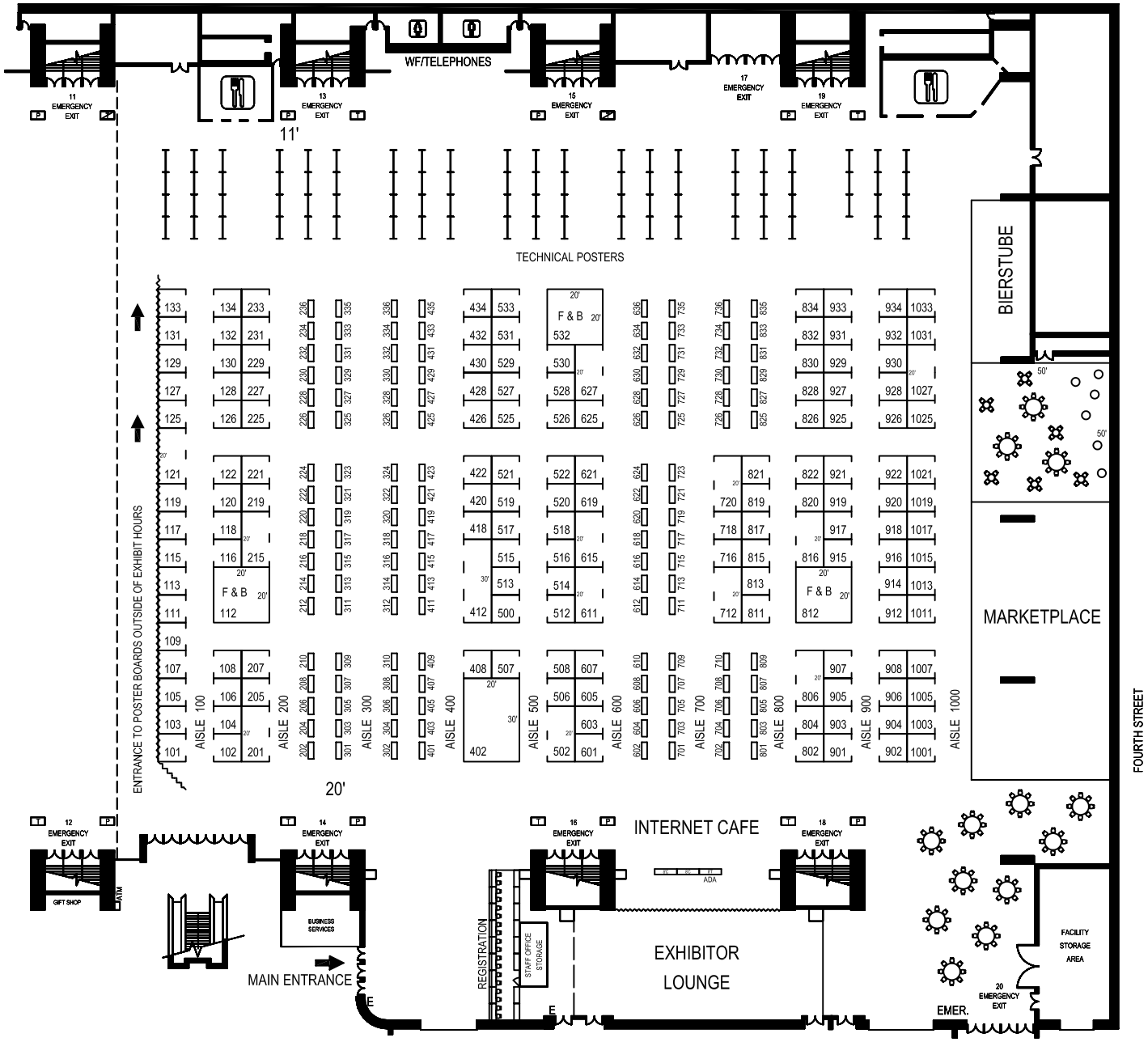


Fourth Floor Level



Moscone Convention Center South

Exhibits Hall C



World Grains Summit: Foods and Beverages Exhibition

Make connections with more than 230 suppliers for the latest updates on ingredients, instruments, equipment, and services. The following descriptions were provided by the exhibiting company to help you target products and services. Additional exhibit information is listed in the Program Addendum.

Come for all three exhibit sessions, enjoy refreshments and the Bierstube, browse the Marketplace for AACC International and MBAA products, and enter your name in the daily prize drawings. *Prizes sponsored by C.W. Brabender Instruments, Inc.*

Exhibit Hours

Sunday, September 17 4:00 – 6:30 p.m.
Monday, September 18 12:00 – 2:00 p.m.
Tuesday, September 19 12:00 – 2:00 p.m.

126 **A. Handtmann Armaturenfabrik,** Arthur-Handtmann-Strasse 13 + 23, D-88400 Biberach, Germany; Telephone: +49 7351 3424542, Fax: +49 7351 3424465, Web: www.handtmann.de. Handtmann engineers and manufactures complete processing lines within breweries—from the yeast and fermentation cellar to the bright beer and filtration cellar. Products range from butterfly valves, double seat valves, tank equipment, pipe fences and CIP plants. Handtmann also manufactures the MMS (Multi Micro System) sterile beer filter and the CSS (Combined Beer Stabilization) system.

201 **A. ZIEMANN GmbH,** Schwieberdinger Str. 86, D-71636 Ludwigsburg, Germany; Telephone: +49 7141 408-0, Fax: +49 7141 408-335, Web: www.ziemann.com. The ZIEMANN Group employs at its four locations in Germany, France, Brazil, and China more than 1200 people. The new joint venture with Lehui/China, i.e., local manufacture in China, combined with European engineering, will ensure successful investments in the Chinese market. In 2005 these companies jointly supplied brewing plants and brewing equipment at a total turnover of more than 300 million euro. The ZIEMANN Group is the world's largest manufacturer and supplier of turnkey breweries, brewing plants, and tank farms for the brewing industry.

See our ad on page 6.

828 **AB Vickers,** Dallow Street, Burton upon Trent, DE14 2PQ, United Kingdom; Telephone: +44 1283 563 268 or +44 7774 725 029, Fax: +44 1283 511 472, Web: www.abvickers.com. AB Vickers will present a range of beer processing materials, including Compac kettle finings, Vicant antioxidants, Profoam foam stabilizer, Foamsol foam control, YeastLife nutrients, and Vicfine isinglass finings. With experience in all types of breweries, from the smallest traditional cask ale brewery to the largest lager breweries, AB Vickers has vast experience in improving process efficiency and beer quality.

802 **AcquiData, Inc.,** 400 Garden City Plz., Suite 445, Garden City, NY 11530; Telephone: +1.516.408.3585, Fax: +1.516.408.3586, Web: www.acquidata.com. Link your lab instruments directly to PCs and automatically build a SQL database of all of your product quality results with AcquiData's Testream/CS!

214 **ADM,** 4666 Faries Pkwy., Decatur, IL 62526; Telephone: 1.800.637.5843, Fax: +1.217.451.7026, Web: www.admworld.com. Archer Daniels Midland Co.'s ingredient offerings include Kansas Diamond® white whole wheat flour, Prolite® wheat protein isolates, black bean tortillas, and corn flour tortillas.

212 **AIB International,** P.O. Box 3999, Manhattan, KS 66505-3999; Telephone: +1.785.537.4750, Fax: +1.785.537.1493, Web: www.aibonline.org. AIB International provides product development and evaluation, nutrition labeling, lab testing, baking science classes, seminars, correspondence courses, publications, production audits, integrated quality systems (Bakers Quality Seal/Gold Standard), food security program, sanitation and safety education, and inspections.

914 **Air Products,** 7201 Hamilton Blvd., Allentown, PA 18195-1501; Telephone: 1.800.654.4567, Fax: 1.800.272.4449, Web: www.airproducts.com. Air Products' new PRISM® oxygen generators offer the ability to produce affordable, high-purity oxygen right at your site, eliminating the hassles of transporting cylinders.

820 **Airflow Sciences Corporation,** 12190 Hubbard St., Livonia, MI 48150; Telephone: +1.734.525.0300, Fax: +1.734.525-0303, Web: www.airflowsciences.com. Airflow Sciences Corporation provides expert testing and analysis, including CFD flow modeling, field testing, physical modeling, data acquisition systems, and custom test equipment fabrication. They also provide the data needed to improve roasting, toasting, baking, drying, mixing, chilling, and all other processes. The company has been helping the food manufacturing industry improve throughput, reduce production costs, avoid scale-up problems, and improve product quality and uniformity since 1975.

1019 **Alex C. Fergusson (AFCO),** 152 Southerly Ln., Orange Park, FL 32003; Telephone: +1.904.278.7464 or +1.904.612.5353, Fax: +1.904.269.1952, Web: www.afcocare.com. Alex C. Fergusson (AFCO) has provided cleaning and sanitizing products/programs to the food industry for over 150 years. AFCO

has a complete line of dispensing equipment and engineering services. HRS/PerOx, a non-rinse PAA foaming sanitizer, will be featured at the booth. An E-2 and E-3 hand-care program will also be presented.

522 **Alfa Laval Inc.**, 5400 International Trade Dr., Richmond, VA 23231; Telephone: 1.866.ALFA LAVAL, Web: www.alfalaval.us. Leading global supplier of centrifugal separators, heat exchangers, flow and tank components, process modules, and yeast systems for the brewing industry. From design planning to production, Alfa Laval is committed to world-class service throughout the lifetime of your brewing processes. With worldwide installations and more than 400 employees dedicated to the industry, Alfa Laval brewery technology has the engineering experience and process expertise to keep your brewery running at the height of efficiency.

202 **American Ingredients,** 3947 Broadway, Kansas City, MO 64111-2516; Telephone: +1.816.561.9050, Fax: +1.816.561.0422, Web: www.americaningredients.com. A full line of ingredients for the milling, baking, and food processing industries plus specialized lab and production equipment.

See our ad on page 2.

525 **Anton Paar USA,** 10215 Timber Ridge Dr., Ashland, VA 23005; Telephone: 1.800.722.7556, Fax: +1.804.550.9074, Web: www.anton-paar.com. Anton Paar specializes in the development and production of highly accurate instrumentation to measure CO_2, alcohol, and real and original extract of beer both on-line and in the lab. Our line of density meters, sound velocity sensors and carbonation meters are designed to perform reliably in the most demanding of environments.

431 **APV Baker,** 3223 Kraft Ave. S.E., Grand Rapids, MI 49512; Telephone: +1.616.784.3111, Fax: +1.616.784.0973, Web: www.apvbaker.com. RTE cereal equipment, process know-how, service, and spare parts for rotary batch cookers, twin screw extruders, cold formers, flaking and shredding rolls, Thermoglide® fluid bed toaster dryer, and coating systems.

430 **APV-Invensys,** 100 South CP Ave., Lake Mills, WI 53551; Telephone: +1.920.648.8311, Fax: +1.920.648.1441, Web: www.apv.com. APV is a world-class supplier of high-quality process engineering solutions and automation to the food, beverage, pharmaceutical, and healthcare industries and has been a leading supplier to the brewing industry for over 80 years. APV's range of manufactured products includes heat exchangers, homogenizers, pumps, and valves for hygienic applications. Plus, APV also offers a complete range of separation technologies, including membrane filtration systems, evaporators, and distillation systems.

415 **Arla Foods Ingredients,** 645 Martinsville Rd., Basking Ridge, NJ 07920; Telephone: +1.908.604.8551, Fax: +1.908.604.9310, Web: www.arlafoodsingredients.com.

610 **Aromatic Inc.,** 120 Post Rd. W., Westport, CT 06880; Telephone: +1.203.341.0400, Fax: +1.203.341.0002, Web: www.aromatic.se. Aromatic's alpha-phase emulsifiers for use with trans fat-free liquid oils (no saturated fat) are low cost solutions! Alpha gels for softness and conditioning. Specialty malt products and release agents. Functional blends especially for whole grain/high fiber in breads, cereals, cakes, cookies, and tortilla applications.

903 **Astoria-Pacific International,** P.O. Box 830, Clackamas, OR 97015-0830; Telephone: 1.800.536.3111 or +1.503.657.3010, Fax: +1.503.655.7367, Web: www.astoria-pacific.com. The Astoria analyzer can be used to monitor vitamins in fortified flour extracts and a variety of applications (bitterness, beta-glucans, diastatic power, etc.) in beer and malt. Please stop by our booth to discuss additional applications (like total protein, TKN, etc.) you might like to automate.

801 **Balchem Encapsulates,** P.O. Box 600, New Hampton, NY 10958; Telephone: 1.877.222.8811 or +1.845.326.5600, Fax: +1.845.326.5717, Web: www.balchem.com. Balchem is uniquely focused on the development and manufacture of microencapsulated ingredients for the bakery, confection, and meat industries. Let our applications and lipid scientists help you differentiate your products with our proprietary technology. Try our USP-grade choline. For information and samples, visit www.balchem.com.

1017 **Barry-Wehmiller Company,** 8020 Forsyth Blvd., St. Louis, MO 63105-1707; Telephone: +1.314.862.8000, Fax: +1.314.862.2457, Web: www.barry-wehmiller.com. Barry-Wehmiller Company is the world leader in providing solutions for product stability in the beverage industry. With over 120 years serving the beverage industry, Barry-Wehmiller is passionate about pasteurizers. Barry-Wehmiller provides flash and tunnel technology for all beverage applications. In addition, Barry-Wehmiller supplies product warmers, coolers, and bottle washers and a complete complement of after-market services, parts, and machine upgrades. For more information, visit our website at www.barry-wehmiller-company.com.

521 **BASF Corporation,** 100 Campus Dr., Florham Park, NJ 07932; Telephone: 1.800.527.9881, Web: www.divergan.basf.de. Haze in beer is caused primarily by polyphenol-protein complexes. Divergan F and RS stabilizers selectively adsorb the polyphenols that cause turbidity. The use of Divergan stabilizers improves the stability of the taste, as the polyphenols, in particular, are prone to polymerize to higher molecular weight products that have a bitter taste. Divergan HM polymer is an excellent adsorber of heavy metal ions in beer. It is used to remove unwanted heavy metals. It alleviates metallic bitterness and oxidative changes in taste and appearance.

916 **BEGEROW USA Inc.,** 9908 Marquette Dr., Bethesda, MD 20817; Telephone: +1.585.398.2783 or +49 172 672 1147 (Germany), Fax: +1.585.398.0067, Web: www.begerow.com. BEGEROW offers the finest in a full range of BECO filter sheets, disc filters, sheet filters, media (BECOFLOC, BECOCEL) and filter cartridges. Additionally, yeast and nutrients plus stabilizers (BECOSORB) are available from one source. Several stocking warehouses in the United States ensure prompt delivery. BEGEROW also offers you, the customer, answers to your filtration and stabilization questions. Call on us!

832 **Best Lab Deals, Inc.,** 1000 Management Way, Garner, NC 27529; Telephone: +1.919.661.8030 or +1.919.329.8567, Fax: +1.919.661.8039, Web: www.bestlabdeals.com. Just outside of Research Triangle Park, NC, is our 68,000-ft^2 distribution and service center. Our goal is to provide the scientific and industrial processing industries with an affordable and quality way to purchase equipment and supplies and receive on time quality service and calibration. Each sales team member will compile a list of your needs and prepare a quote with the quality equipment, supplies, or chemicals at the prices you need to fit your budget. ISO 17025 certified pipette calibration lab.

1007 **Bio-Chem Laboratories,** 1049 28th St. S.E., Grand Rapids, MI 49508; Telephone: +1.616.248.4900, Fax: +1.616.248.4904, Web: www.bio-chem.com. Bio-Chem Laboratories is a full-service laboratory providing a variety of services to the brewing industry. Bio-Chem delivers quality analytical testing in a timely manner through the use of state-of-the-art technology and outstanding customer service.

304 **Blue Diamond Growers,** P.O. Box 1768, Sacramento, CA 95812; Telephone: +1.916.442.0771, Fax: +1.916.446.8442, Web: www.bluediamond.com. Almonds: sliced, slivered, diced, buttered, or coated, this ingredient makes healthful sense in cereal and baked goods applications. The future for almonds never looked better.

704 **BLUE PLANET FOODS, INC.,** 9104 Apison Pike, P.O. Box 2178, Collegedale, TN 37315; Telephone: +1.423.396.3145 or 1.877.396.3145, Fax: +1.423.396.3402, Web: www.blueplanetfoods.net. Seeking your whole-grain solution? Blue Planet Foods is your answer. By manufacturing granola for over 30 years, we know "whole grains." We also manufacture dessert toppings, toasted oats, graham pie shells, and are a private label cereal manufacturer. As we have the capability to design a product around your specifications, custom formulations are not a problem. Intrigued? We hope so. Come see us and let's discuss your next project.

1031 **BOC,** 575 Mountain Ave., Murray Hill, NJ 07974; Telephone: +1.908.646.8100, Fax: +1.908.771.1375, Web: www.boc.com. BOC CryoCrystalliser shortening process produces high-performance shortening. Low cost/capital solution to eliminate trans fat in bakery products.

531 **Brabender GmbH & Co. KG,** Kulturstrasse 51-55, D-47055 Duisburg, Germany; Telephone: +49 203 7788 0, Fax: +49 203 7788 100, Web: www.brabender.com.

533 **C. W. Brabender Instruments, Inc.,** 50 E. Wesley St., South Hackensack, NJ 07606; Telephone: +1.201.343.8425, Fax: +1.201.343.0608, Web: www.cwbrabender.com. C. W. Brabender will feature our modernized measuring instrumentation: Farinograph®-E, Extensograph®-E, Amylograph-E, Viscograph-E, and Glutograph-E. In addition, information pertaining to our complete product line will be available.

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215 **Brewers Supply Group,** 800 W. First Ave., Shakopee, MN 55379; Telephone: 1.800.374.2739, Fax: +1.952.224.1385, Web: www.brewerssupplygroup.com. Suppliers of the finest brewing ingredients from around the world. With five locations across the United States, we supply domestic and imported malt, hops, and other brewing ingredients with the technical expertise to support our products.

233 **Brewing Research International (BRi),** Coopers Hill Rd., Nutfield, Surrey RH1 4HY, United Kingdom; Telephone: +44 1737 822272, Fax: +44 1737 822747, Web: www.brewingresearch.co.uk. BRi is the premier technology and information provider to the global brewing, malting, and wine industries. BRi provides beer consumer research, flavor evaluation, analysis, auditing, troubleshooting, NPD, technical research, benchmarking, dispense, and microbiological services. BRi's membership package is like an insurance policy, including an international beer safety info and alert service, a safety research portfolio, a 24/7 safety help line, a health research and info service, and the world's largest info service via its website.

507 **brewmaxx GmbH & Co. KG,** Einsteinstrasse 8, D-91074 Herzogenaurach, Germany; Telephone: +49 9132 777 40, Fax: +49 9132 777 450, Web: www.brewmaxx.com. brewmaxx—the innovative process control system for the brewing industry. The brewmaxx automation solution starts with the raw material and covers the entire production block brewhouse and cellar right up to filling and packaging, including auxiliaries. The brewmaxx product family provides the basis for this bridging of the process control level and corporate management level. The services offered by brewmaxx cover the entire project process from consultation and planning and project management, through to training and aftersales services.

712 **Briess Malt & Ingredients Co.,** 625 S. Irish Rd., P.O. Box 229, Chilton, WI 53014-0229; Telephone: 1.800.657.0806, Fax: +1.920.849.4277, Web: www.briess.com.

1033 **Briggs of Burton, Inc.,** 5 Marway Cir., Rochester, NY 14624; Telephone: +1.585.426.2460, Fax: +1.585.426.0250, Web: www.briggsplc.co.uk. Briggs excels in mash conversion, mash separation, wort boiling, yeast management, dry goods, the process

block, and keg racking. Briggs Symphony external wort boiling technology is now bringing major benefits in North America. Learn about our experienced engineering support, dedicated service, and range of in-house project management and automation services.

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921 **Brookfield Engineering,** 11 Commerce Blvd., Middleboro, MA 02346; Telephone: +1.508.946.6200, Fax: +1.508.946.6262, Web: www.brookfieldengineering.com. Featuring our enhanced, low-cost, LFRA texture analyzer now with computer control. Small in size—big on results—come see what the LFRA can do for you. Also our DVII+ PRO viscometer now has control software providing superior viscosity measurement. We will also have our new in-line viscometer AST100—an ultrasonic design ensures easy cleanability, little maintenance, and versatile application possibilities. Be sure to stop by and see what Brookfield can do for you regarding viscosity and texture measurement.

611 **Bruker BioSpin Corp., EPR Division,** 44 Manning Rd., Billerica, MA 01821; Telephone: +1.978.663.7406, Fax: +1.978.670.8851, Web: www.bruker-biospin.com. Bruker manufactures EPR & FT-IR spectrometers for use in flavor-stability and quality-control applications. Bruker's EMX spectrometer is a high throughput research system for both liquid and solid samples. The e-scan bench-top spectrometer provides rapid, automated analysis for optimizing your beer's shelf life.

927 **Buchi Analytical,** 19 Lukens Dr., Suite 400, New Castle, DE 19720; Telephone: +1.302.652.3000, Fax: +1.302.652.8777, Web: www.buchi-analytical.com. Buchi Analytical products include FTNIR systems for food, pharmaceutical, and industrial labs or processes and Flash & Prep chromatography for compound purification. Other products include systems for distillation, extraction, and digestion for food and environmental applications.

628 **Budenheim,** 245 Newton Rd., Suite 305, Plainview, NY 11803; Telephone: +1.732.249.9908 or +1.732.371.3558, Web: www.gallard.com. CFB Budenheim is one of the leading global manufacturers of food phosphates and SAS, covering applications in baking, dairy, and mineral fortification. A complete range of chemical leavening acids are produced in state-of-the art equipment in our AIB certified plants. Various phosphates are available as nutrients and mineral fortifiers for many food products.

512 **Buhler Inc.,** 13105 12th Ave N., Plymouth, MN 55441; Telephone: +1.763.847.9900, Fax: +1.763.847.9911, Web: www.buhlergroup.com. Buhler is a worldwide organization providing solutions and partnerships for the food industry. Activities in extrusion include RTE cereals, pet foods, ingredients, aquafeed, and snacks. The focus is twin-screw cooking and forming and fluid-bed drying.

See our ad on the Program Tab back.

827 **Bunge Milling,** 11720 Borman Dr., P.O. Box 28500, St. Louis, MO 63146-1000; Telephone: 1.800.528.4633, Fax: +1.314.292.2333, Web: www.bungenorthamerica.com. Bunge Milling produces yellow and white degermed corn products, including grits, meals, flours and bran, and whole-grain corn products. Bunge Milling is the largest corn dry miller in the United States, with mills in Atchison, KS, Crete, NE, and Danville, IL, as well as having facilities in Canada and Mexico.

829 **Bunge Oils,** 725 N. Kinzie Ave., Bradley, IL 60915; Telephone: +1.815.523.3518, Fax: +1.815.939.4289, Web: www.bungeoils.com.

428 **Butter Buds Food Ingredients,** 2330 Chicory Rd., Racine, WI 53403; Telephone: 1.800.426.1119, Fax: +1.262.598.9999, Web: www.bbuds.com. We use proprietary enzyme modification technology to "unlock" the potent flavor elements in butter, cream, cheese, and other flavorful fats, delivering highly concentrated natural flavor in convenient powdered, paste, and liquid form. These natural dairy concentrates are used at extremely low applications levels and are kosher and halal compliant, easy to use, and stable in price. They allow the production of better tasting, more economical, healthier foods with very clean label statements. Organic forms of core products are now available.

807 **Calibre Control International Ltd.,** Asher Court, Lyncastle Way, Appleton, Warrington WA4 4ST, United Kingdom; Telephone: +44 1925 860401, Fax: +44 1925 860402, Web: www.calibrecontrol.com. Calibre will be displaying the very latest version of the popular C-CELL imaging system for baked products. The new version includes many additional features and advanced analysis data. See a demonstration at the table top exhibit or visit www.c-cell.info.

612 **California Natural Products,** P.O. Box 1219, Lathrop, CA 95330; Telephone: +1.209.858.2525, Fax: +1.209.858.4076, Web: www.cnp.com. Syrups, solids, and natural functional ingredients from grain—rice syrups, rice syrup solids, rice oligodextrins, tapioca syrup, rice milk powder, Completo (the soluble whole-grain rice, in powder or liquid), and Bake-Trim (the natural rice syrup solid dough conditioner, emulsifier, and fat replacer). Organic and conventional versions are available.

908 **Cambridge Wire Cloth Co.,** 105 B Goodwill Rd., P.O. Box 399, Cambridge, MD 21613; Telephone: 1.877.226.9473, Fax: +1.410.228.2617, Web: www.camwire.com. Premium brews deserve our premium leaf. Cambridge Wire Cloth Continuweld® 360 filter leaves represent innovation in pressure filtration technology. These leaves feature continuous nonporous welding of filter cloth to solid bar frame for the ultimate in sanitary, leak-proof performance. Cambridge can easily repair your 360's to like-new condition.

306 **Can-Oat Milling Inc.,** 1 Can-Oat Dr., Portage La Prairie, MB R1N 3W1, Canada; Telephone: 1.800.663.6287, Fax: +1.204.857.9500, Web: www.can-oat.com.

705 **Caravan Products Co., Inc.,** 100 Adams Dr., Totowa, NJ 07512; Telephone: 1.800.526.5261, Fax: +1.973.256.0727, Web: www.caravanproducts.com. The variety bread specialist providing the best products—bases, mixes, and gourmet sweets—and unrivalled on-site technical service from coast to coast.

816 **Cargill,** 15407 McGinty Rd. W., Wayzata, MN 55391; Telephone: +1.952.742.7575, Web: www.cargill.com.

225 **Carmi Flavor & Fragrance Co., Inc.,** 6030 Scott Way, Commerce, CA 90040; Telephone: +1.323.888.9240, Fax: +1.323.888.9339, Web: www.carmiflavors.com. Carmi Flavors manufactures a vast selection of high-quality natural, natural/artificial, artificial, and organic flavors in liquid or powder form for the entire food and beverage industries. Our flavors are available in warehouses throughout the United States and Canada.

122 **CE Elantech, Inc.,** 170 Oberlin Ave. N., Suite 5, Lakewood, NJ 08701; Telephone: +1.732.370.5559, Fax: +1.732.370.3888, Web: www.ceelantech.com. North American distributor for thermo electron combustion elemental analyzers. The Flash EA1112 is available in a wide range of configurations: N/protein through CHNS/O for both solid and liquid samples. This design features improved performance, large sample size capacity (up to 1 g and 100 µL for liquids). The latest Eager 300 software offers a higher level of automation. CE Elantech became the distributor for the NIR Technology Australia line of near infrared analyzers and Weiss Enterprises SeedCount image analysis system.

116 **Centec LLC,** P.O. Box 820, Germantown, WI 53022; Telephone: +1.262.251.8209, Fax: +1.262.251.8376, Web: www.centec-usa.com.

917 **Charm Sciences, Inc.,** 659 Andover St., Lawrence, MA 01843; Telephone: +1.978.687.9200, Web: www.charm.com. Charm Sciences offers more easy-to-use lateral flow strips for mycotoxins, including the only quantitative approved test strip for aflatoxin and the only commercial strip tests for ochratoxin and zearalenone. Visual and reader options are available; a unique software program provides custom reports for end users and grain buyers.

822 **ChemTreat, Inc.,** 4461 Cox Rd., Glen Allen, VA 23060; Telephone: +1.804.935.2000, Fax: +1.804.965.6974, Web: www.chemtreat.com. ChemTreat is the largest U.S. company dedicated solely to industrial water treatment. An employee-owned company, ChemTreat prides itself on experienced service engineers offering a complete line of boiler, cooling, and process chemicals.

809 **CHOPIN Technologies,** 20 Avenue Marcellin Berthelot, ZI du Val de Seine, 92390 Villeneuve la Garenne, France; Telephone: +33 1 41 47 50 88, Fax: +33 1 41 47 92 28 27, Web: www.chopin.fr. CHOPIN Technologies manufactures and provides the methods, laboratory apparatus, and equipment necessary for the control of the characteristics and quality of cereals, flours, and their derivatives. CHOPIN Technologies recently enlarged its range of products, including grain analyzers and thermometry tools to give complete and adapted solutions for each specific actor in the cereal market, from the field to the process. Its solutions are elaborated in close connection with the standardizing organizations of the industry.

See our ad on the Recognition Tab back.

426 **Church & Dwight Co., Inc.,** 469 N. Harrison St., Princeton, NJ 08543-5297; Telephone: 1.800.221.0453, Fax: +1.609.497.7176, Web: www.ahperformance.com. Trust Arm & Hammer, the bicarbonate experts, for all your leavening needs—sodium, potassium, and ammonium bicarbonates; tortilla blend; and treated free-flowing sodium bicarbonates. Church and Dwight Co., Inc. products have the purity and particle size, backed by technical expertise, to support your most critical applications. Talk to us about low-sodium reformulations and potassium supplementation, dimensional control, and browning!

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1025 **CII Laboratory Services,** 10835 N.W. Ambassador Dr., Kansas City, MO 64153; Telephone: +1.303.774.8262, Fax: +1.303.774.7545, Web: www.ciilab.com. CII is the leading cereal grain and flour testing laboratory in the United States. CII is a full-service food-testing laboratory, including microbiology, HPLC, GC, sanitation, nutrition, etc. We are an ISO certified laboratory and participate in numerous proficiency programs. AACC International, AOC, AOAC Intl., FDA, etc. methods are used. Specialists in and focused on the cereal grain industry.

See our ad on Cover 3.

314 **Clarkson Grain/Clarkson Soy Products,** 320 East South St., P.O. Box 80, Cerro Gordo, IL 61818-0080; Telephone: +1.217.763.2861, Fax: +1.217.763.2111, Web: www.clarksongrain.com. Clarkson supplies superior IP and organic raw materials and ingredients from both proprietary and commercial corn and soy genetics to meet your specific product and processing requirements.

719 **Clextral, Inc.,** 14450 Carlson Cir., Tampa, FL 33626; Telephone: +1.813.854.4434, Fax: +1.813.855.2269, Web: www.clextral.com. Clextral provides turnkey extrusion lines for food processing, such as snack foods, cereals, pregel, protein extrusion, chemical reactions, etc. The heart of the lines is the Evolum twin-screw extruder, which features high torque, high sanitation, improved heat exchange, hygienic design, and easy cleaning. A specialist in die design and calibration units—from 100 kg/hr up to 25 Mt/hr—Clextral offers process know how, aftersales services, and a pilot plant for trials and product development.

101 **Cognis Corporation – QTA,** 4900 Este Ave., Cincinnati, OH 45232; Telephone: +1.513.482.3882, Fax: +1.513.482.3172, Web: www.qta.com.

821 **Colloides Naturels, Inc.,** 1140 US Hwy 22 E., Suite 102, Bridgewater, NJ 08807; Telephone: +1.908.707.9400, Fax: +1.908.707.9405, Web: www.cniworld.com.

208 **Conte Luna Foods/Minot Milling,** 760 South 11th St., Philadelphia, PA 19147; Telephone: +1.215.925.3339, Fax: +1.215.925.9904. Conte Luna Foods is an industrial pasta manufacturer that supplies all segments of the food processing industry. We specialize in pasta that is custom designed to hold up in retort, freeze-thaw, low-moisture, fresh, and microwaveable applications. Minot Milling is a flour milling division which has two separate milling functions. We mill durum and hard red spring wheat destined for both pasta manufacturers and roll, bagel, and specialty bread producers. Our mills and pasta plants are all organic certified, kosher certified, and reviewed by ABA and NFP.

513 **Corn Products U.S.,** 5 Westbrook Corporate Ctr., Westchester, IL 60154; Telephone: +1.708.551.2600, Fax: +1.708.551.2700, Web: www.cornproductsus.com.

934 **Covance Laboratories, Inc.,** 3301 Kinsman Blvd., Madison, WI 53704; Telephone: 1.888.COVANCE, Web: www.covance.com. Analytical testing services to the food, dietary supplement, and biotechnology industries include nutrients, stability, microbiology, phytochemicals, residues, product container/enclosure, raw materials, botanicals, and method development.

729 **CreaFill Fibers Corp.,** 10200 Worton Rd., Chestertown, MD 21620; Telephone: +1.410.810.0779, Fax: +1.410.810.0793, Web: www.creafill.com. CreaFill Fibers offers CreaFibe, a family of functional fibers that includes bamboo, wheat, and alpha-cellulose fibers. CreaFill Fibers is dedicated to innovative fiber solutions for your formulation challenge.

420 **Creative Research Management,** 2029 E. Harding Way, Stockton, CA 95205; Telephone: +1.209.938.0900, Fax: +1.209.938.0769, Web: www.crmcorp.net. GrainLife™ ingredients are *whole grains* processed in a new way to produce concentrates and powders with highly desirable functional properties. They can be added to beverages, frozen desserts, yogurts, and other smooth-textured foods at 8 grams or more per serving, easily achieving levels that qualify for use of the Whole Grains Council's stamps. RiceLife®, OatLife™, and WheatLife™ form milk-like emulsions with clean, mild tastes, offering new opportunities for dairy-free/vegan products, as well as for whole-grain "fortification" of traditional foods.

102/104 **Danisco USA,** Four New Century Pkwy., New Century, KS 66031; Telephone: +1.913.764.8100, Fax: +1.913.764.9157, Web: www.danisco.com.

736 **David Michael & Co.,** 10801 Decatur Rd., Philadelphia, PA 19154; Telephone: +1.215.632.3100, Fax: +1.215.637.3920, Web: www.dmflavors.com. With over 30,000 formulations, David Michael can provide flavors, stabilizers, and colors for use in virtually any food or beverage application. We can also assist you with your total product development process. Talk with us and see how our more than 100 years of experience can help you hit your flavor target faster.

805 **Decagon Devices, Inc.,** 950 N.E. Nelson Ct., Pullman, WA 99163; Telephone: +1.509.332.2756, Fax: +1.509.332.5158, Web: www.decagon.com. Decagon, a world leader in water activity technology, sets industry standards with a complete line of water activity instrumentation.

528 **Devansoy, Inc.,** 206 West 7th St., Carroll, IA 51401; Telephone: +1.712.792.9665, Fax: +1.712.792.2712, Web: www.devansoy.com. Devansoy is a supplier of all natural and organic soy ingredients. Products include full-fat, low-fat, and enzyme active soy flours, as well as liquid and powder soy proteins. Applications include whitening, egg replacer, and moisture retention in baked goods. Custom blends are also available.

906 **DIAGNOSTIX,** 400 Matheson Blvd. E., Mississauga, ON L4Z 1N8, Canada; Telephone: +1.905.890.6023, Fax: +1.905.890.6024, Web: www.diagnostix.ca.

717 **Diehl Food Ingredients, Inc.,** 24 N. Clinton St., Defiance, OH 43512; Telephone: 1.800.251.3033, Web: www.diehlinc.com.

716 **domnick hunter,** 5900-B Northwoods Pkwy., Charlotte, NC 28269; Telephone: 1.800.345.8462 or +1.704.921.9303, Fax: +1.704.921.1960, Web: www.domnickhunter.com. domnick hunter manufactures cartridge filters used for filtration of beer, process water, steam, sterile air and CO_2, CO_2 purifiers and MAXIGAS nitrogen gas generators. MAXIGAS generates nitrogen gas on-site from compressed air with flow rates available up to 10,000 scfh, with nitrogen purity of 97–99.999%.

425 **The Dow Chemical Company,** 171 River Rd., Piscataway, NJ 08854; Telephone: 1.800.488.5430, Fax: +1.989.638.9836, Web: www.methocelfood.com. METHOCEL food gums are used in bakery products in a variety of ways. They help retain moisture longer, improving texture and extending shelf life. They also provide mouthfeel that mimics fat, increase baked volume, and more uniform crumb structure.

731 **EaglePicher Filtration & Minerals,** 9785 Gateway Dr., Suite 1000, Reno, NV 89521; Telephone: +1.775.824.7600, Fax: +1.775.824.7601, Web: www.eaglepicher.com. EaglePicher Filtration & Minerals, a leading global filtration company specializing in the production of DE filter aids including low BSI grades, has more than 60 years of experience in food and beverage filtration. Optimization services are also provided to reduce filter aid usage and increase throughput while maintaining your quality.

912 **Ecolab Inc.,** 370 Wabasha St. N., St. Paul, MN 55102; Telephone: +1.651.293.2233, Fax: +1.651.293.2260, Web: www.ecolab.com. Ecolab is the market leading global supplier of sanitation products, systems, and services to the dairy, food, and beverage processing industries. Products include advanced cleaners and sanitizers, conveyor lubricants, CIP and automated systems and services, comprehensive water treatment, and pest elimination services.

511 **Edlong Dairy Flavors,** 225 Scott St., Elk Grove Village, IL 60007; Telephone: +1.847.439.9230, Fax: +1.847.439.0053, Web: www.edlong.com. The Edlong technical solutions team members specialize in concentrated dairy flavors and are proud to be recognized as the experts in this technology. For commodity cost reduction, batch-to-batch consistency, or stability in harsh, high-heat environments, look to Edlong for a consultation from our R&D Help Desk.

See our ad on page 33.

619 **elementar Americas, Inc.,** 520 Fellowship Rd., Suite B-204, Mt. Laurel, NJ 08054-3407; Telephone: +1.856.787.0022 or 1.800.787.1970, Fax: +1.856.787.0055, Web: www.CHNOS.com. The immensely popular rapid N, Dumas, nitrogen/protein analyzer is now smaller, faster and as robust as ever. Elementar is proud to announce the release of the rapid N cube. Just 18 in. wide, the rapid N cube features a 60 position auto-carousel (120 positions available), new electronics and software, and increased performance. Come see the future of nitrogen/protein analyzers.

901 **ENERFAB, Inc.,** 4955 Spring Grove Ave., Cincinnati, OH 45232; Telephone: +1.513.641.0500, Fax: +1.513.242.6833, Web: www.enerfab.com. ENERFAB is a process solutions provider to the brewing industry, with complete design-build capabilities. Core competencies include brewhouse equipment and renovation, fermentation/aging vessel fabrication, shop and field tank fabrication, piping systems, tank lining, turnkey construction, and parts and service.

527 **ENRECO, Inc.,** 5703 County Rd. U, Newton, WI 53063; Telephone: 1.800.962.9536 x112, Fax: +1.920.726.4224, Web: www.enreco.com. ENRECO®, Inc., based in Wisconsin, is a leading manufacturer and innovator of stabilized, ground, fortified flaxseed that locks in omega-3 EFAs, flavor, and aroma. ENRECO®, Inc. is AIB "Excellent" rated, kosher certified, and OneCert organic certified and provides a 12-month guarantee on stabilized ground flaxseed. We've been "Making the best foods better" for 19 years.

325 **EnviroLogix Inc.,** 500 Riverside Indl. Pkwy., Portland, ME 04103; Telephone: +1.207.797.0300 or 1.866.408.4597, Fax: +1.207.797.7533, Web: www.envirologix.com. With a customer-driven approach, EnviroLogix provides rapid test kits to detect mycotoxins and genetic modifications (GM) in grain. QuickTox™ kit for aflatoxin (GIPSA approved) are simple lateral flow strips for screening and quality assurance of grain—results are given in as few as 2–3 min. QuickStix™ strips screen for GMs in seeds, plants, and grains. Save time with our common extraction and innovative QuickComb™, detecting multiple corn traits with one sample preparation. The ELISA plate kit format is available when quantitative determinations are needed.

930 **EnviroTower,** 380 Adelaide St. W., Toronto, ON M5V 1R7, Canada; Telephone: +1.416.977.1105 x123, Fax: +1.416.913.2176, Web: www.envirotower.com. EnviroTower is one of the most technically advanced systems for cooling tower water treatments. The patented system completely replaces traditional chemical treatments; providing total control of scale, fouling, corrosion, and microbiological contamination to create an exceptionally clean system that maximizes operating efficiency and minimizes corrosion-causing bacteria and other potentially harmful organisms, like *Legionella*. EnviroTower is environmentally safe, with many opportunities for total water recycling.

602 **Enzyme Development Corp.,** 360 West 31st St., Suite 1102, New York, NY 10001-2727; Telephone: +1.212.736.1580, Fax: +1.212.279.0056, Web: www.EnzymeDevelopment.com. Enzymes for food applications such as animal feeds, brewing, and baking, including shelf-life extension for flour tortillas.

701 **Equichem International, Inc.,** 510 Tower Blvd., Carol Stream, IL 60188-9426; Telephone: +1.630.784.0432, Fax: +1.630.784.0436, Web: www.equichem.com. Equichem develops and manufactures functional ingredients, specialty enzyme blends, and enrichment premixes for use in various food processing applications such as bakery, beverage, and cereal milling. Flour and bakery additives can be made to target specific flour properties while accommodating bakery product or manufacturing specifications. Our enzyme and enrichment premixes are custom formulated and blended, allowing versatility for the food developer and producer to meet their requirements for a final product.

109 **Eurofins Scientific,** 6555 Quince Rd., Suite 202, Memphis, TN 38119; Telephone: +1.901.507.3962, Fax: +1.901.272.2926, Web: www.eurofinsus.com.

226 **Farbest Brands,** 160 Summit Ave., Montvale, NJ 07645; Telephone: +1.201.573.4900, Fax: +1.201.573.0404, Web: www.farbest.com. Farbest Brands produces and distributes specialty food ingredients. Our product line includes dairy proteins (caseinates, whey proteins, dairy blends), vitamins, gum acacia, starches, crystalline fructose, and liquid systems.

326 **Farmer Direct Foods, Inc.,** P.O. Box 326, Atchison, KS 66002; Telephone: +1.913.367.4422, Fax: +1.913.367.4443, Web: www.farmerdirectfoods.com.

520 **Fiberstar, Inc.,** 3023 15th St. S.W., Willmar, MN 56201-9670; Telephone: +1.320.231.1829, Fax: +1.320.231.3741, Web: www.fiberstar.net. Fiberstar, Inc. is an innovative and technology-driven company.

We have developed a line of Citri-Fi® products made from fresh, wholesome orange pulp that are all natural, neutral in taste, and have a very high water- and oil-holding capacity. The products provide remarkable functionalities in moisture management and improved nutritional benefits when added to food products, including bakery, meat fillings, snacks, desserts, dairy, and deli salads. Our Citri-Fi® products are GRAS, non-GMO, non-allergenic, and kosher-parve.

514 **FILTROX North America,** 9805 N.E. 116th, Suite A-200, Kirkland, WA 98034-4248; Telephone: +1.425.820.4850 or 1.800.473.4526, Fax: +1.425.820.2816, Web: www.filtrox.ch. FILTROX provides Swiss quality, long-term experience, and a comprehensive product range. FILTROX offers everything for your filtration process through quality product and technical application support. Due to our comprehensive assortment of filter media, we offer solutions tailored to your individual requirements. If you're looking for filter equipment, sheets, or modules, count on FILTROX, the name that represents the high standard of Swiss quality in all its products and services.

303/305 **Firmenich Inc.,** P.O. Box 5880, Princeton, NJ 08540; Telephone: +1.609.452.1000, Fax: +1.609.452.6077, Web: www.firmenich.com. Firmenich, a leader in supplying flavors to the bakery and cereal industries, offers a diverse range of flavors that includes bake-stable encapsulated flavors, flavor maskers for whole-grain products, and indulgent sweet brown flavors and fruit flavors. This year we are featuring our newest range of butter and vanilla flavors.

803 **Flavorchem,** 1525 Brook Dr., Downers Grove, IL 60515; Telephone: +1.630.932.8100, Fax: +1.630.932.4626, Web: www.flavorchem.com.

307 **Fleischmann's Yeast, A Division of AB Mauri Food Inc.,** 240 Larkin Williams Industrial Ct., St. Louis, MO 63026; Telephone: +1.636.349.8800 or +1.636.349.8842, Fax: +1.636.349.8860, Web: www.fleischmannsyeast.com. Fleischmann's Yeast, a Division of AB Mauri Food Inc., is a market leader in yeast and baking ingredient products. The company, headquartered in Fenton, MO, with four manufacturing plants in North America, sells yeast under the Fleischmann's® yeast brand name and bakery ingredients, including powdered dough conditioners, tablet dough conditioners, chemical leaveners, mold inhibitors, syrups and malts, vinegars and acidulants, and grain blends, under the AB Mauri™ brand name. For more information, visit www.fleischmannsyeast.com.

728 **FONA International Inc.,** 1900 Averill Rd., Geneva, IL 60134; Telephone: +1.630.578.8600, Fax: +1.630.578.8601, Web: www.fona.com. FONA International creates and manufactures flavors for some of the largest food, beverage, and nutraceutical companies in the world. It offers flavor solutions for the confection, sweet, culinary, and beverage market segments through its state-of-the-art worldwide headquarters located in Geneva, IL.

530 **Food & Beverage Cybrary,** 7932 Santa Fe, Overland Park, KS 66204; Telephone: +1.913.307.9010 or 1.877.292.7279, Fax: +1.913.307.9011, Web: www.foodcybrary.com. Free membership with all the benefits! The new Food & Beverage Cybrary was designed specifically with the needs of the food scientist in mind. Become a member today at www.foodcybrary.com and let the Food & Beverage Cybrary become your personal R&D assistant. With your free membership you can 1) search all ingredient suppliers simultaneously; 2) find exactly the results you need with highly refined search capabilities; 3) access data sheets, MSDS, formulations, technical articles, and much more; and 4) request samples and contact suppliers directly.

708 **Food Processing Center,** 143 Food Industry Complex, UNL East Campus, Lincoln, NE 68583; Telephone: +1.402.472.2832, Fax: +1.402.472.1693, Web: fpc.unl.edu. The Food Processing Center at UNL provides confidential pilot plant, product development, and business services to the food industry.

622 **Fortitech, Inc.,** Riverside Technology Park, 2105 Technology Dr., Schenectady, NY 12308; Telephone: +1.518.372.5155 or 1.800.950.5156, Fax: +1.518.372.5599, Web: www.fortitech.com. Fortitech is the world leader in the development of custom nutrient premixes for the food, beverage, and pharmaceutical industries. For more information, visit www.fortitech.com.

720 **FOSS North America,** 7682 Executive Dr., Eden Prairie, MN 55344; Telephone: 1.800.547.6275, Fax: +1.952.974.9823, Web: www.foss.dk. FOSS provides dedicated analytical solutions that ensure optimal production of food and agricultural products. FOSS solutions provide analysis and control throughout the production process, from raw material to finished product and from routine analysis to at-line and in-line process control. Visit our website at www.foss.dk.

933 **Frings America/White Labs, Inc.,** 1413 Sherman Rd. Unit 30, Romeoville, IL 60446; Telephone: +1.630.783.1407, Fax: +1.630.783.1410, Web: www.fringsamerica.com. Frings America manufactures equipment for yeast propagation with a unique aeration system. Frings also provides consulting and training services for yeast propagation. White Labs produces certified pure liquid yeast for brewers, distillers, and wineries. The full-service laboratory provides beer and microbial analysis, yeast banking, lab media, supplies, quality control test kits, and brewing accessories.

710 **Frutarom Inc.,** 9500 Railroad Ave., North Bergen, NJ 07047-1422; Telephone: +1.201.861.9500, Fax: +1.201.861.8711, Web: www.frutarom.com.

308 **Fuchs North America/Baltimore Spice, Inc.,** 9740 Reisterstown Rd., Owings Mills, MD 21117; Telephone: 1.800.365.3229, Fax: +1.410.363.1700, Web: www.baltimorespice.com. Spices and seasoning blends are used to provide processing solutions, prolonged shelf life, enhanced flavor, and visual appeal. Diminicol® (a plant sterol that may help lower cholesterol) can be used in a wide variety of dairy, meat, food, and beverage applications.

402 **GEA Ecoflex North America, Inc.,** 4810 Poplar Place Dr., Suite 100, Louisville, KY 40213; Telephone: +1.502.962.3535, Fax: +1.502.962.5497, Web: www.geaecoflex.com. GEA Ecoflex is a leading manufacturer of plate heat exchangers (PHEs), specializing in gasketed, semi-welded, fully-welded and brazed PHEs. We are proud to announce the introduction of our newest free flow plate, the NF350H. Come by our booth and take a look at the plate for yourself.

402 **GEA Liquid Processing (Niro Inc.),** 1600 O'Keefe Rd., Hudson, WI 54016; Telephone: +1.715.386.9371, Fax: +1.715.386.9376, Web: www.niroinc.com. GEA Liquid Processing represents Huppmann, Tuchenhagen Brewery Systems, and GEA Diessel in North America and, therefore, can mix and match the offerings of the entire GEA P-Division for the benefit of the U.S. brewery industry. Additionally, GEA Liquid Processing adds value in the form of local engineering, procurement, fabrication, installation, and service staff. That combined with on-going technology transfer to further improve efficiencies and project execution.

918 **Gerstel, Inc.,** 1510 Caton Center Dr., Suite H, Baltimore, MD 21227; Telephone: +1.630.579.4614 or +1.410.247.5885, Fax: +1.630.579.4621, Web: www.gerstelus.com. Gerstel GC and GC/MS solutions are designed to optimize performance, enhance productivity, and extend capabilities. Our sample conditioning, introduction, and automation systems enable our customers to 1) achieve ultra-low detection levels in complex matrices using standard GC instruments and detectors; 2) increase sample throughput and analytical productivity; 3) simplify and minimize sample preparation; 4) adapt to new analytical techniques and challenges; and 5) achieve results they otherwise could not obtain.

316 **Givaudan,** 11812 Wayzata Blvd., Suite 224, Minnetonka, MN 55305; Telephone: +1.952.541.4960, Fax: +1.952.541.0425, Web: www.givaudan.com. Givaudan will show a collection of new and improved, high-impact flavors.

811 **GKD-USA, Inc.,** 825 Chesapeake Dr., Cambridge, MD 21613; Telephone: 1.800.453.8616, Fax: +1.410.221.0544, Web: www.gkdusa.com. GKD is a worldwide company, weaving high-quality filtration media and providing solutions, as well as technical assistance, to the beer industry. GKD-USA, Inc. manufactures new filter screens and performs the re-screening of other filter screens presently used in the beer industry. The NeverLeak design filter leaf, the precision woven KPZ 55 filter media, and the new outlet will be displayed.

925 **GNT USA, Inc.,** 660 White Plains Rd., Tarrytown, NY 10591; Telephone: +1.914.524.0600, Fax: +1.914.524.0681, Web: www.gntusa.com. GNT offers two product lines: 1) EXBERRY natural food colorants made from fruits and vegetables. All colors are GMO-free, kosher, organic compliant, and can be used worldwide. They provide vibrant and stable colors for numerous grain-based products, including beverages, cereals, and bars. 2) Nutrifood fruit and vegetable extracts. Standardized for phytonutrients these products are a great way to enhance the nutritional value of existing grain-based products. GNT also offers color matching, formulation assistance, and excellent customer service.

502 **Gold Coast Ingredients Inc.,** 2429 Yates Ave., Commerce, CA 90040; Telephone: +1.323.724.8935, Fax: +1.323.724.9354, Web: www.goldcoastinc.com.

See our ad on the Exhibition Tab front.

403 **Grain Millers, Inc.,** 9531 W. 78th St., Suite 400, Eden Prairie, MN 55344; Telephone: +1.952.829.8821 or 1.800.232.6287, Fax: +1.952.829.8819, Web: www.grainmillers.com. Full line of specialty grain items and multigrain blends. Wide range of flakes, flour, steel-cut, pearled grains, and custom products produced from oats, barley, wheat, rye, triticale, and organic grains. Using a unique, proprietary process, oat fiber and stabilized wheat germ/bran blends are now available as ingredients or used in custom blends. With plants in Canada, the West Coast, and the Midwest, Grain Millers is the only miller able to meet your needs for grain-based ingredients, as well as grain blends and mixes, from multiple locations.

See our ad on the Exhibition Tab back.

310 **Grain Processing Corporation,** 1600 Oregon St., Muscatine, IA 52761; Telephone: +1.563.264.4265, Fax: +1.563.264.4289, Web: www.grainprocessing.com. Quality ingredients for the food industry: MALTRIN® maltodextrins and corn syrup solids, PURE-COTE® film-forming starches, PURE-DENT® absorbent starches, INSCOSITY® cold water swelling starches, and PURE-GEL® stabilized starches.

907 **GTC Nutrition,** 600 Corporate Cir., Suite H, Golden, CO 80401; Telephone: +1.303.216.2489, Fax: +1.303.216.2477, Web: www.gtcnutrition.com. GTC Nutrition is a recognized leader in providing customized nutrition solutions to the food processing, dietary supplement, and animal feed industries. GTC Nutrition promotes health throughout North, Central, and South America, Australia, and New Zealand with innovative functional food ingredients and unsurpassed customer support. For more information, visit gtcnutrition.com.

323 **Gum Technology Corporation,** 509 W. Wetmore Rd., Tucson, AZ 85705-1521; Telephone: 1.800.369.4867 or +1.520.888.5500, Fax: +1.520.888.5585, Web: www.gumtech.com. Gum Technology Corporation has over 25 years of experience using research and development technology to formulate and supply an extensive choice of natural gum blends, hydrocolloids, and stabilizers. Gum Technology Coyote brand products create emulsions, suspend particulates, extend shelf life, retain moisture, provide freeze thaw stability, create gels, and add unique textures in products in the food and nutraceutical industries.

See our ad on page 27.

1027 **Gusmer Enterprises,** 1165 Globe Ave., Mountainside, NJ 07092; Telephone: +1.908.301.1811, Fax: +1.908.301.1812, Web: www.gusmerenterprises.com. For more than 80 years, Gusmer Enterprises has been dedicated to providing service with knowledge to the brewing industry. Gusmer Enterprises supplies the brewing, malting, and distilling industries with a wide variety of products. Instrumentation, malt mills, malting equipment, filtration media, processing aids, and spent grain handling equipment are only a few examples of our extensive product line.

601 **Haffmans,** 1330 Anvil Dr., Rockford, IL 61115; Telephone: +1.815.639.0322, Fax: +1.815.639.1135, Web: www.haffmans.nl. Haffmans CO_2 gas recovery technology includes brewery-type CO_2 recovery plants, liquid CO_2 stripping systems (CO24U) and the energy-efficient heat recovery system, LiquiVap. Haffmans quality control product line includes instruments that measure CO_2, O_2, foam, and turbidity and monitor pasteurization and bottle and keg washing processes. A range of "plug-and-play" units for water-deaeration, blending, and carbonation are also available in different types and capacities.

106 **Hesco, Inc.,** P.O. Box 815, Watertown, SD 57201; Telephone: +1.605.884.1100, Fax: +1.605.884.1133, Web: www.hesco-inc.com. Hesco provides organic specialty grains, conventional specialty grains, and specialty ingredients. Hesco also offers a comprehensive trading division of raw grains. Hesco provides a wide range of grain-related ingredients to mix companies, bakeries, cereal, chip, and cracker companies, including a large presence in the pet food industry.

402 **HUPPMANN AG,** Heinrich-Huppmann-Str. 1, 97318 Kitzingen, Germany; Telephone: +49 9321 303-104, Fax: +49 9321 303-603, Web: www.huppmann.com. Successful brewers require a reliable partner to expertly support them. Large and small breweries all over the world select HUPPMANN because we perfectly meet their high requirements for quality, efficiency, functionality, and reliability. From the brewhouse to the entire cold process area, including refrigeration and process automation, we are always at your service.

616 **ICC-International Association for Cereal Science & Technology,** Marxergasse 2, A-1030 Vienna, Austria; Telephone: +43 1 707 72020, Fax: +43 1 707 72040, Web: www.icc.or.at. ICC was founded in 1955 on the occasion of the 3rd International Bread Congress in Hamburg, Germany. Its original objective was the development of internationally approved and accepted standard testing procedures for cereals and flour. Today the ICC is one of the foremost international organizations in our field dedicated to international cooperation and the dissemination of up-to-date information. At present, more than 50 countries from five continents are represented in the ICC. For more information, please visit our homepage at www.icc.or.at.

409 **ICL Performance Products LP,** 622 Emerson Rd., Suite 500, St. Louis, MO 63141; Telephone: +1.314.983.7500 or +1.314.983.7940, Fax: +1.314.983.7636, Web: www.icl-perfproductslp.com. ICL is featuring Levona™ calcium enriched, zero sodium leavening agent. Levona™ is a new leavening acid with controlled release for convenient, better for you baked goods. ICL offers a complete line of phosphates and acids for leavening, shelf life, and dough conditioning of grain-based products. We also support meat, poultry, seafood, beverage, and dairy applications. Phosphates improve texture, flavor, nutritional value, and appearance of foods. ICL recently introduced new market-focused literature. ICL is the leader in creative phosphate solutions.

See our ad on the Program Tab front.

220 **INEOS Silicas,** 111 Ingalls Ave., Joliet, IL 60435; Telephone: +1.815.727.3651, Fax: +1.815.727.5312, Web: www.ineossilicas.com. Global supplier of silica-based beer stabilizers, including the Lucilite and Chill-Garde product range. Please stop by to learn about our products for protein and tannoid removal and discuss how we can help reduce costs and improve beer quality.

421 **InfraReady Products (1998) Ltd.,** 850C 56th St. E., Saskatoon, SK S7K 5Y8, Canada; Telephone: +1.306.242.4950, Fax: +1.306.242.4213, Web: www.infrareadyproducts.com. The good we get from grain! Adding value to cereal grains, oilseeds, and legumes, the InfraReady process increases water absorption, improves texture, and reduces microbiological and enzymatic activity.

311 **Innophos, Inc.,** 259 Prospect Plains Rd., Bldg. G, Cranbury, NJ 08512-8000; Telephone: +1.609.495.2495, Fax: +1.609.860.1706, Web: www.innophos.com. Innophos, Inc. offers a full range of food-grade phosphates and sodium bicarbonate that combine with other ingredients to enhance baked goods. New product launches: CAL-RISE, DOUGH-RISE and TORTILLA-RISE. Innovate with phosphate.

210 **International Bakers Services, Inc.,** 1902 N. Sheridan Ave., South Bend, IN 46628; Telephone: +1.574.287.7111, Fax: +1.574.287.7161, Web: www.flavors.org. Manufacturer of flavors and flavor blends for the baking and cereal industries.

309 **International Fiber Corp.,** 50 Bridge St., No. Tonawanda, NY 14120; Telephone: +1.716.693.4040, Fax: +1.716.693.3528, Web: www.ifcfiber.com. International Fiber Corporation provides many ways to improve your products using Solka-Floc and JustFiber functional fibers. We are also the North American distributor of Fibrex sugar beet fiber. Products are available in blends, pellets, and granules.

607 **International Specialty Products,** 1361 Alps Rd., Wayne, NJ 07470; Telephone: +1.973.872.4403, Fax: +1.973.628.3886, Web: www.ispcorp.com. ISP is recognized worldwide for its Polyclar line of products (PVPP) used for stabilization and clarification of beer. The line includes products to remove haze-causing polyphenols (Polyclar 10 and Polyclar Super R), and for the simultaneous balanced removal of haze-causing polyphenols and proteins (Polyclar Plus 730). ISP is also a basic supplier of alginates (PGA) to enhance and stabilize foam in beer. Polyclar Brewbrite, a new addition to our product line, is a wort clarifier and stabilizer and also, provides higher wort yield, reduced fermentation time, and longer filter run lengths.

322 **J. Rettenmaier USA L.P.,** 16369 US Hwy 131, Schoolcraft, MI 49087; Telephone: +1.269.679.2340, Fax: +1.269.679.2364, Web: www.jrsusa.com. J. Rettenmaier USA manufactures dietary fibers including VITACEL® oat, wheat, sugarcane, cottonseed, bamboo, and powdered cellulose for reducing carbs in the tortilla and cereal industries.

735 **J.R. Short Milling Co.,** 1580 Grinnell Rd., Kankakee, IL 60901; Telephone: 1.800.544.8734, Fax: +1.815.937.8806, Web: www.shortmill.com. J.R. Short Milling Co. is the largest producer of snack pellets in the United States and has two state-of-the-art production lines, a pilot-plant facility for developing new products, and 20 years of experience in the extruded snack industry. Products are made from whole grains, wheat, corn, potato, rice, soy, oat, tapioca, etc. Products can be preflavored with sweet, savory, fruit, or vegetable. J.R. Short also supplies corn meals/flours, bran, whole ground corn, and specialty ingredients that include pre-gel flours, toasted corn/wheat brans/germs, and confectionary flakes.

608 **Jeneil Biotech, Inc.,** 400 N. Dekora Woods Blvd., Saukville, WI 53080; Telephone: +1.262.268.6815, Fax: +1.262.268.6820,

434 **JohnsonDiversey Inc.,** 3630 E. Kemper Rd., Cincinnati, OH 45241; Telephone: 1.800.233.1000, Web: www.johnsondiversey.com. JohnsonDiversey Inc. is a global cleaning and sanitation company with 20,000 associates in more that 60 countries serving the brewing industry. JohnsonDiversey has the technology and expertise to help you exceed your hygiene standards. This results in a better looking and better tasting product, while reducing water, energy, other utility usage, and environmental impact.

817 **Kanawha Scales & Systems,** 303 Jacobson Dr., P.O. Box 569, Poca, WV 25213; Telephone: +1.304.541.3100 or +1.304.755.8321, Fax: +1.304.755.3327, Web: www.kanawhascales.com. Is moisture a concern in your process/product? How would your process benefit from accurate, on-line, real-time moisture measurement? Need a non-invasive, fast, moisture analyzer that provides easy plant system integration? Moist///Scan® in-line moisture analysis technology will facilitate increased yields, improved product quality, reduced down-time, and increased efficiency. Let us tell you how!

317 **Kerry Bio-Science,** 5115 Sedge Blvd., Hoffman Estates, IL 60192; Telephone: +1.847.645.7354, Fax: +1.847.645.7341, Web: www.kerrynet.com. Creation and application of food ingredients; technical experts and marketing professionals work with customers to provide solutions for the changing needs of the food industry.

928 **Krones/Steinecker Inc.,** 9600 S. 58th St., Franklin, WI 53132; Telephone: +1.414.409.4000, Fax: +1.414.409.4100, Web: www.krones.com. Krones AG/Steinecker covers all aspects of brewing, from malt intake to filtered beer, including brewhouse and filter plants and fermentation and storage cellars. Merlin, Pegasus, Twin-Flow-System filters, Stromboli, and ShakesBeer rank among the best known Steinecker innovations. The latest development, "WhirlShip" Calypso, will be launched this year.

825 **Lallemand Baking Solutions,** 5494 Notre Dame Est., Montreal, QC H1N 2C4, Canada; Telephone: +1.514.251.3620, Fax: +1.514.255.6861, Web: www.lallemand.com. Lallemand Baking Solutions is the specialty baking ingredients business of Lallemand, the Canadian yeast and bacteria company. Lallemand Baking Solutions supplies Essential® enzyme-based dough conditioners, Fermaid® yeast-based dough relaxers, Lalvain du Jour®, and Florapan® sour dough starters to the global baking industry.

319 **Littleford Day, Inc.,** 7451 Empire Dr., Florence, KY 41042; Telephone: +1.859.525.7600, Fax: +1.859.525.1446, Web: www.littleford.com.

411 **Loders Croklaan,** 24708 W. Durkee Rd., Channahon, IL 60451; Telephone: +1.815.730.5393, Fax: +1.815.730.5202, Web: www.croklaan.com. Loders Croklaan will feature no trans, nonhydrogenated fats, oils, and emulsified shortenings. All are non-GMO and stable, have a long shelf life, and are kosher certified.

835 **Lonza Inc.,** 90 Boroline Rd., Allendale, NJ 07401; Telephone: 1.800.777.1875, Fax: +1.201.785.1364, Web: www.lonza.com. Lonza is a leader in food emulsifiers specializing in glycerol, polyglycerol, sorbitan, and ethoxylated esters for a variety of applications.

134 **MacDonald Steel Ltd.,** 200 Avenue Rd., Cambridge, ON N1R 8H5, Canada; Telephone: +1.519.620.0500 x5219 or +1.519.740.9399 x5219, Fax: +1.519.621.4995, Web: www.macdonaldsteel.com. Designers and manufacturers of equipment for commercial production and pilot plants in the malting, milling, and brewing sectors. Automated pilot malting and brewing plants. Vessel fabrication to 10,000 HL capacity in our plant. Brewhouse and cellar vessels and equipment. Glycol chillers, dry bulk storage, pneumatic conveyance, process piping, pumps, and valves (representing Kieselmann in North America). Specialty products for pilot-plant bottle filling, crowning, and pasteurizing. Working globally with competent partners. Additional website, www.hdpcanada.

315 **Manildra Group USA,** 4210 Shawnee Mission Pkwy., Suite 312A, Shawnee Mission, KS 66212; Telephone: +1.913.362.0777, Fax: +1.913.362.0674, Web: www.manildrausa.com. Manildra Group USA will be showing its line of GemTec/Star wheat proteins and starches. These products are well suited for a wide variety of food applications, which include low-carb, high-protein, and reduced-GI products.

204 **Matsutani America, Inc.,** 668 Phillip Cir., Forsyth, IL 62535; Telephone: +1.217.875.9819, Fax: +1.217.875.9821, Web: www.matsutaniamerica.com. Fibersol®-2, a 90% water-soluble dietary fiber from Matsutani America, Inc., functions in baked goods to help maintain healthy blood sugar and insulin levels, intestinal function and regularity, and serum lipids, including blood triglycerides and cholesterol.

711 **McCormick & Co.,** 226 Schilling Cir., Hunt Valley, MD 21031; Telephone: 1.800.346.2634, Fax: +1.952.345.0383, Web: www.mccormick.com. McCormick Flavor—Specialists in Consumer Preferred™ flavors and seasonings for cereal-based foods. Featuring flavors for dry cereals and seasonings for grain-based snack foods. Come hear about our new "Create It Center" opening this fall. McCormick also flavors beverages, so please stop at our booth.

324 **Medallion Laboratories/General Mills,** 9000 Plymouth Ave. N., Minneapolis, MN 55427; Telephone: +1.763.764.4453 or 1.800.245.5616, Fax: +1.763.764.4010, Web: www.medlabs.com. Medallion Laboratories provides the food industry with quality analytical services in nutritional labeling, vitamins, minerals, additives, microbiology, and physical testing. We have added additional expertise in sensory analysis, pilot-plant services, storage testing (with predictive shelf-life modeling), and consumer testing. Stop by our booth to discuss your analytical needs and projects.

216 **Meduri Farms, Inc.,** 12375 Smithfield Rd., Dallas, OR 97338; Telephone: +1.503.623.0308 or +1.503.623.8220, Fax: +1.503.623.0726, Web: www.medurifarms.com. Meduri Farms, Inc. is a leading provider of premium specialty dried fruits. We have been manufacturing our products in the Pacific Northwest since 1984. We are very pleased to offer our extensive line of infused fruits to food manufacturers worldwide. Our product line consists of dried apples, apricots, blueberries, cranberries, peaches, red raspberries, strawberries, red tart cherries, sweet cherries, and tropical fruits.

606 **Megazyme International Ireland Ltd.,** Bray Business Park, Bray, Wicklow, Ireland; Telephone: +353 1 286 1220, Fax: +353 1 286 1264, Web: www.megazyme.com. Test kits and reagents for the food, feed, fermentation, dairy, and beverage industries. Megazyme has recently expanded its product range to include test kits specifically tailored for the wine industry.

624 **The Mennel Milling Company,** P.O. Box 806, Fostoria, OH 44830; Telephone: +1.419.435.8151 x210, Fax: +1.419.436.5150, Web: www.mennel.com. The Mennel Milling Company offers a complete line of soft, hard, and spring wheat flours. In addition, Mennel also can provide enzyme-deactivated flours, as well as other specialty flours. Mennel has locations in Ohio, Michigan, Virginia, and Illinois.

715 **Merlin Development, Inc.,** 181 Cheshire Ln., Suite 500, Plymouth, MN 55441; Telephone: +1.763.475.0224, Fax: +1.763.475.1626, Web: www.merlindevelopment.com. A full-service food product development and research company providing support from concept to commercialization.

526 **MEURA s.a.,** Rond Point J.-B. Meura, 1, 7600 Péruwelz, Belgium; Telephone: +32 69 886988, Fax: +32 69 886980, Web: www.meura.com. Meura, founded in Belgium in 1845, specializes in engineering, design, and manufacturing of brewhouses, yeast management plants, and turnkey projects. The Meura 2001 mash filter is recognized worldwide as a state-of-the-art mash filtration technology that improves wort quality, extract yield, productivity, and high-gravity brewing.

634 **MGP Ingredients, Inc.,** 1300 Main St., P.O. Box 130, Atchison, KS 66002; Telephone: +1.913.367.1480, Fax: +1.913.367.0192, Web: www.mgpingredients.com. MGP Ingredients, Inc. supplies markets around the world with a wide array of natural ingredients for food applications. These include an innovative group of specialty wheat proteins for use in multiple food systems and specialty wheat starches used in food and industrial applications.

405 **Millipore Corporation,** 900 Middlesex Turnpike, Billerica, MA 01821; Telephone: +1.845.621.6560, Fax: +1.845.621.6544, Web: www.millipore.com. Millipore is a leading bioprocess and bioscience products and services company. With proven products and 50+ years of experience, you can count on Millipore—the first time and over time—to provide filters and process monitoring tools (PMT) that support beverage safety, quality and flavor. Because a lot depends on what's NOT inside!

627 **Mitsubishi International Food Ingredients,** 5080 Tuttle Crossing Blvd., Suite 400, Dublin, OH 43016; Telephone: +1.614.652.1111, Fax: +1.614.798.8339, Web: www.mifiusa.com. Mitsubishi Int'l Food Ingredients is one of the largest food ingredients distributors established in North America, handling over 3,000 products from all over the world. Mitsubishi Corporation group produces high-quality crystalline maltitol at its own state-of-the-art facilities in Japan and Thailand. We wish to extend our experience and know-how of maltitol application in various food and beverage applications and, most importantly, serve you at the best price. Our crystalline maltitol is now available under the brands LESYS and AMALTY MR.

See our ad on page 19.

218 **Morton Salt,** 123 N. Wacker Dr., Chicago, IL 60606; Telephone: +1.312.807.2000, Fax: +1.312.807.2899, Web: www.mortonsalt.com. Morton Salt offers 20 grades of salt for baking, cereal products, and snack foods. We will be featuring Starflake® dendritic salt, a porous crystal salt and Morton® potassium chloride for sodium reduction or potassium fortification. Refined sea salt will also be available.

435 **Mother Murphy's Flavors,** 2826 S. Elm St., Greensboro, NC 27416; Telephone: +1.336.273.1737, Fax: +1.336.273.2615, Web: www.mothermurphys.com. Mother Murphy's Laboratories (MML) has been a quality supplier to the baking and cereal industries for over 60 years, offering the highest quality flavors and service at an affordable price. MML will be showcasing pure vanilla extracts, 100% organic vanilla extract, and other fine flavors for this cereal category.

626 **National Food Laboratory, Inc.,** 6363 Clark Ave., Dublin, CA 94568-3097; Telephone: +1.925.828.1440, Fax: +1.925.833.9239, Web: www.TheNFL.com. The NFL provides the broadest range of resources to the food and beverage industries, including product and process development, food chemistry, microbiology, and consumer and sensory research. With all these services under one roof, we help our clients' launch new products faster and make protecting existing brands easier.

707 **National Mfg.,** 507 J St., Lincoln, NE 68508-2935; Telephone: +1.402.475.3400, Fax: +1.402.476.1675,

621 **National Starch Food Innovation,** 10 Finderne Ave., Bridgewater, NJ 08807; Telephone: +1.908.685.5257, Fax: +1.908.685.5335, Web: www.foodinnovation.com.

1011 **Neogen Corporation,** 620 Lesher Place, Lansing, MI 48912; Telephone: +1.517.372.9200, Fax: +1.517.372.0108, Web: www.neogen.com.

713 **New & Improved,** 9306 State Route 30, Paul Smiths, NY 12970; Telephone: +1.518.327.3554, Fax: +1.518.327.3487, Web: www.newandimproved.com.

121 **NIR Technology Systems,** 56 Kitchener PDE, Suite 103, Bankstown, NSW 2200, Australia; Telephone: +61 2 9708 5068, Fax: +61 2 9708 5537, Web: www.nirtech.net. Manufacturers of near infrared analyzers. Our products include whole grain analyzers for farmers, bulk handlers, and grain traders; near infrared transmission analyzers for the wine, beer, dairy, meat, olive, and baking industries; on-line NIR analyzers; and portable NIR analyzers for material identification. Our slogan is; "Solutions in Sampling" to reflect our ability to design and implement unique sampling systems to solve your analysis problems.

603 **Norit Process Technologies,** 1330 Anvil Dr., Rockford, IL 61115; Telephone: +1.815.639.0322, Fax: +1.815.639.1135, Web: www.norit.com. Norit Process Technologies (Norit PT), a member of the NORIT Group, is a leading supplier of cross-flow beer membrane filtration (BMF) systems as an alternative to kieselguhr (DE) in the brewing industry. Norit PT also offers technology for the decolorization of beer using a combination of membranes and activated carbon, as well as cross-flow membrane bioreactors (MBR) for the production of process water and the treatment of waste water.

932 **Novozymes,** 77 Perry Chapel Church Rd., Franklinton, NC 27525; Telephone: +1.919.494.3000, Fax: +1.919.494.3485, Web: www.novozymes.com. Novozymes has a proven record of developing enzymatic solutions for the baking industry. Among these are Novamyl® for preserving crumb freshness and extending shelf life without compromising quality and Lipopan® F for improved dough strengthening.

224 **NP Analytical Laboratories,** Checkerboard Sq., St. Louis, MO 63164; Telephone: +1.314.982.1310 or 1.800.423.6832, Fax: +1.314.982.1078, Web: www.npal.com. NP Analytical Laboratories provides comprehensive testing of foods and ingredients for nutrients, contaminants, microbial pathogens, and quality indicators. Services include measurement of vitamins, minerals, dietary fiber, fatty acids, sugars, amino acids, preservatives, fat quality and stability, pesticides, mycotoxins, and complete nutrition labeling services. Microbial shelf-life and challenge studies are also offered.

412 **NutraCea,** 1261 Hawks Ct., El Dorado Hills, CA 95762; Telephone: +1.916.933.7000, Fax: +1.916.933.7001, Web: www.nutracea.com. NutraCea is a world leader in stabilized rice bran technology. Through its wholly owned subsidiary RiceX, the company manufactures, as well as distributes, products and food ingredients made from rice bran through its proprietary technology and processes. The company has developed intellectual property to create a range of proprietary product formulations, delivery systems, and whole-food nutrition products. NutraCea's proprietary technology enables the creation of food and nutrition products from rice bran, normally a wasted by-product of standard rice processing. In addition to its whole-foods products, NutraCea develops families of health-promoting "nutraceuticals," including natural

arthritic relief and cholesterol-lowering products. More information can be found in the company's filings with the SEC, and you can visit the NutraCea website at www.NutraCea.com.

330 **Nutraceuticals World,** 70 Hilltop Rd., Suite 3000, Ramsey, NJ 07446; Telephone: +1.201.825.2552, Fax: +1.201.825.0553, Web: www.nutraceuticalsworld.com. *Nutraceuticals World* is the premier magazine serving dietary supplements, functional foods, nutritional beverages, and sports nutrition industries globally. By providing valuable information on new product launches, marketing trends, ingredient sourcing, packaging, manufacturing equipment, and industry trends, *Nutraceuticals World* is an important resource for the food industry worldwide.

318 **Oat Ingredients, llc,** 4368 Park Ct., Boulder, CO 80301; Telephone: +1.303.818.1117, Fax: +1.413.385.9391, Web: www.oatingredients.com. Advanced nutrition for your heart. OatWell® oat bran and oat flour ingredients from CreaNutrition-Swedish Oat Fiber are all natural. OatWell® ingredients, which are high in soluble (beta-glucan) and dietary fibers (to 44%), are oat-based food ingredients with retail applications. AACC International helped define oat brans for FDA health claims in heart healthy food applications. OatWell® oat bran and oat flour ingredients have low GI and can be used in heart healthy snack, weight management, and sustained energy applications. Oat Ingredients is now offering OatWell® oat oil to the U.S. market. OatWell® is imported, marketed, and distributed by Oat Ingredients, llc.

725 **Ocean Nutrition Canada Limited,** 101 Research Dr., Dartmouth, NS B2Y 4T6, Canada; Telephone: +1.902.480.3200 or 1.888.980.8889, Fax: +1.902.480.3199, Web: www.ocean-nutrition.com. Ocean Nutrition Canada Limited (ONC) is a leading global supplier of quality, marine-based health and nutrition products and is the largest producer of long chain omega-3 fatty acids from fish oil in North America. ONC's primary focus is MEG-3® brand omega-3 EPA/DHA purified fish oil ingredients. ONC produces highly concentrated omega-3 powders that have been successfully incorporated through their patented microencapsulation technology, Powder-loc™, into a wide range of food products.

815 **OMIC USA Inc.,** 3344 N.W. Industrial St., Portland, OR 97210; Telephone: +1.503.223.1497, Fax: +1.503.223.9436, Web: www.omicusa.com. OMIC USA is an analytical laboratory performing pesticide residue, nutritional, microbiological, and GMO analyses. We are a ISO 9001:2000 and 17025 certified laboratory. We have completed our method development for the positive list system for rice, wheat, and barley, which was implemented in May 2006 by the Japan Ministry of Health, Labor and Welfare.

408 **optek-Danulat, Inc.,** N118 W18748 Bunsen Dr., Germantown, WI 53022; Telephone: +1.262.437.3600, Fax: +1.262.437.3699, Web: www.optek.com. optek is a world-class manufacturer of process scale UV-VIS-NIR absorbance- and light scatter-based photometers and turbidimeters and laboratory turbidity analyzers, providing market-specific application expertise.

227 **Oxford Instruments Molecular Biotools,** 8403 Cross Park Dr., Suite 3F, Austin, TX 78754; Telephone: +1.512.339.0640, Fax: +1.512.339.0620, Web: www.oxford-instruments.com. The acquisition of Resonance Instruments last year has now firmly established us as the market leader in low-resolution benchtop NMR. Mainstream applications for fat and moisture measurement in seeds, spin finish on fiber, and fluorine in toothpaste are complimented by a wide range of other applications across the food, polymers, and petrochemical industries and in many research centers. The latest advanced product range offers fully packaged applications in a footprint less than half the size of our competitors.

831 **Pacific Coast Chemicals,** 2424 Fourth St., Berkeley, CA 94710; Telephone: +1.510.549.3535, Fax: +1.510.549.0890, Web: www.pcchem.com. We will be exhibiting product and ingredient brochures for lines represented by Pacific Coast Chemicals.

902 **Pall Corporation,** 25 Harbor Park Dr., Port Washington, NY 11050; Telephone: 1.866.905.7255, Fax: +1.516.625.3610, Web: www.pall.com. Pall Corporation is the largest and most diverse filtration, separations, and purifications company in the world. You can rely on Pall for a proven solution to all of your filtration or separations needs. We design, develop, and manufacture an unparalleled range of advanced filter media, associated equipment, separation systems, and membrane processes. For the food and beverage industries, Pall has developed filtration and advanced filtration systems that meet market needs for reliability and cost effectiveness. Easy to install, and simple to use, the space-saving systems satisfy a wide variety of filtration requirements. Pall filters remove particulate contamination, ensure the absence of spoilage microorganisms, and provide high-quality air and gases. Membrane processes can additionally concentrate products without heat, purify and clarify, selectively remove components, and even deal with process effluent.

See our ad on Cover 2.

231 **Paul Mueller Company,** 1600 Phelps St., Springfield, MO 65802; Telephone: +1.417.575.9565, Fax: +1.417.575.9669, Web: www.muel.com. Paul Mueller Company, centrally located in Springfield, MO, specializes in the design and manufacture of stainless-steel processing systems and equipment for the food, dairy, beverage, chemical, pharmaceutical, biotechnology, and pure water industries. Since our inception in 1940, Mueller has evolved into a global process solution provider. Today Paul Mueller Company is a certified ISO 9001:2000 company with nearly 1 million ft^2 of manufacturing space. Our products are used in over 100 countries in a wide variety of applications.

723 **PB Leiner,** P.O. Box 654, New Hope, PA 18938; Telephone: +1.215.862.6680, Fax: +1.215.862.6681, Web: www.gelatin.com. Manufacturer of porkskin and beefskin gelatin specializing in the food industry.

931 **Perlick Corporation,** 8300 W. Good Hope Rd., Milwaukee, WI 53223; Telephone: +1.414.353.7060, Fax: +1.414.353.7069, Web: www.perlick.com. Perlick is a leader in the beverage dispensing, bar equipment, and brewery fitting industry. Just a few of our new products that are now available are the ASME Code-approved pressure safety device, the air actuated and manually operated sanitary sampling valve, and forward-sealing NSF all stainless-steel beer faucet.

806 **Perten Instruments, AB,** P.O. Box 5101, SE-14105 Huddinge, Sweden; Telephone: +46 8 880 990, Fax: +46 8 881 210, Web: www.perten.com. Specialists in the quality control of grain, flour, food, and feed. Discuss sprout damage (Perten/Hagberg Falling Number Method), gluten and rheological properties, NIR, lab mills, single-kernel analysis, moisture meters, and many other topics with our experts who will be on hand. Perten can help you measure many constituents and important process control points. The results can then be used to optimize your process, resulting in improved efficiency, profitability, and customer satisfaction.

806 **Perten Instruments Inc.,** 6444 S. 6th Street Rd., Springfield, IL 62712; Telephone: +1.217.585.9440, Fax: +1.217.585.9441, Web: www.perten.com. Six-second analysis of grains, grain products, baked goods, snack foods, feeds and ingredients, ethanol process, and by-products. Measure moisture, protein, fat/oil, sugars, fiber, starch, ethanol, amino acids, free fatty acids, and many others on Perten's DA 7200 NIR diode array-based analyzer. The analyzer is fast, accurate, and easy to use—no sample cups, no grinding for most products, and precalibrated for hundreds of applications. We offer complete support services—calibration development, maintenance, and training. Stop by to discuss your specific needs.

See our ad on page 1.

726 **PGP International,** 351 Hanson Way, Woodland, CA 95776; Telephone: +1.530.662.5056 or 1.800.333.0110, Fax: +1.530.662.6074, Web: www.pacgrain.com. PGP International is a leading developer and manufacturer of crisp rice, extruded particulates, rice flours and blends, millet and sorghum flours, protein crisps, and specialized functional grain-based ingredients. Contact PGP International for more information.

702 **Pizzey's Milling USA,** 4330 Lee Ave., Gurnee, IL 60331; Telephone: +1.847.775.1400, Fax: +1.847.775.1409, Web: www.pizzeys.com.

614 **Prayon Inc.,** 1610 Marvin Griffin Rd., P.O. Box 1473, Augusta, GA 30903-1473; Telephone: +1.706.771.3403 or +1.609.443.3795, Fax: +1.706.798.0015, Web: www.prayoninc.com. For a complete range of phosphate products for baking and cereal applications, contact Prayon, Inc. to discuss our calcium, sodium, aluminum, and potassium phosphates.

413 **Primera Foods,** 612 S. 8th St., Cameron, WI 54822; Telephone: +1.715.458.4075, Fax: +1.715.458.4078, Web: www.primerafoods.com. Primera Foods is a specialty ingredient manufacturer with a focus on bringing innovation, service, and quality to our customers. Our product line includes encapsulated ingredients, egg products, egg replacers and extenders, specialty egg ingredients, tapioca and rice products, agglomerated hydrocolloids, and tomato powders.

804 **Pulse Canada,** 1212-220 Portage Ave., Winnipeg, MB R3C 0A5, Canada; Telephone: +1.204.925.4455, Fax: +1.204.925.4454, Web: www.pulsecanada.com. Pulses are beans, peas, lentils, and chickpeas. They are high in complex carbohydrates, including fiber and resistant starch and protein, minerals, vitamins such as folate, and phytochemicals. As a source of these components, pulses offer many benefits for nutrition, health, and chronic disease prevention, including cholesterol and lipid lowering, improved glycemic control, and promotion of satiety. Pulses and their components (e.g., fiber, protein, and starch) can be used in various food product applications for their functional properties.

516 **Puratos Corporation,** 1941 Old Cuthbert Rd., Cherry Hill, NJ 08034; Telephone: +1.856.428.4300, Fax: +1.856.428.2939, Web: www.puratos.us. Puratos is committed to being your reliable partner in innovation. Our passion is to help bakers, pastry chefs, and chocolatiers be successful in their business. We work side by side with our customers to develop original and innovative ingredients, technologies, and solutions. Our Puratos companies, combined with a network of independent distributors, allow us to serve you nationwide.

See our ad on the Index Tab front.

834 **PureMalt Products Ltd.,** Victoria Bridge, Haddington, East Lothian EH41 4BD, United Kingdom; Telephone: +44 1620 824696, Fax: +44 1620 822018, Web: www.puremalt.com. Following on from the successful range of BrandMakers, which deliver flavor and color management for a variety beers in the cellar, PureMalt's program of continuous improvement has developed an outstanding malt base for the production of nonalcoholic and reduced-alcohol beers. This will be demonstrated at our booth in San Francisco. Food companies are welcome to view our range of liquid and dry cereal and malt extracts for a wide variety of applications in foodstuffs, including gluten-free extracts.

721 **QA Products, Inc.,** 1301 Mark St., Elk Grove Village, IL 60007; Telephone: +1.847.595.2390, Fax: +1.847.595.1960, Web: www.qaproducts.com. QA Products is a leading producer of confectionery toppings and inclusions serving the food industry. QA's Decorettes, innovative shapes, colored sugars, tablets, crunches, and nut pastes, add vibrant colors, unique

textures, and customized flavors to your finished product.

205 **Quali Tech, Inc.,** 318 Lake Hazeltine Dr., Chaska, MN 55318-1093; Telephone: +1.952.448.5151, Fax: +1.952.448.3603, Web: www.qualitechco.com. Innovative particulate options for delivery of flavor, color, and various nutriceutical ingredients, including fruit, fiber, proteins, amino acids, minerals, vitamins, etc. Available also in non-GMO, non-trans and sugar free versions. Offered in sweet and non-sweet/savory formats for various applications. Flav-R-Grain toasted corn germ is 100% natural and utilized in bakery, snack food, cereal, and various multi-grain or whole-grain applications where improved flavor and visual aspect is important.

422 **QUALISOY,** 424 2nd Ave. W., Seattle, WA 98119; Telephone: +1.206.270.4634, Fax: +1.206.270.4656, Web: www.QUALISOY.com. QUALISOY™ is a collaborative effort among the soybean industry helping to market the availability of trait-enhanced soybeans and soybean oil. Low-linolenic soy oils are now commercially available for food companies looking to reduce or eliminate trans from products. Stop by booth 422 for more information about QUALISOY or visit www.QUALISOY.com.

222 **Quality Ingredients Corp.,** P.O. Box 306, Chester, NJ 07930; Telephone: 1.800.843.6314, Fax: +1.908.879.2502, Web: www.qicusa.com. Quality Ingredients Corporation is a manufacturer/distributor of malts, molasses, and other cane/corn-based sweeteners as well as preservatives, emulsifiers, fibers, dough conditioners, multi-grain mixes, corn meal and flour, rice flour, wheat gluten, and acacia gum. Our organic product line includes evaporated cane sugars, as well as BakOmega stabilized flax flour.

703 **R-Biopharm, Inc.,** 7950 Old US 27 S., Marshall, MI 49068; Telephone: +1.269.789.3033, Fax: +1.269.789.3070, Web: www.r-biopharm.com. R-Biopharm develops, manufactures, and markets rapid enzyme immunoassays for the detection of residues in food and feed. They include test kits for mycotoxins, hormones and anabolics, antibiotics, vitamins, food allergens, microbiology, and hygiene. R-Biopharm recently launched VitaFast® test kits for vitamin analysis in food, feed, and pharmaceutical products. The new VitaFast® product line determines the vitamin content microbiologically, utilizing a microtiter plate coated with specific microorganisms. VitaFast® test kits significantly reduce hands-on time compared with traditional microbiological methods. They provide greater reliability, higher productivity, and significant cost reduction. The product line includes folic acid, vitamin B_{12}, biotin, niacin, pantothenic acid, thiamine, riboflavin, and pyridoxine.

423 **Research Products Company,** P.O. Box 1460, Salina, KS 67402-1460; Telephone: +1.785.825.2181, Fax: +1.785.825.8908, Web: www.researchprod.com. Research Products Company has supplied and serviced the milling industry for many years and is recognized as a dependable partner for flour treatments and additives.

418 **RIBUS, Inc.,** 20 S. Central Ave., Suite 106, St. Louis, MO 63105; Telephone: +1.314.727.4287, Fax: +1.314.727.1199, Web: www.ribus.com.

813 **Riken Vitamin USA, Inc.,** 1901 N. Roselle Rd., Suite 563, Schaumburg, IL 60195; Telephone: +1.847.310.8007, Fax: +1.847.310.8177, Web: www.rikenvitamin.com. RIKEN, a worldwide leader in food emulsifiers, offers a variety of monoglycerides, specialty esters, bread improvers, cake emulsifiers, and more.

519 **RITO Partnership,** 8 Jackson St., San Francisco, CA 94111; Telephone: +1.415.956.7251, Fax: +1.415.394.9023, Web: www.ricebranoil.biz.

427 **Riviana Foods Inc.,** 2777 Allen Pkwy., Houston, TX 77019; Telephone: +1.713.529.3251, Fax: +1.713.529.1661, Web: www.RivianaIndustrial.com. Riviana offers a variety of rice products that include instant rice, milled rice, wild rice, crisp rice, IQF rice, and rice flour. We are a full-service rice supplier (www.RivianaIndustrial.com).

1021 **Rockwell Automation,** 1201 S. Second St., Milwaukee, WI 53204-2496; Telephone: +1.440.646.4013, Fax: +1.440.646.3525, Web: www.rockwellautomation.com. Rockwell Automation's unique combination of control and information architecture, services, and intimate understanding of beverage and brewing applications will help you improve productivity and agility while reducing total cost of ownership. See how Rockwell Automation can help you address plant or enterprise control and information needs.

508 **Roman Meal Milling Co.,** 4014 15th Ave. N.W., Fargo, ND 58102; Telephone: +1.701.282.9656, Fax: +1.701.282.9743, Web: www.romanmealmilling.com. Specialty milled and blended grain components as ingredients for bread, granola, and donut toppings. Contract processing/blending/packaging. Certified organic/kosher.

718 **Romer Labs, Inc.,** 1301 Stylemaster Dr., Union, MO 63084; Telephone: +1.636.583.8600, Fax: +1.636.583.6553, Web: www.romerlabs.com. Romer Labs, Inc. offers fluorometric, ELISA, and lateral flow mycotoxin detection test kits. Kits are offered in qualitative and quantitative formats. We offer laboratory equipment and a full-service analytical laboratory. Our Total Quality Assurance & Mycotoxin Risk Management Program is what makes us the worldwide leader in providing mycotoxin solutions.

905 **S. S. Steiner, Inc.,** 655 Madison Ave., New York, NY 10021; Telephone: +1.212.838.8900, Fax: +1.212.593.4238, Web: www.hopsteiner.com. S.S. Steiner is a full-service worldwide grower, processor, and dealer of hops and hop products. Additional information regarding the purchase of whole leaf, pellets (90 and 45), CO_2 extract, and other modified

hop products in a variety of package sizes is available on our website at www.hopsteiner.com.

615 **Sensient Colors Inc.,** 2515 N. Jefferson Ave., St. Louis, MO 63106; Telephone: +1.314.889.7600, Fax: +1.314.286.7160, Web: www.sensient-tech.com. Sensient Food Colors will feature our full line of natural and synthetic colors. Stop by our booth to view Sensijet, a color delivery system that includes full-color digital imagery on a variety of food products. Also on display will be our SpectraFlecks, water-soluble colored and/or flavored film flakes that add sparkled bursts of colors to confections and other food products.

618 **Sensient Flavors,** 5600 W. Raymond St., Indianapolis, IN 46241-4343; Telephone: 1.800.445.0073, Fax: +1.317.244.6076, Web: www.sensient-tech.com. Sensient Flavors includes a wide range of flavors, which include vanillas, brown flavors, fruit flavors, and many others. We also offer specialized ingredients, such as sweet inclusions.

826 **Siebel Institute of Technology/World Brewing Academy,** 1777 N. Clybourn Ave., Suite 2F, Chicago, IL 60614; Telephone: +1.312.255.0705, Fax: +1.312.255.1312, Web: www.siebelinstitute.com. The Siebel Institute of Technology & World Brewing Academy offer more brewing-specific courses than any other school, with over 20 workshops, courses, and programs. We offer campus- and web-based courses covering every relevant area of brewing technology, and we can bring training to your company anywhere in the world. The Siebel Institute also offers a full range of services, including consulting, contract research, laboratory services, yeast maintenance and production, and advanced DNA fingerprinting.

221 **Siemens Energy and Automation,** 3333 Old Milton Pkwy., Alpharetta, GA 30005; Telephone: +1.702.454.3794, Fax: +1.678.297.8102, Web: www.sea.siemens.com. As a partner to grain processors around the world, Siemens offers optimized solutions for water, energy, and brewing production management. Our systems and technology have enabled our users to achieve significant business returns and assure regulatory compliance. Siemens provides complete end-to-end solutions, from raw materials processing to packaging of finished product.

219 **Siemens Water Technologies,** 10 Technology Dr., Lowell, MA 01851; Telephone: 1.800.525.0658, Web: www.usfilter.com. Siemens Water Technologies offers the most complete line of water and waste water treatment equipment and technologies for the beverage industry. Our water treatment processes include membrane filtration, pretreatment, disinfection, and oxygen removal systems. Our waste water treatment technologies include chemical/physical, biological, evaporation, and recovery and provides the tools you need to meet compliance issues, minimize waste, and reduce BOD levels. We design, build, install, and operate complete water and waste water systems.

727 **Siemer Milling Company,** 111 W. Main St., P.O. Box 670, Teutopolis, IL 62467; Telephone: +1.217.857.3131, Fax: +1.217.857.3092, Web: www.siemermilling.com.

529 **Silliker, Inc.,** 900 Maple Rd., Homewood, IL 60430; Telephone: +1.708.957.7878, Fax: +1.708.957.1483, Web: www.silliker.com. Silliker, Inc. food safety experts provide support to food manufacturers, restaurants, and retailers to help assure product safety and nutrition. Working together, we'll help your company assess product safety, assure quality, guard against contamination and spoilage, verify products and processes, keep your costs under control and empower employees through education programs.

429 **The Solae Company,** P.O. Box 88940, St. Louis, MO 63188; Telephone: +1.314.659.3000, Fax: +1.314.659.5751, Web: www.thesolaecompany.com. The Solae Company is a leading marketer of high-quality soy-based ingredients, including soy protein isolate, concentrate, and nuggets; soy fiber; and soy lecithin. Learn more about the unique health and nutrition benefits of our ingredients and how they positively impact shelf life, provide structure in baked goods, and add texture to snacks, nutrition bars, and more.

320 **Solvay Chemicals, Inc.,** 3333 Richmond Ave., Houston, TX 77098; Telephone: +1.713.525.6500 or +1.618.655.9850, Fax: +1.718.655.9870, Web: www.solvaychemicals.us. Solvay Chemicals manufactures products used in the food industry for leavening, dough conditioning, calcium enrichment, preservation, flow/surface modifiers, and sterilization.

105 **Sosland Publishing Co.,** 4800 Main St., Suite 100, Kansas City, MO 64112; Telephone: +1.816.756.1000, Fax: +1.816.756.0494, Web: www.sosland.com. Sosland Publishing Co. magazines include *Baking & Snack*, *Milling & Baking News*, *Food Business News*, *World Grain*, *Grain & Milling Annual*, and *Baking & Snack International*.

206 **Spray Dynamics, Ltd.,** 108 Bolte Ln., St. Clair, MO 63077; Telephone: +1.636.629.7366, Fax: +1.636.629.7455, Web: www.spraydynamics.com.

517 **Strategic Diagnostics Inc.,** 111 Pencader Dr., Newark, DE 19702-3322; Telephone: 1.800.544.8881, Fax: +1.302.456.6782, Web: www.sdix.com.

605 **Südmo North America,** 1330 Anvil Dr., Rockford, IL 61115; Telephone: +1.815.639.0322, Fax: +1.815.639.1135, Web: www.sudmona.com. Südmo, a member of the NORIT Group, is a leading supplier of high-quality stainless-steel double-seat, single-seat, sampling, regulating, tank outlet, butterfly, ball, and specialty valves, as well as instrument housings and fittings, complete manifolds, and control tops. Sudmo provides same day emergency spare parts, 24/7 product support, maintenance training, and process design application and automation integration review services to assist you in reaching maximum plant efficiency.

920 **SunOpta Grains and Foods Group,** 3824 S.W. 93rd St., P.O. Box 128, Hope, MN 56046; Telephone: +1.507.451.6030, Fax: +1.507.451.8201, Web: www.sunrich.com. SunOpta Grains and Foods Group (formerly Sunrich) specializes in sourcing, processing, and distributing natural and organic grains and specialized functional ingredients. Vertical integration allows us to monitor the growth of identity-preserved crops used for whole-grain and ingredient applications. Key ingredient offerings include organic corn, soy, and sunflower; dairy cheese and savory powders; sweeteners; fiber; vegetable oils; aseptic copacking; and private-label manufacturing of grain-based beverages.

922 **SunOpta Ingredients Group,** 25 Wiggins Ave., Bedford, MA 01730; Telephone: 1.800.353.6782 or +1.781.276.5100, Fax: +1.781.276.5125, Web: www.sunopta.com. SunOpta Ingredients Group is the world's largest producer of oat fiber. SunOpta Ingredients Group also offers soy, wheat, bamboo, cellulose, and organic fibers; stabilized brans (oat, wheat, corn) and wheat germ; cellulose gel; ingredient systems; specialty starches; dry sweeteners (honey, molasses); and grade A acid whey. Use SunOpta ingredients to make fiber claims, improve texture, reduce breakage, and extend shelf life!

236 **Symrise Inc.,** 300 North St., Teterboro, NJ 07608; Telephone: 1.800.422.1559, Fax: +1.201.288.7373, Web: www.symrise.com. Symrise is the recognized leader in developing, establishing, and maintaining successful brands through its flavor experts in Sweet Business Units for both retail and foodservice industries.

904 **Tate & Lyle,** 2200 E. Eldorado St., Decatur, IL 62521; Telephone: +1.217.423.4411, Fax: +1.217.421.3167, Web: www.tateandlyle.com.

See our ad on the Recognition Tab front.

518 **Tec5USA, Inc.,** 80 Skyline Dr., Plainview, NY 11803; Telephone: +1.516.653.2000, Fax: +1.516.939.0555, Web: www.tec5usa.com. High-quality products for spectroscopy: light sources, fiber light guides, spectrometers, and operating electronics for PDA/CCDs; spectrometer systems for multiple applications in lab or on-line process, e.g., concentration, filter transmission, color, etc. Various software support. Full line of Hellma spectroscopy cells, fiber optic immersion probes and new Hellma TrayCell for 0.7-µL volume analysis.

407 **Texture Technologies Corp,** 18 Fairview Rd., Scarsdale, NY 10583-2136; Telephone: +1.914.472.0531, Fax: +1.914.472.0532, Web: www.texturetechnologies.com. The TA.XTPlus texture analyzer system provides complete tests for all forms of cereal products. Among the attributes it quantifies are dough and gluten extensibility, dough stickiness, bread freshness, pasta firmness and stickiness, pizza dough and crust firmness and toughness, tortilla freshness and bendability, snack food crunchiness, breakfast cereal bowl life, cookie and cake firmness, and much more. The TA.XTPlus can even simultaneously quantify the acoustic profile of a product. Please visit our table top to learn what our system can do for you.

See our ad on page 24.

830 **Thermo Electron Corporation,** 501 90th Ave. N.W., Minneapolis, MN 55433; Telephone: +1.763.783.2500, Fax: +1.763.780.2315, Web: www.thermo.com. Thermo Electron introduces the CrystalVision CO_2 sensor that continuously measures the dissolved carbon dioxide concentration in carbonated beverages. With an extremely low cost of ownership, CrystalVision is a simple and cost-effective sensor to install, maintain, and integrate into your process. The sensor also measures temperature and provides valuable information on the completion of the CIP (clean-in-place) cycle. The sensor's compact solid-state design fits into a standard Varinline connection fitting.

229 **THONHAUSER USA Inc.,** 3036 Chardale Ct., Cincinnati, OH 45248; Telephone: +1.513.347.6263, Web: www.thonhauser.net. THONHAUSER, an Austria-based company, is a leader in inline verification of clean in Europe. THONHAUSER will be exhibiting its unique in-line instant verification of clean system. The technology uses a color change solution and photo eye equipment to ensure the hygienic condition of the system in quantified readouts. This technology can be used for beverage process and dispensing systems. This technology has enjoyed great success with European breweries and is now available in the United States.

506 **TIC Gums,** 4609 Richlynn Dr., Belcamp, MD 21017; Telephone: +1.410.273.7300 or 1.800.899.3953, Fax: +1.410.273.6469, Web: www.ticgums.com. Gums can be used to increase your production rate, improve product quality, and prevent sticking and staling, as well as to reduce the fat content of the finished product. TIC Gums offers a range of products specially formulated to meet the needs of food and beverage manufacturers. TIC Gums can help you boost your fiber content without masking flavors, ask us how or visit www.ticgums.com.

919 **TNO Life Sciences Inc.,** 36 Erwin St., North Reading, MA 01864; Telephone: +1.978.207.0258 or +1.978.886.5986, Fax: +1.978.207.0259, Web: www.tno-northamerica.com. TNO Life Sciences Inc. is part of Dutch-based TNO Quality of Life; we are the world's largest research company in food and nutrition. Our portfolio in carbohydrate analysis and research is unique, covering physical, (bio)chemical, nutritional, and safety aspects in a multidisciplinary way.

402 **Tuchenhagen Brewery Systems GmbH,** Am Industriepark 2-10, D-21514 Büchen, Germany; Telephone: +49 41 55490, Fax: +49 41 55492770, Web: www.tuchenhagen.com. Tuchenhagen Brewery Systems is a world-leading supplier of equipment, unit operations, and process systems, as well as complete turnkey plants. We offer our customers the security of an international company—in every respect. That is why we are not just acting exclusively as engineering

specialists—we also symbolize economic stability, innovative strength, and reliability.

402 **Tuchenhagen Flow Components, LLC,** 90 Evergreen Dr., Portland, ME 04103; Telephone: +1.207.797.9500, Fax: +1.207.878.7914, Web: www.tuchenhagen.com.

108 **Unity Scientific, Inc.,** P.O. Box 1030, Purcellville, VA 20134; Telephone: +1.540.338.8991, Fax: +1.540.338.8992, Web: www.unityscientific.com.

313 **Valley Fig Growers,** 2028 S. Third St., Fresno, CA 93702; Telephone: +1.559.237.3893 x106, Fax: +1.559.237.3898, Web: www.valleyfig.com, World's most diversified full-line supplier and processor of California dried figs. Includes whole, sliced, and diced figs (assorted colors and flavors), along with fig paste (seeded and deseeded), soft/slurry pastes, concentrates, powder, granule, extruded fruit nuggets (assorted colors and flavors), and fig fillings (assorted colors and flavors). Custom manufacturing and extrusion. Kosher, natural, and certified organic figs also available. Visit us at www.valleyfig.com.

432 **Van Drunen Farms,** 300 W. 6th St., Momence, IL 60954; Telephone: +1.815.472.3100, Fax: +1.815.472.3850, Web: www.vandrunenfarms.com. Van Drunen Farms is a primary processor of functional food ingredients, specializing in fruits, vegetables, and customized quality IQF herbs and roasted vegetables. Our processing capabilities include freeze-drying, drum-drying, spray-drying, sugar infusion, fermentation, grinding, and blending.

417 **Vanlab Corporation,** 86 White St., Rochester, NY 14608; Telephone: +1.585.232.6647, Fax: +1.585.232.6168, Web: www.vanlab.com. Vanlab Corporation manufactures a broad line of liquid and dry bakery flavors, specializing in vanillas (natural and artificial) and allergen-free nut flavors.

301 **VICAM,** 313 Pleasant St., Watertown, MA 02472; Telephone: +1.617.926.7045, Fax: +1.617.923.8055, Web: www.vicam.com. VICAM offers mycotoxin and microbiological testing systems for the coffee, dairy, food, and feed industries, as well as tests for wheat quality and molds in fruits.

328 **Virginia Dare,** 882 Third Ave., Brooklyn, NY 11232; Telephone: +1.718.788.1776, Fax: +1.718.768.3978, Web: www.virginiadare.com. Virginia Dare is a manufacturer of a wide range of sweet and fruit flavors, premium vanilla, and masking flavors for sweet goods, grain-based foods, and health and wellness products. Learn about the new developments regarding flavors and masking flavors for whole-grain products.

327 **VITAMINS, INC.,** 200 E. Randolph Dr., Suite 5130, Chicago, IL 60601-6436; Telephone: +1.312.861.0700, Fax: +1.312.861.0708, Web: www.vitamins-inc.com. Defatted wheat germ products and their applications, wheat germ oil, and various vitamins (liquid and dry), including our Lipo coated vitamins.

302 **Watson Inc.,** 301 Heffernan Dr., West Haven, CT 06516; Telephone: +1.203.932.3000 or 1.800.388.3481, Fax: +1.203.932.8266, Web: www.watson-inc.com. Watson manufactures a full range of standard enrichment blends, or we can custom formulate a vitamin/mineral premix to achieve the nutritional profile you desire. Watson also manufactures a full line of functional bakery ingredients. Watson has two production facilities in Connecticut and Illinois, as well as three in-house labs for R&D and QC.

See our ad on the Abstracts Tab front.

120 **Weiss Enterprises Inc.,** 51 Turtle Bay Dr., Branford, CT 06405; Telephone: +1.203.488.6930, Fax: +1.203.488.6930, The Seedcount digital image analysis instrument is designed for assessing the quality of grains, including wheat, barley, rice, and corn. The instrument provides size distribution tables, thousand-kernel weight, plumpness, and screening equivalents. It also measures blackpoint, *Fusarium* infection, heat damage, dockage, and test weight. The instrument can be used to measure kernel size, horneous endosperm, dent size, red streaks, and color and crown in corn and chalk in rice. It is a low-cost, easy-to-use, rapid instrument intended for use at the point of sale of grain.

401 **Wenger Manufacturing,** 714 Main St., Sabetha, KS 66534; Telephone: +1.785.284.2133, Fax: +1.785.284.3861,Web: www.wenger.com. Wenger will be supplying literature and technical information on extrusion and drying equipment for the cereal and snack industries.

See our ad on Cover 4.

402 **Westfalia Separator,** 100 Fairway Ct., Northvale, NJ 07647; Telephone: +1.201.767.3800, Fax: +1.201.767.3416, Web: www.wsus.com. Westfalia Separator, Inc. is a leading manufacturer and distributor of high-quality centrifuges for a wide variety of applications within the beverage industry. Westfalia is a full-service organization offering complete service, testing, engineering, repair, and spare parts capability. Westfalia Separator is now offering **PRO**FI—a new DE-free filtration system. Westfalia Separator has been manufacturing centrifuges since 1893; its North American headquarters is located in Northvale, NJ. Contact Westfalia Separator for additional information.

1001 **Weyermann Specialty Malts,** Brennerstrasse 17-19, 96052 Bamberg, Germany; Telephone: +49 951 93220 33, Fax: +49 951 93220 933, Web: www.weyermann.de.

625 **Whatman Inc.,** 200 Park Ave., Suite 210, Florham Park, NJ 07932; Telephone: +1.973.245.8300, Fax: +1.973.245.8329, Web: www.whatman.com. Products and technical services focusing on microbiological testing in the food and beverage, pharmaceutical, and environmental markets.

926 **Wittemann Co., LLC,** 1 Industry Dr., Suite A, Palm Coast, FL 32137; Telephone: +1.386.445.4200, Fax: +1.386.445.7042, Web: www.wittemann.com. Founded in 1874, Wittemann today is a leading USA-based company, globally recognized as a leader in the design, manufacture, and supply of complete systems and equipment for CO_2 recovery, production, purification, liquefaction, carbonation, vaporization, and cylinder filling. Wittemann has equipment installed in over 100 countries and offers complete service, including installation supervision, commissioning, and spare parts.

See our ad on page 15.

709 **Wolverine Proctor & Schwartz, Inc.,** 251 Gibraltar Rd., Horsham, PA 19044; Telephone: +1.215.443.5200, Fax: +1.215.443.5206, Web: www.wolverineproctor.com.

207 **The Wright Group,** 6428 Airport Rd., Crowley, LA 70526; Telephone: +1.337.783.3096, Fax: +1.337.783.3802, Web: www.thewrightgroup.net. Delivering balanced fortification solutions is our business. Our custom nutrient premixes, SuperCoat® microencapsulates and Wrightmade™ bakery ingredients and enrichments deliver innovation, technical expertise, and superior service.

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312 **The XIM Group, LLC,** 1104 Jefferson St., Sabetha, KS 66534; Telephone: +1.785.547.5138, Fax: +1.785.284.2335, Web: www.ximgroup.com. The XIM Group is a product development and project management group serving the food, feed, and pharmaceutical industries. XIM's principals bring a wealth of experience coupled with a synergistic blend of individual competencies, resulting in a unique combination of skills available to help you meet your needs. XIM's long-term focus is on exploring, identifying, and implementing key new technologies that address long-term problems in the industries they serve. Key focus areas include food safety, shelf-stable foods, biosecurity, and continuous processing.

915 **Zeltex, Inc.,** 130 Western Maryland Pkwy., Hagerstown, MD 21740; Telephone: +1.301.791.7080, Fax: +1.301.733.9398, Web: www.zeltex.com.

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