Scaling Hops

A comparison between homebrew and commercial scale utilization

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36th Annual American Homebrewers Association®
National Homebrewers Conference

Outline

- Background
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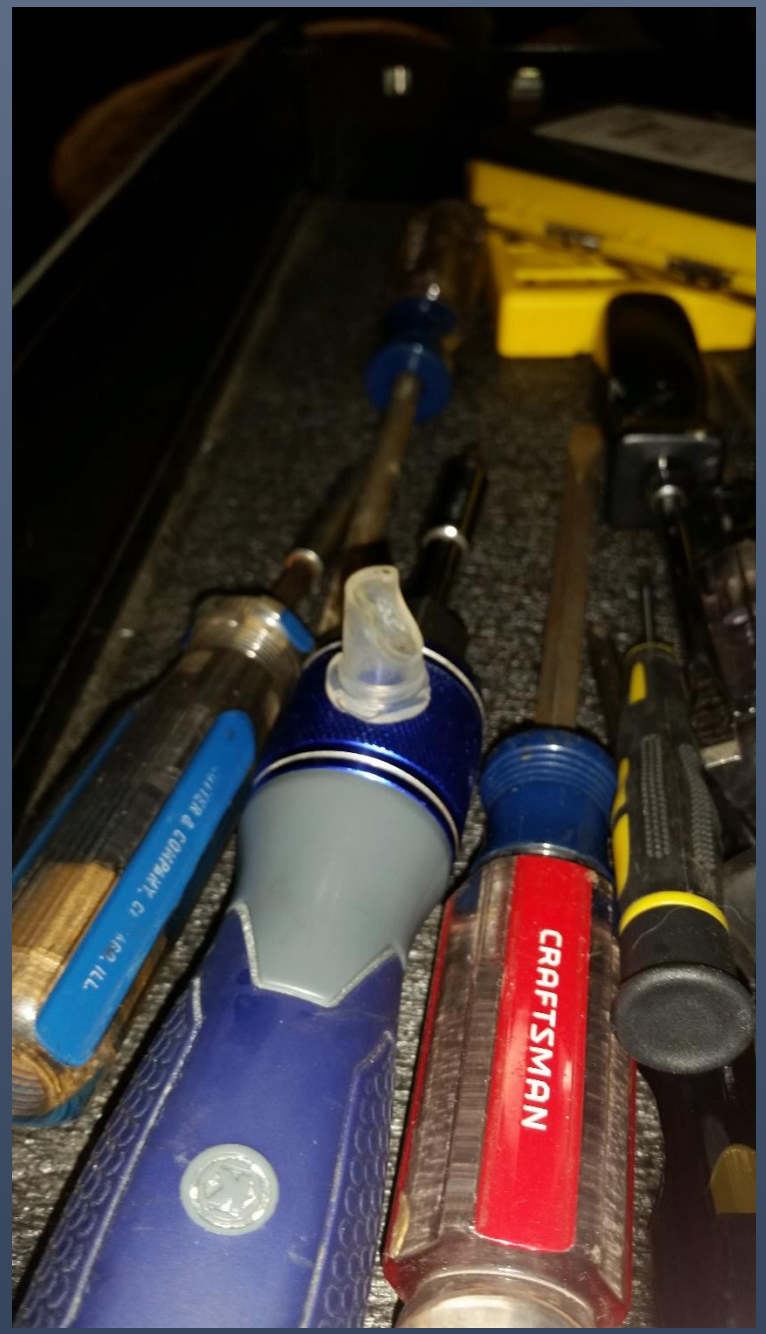
- Differences
- Lab Analysis Results
- Sensory Results
- Conclusions



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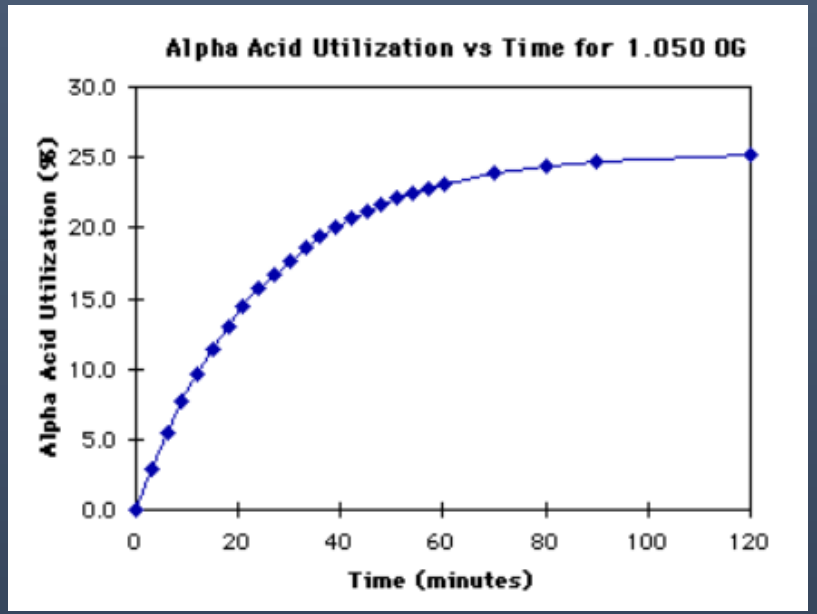
Background

- Columbus Brewing Company's "Hop Odyssey Series"
  - Helped learn what effects hops and rate had on beers
  - Learned can only put so much in the kettle and whirlpool
- Brewed several batches commercially and noticed process differences between home brewing and the commercial brewing.
  - 30 BBL vs 10 gallon
  - Hops never came through on homebrew version compared to commercial version.
  - Started experimenting and adapted certain processes.
  - Inspired many conversations and discussions (and beers).

Why is there something different between your batch and mine?

Hop Utilization

- Hop utilization is the percentage of alpha acids that are isomerized and remains in the finished beer.
  - The utilization of the bitter substances rarely exceeds 30% in commercial breweries and is often much lower.
  - O.G., brew house equipment, etc.
- Estimate Bitterness for your beer.
  - Well know for traditional hopping techniques



Tinseth (http://www.realbeer.com/hops/research.html)

Commercial - Utilization

- Calculate IBUS from an in-house formula, its used as a baseline when creating new recipes.
  - Know the number is not actual but know the results (in flavor).
  - Repeatable
- Perception vs. Numbers

"IBUs have become more of a marketing tool when really it's an analytical tool." - Eric Bean 2014

Method

- Recipe
  - Columbus Brewing Company's flagship IPA as base beer
- Brew 3 batches
  - 3 – Production 30BBL batches
  - 3 – 15 gallon Homebrew Versions
    - Change hopping schedule in each homebrew version
- Pitch same yeast at same pitching rates
- Ferment similar times and temperature
- Lab Analysis of all 6 batches
- Sensory Analysis of all 6 batches with taste panel

Columbus IPA (Base Recipe)

- 30 BBL (about 230- 5 gal HB Batches)
- OG 14.5P (1.059)
- FG 2.8P (1.011)
- SRM – 8
- IBUs – 55 (Estimate- More to come)
- 90 minute boil
- ABV – 6.3%

Columbus IPA- Hombrew (5 Gal)

- 9.5 Lbs Superior Pilsner
- 2.0 Lbs Vienna
- 0.5 Lbs C45

- 90 Min: Columbus – 0.5 Oz- 30.3 IBUs
- 45 Min: Centennial – 0.18 Oz- 6.2 IBUs
- 15 Min: Citra – 0.41 Oz- 11.2 IBUs
- Whirlpool: Simcoe – 0.44 Oz- 4.6 IBUs
- Whirlpool: Amarillo – 0.44 Oz – 3.25 IBUs
- Dry Hop - Simcoe – 4.8 Oz – 0 IBUs
- Dry Hop - Amarillo – 4.8 Oz – 0 IBUs

Hop IBU Estimation – 30 BBL Commercial

Hops	Add Time	CBC Est	Tinseth	Rager	BeerSmith
Columbus	90	34	27.7	33.6	24.7
Centennial Select	45	5	5.9	6.8	5.3
Citra	15	8	10.7	6.8	9.6
Simcoe	Whirlpool	4.6	0	0	4.6
Amarillo	Whirlpool	3.25	0	0	6.8
Simcoe	Dry	0	0	0	0
Amarillo	Dry	0	0	0	0
Total		54.85	44.3	47.2	51

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Homebrew Batches

- Pull 19 gallons wort from Kettle @ Boil
- Boil 19 gallons for 15 gallons @ Knockout

	#1 Hop Addition (Minutes)	#2 Hop Addition (Minutes)	#3 Hop Addition (Minutes)
Columbus	90	90	0
Centennial Select	45	0	0
Citra	15	0	0
Simcoe	0	0	0
Amarillo	0	0	0
Simcoe	Dry	Dry	Dry
Amarillo	Dry	Dry	Dry

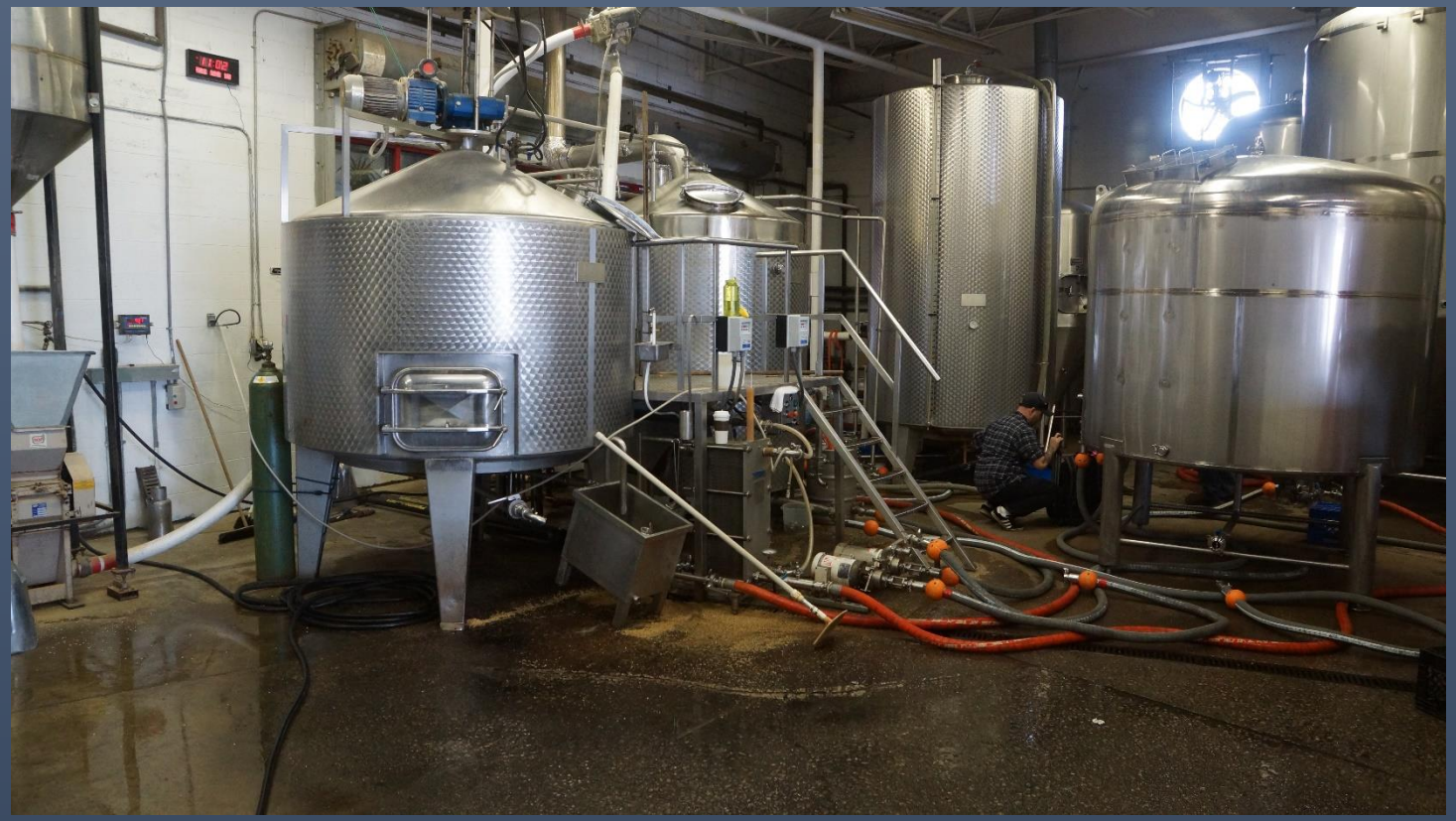
Hop Additions By IBU (15 Gallon)

		Batch #1			Batch #2			Batch #3		
	Target IBU	Time	Oz.	IBUs	Time	Oz.	IBUs	Time	Oz.	IBUs
Columbus	34	90	1.38	32	90	1.38	32	0	4	34
Centennial Select	5	45	0.52	6.8	0	1.25	6.5	0	1.25	6.5
Citra	8	15	.75	7.3	0	1	7.6	0	1	7.6
Simcoe	4.6	0	1.26	4.6	0	1.26	4.6	0	1.26	4.6
Amarillo	3.25	0	1.26	3.25	0	1.26	3.25	0	1.26	3.25
Total	54.85		5.2	54		6.2	54		8.8	56

Differences

- Kettle Geometry (in a perfect world)
  - Commercial – Sheer Volume – Lots of oils!
  - More contact heating surface area
  - Also better thermal mass
- Boil-off Volume
  - 30BBL
    - Steam Boiler – Heat applied from bottom and sides
    - Boil loss – 31/33BBL gallons (5%)
    - Older brewhouse – Battle between yield and quality
  - 15 gal
    - Direct – Heat applied only at bottom
    - Boil loss – 4.25 Gallons (15%)
    - More carmelization of the wort and darker SRM into the fermenter

Differences



Differences

- Whirlpool Vs Steep
  - 30 BBL
    - 30 minutes to transfer 30BBL wort to Whirlpool (less trub in whirlpool)
    - Hops added @ 10 minute whirlpool and start transferring to ferment from top
    - 60 minutes to transfer from Whirlpool thru heat exchanger to Fermenter
      - Hops still in contact with some wort during this time
    - Temperature remains relatively constant during this time 212F to 200F at Whirlpool
  - 15 Gal
    - 0 time to transfer for 15 gal version (More trub)
    - Stir Like Hell!!!!! Then rest…
    - 15 minutes to transfer from Whirlpool thru heat exchanger to Fermenter
    - Temperature drops from 212F to 187F during 30 min steep

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Lab Analysis

Thanks Rich Michaels
of
F.X. Matt Brewing for providing lab analysis for this talk

BU Results

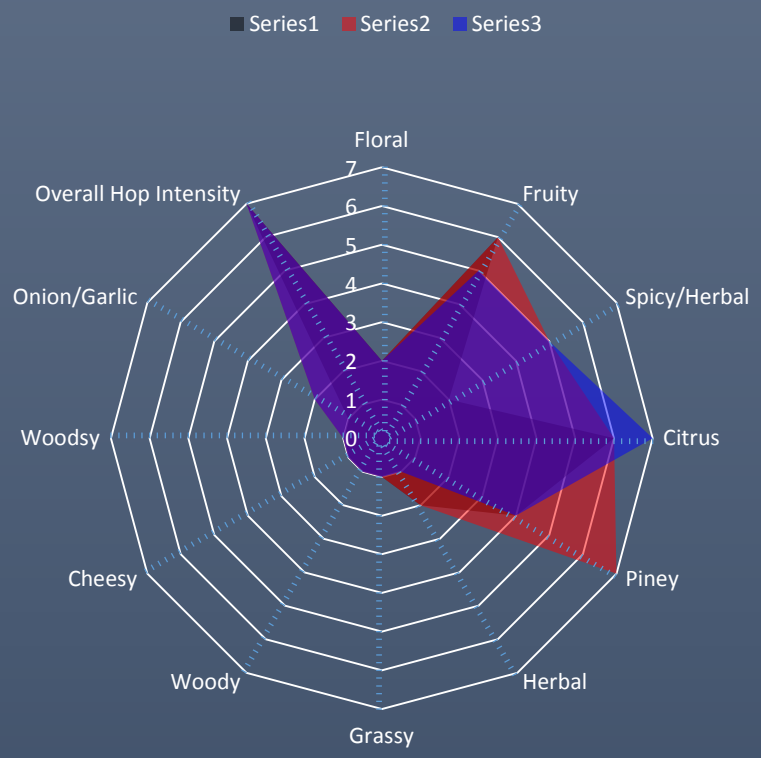
Batch	IBU
C1	65.0
C2	62.4
C3	64.0
HB1	64.9
HB2	---
HB3	61.5

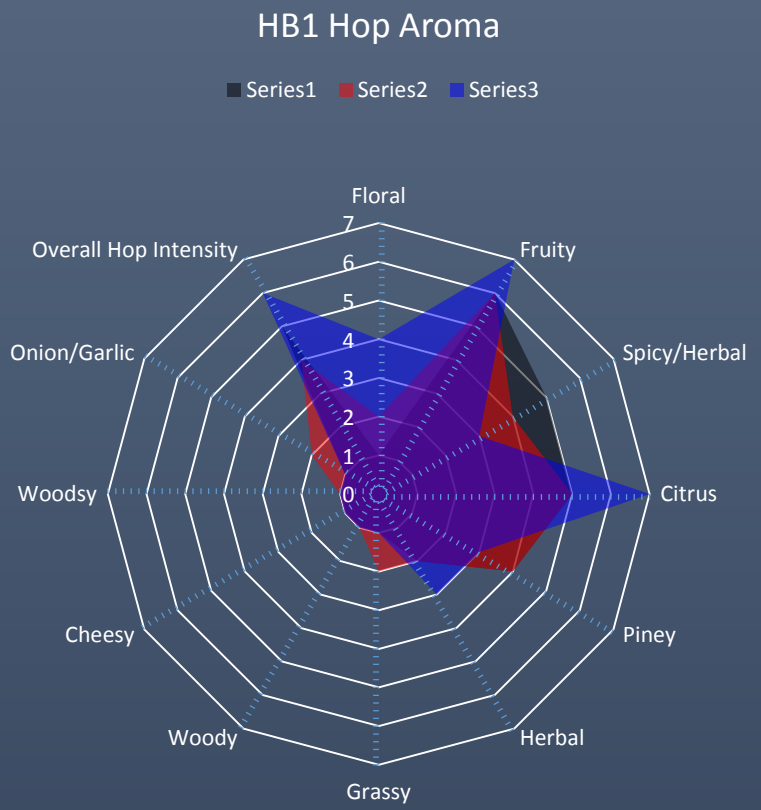
Sensory Analysis

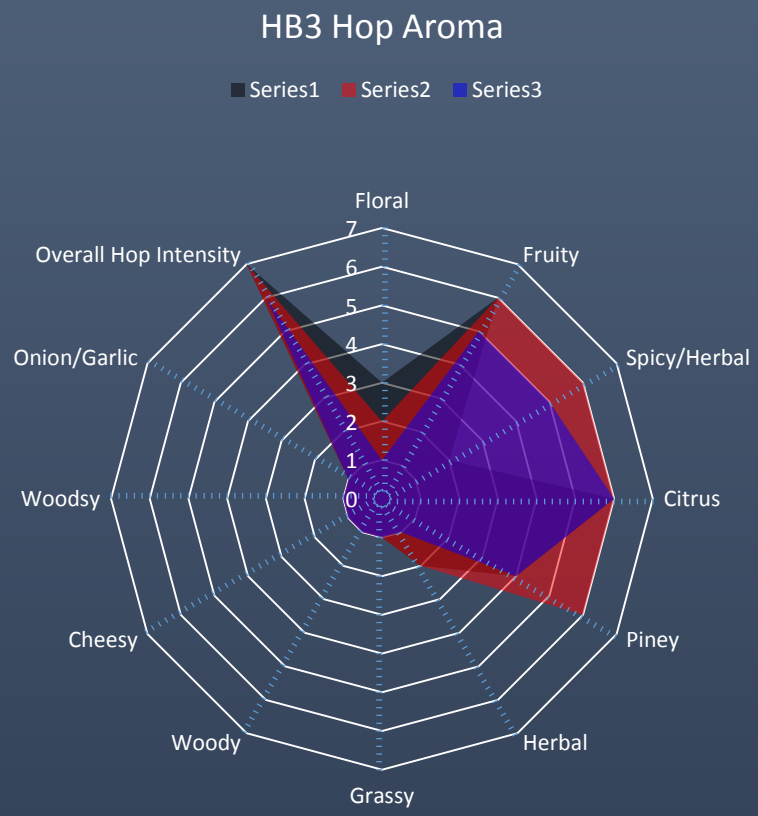
Sensory Overall

- Bitterness level was perceived similar in all beers
  - Commercial beers were perceived to have a cleaner fermentation character
- Hop aromatics and flavors in HB3 were most similar to the commercial versions
  - HB3 was much fresher – 2 mos.
- HB1 had similar bitterness, but perceived with less hop character in aroma and flavor.
- HB2 was more similar to HB3, but not as intense.

Aroma







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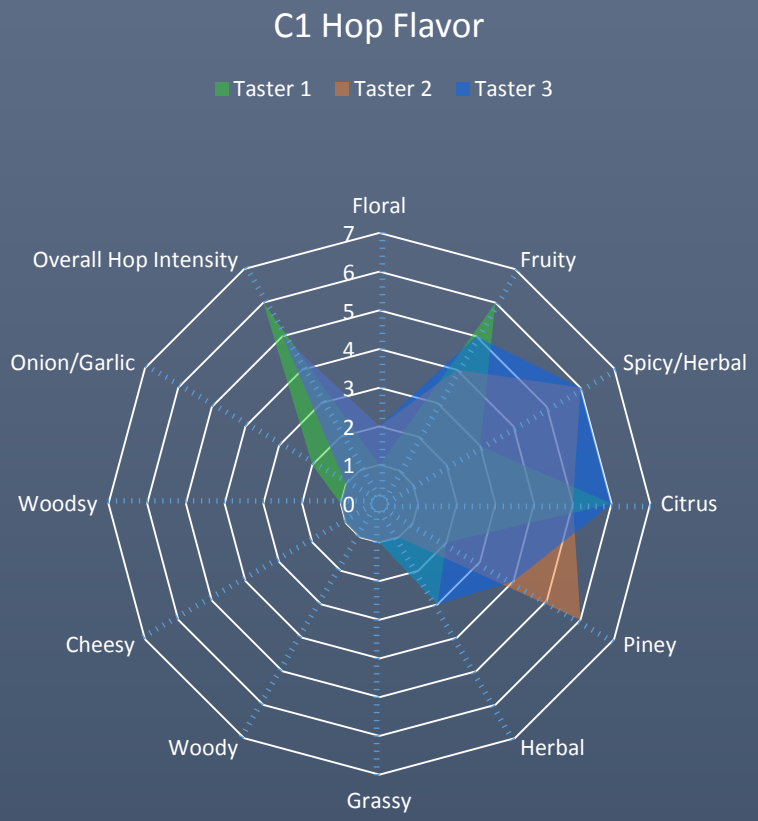
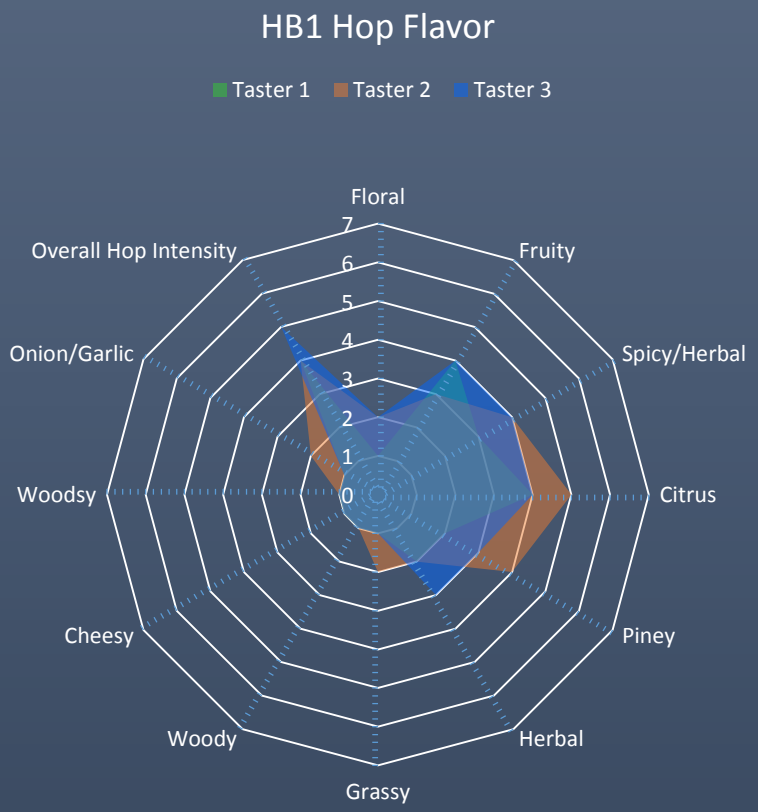
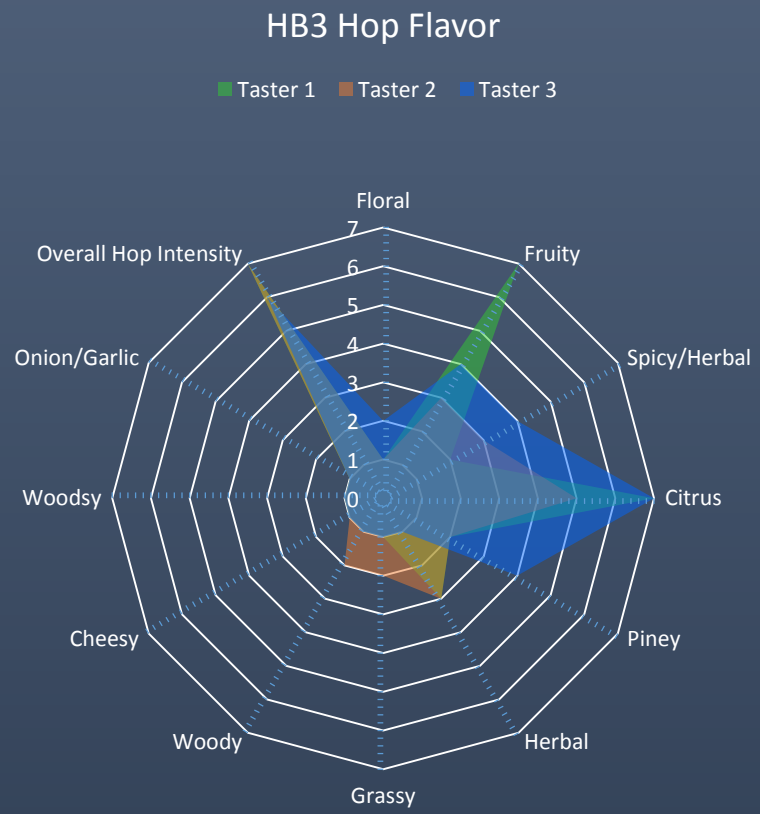
Flavor







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Conclusions

- Bitterness scales in a more predictive manner than does hop flavor or aroma.
  - Formulas under predict BU's but are fairly consistent.
  - Can get significant bitterness from late addition hops.
- Preliminary results suggest that greater hop mass contributes more hop aromas and flavors.
  - But excessive amounts are not needed
- The best method to understand hop utilization is to brew using your system and be consistent with how you estimate bitterness.
  - Adjust based on your results
  - Be Consistent

Thanks for coming!

Questions?