What's on the menu? Fundamentals of yeast nutrition

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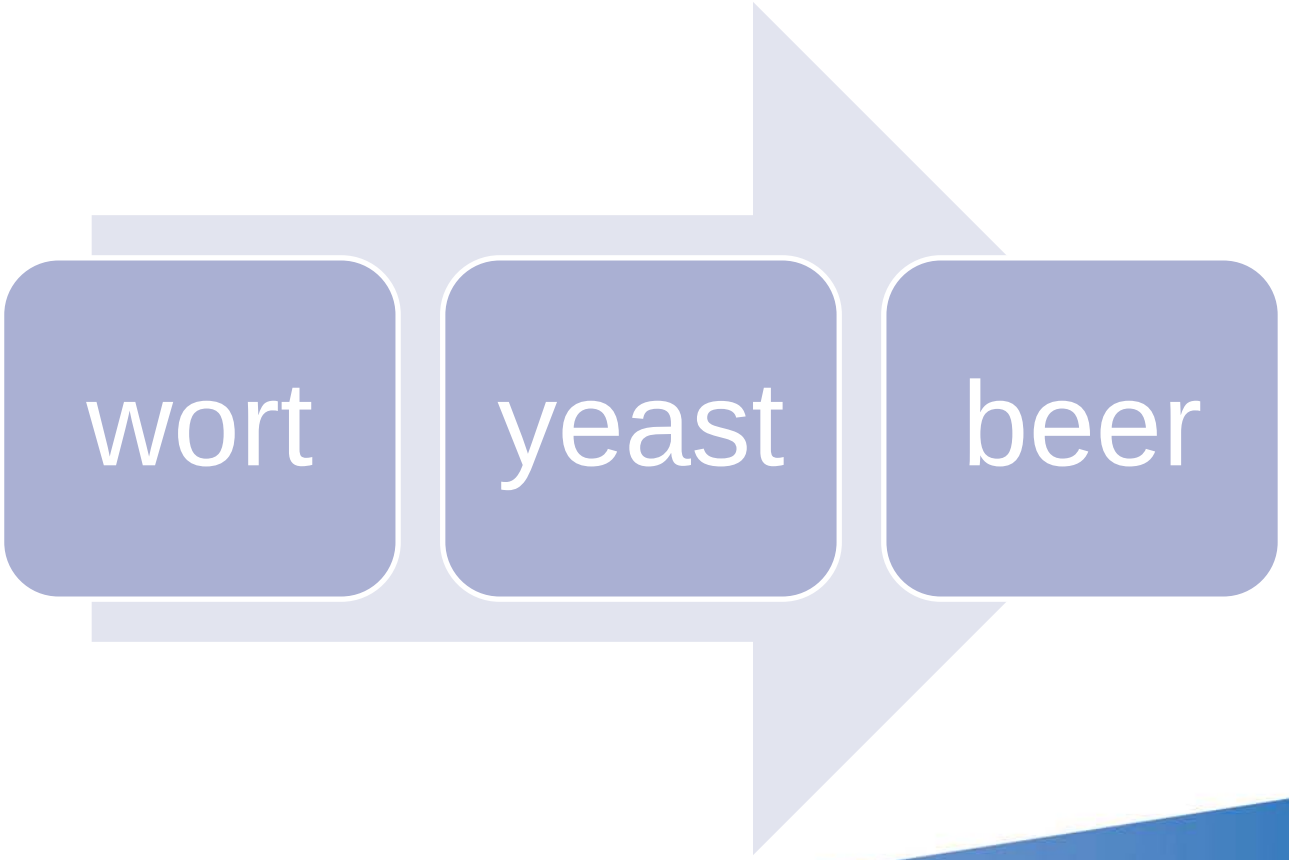
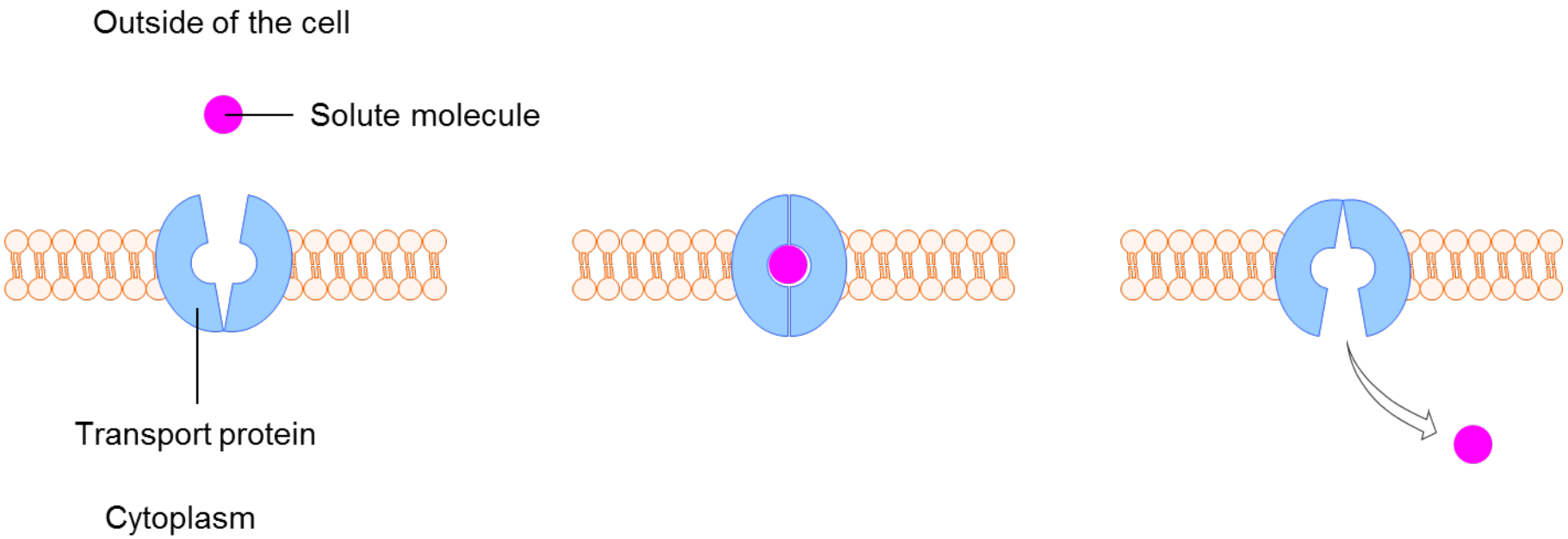
What is it and why do we care?

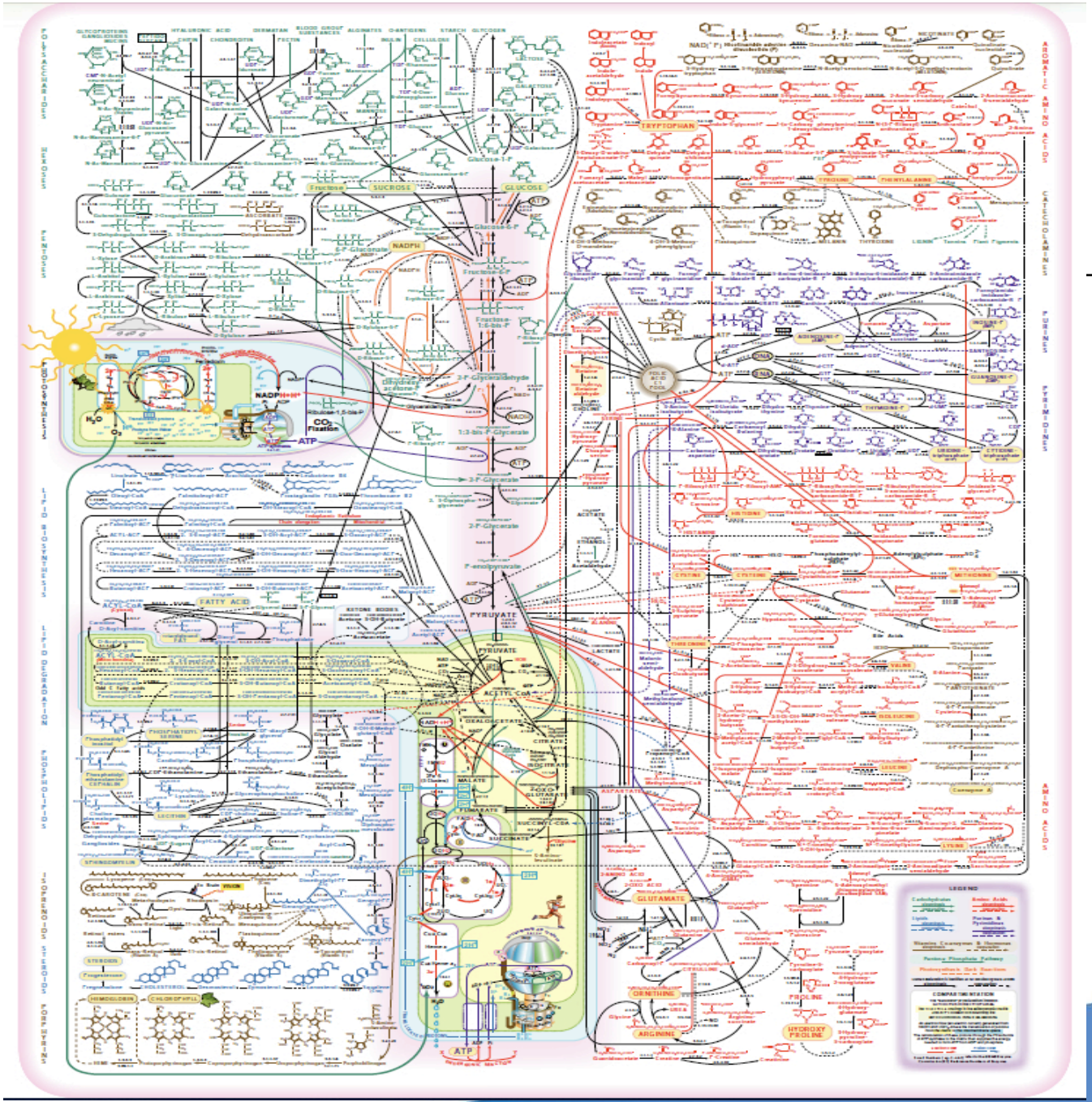
YEAST NUTRITION

Food, glorious food!



How do yeast eat?





How does yeast make alcohol?

Provided by Prof. G. Walker

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Distinctly Ambitious
www.hw.ac.uk

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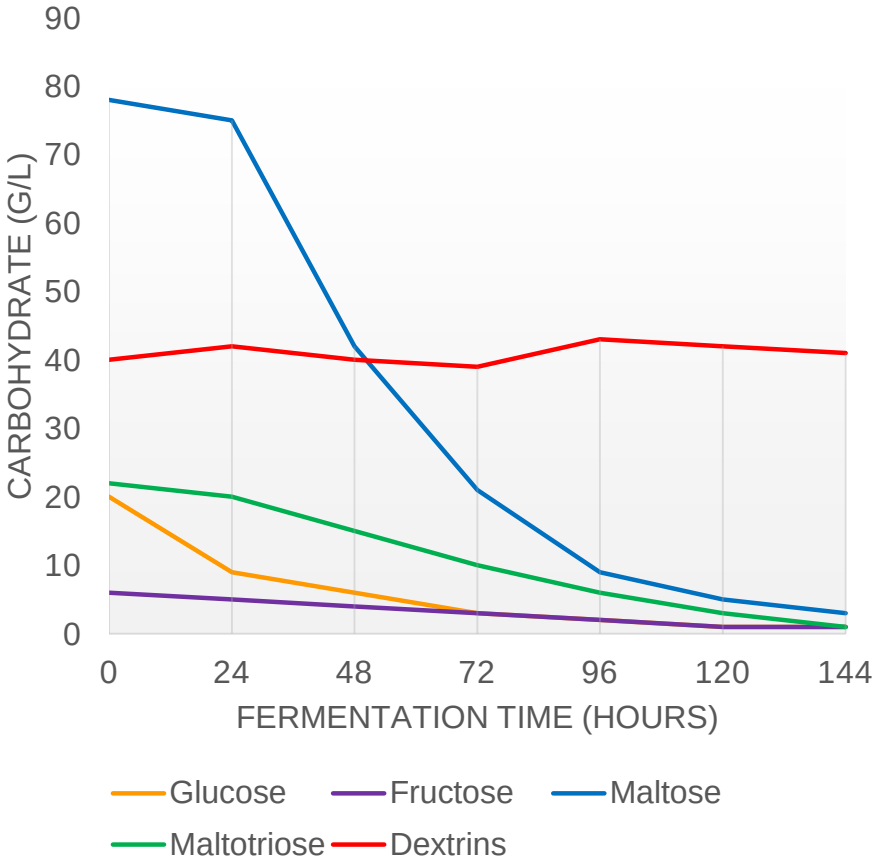
YEAST DIET: THE ESSENTIALS

Brewers' wort

- Carbohydrates
  - Glucose
  - Fructose
  - Sucrose
  - Maltose
  - Maltotriose
  - Maltotetraose and larger dextrins
- Vitamins
- Nucleic acids
- Hop components
- Free Amino Nitrogen (FAN)
  - Amino acids
  - Ammonia
  - Small peptides
- Glycopeptides and proteins
- Water
- Ions
- Melanoidins

Carbohydrates

Uptake Of Wort Sugars



Wort Fermentable Sugars

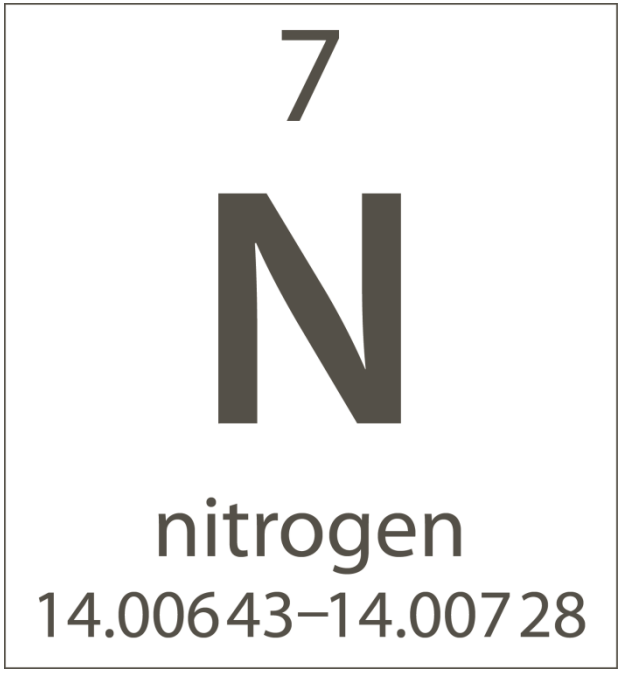
- Fructose ~ 2 %
- Glucose ~ 8 %
- Sucrose ~ 6 %
- Maltose ~ 45 %
- Maltotriose ~ 10 %

Oxygen: opportunity and threat

- Absence of oxygen – only fermentative growth
- Synthesis of sterols and UFA's (biomass – membrane components essential for growth)
- Oxygen depleted – division and growth restricted – become fully fermentative

Free Amino Nitrogen

- Source of nitrogen
- Levels?
- Ale yeast higher FAN needs than lager
- Protein stand/rest



Valine: the villain of the piece?

- Vicinal diketones – by-products of valine and isoleucine
- Supplementation reduces diacetyl formation!

Proteins: friend or foe?

- Nutrition
  - But only as amino acids or small peptides
    - Cell structures
    - Higher alcohols
- Haze
  - Protein-polyphenol complexes forming permanent or non-permanent hazes
- Foam
  - Foam positive proteins contribute to head formation

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The role of micronutrients

SOMETHING IN THE WATER?

The need for ions

Ion	Function
Zinc	Essential for growth, enzyme co-factor, stress protectant against ethanol toxicity
Manganese	Enzyme co-factor, cell and organelle structure
Magnesium	Essential in many enzymes involving ATP, cell and organelle structure
Calcium	Stimulates growth, depresses wort pH, and has a role in flocculation
Copper	Enzyme co-factor, binds to some proteins
Potassium	Component of transport system for nutrient uptake
Phosphate	Synthesis of organic phosphorus containing compounds
Sulphate	Synthesis of S – containing compounds

Other roles of ions

Zinc	Protect against ethanol stress
Magnesium	Stabilising membrane, inhibit stress induced proteins
Calcium	Flocculation at end of fermentation, protect against ethanol stress
Copper	Eliminate H_2S from beer as insoluble hydrogen sulfide
Chloride	Inhibitory at high concentrations
Iron	Toxic to yeast

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VITAMINS

Vitamins

- Many essential vitamins cannot be synthesised by yeast
  - Biotin
  - Pantothenic acid
  - Nicotinic acid
  - Thiamine (Vitamin B)

Image from www.clker.con

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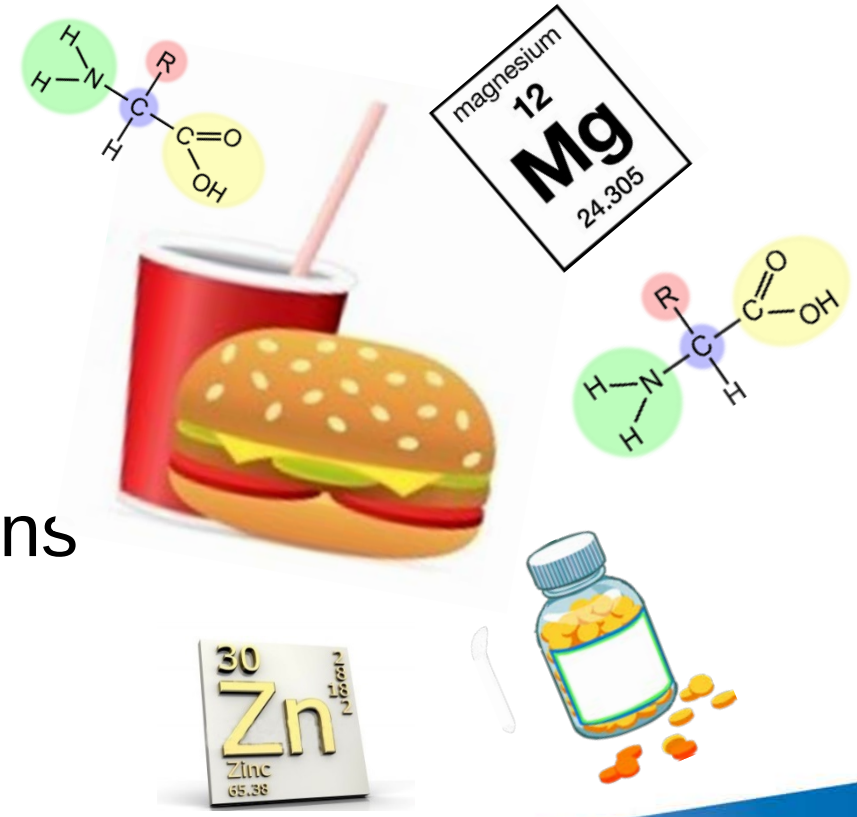
NOT ALL NUTRITION IS EQUAL

Wort Soup

- Nutritional variation
  - Strain specific
  - Between breweries (same strain)
  - Water supply
  - Grist composition and adjunct use
  - Brewhouse design
  - Environmental conditions
  - Brew length and type of beer produced
- Yeast ignores
  - Dextrins
  - β-glucans
  - Pentosans
  - Large proteins
  - Phenolics

Yeast Food

- Prevent slow fermentations
- Useful for high adjuncts/low nitrogen worts
- Consistent fermentations



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PRACTICAL CONSIDERATIONS

Practical considerations

- Ethanol stress
- Using antifoams
- Use of stabilisation products

Source: www.bsgcraftbrewing.com

The fundamental takeaway messages

THE YEAST MENU

Takeaway menu

- The diversity of yeast nutritional needs
- What can be essential can also be toxic in excess
- Supplementation can make up for deficiencies

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Any questions?

THANK YOU