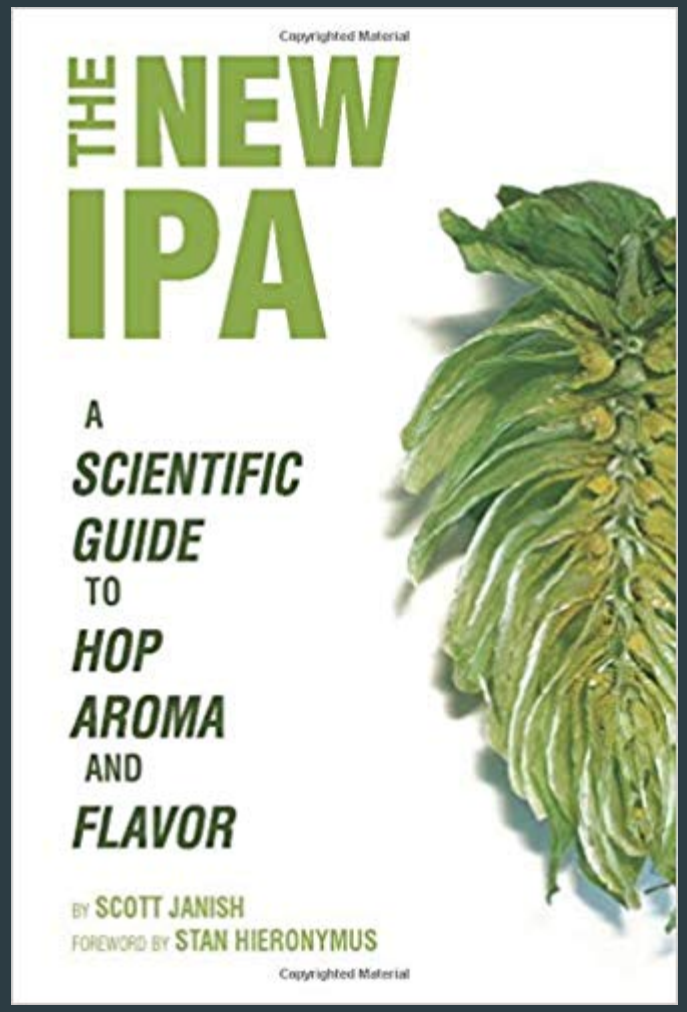
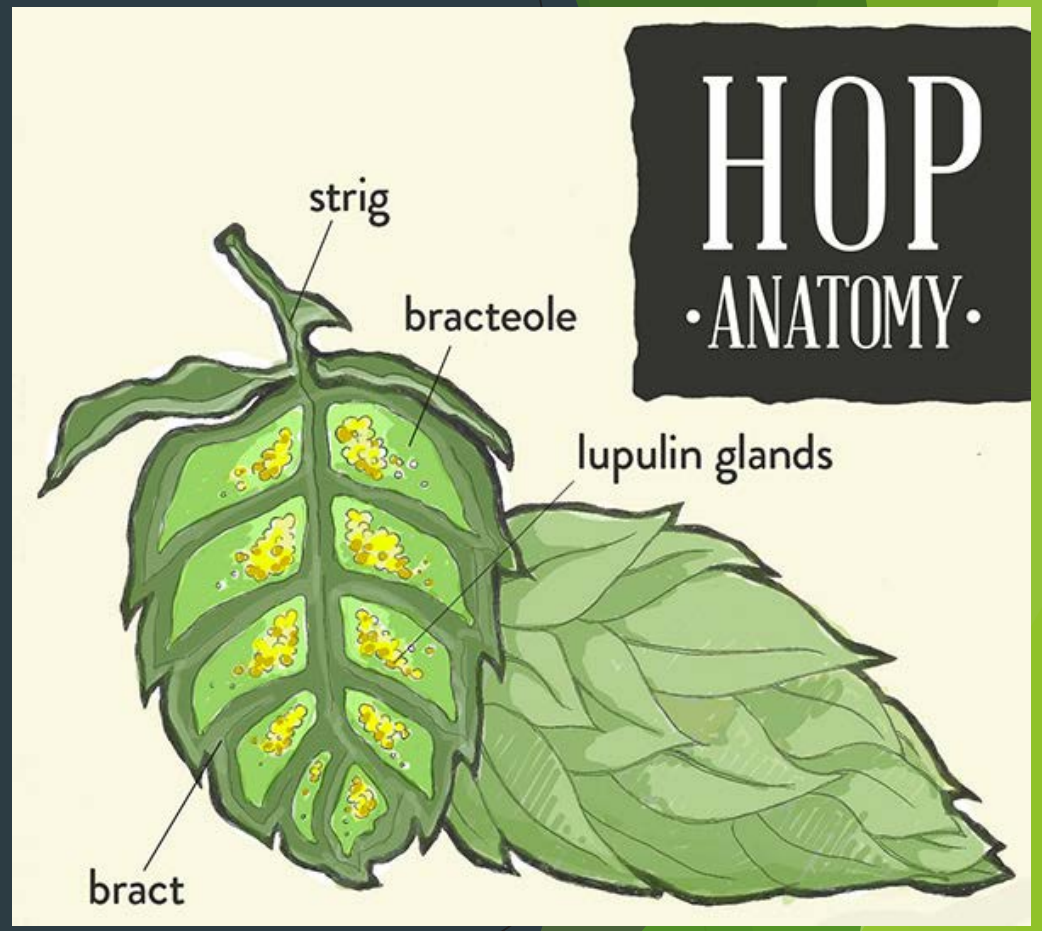


Book Review: *The New IPA*

Tucson Homebrew Club – July 2019

Hop Components

- Alpha acids
  - Humulone
  - Adhumulone
  - Cohumulone
- Beta Acids
- Essential Hop Oils
  - Hydrocarbons
  - Oxygenated components
  - Sulfur containing components



Essential Hop Oils

- Essential Hop Oils in Brewers Gold hop
  - Hydrocarbon components (40 – 80%)
    - Not very soluble and highly volatile
    - Aliphatic
    - Monoterpenes
      - Known for being spicy green and herbal, contains myrcene
    - Sesquiterpenes
      - Tend to be more woody
    - Examples of hydrocarbons are myrcene, cause α-humulne and ß-caryophyllene
  - Oxygenated components (30%)
    - More soluble than hydrocarbons
    - Largely responsible for fruit flavor and aroma components of beer
    - Consist of alcohols, aldehydes, acids, ketones, epoxides and esters.
  - Sulfur containing components (<3%)

Hot-side Hopping

- 2015 BrewingScience paper studied the effect of hop additions at various times using Saaz in a Pilsner recipe
- Floral compounds tend to decrease with boil time
- Spicy compound increased with boil time
- Whirlpool addition only was rated less spicy/herbal but high in grass/green resinous aroma
- Late addition only was rated as having a woody character
- Early addition only was rate as having a high spicy/herbal aroma
- Longer boil times can cause α-humulne and β-caryophyllene hydrocarbons to oxidize and remain in the finished beer.

Bittering Hops for NEIPAs

- Bittering hops for New English Style IPAs should be lower in α-humulne and ß-caryophyllene

Recommended	Not Recommended
Citra	East Kent Golding
Mosaic	Fuggle
Galaxy	Northern Brewer
Bravo	Perle
Galena	Hallertau
Columbus	Pacific Jade
Waimea	Nelson Sauvin

- Only for IPAs where fruit forward flavor and aroma is the goal!

Late Hop vs Dry Hop

- A 1983 study compared the difference in a beer made with Styrian Goldings hop extract added at two different times:
  - Last 5 minutes of the boil
  - Added as a dry hop addition
- Results showed higher levels of hydrocarbons in the beer that received the extract as a dry hop addition
- Dry hop beer showed higher hydrocarbon level (like myrcene) and had a more spicy/resinous flavor

- For NEIPAs, hops used for dry hopping should be lower in myrcene or used with restraint.
- High level of myrcene in a beer can create an green/resinous flavor

Late Hop Addition

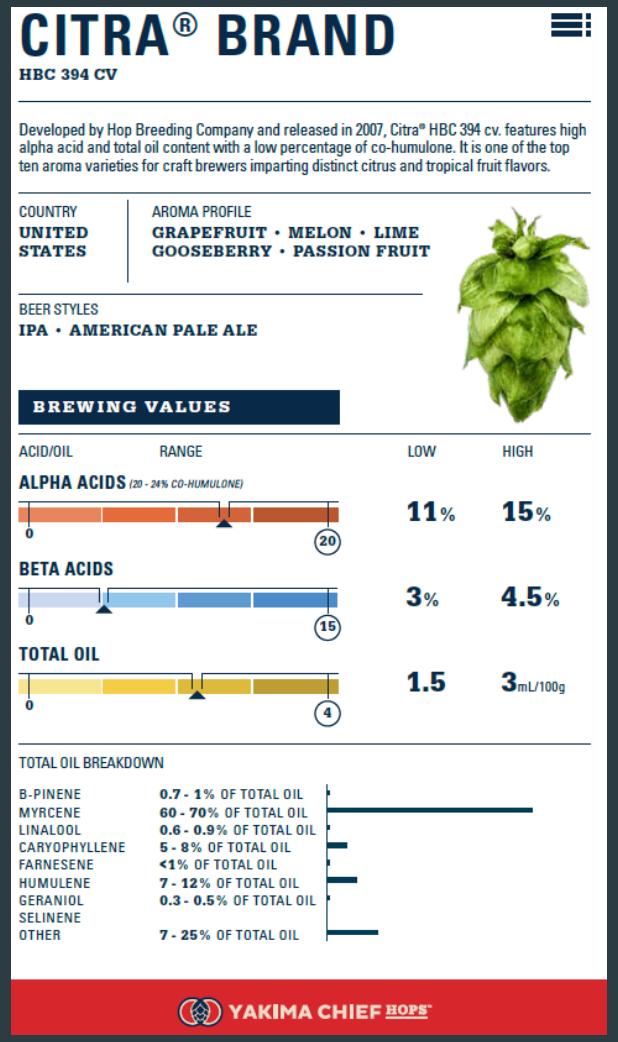
- Oxygenated components of a hop are largely responsible for fruit forward flavors.
- Common examples are Linalool and Geraniol
- Oxygenated components are much less volatile than hydrocarbons and are more likely to remain in the finished beer.
  - Myrcene transfers at a rate of less than 1%
  - Linalool transfers at a rate of 33%
- Myrcene is typically 100 times more abundant in a hop than Linalool
- Hops added during a whirlpool (post boil) will add primarily oxygenated components to the wort, like Linalool, while hydrocarbons like Myrcene will not remain.
- This should lead to an increase a fruit forward flavors without addition significant harshness to the beer.

Late Addition Hops for NEIPAs

- Late addition hops for New English Style IPAs should be high in total oil, specifically in linalool and geraniol

High Oil	Lower Oil
Citra	Cascade
Mosaic	Fuggle
Simcoe	Glacier
CTZ	Golding
Ekuanot	Northern Brewer
Bravo	Saaz
Centennial	Tettnang

YCH Page

- 

CITRA® BRAND

HBC 394 CV

Developed by Hop Breeding Company and released in 2007, Citra® HBC 394 cv. features high alpha acid and total oil content with a low percentage of co-humulone. It is one of the top ten aroma varieties for craft brewers imparting distinct citrus and tropical fruit flavors.

COUNTRY
UNITED STATES

AROMA PROFILE
GRAPEFRUIT • MELON • LIME
GOOSEBERRY • PASSION FRUIT

BEER STYLES
IPA • AMERICAN PALE ALE

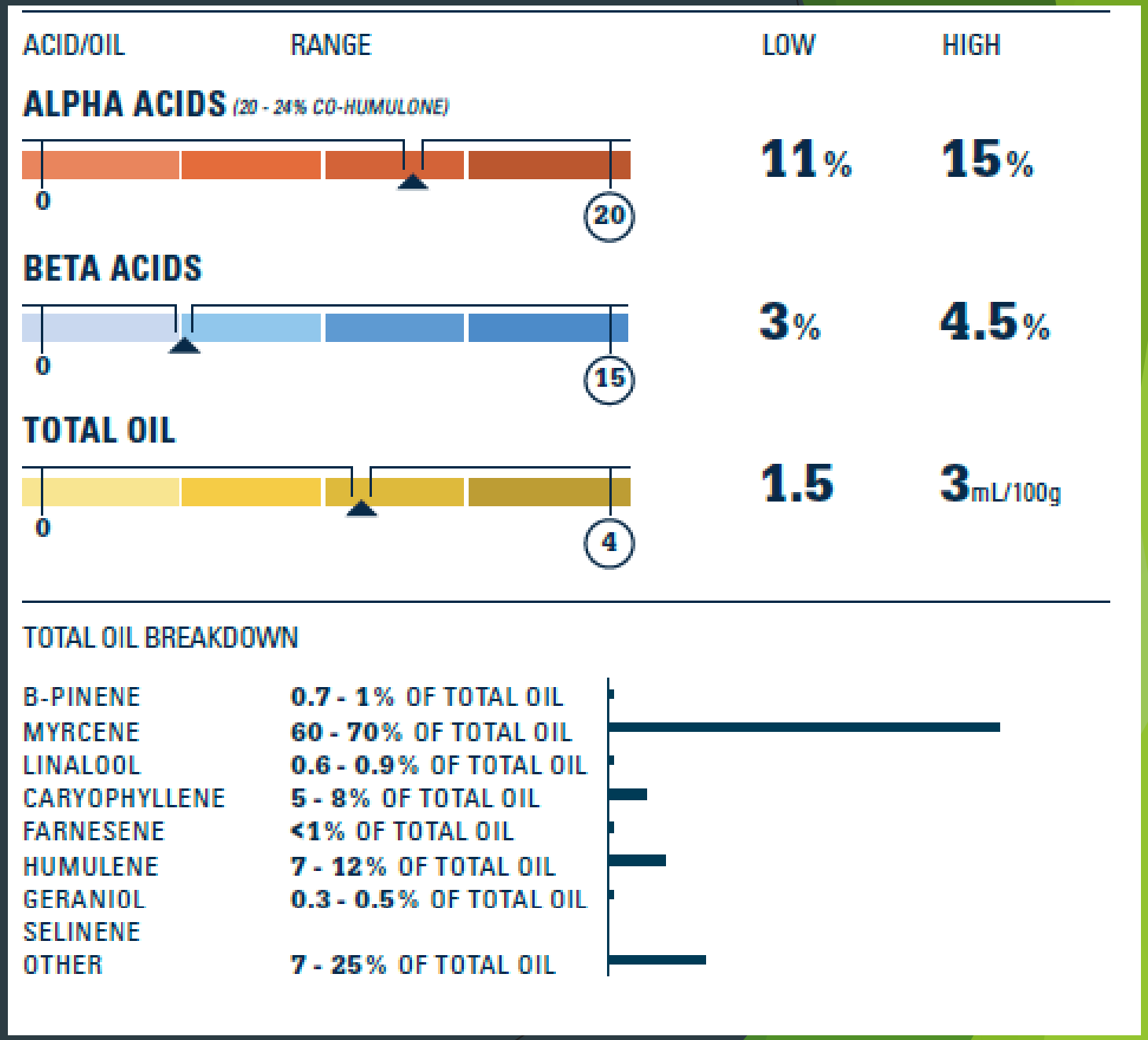
BREWING VALUES

ACID/OIL	RANGE	LOW	HIGH
ALPHA ACIDS (20 - 24% CO-HUMULONE)	0 – 20	11%	15%
BETA ACIDS	0 – 15	3%	4.5%
TOTAL OIL	0 – 4	1.5	3mL/100g

TOTAL OIL BREAKDOWN

B-PINENE	0.7 - 1% OF TOTAL OIL
MYRCENE	60 - 70% OF TOTAL OIL
LINALOOL	0.6 - 0.9% OF TOTAL OIL
CARYOPHYLLENE	5 - 8% OF TOTAL OIL
FARNESENE	<1% OF TOTAL OIL
HUMULENE	7 - 12% OF TOTAL OIL
GERANIOL	0.3 - 0.5% OF TOTAL OIL
SELINENE	
OTHER	7 - 25% OF TOTAL OIL

YAKIMA CHIEF HOPS



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HUMULENE	7 - 12% OF TOTAL OIL
GERANIOL	0.3 - 0.5% OF TOTAL OIL
SELINENE	
OTHER	7 - 25% OF TOTAL OIL

Citra

ACID/OIL	RANGE	LOW	HIGH
ALPHA ACIDS *(20 - 24% CO-HUMULONE)*	0 – 20	11%	15%
BETA ACIDS	0 – 15	3%	4.5%
TOTAL OIL	0 – 4	1.5	3 mL/100g

TOTAL OIL BREAKDOWN

B-PINENE	0.7 - 1% OF TOTAL OIL
MYRCENE	60 - 70% OF TOTAL OIL
LINALOOL	0.6 - 0.9% OF TOTAL OIL
CARYOPHYLLENE	5 - 8% OF TOTAL OIL
FARNESENE	<1% OF TOTAL OIL
HUMULENE	7 - 12% OF TOTAL OIL
GERANIOL	0.3 - 0.5% OF TOTAL OIL
SELINENE	
OTHER	7 - 25% OF TOTAL OIL

Fuggle

ACID/OIL	RANGE	LOW	HIGH
ALPHA ACIDS *(25 - 30% CO-HUMULONE)*	0 – 20	3%	5.6%
BETA ACIDS	0 – 15	2%	3%
TOTAL OIL	0 – 4	0.7	1.4 mL/100g

TOTAL OIL BREAKDOWN

B-PINENE	
MYRCENE	24 - 28% OF TOTAL OIL
LINALOOL	
CARYOPHYLLENE	9 - 13% OF TOTAL OIL
FARNESENE	5 - 7% OF TOTAL OIL
HUMULENE	33 - 38% OF TOTAL OIL
GERANIOL	
SELINENE	
OTHER	14 - 29% OF TOTAL OIL

Whirlpool Temperature

- Takako Inui, a Specialist in the Beer Development Department at Suntory Beer Ltd in Japan ran a test to determine the effect of the whirlpool temperature on hop flavor and aroma:
  - Measured results
    - 185° F resulted in a beer with the highest measured linalool
    - 167° F and 203° F resulted in a beer with slightly less linalool
  - Subjective results
    - 203° F scored highest for citrusy, spicy, and ester descriptors.
    - 185° F scored highest for floral and herbal descriptors
    - 167° F scored lowest in all descriptors except for woody

Whirlpool Duration

- Rock Bottom Brewery ran an experiment with four variations of late hop additions.
- 1) Short: 1 lb of Amarillo per bbl at end of boil, with 50 min of postboil residence
- 2) Long: 1 lb of Amarillo per bbl at end of boil, with 80 min of postboil residence
- 3) Half: 0.5 lb of Amarillo per bbl at end of boil, with 80 min of postboil residence and 0.5 lb of Amarillo per bbl as dry hops
- 4) Dry: 1 lb of Amarillo per bbl as dry hops, with no kettle hops

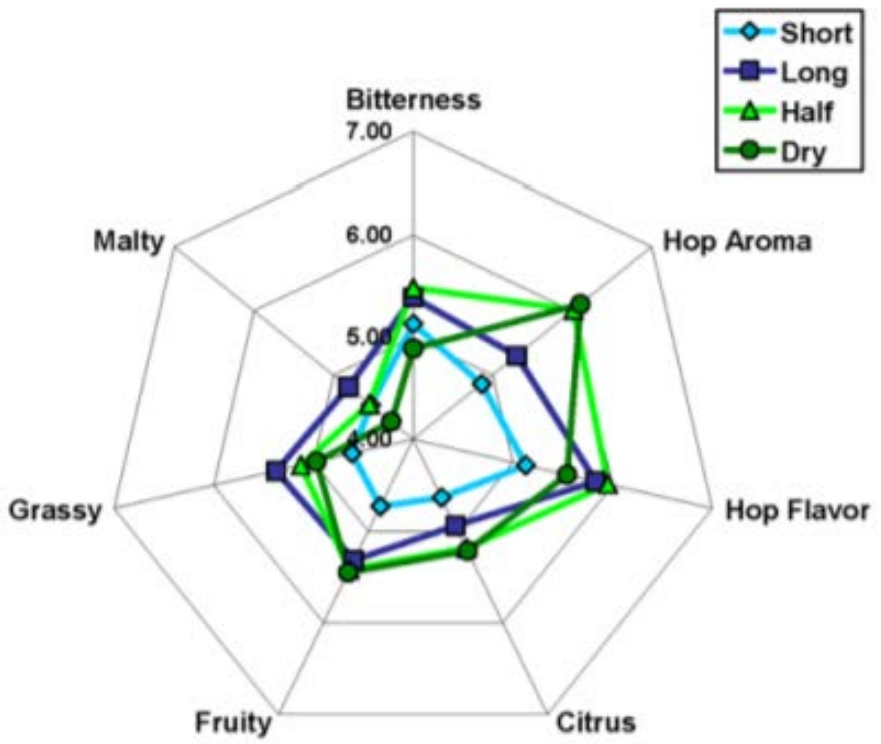

Figure 1. Mean scores for each characteristic analyzed for four hopping procedures. The graph metric is from 4 to 7.

Whirlpool Duration

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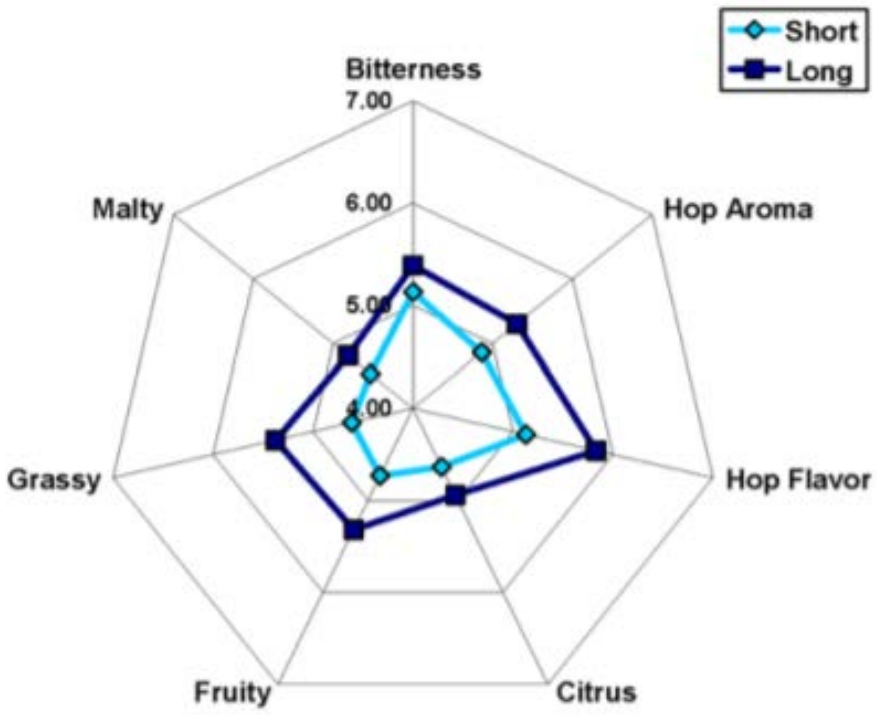

Figure 2. Comparison of results of short- and long-hopping procedures. The graph metric is from 4 to 7.

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- *Maximizing Hop Aroma and Flavor Through Process Variables, Van Havig, Rock Bottom Breweries, Portland, OR.*
  - MBAA TQ doi:10.1094/TQ-47-2-0623-01