WHY BEER IS COMPLICATED

and what we don't know

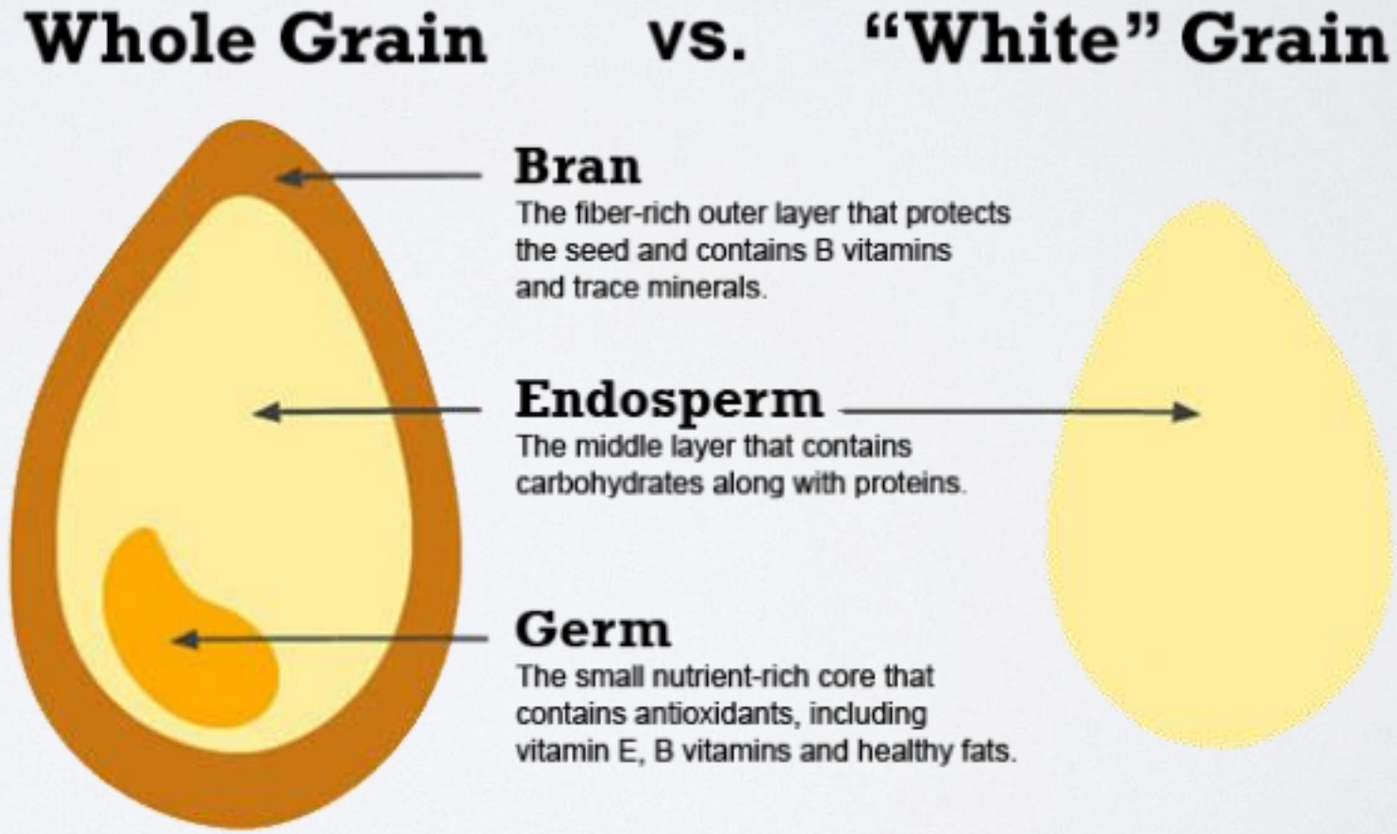
as told by a food scientist

MY BACKGROUND

- Chemist — Started @ Baskin Robbins
- Flavor Chemist - sweetened modifiers
- Food Scientist - grain separations & processing

RICE BRAN

- Is Not Rice
- Is Not Hulls



RICE BRAN

- Protein
- Carbohydrates
- Fiber
- Bran Oil

BEER

- Extra Hoppy
- More Bitter

THE JOURNEY

- What I suspected was happening
- What the results were showing
- Why beer hop science is Fi#&ing complicated

WHY WE ADD HOPS

- When the 1st addition of hops are added to the boil, the goal is to extract the active humulone components – for simplicity, let's also included all the cohumulon, iso humulone, adhumulone and pre and post humulones.

- As these humulones are extracted and when heated in the boil, they isomerize to form their alpha acids. These alpha acids impart the bitterness that give the beer its wonderful flavor.

- **We are only getting a partial extraction because of the solubility.** Only a portion of the humulon is typically extracted and makes its way into the beer. It is also estimated that 20-30% of the humulones are in the spent hops.

- That means that they never made it out of the spent hops because they simply can't due their poor water solubility. If you could extract more of the humulones, they you would have more alpha acids. More alpha acids means more bittering.

WHAT THE IDEA WAS..

- As mentioned, humulone is slightly soluble in in boiling water. What we have found is that by adding a small amount of rice bran mixed in with your boiling hops, you can use the non polar oils that are contained in the rice bran to act as a nonpolar solvent to extract more humulone from your bittering hops.

- Rice Bran contains carbohydrates, protein, fiber and bran oil. The bran oil is a mixture of lecithins, fatty acids, vitamin e, tocopherols etc.

- We can think of this as a non polar solvent

SIMPLE TEST FORMULA

- Brewed using a PicoBrew

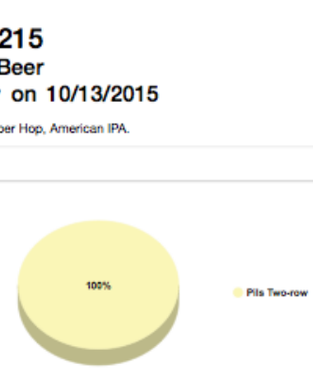
6/28/2016 Recipe Details

Test 101215
Specialty Beer
designed by Rick Ray on 10/13/2015

A Golden, Intensely Bitter, super Hop, American IPA.

VITAL STATS

Style	BJCP 2008 : 23.A Specialty Beer
OG/FG/IBU	1.0494 / 1.0069 / 79
SRM	3
ABV	5.5%
Starting Water	3.55 gal Water
Starting Water Weight	29.63 lbs
Batch Size	2.5 gal



MALTS

Type	Amount (lb)	Gravity (pts)	Color (pts)
Pils Two-row	7 lbs	49.41	2.9

HOPS

Type	Amount (oz)	Alpha Acid %	Time
Cascade	1	7.1	60
Cascade	1	7.1	30

MASH

Type	Temp (F)	Time	Style
Single Step Infusion Mash	152	90	Infusion

BOIL

Type	Temp (F)	Time	Ramp
First Boil	207	60	True

YEAST

Name	Expected AA%	Range Temp (F)	Pitch Temp (F)
Fermentis Safale US-05	86	59 - 71	65

FERMENTATION DIRECTIONS

Normal Ale Fermentation

Cool to 65 F and keep temperature consistent for 10 Days

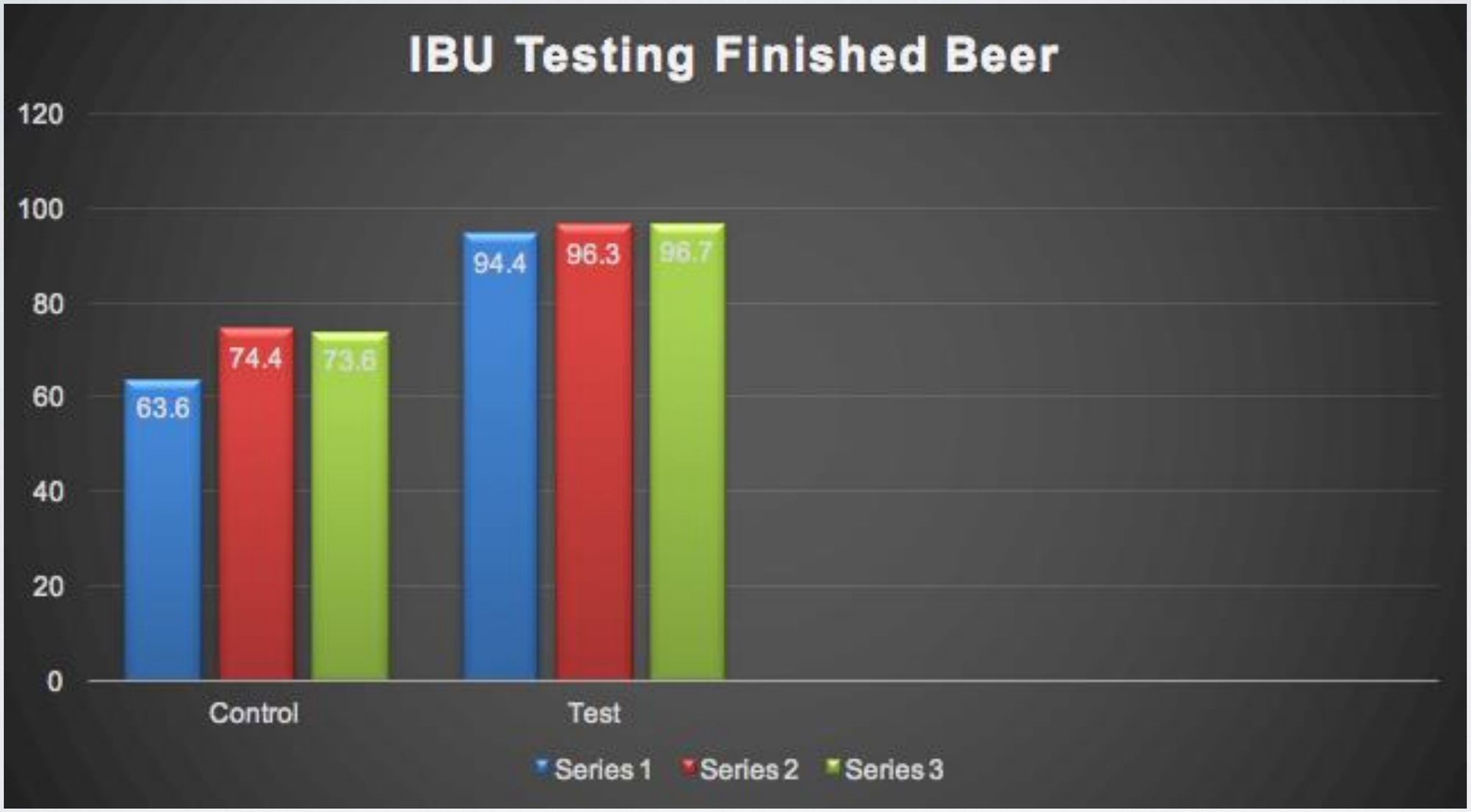
NOTES

Recipe Notes

Test to try with and without ProRyza Brew in Hop additions for IBU's

https://picobrew.com/Members/Recipes/ParseRecipe.cshtml?id=ba809ffa83ce490e8c8ff1534c21d6b6 1/2

NICE INCREASE IN IBU'S, BUT…..

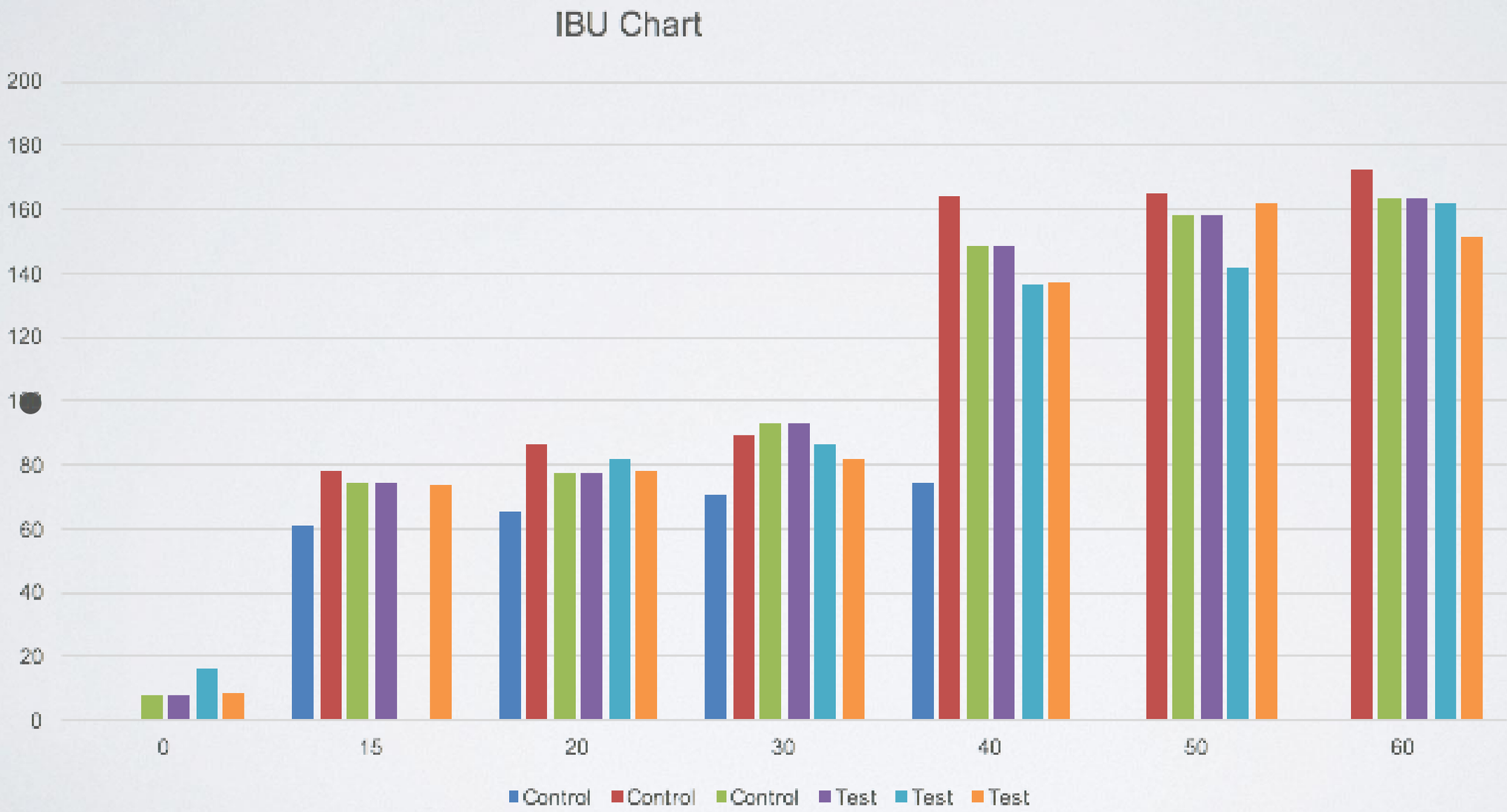


WHY

- We show a 29% increase in finished beer IBU’s

- WHY ???

IBU CHART VS BOIL



GRAPH SHOWS LITTLE DIFFERENCE

- We expected to see a big jump in IBU's with the test samples.

- IBU's were measures using ASBC spectrophotometric analysis

IS IT THE FERMENTATION?

- We know that IBU values will drop during fermentation.

- Maybe we are changing the surface charges and they yeast will bind less to the alpha acids.

- How to check that ??

YEAST AND ALPHA ACIDS

- Yeast cells will grab onto alpha acids during fermentation

- Exactly how this occurs is not known. It may have something to do with the electrical charges on iso-alpha acid and beta acids, and the charges of proteins embedded in the yeast cell wall. When the yeast flocculate, they may pull iso-alpha and beta acids with them.

- The oils in rice bran act to change the surface charge and keep the yeast from pulling out the alpha acids. This keeps the alpha acids in solution giving you a higher IBU beer.

FLOCCULATION AND SEDIMENT

- Control

st

FERMENTATION NUMBERS

- Took wort sample, pitched yeast
- Divided into 2 samples
- Added Rice Bran into test sample
- No difference in measured IBU’s
- Taste difference :-)

WHY A TASTE DIFFERENCE

- Rice Bran - protein, fiber, carbohydrates, bran oil
- Bran Oil is a mix of fatty acids, lecithins, sterols etc
- Yeasts will eat fatty acids in anaerobic phase
- More activity = more flavor and aroma
- How to check that ??

GC / MS

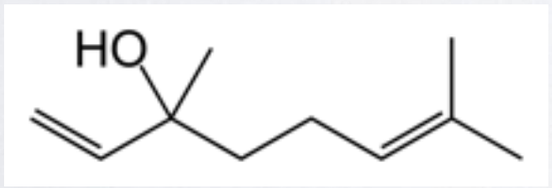
- To Be Determined

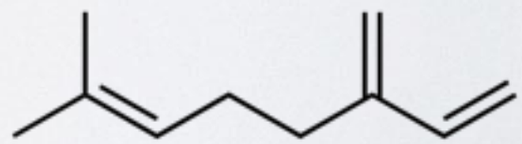
- Because typical analysis may not work

2ND ADDITION OF HOPS FOR FLAVOR

- Aromatic flavor compounds are oil soluble

- Linalool, Myrcene, Terpeniol etc





DRY HOPPING

- The aromatic flavor chemicals are oil soluble and you use the ethyl alcohol to act as the non polar solvent to pull out these flavor chemicals and get them back into your beer.

- By adding some rice bran you will get additional flavor aromatics because the oil in the rice bran is more non polar. The more non polar, the better the solvent effect.

- You do see increased bitterness if left too long.

SUMMARY AND QUESTIONS

- The 29% increase in finished beer IBU's does vary with the hops used.

- Spectrophotometric vs HPLC show different numbers

- Bitterness also comes from polyphenols. Looks like the rice bran is making the bittering polyphenols more water soluble.

- Fermentation does seem to be very different, and work needs to be done to better understand the surface tension and the acid/yeast interactions.

THANK YOU

- Special thanks to Pico Brew

- Sweet Water Sciences, White Labs, Imperial Organic Yeast and all the brewers who have been kind enough to help answer my crazy questions.