Co-Humulone Friend or Foe?

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What is co-Humulone?

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- The primary bittering components of hops are three alpha acids:
  - Humulone
  - Ad-Humulone
  - Co-Humulone
- Combined these are collectively known as the AA% of a hop

Alpha Acid----->iso-Alpha Acid

- Alpha Acids only become bitter by boiling, changing them into isomerized Alpha Acids or iso-Alpha Acids
- iso-Humulone
- iso-Adhumulone
- Iso-co-Humulone

Differences in the Alpha Acids

- Isomerization: the individual acids isomerize at slightly different rates giving different amounts of iso-Acid which in turn gives higher or lower measured IBUs
- Different pH levels influence isomerization of individual acids
- Survival of the pH drop during fermentation. More iso-co-Humulone survives the drop.

Original Study

- Overview:
- 1972 Dr. Rigby
- Isolated the individual alpha acids
- Brewed beers using equal amounts of Humulone and co-Humulone
- Beers given to tasters
- Tasters found beer made with co-Humulone to be “harsher”…

OF COURSE!

- All the beers had very different IBUs because of the differences in isomerization and the pH drop.
- Co-H beer had 62% more IBUs
- No attempt to brew beers with equal IBUs

Experiment #1

- Basic pale ale
- Highest co-H hop: Cascade (33-37%)
- Lowest co-H hop: Simcoe (17-22%)
- Calculated 40 IBUs
- Lab analysis
- Taste test

Results

- Cascade (high co-H) 42 IBUs
- Simcoe (low co-H) 33 IBUs
- 27% difference in IBUs!
- Tasters obviously found the more bitter beer….more bitter.
- Same yeast, fermentation profile

2nd Experiment

- Selection of 7 hops varying wildly in co-Humulone levels sent to NCSU for HPLC analysis of alpha acids.
- Brew beers with all hops including several repeats to show consistency.
- Analyze IBUs
- Attempt to come up with factor that can make hop calculations more accurate

Co-Humulone results

- #1 Cluster (37-43%) actual: 45%
- #2 Brewers Gold (40-48%) actual: 42%
- #3 Vanguard (14-16%) actual: 15%
- #4 Simcoe (15-20%) actual: 15%
- #5 Aramis (21-24%) actual: 20%
- #6 Columbus (28-32%) actual: 31%
- #7 Cascade (33-37%) actual 35%

Problem #1

- HPLC total AA% seemed troublingly low
- Simcoe 7.3% AA
- Columbus 11.6% AA
- Cluster 4.7% AA
- HPLC is known to be up to 30% low in total AA readings
- Accurate in the co-H ratio

Deal With It

- Went with the printed AA% on hop packages.
- New crop
- Sealed vacuum packed in foil
- Kept cold
- Real world scenario for brewers

Problem #2

- Which hop calculator to use?
- Tinseth supposed to be most accurate
- Every calculator gives different results
- Went with calculator on Tinseth's Hop Page website

Monster Brew

- 11 brews in 6 days
- Big mash: 15 gals of wort
- Separate boils in same kettle/same burner
- Dry yeast US-05
- 100% pale malt/ 35 IBUs

Beer IBU Analysis

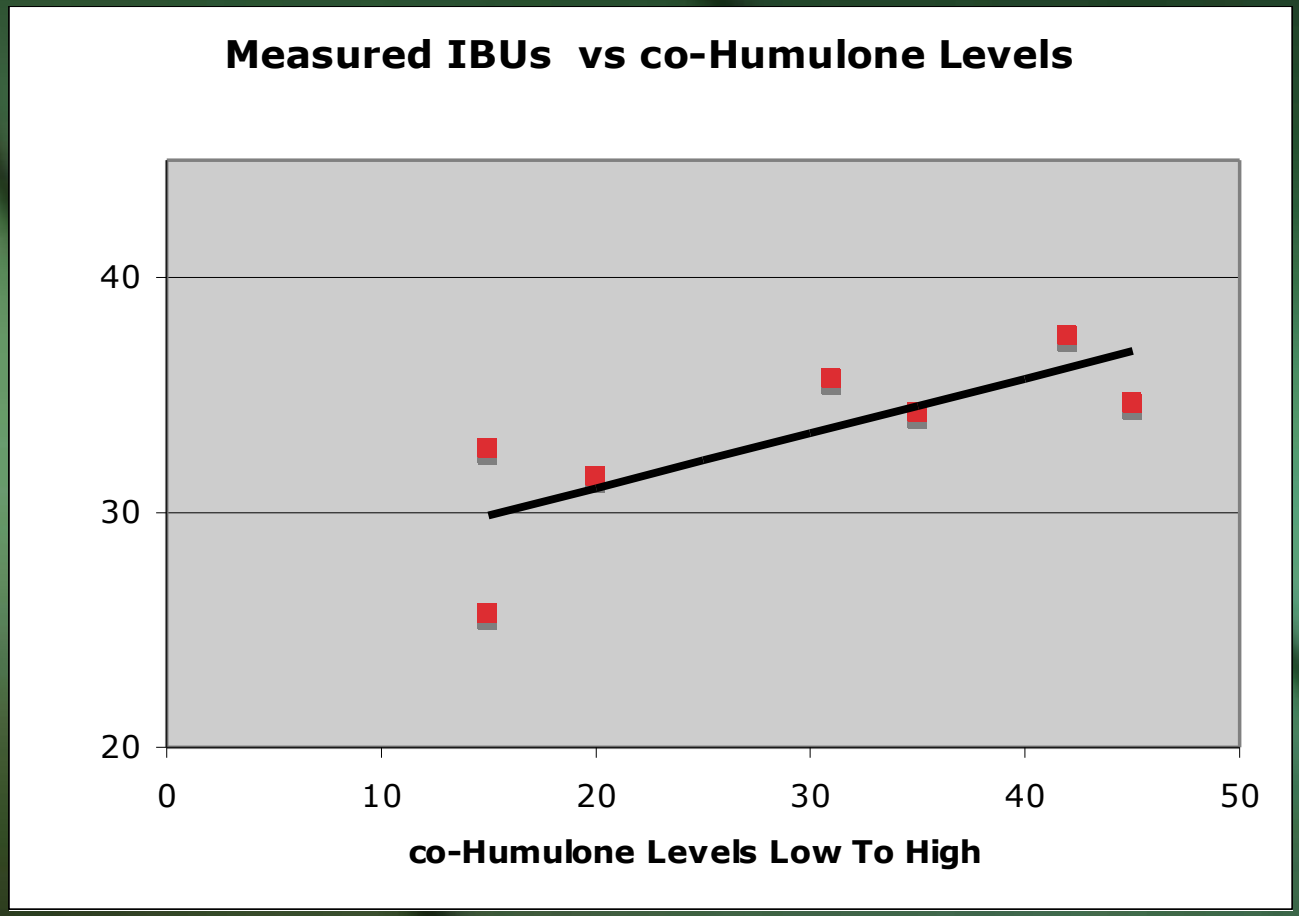
Sierra Nevada lab did the testing

- #1 34.65 IBUs
- #2 37.5 IBUs
- #3 25.65 IBUs
- #4 33.3 IBUs
- #5 31.5 IBUs
- #6 35.7 IBUs
- #7 34.25 IBUs

Checking Consistency

- Repeatability tests

Columbus: 35.7 vs. 36.2
Simcoe: 33.3 vs. 32.7


Measured IBUs vs co-Humulone Levels
40
30
20
0
10
20
30
40
50
co-Humulone Levels Low To High

Graph Analysis

- Fairly consistent increase in IBUs with increased co-H level
- 35% difference in IBUs between highest and lowest co-H levels
- 47% difference between 2nd highest and lowest co-H levels
- Equivalent of 14-18 IBU variation in a 40 IBU beer

Takeaways from Experiment

- Shows consistent increase in IBUs relative to co-H levels
- Some outliers
- Possibly add up to 45% more hops for low co-H varieties
- Not enough info yet to have a co-H factor

Proof Is In The Pudding

- IBUs and perceived bitterness
- Maybe co-H does taste “harsh”
- Only way to tell is organoleptically
- Brew two beers same or very close in measured IBUs
- One hop addition
- No minerals
- 100% pale malt

Lab Analysis of Sample Beers

Beer #1: using low co-H hop (Vanguard) adjusted upwards by 46% according to experiment.

Calculated at 30 IBUs

Measured at 31.7 IBUs

Lab Analysis Of Sample Beers

Beer #2: using low co-H hops (Vanguard) adjusted upward by 46% according to experiment.

Calculated at 50 IBUs

Measured at 44.7 IBUs

Lab Analysis of Sample Beers

Beer #3: Using high co-H hops (Brewers Gold)

Calculated at 40 IBUs

Measured at 38.7 IBUs

Blending

- Brewers Gold= 38.7 IBUs
- Blend of 46% beer #1 and 54% beer #2- 38.7 IBUs
- Rare chance to taste two beers with same measured IBUs and compare bitterness

High co-H vs. Low co-H Taste Showdown

- Measured IBUs:
- Beer #1 38.7 IBU
- Beer #2 38.7 IBU

- Does either taste more coarse or harsh?
- vote

Benefits of Removing the Stigma of high co-Humulone

- Farmers and brewers can concentrate on flavor and aroma characteristics of hops instead of low co-H
- Think of them as having "extra alpha acid". If you can adjust your calculations then it is more bang for your buck

Thanks

- Gabe Pickard
- Green Man Brewery
- Sierra Nevada Lab
- UNCS Food Program

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