TECHNIQUES FOR BREWING AWESOME IPAs

New process developments, new ingredients and new IPA styles
Objectives

- Review IPA style guidelines and brewing techniques
- Review some new developments with hop varieties and hop research
- Hopping schedules in the brewhouse
- Dry-hopping techniques
- Brewing IPA’s with fruit or botanicals
- Style variations of IPA:
  - Double/Imperial IPA
  - Black IPA
  - Belgian IPA
  - Wit/White IPA
  - Session IPA/ ISA
  - IPL
  - What’s next?
The IPA Revolution

• Early craft brewers inspired by Ballantine’s IPA
• Later craft brewers inspired by Anchor Liberty Ale, Sierra Nevada Celebration Ale, and Grants IPA
• American IPA now consistently the highest entered category at both GABF and WBC
• IPA Variations:
  – Double/Imperial IPA
  – Black IPA
  – Belgian IPA
  – White IPA
The IPA Revolution! Ingredients

• Malt:
  – American IPA: Pale Ale malt with small % of crystal or Munich
  – English IPA: 100% English Pale Ale Malt-or to be really authentic, 100% Extra Pale (aka White) malt.

• Hops:
  – American: The 4 “C”s, Amarillo, Simcoe, Citra, and whatever is new, intense, fruity and dank!
  – English: English hops, maybe some small amounts of American hops in the blend.
  – New Zealand/Australia
  – German (????)

• Yeast: WLP001 or WY1056, reasonably clean ale yeast
• Water: Varies, usually with added salts
The IPA Revolution! Brewing

• Single Infusion Mash
• Sparge
• 60-90 minute boil
• Multiple/variable hopping regimes
  – Target 50-75 IBU
  – 0.5-1.5 lbs/bbl (0.26-0.77 oz/gallon)
• Dry-hop at 0.25-1.5 lbs/bbl (0.13-0.77 oz/gal)
# Summary of IPA Brewing Parameters

<table>
<thead>
<tr>
<th>IPA RECIPES</th>
<th>Recipe Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Burton IPA</td>
<td>Scottish IPA</td>
</tr>
<tr>
<td><strong>Pale Malt %</strong></td>
<td>100%</td>
</tr>
<tr>
<td><strong>Crystal Malts used</strong></td>
<td>no</td>
</tr>
<tr>
<td><strong>Typical crystal %’s</strong></td>
<td>na</td>
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<tr>
<td><strong>Adjuncts</strong></td>
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<tr>
<td><strong>%’s</strong></td>
<td>na</td>
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<tr>
<td><strong>Roasted Malts</strong></td>
<td>none</td>
</tr>
<tr>
<td><strong>Mash Conversion Time</strong></td>
<td>120 minutes</td>
</tr>
<tr>
<td><strong>OG °P (SG)</strong></td>
<td>15.0-18.75 (1.060-1.075)</td>
</tr>
<tr>
<td><strong>Fermentability</strong></td>
<td>High!</td>
</tr>
<tr>
<td><strong>Target TG °P(SG)</strong></td>
<td>0.75-5 (1.003-1.020)</td>
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<tr>
<td><strong>abv target</strong></td>
<td>5-7%</td>
</tr>
<tr>
<td><strong>Typical Hopping Rates</strong></td>
<td>5-6.0</td>
</tr>
<tr>
<td><strong>Ounces per gallon</strong></td>
<td>2.6-3.2</td>
</tr>
<tr>
<td><strong>Recommended hop varieties</strong></td>
<td>East Kent Goldings</td>
</tr>
<tr>
<td><strong>Dry Hop (lbs/bbl)</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Multiple Dry-hops</strong></td>
<td>occasionally in casks</td>
</tr>
<tr>
<td><strong>IBU in finished beer</strong></td>
<td>~70</td>
</tr>
</tbody>
</table>

- **Comments**: Long, low intensity wort boil, 2-3 hours. Ferment cool! Most gravities dropped to 40-60. Based on GABF guidelines. Real examples are all over the map. More recent versions moving to less crystal malt. Age 12 months or more.
American IPA

- American-style India pale ales range from gold to copper or red/brown in color. Chill haze is allowable at cold temperatures and hop haze is allowable at any temperature. American-style India pale ales possess medium maltiness which contributes to a medium body. These beers are perceived to have medium-high to very high hop bitterness, a full flowery hop aroma and a strong hop flavor. The style is further characterized by floral, fruity, citrus-like, piney, resinous, or sulfur-like American-variety hop character. Note that one or more of these American-variety hop characters is the perceived end, but the hop characters may be a result of the skillful use of hops of other national origins. They are medium bodied. Fruity-ester flavors and aromas are moderate to very strong. Diacetyl can be absent or may be perceived at very low levels. The use of water with high mineral content results in a crisp, dry beer. *English and citrus-like American hops are considered enough of a distinction justifying separate American-style IPA and English-style IPA categories or subcategories. Hops of other origins may be used for bitterness or approximating traditional American or English character. See English-style India Pale Ale*

- Original Gravity (ºPlato) 1.060-1.075 (14.7-18.2 ºPlato) ● Apparent Extract/Final Gravity (ºPlato) 1.012-1.018 (3-4.5 ºPlato) ● Alcohol by Weight (Volume) 5-6% (6.3-7.5%) ● Bitterness (IBU) 50-70 ● Color SRM (EBC) 6-14 (12-28 EBC)
ENGLISH IPA

This is pale gold to deep copper-colored ale. Chill haze is allowable at cold temperatures. English-style India pale ales possess medium maltiness and body. Most traditional interpretations of English-style India pale ales are characterized by medium to medium-high hop bitterness with a medium to medium-high alcohol content. Hops from a variety of origins may be used to contribute to a high hopping rate. Earthy and herbal English-variety hop character is the perceived end, but may be a result of the skillful use of hops of other national origins. The use of water with high mineral content results in a crisp, dry beer, sometimes with subtle and balanced character of sulfur compounds. It has a medium to high, flowery hop aroma and may have a medium to strong hop flavor (in addition to the hop bitterness). Fruity-ester flavors and aromas are moderate to very strong. Diacetyl can be absent or may be perceived at very low levels. Hops of other origins may be used for bitterness or approximating traditional English character.

Original Gravity (ºPlato) 1.050-1.064 (12.5-15.7 ºPlato) ● Apparent Extract/Final Gravity (ºPlato) 1.012-1.018 (3-4.5 ºPlato) ● Alcohol by Weight (Volume) 4-5.6% (5-7%) ● Bitterness (IBU) 35-63 ● Color SRM (EBC) 6-14 (12-28 EBC)
IPA new developments-HOPS

- New trends in hop research
- New Hop Varieties
  - New Southern Hemisphere varieties
  - New European varieties
  - New American varieties
- Hopping schedules in the brewhouse
- Dry-hopping techniques
Hop Flavor Compounds

- Myrcene: spicy, petroleum,
- Caryophellene
- Farnesene
- Humulene
- Linalool: floral, citrus
- Geraniol: floral, rose
- Limonene: citrus, fruity
- Terpineol: woody, resinous
- Nerolidol: rose, apple, woody
- Beta-Pinene: spicy, piney
- Citronellol: citrus, lemon
- Cadinene: citrus
Hop research

• Studies being done to analyze hop flavor through the brewing process
  – Bio-transformation of hop oil by yeast:
    • Examples: Geraniol to B-Citronellol
  – Influence of yeast ester production on hop aromas
  – Fermentation temperature and pitching rate-lower can increase hop flavors

• Hop Processing impact on flavor
  – Early vs late harvest
  – Low or high temperature kilning
  – How to minimize garlic/onion?
Hop research

- Hop Pre-isomerization to increase utilization-up to 65%
- Non-iso-humulone bittering compounds
- Impact of oxidation on hop bitterness and hop flavor
- Direct pelletizing-no baling: is there a flavor difference?
- Loose pack pellets vs. hard pack pellets
Hop Research

• The “real” impact of mash hopping, first wort hopping???

• Hop breeding programs taking on a new life
  – Public: WSU, USDA
  – Private: Hop Breeding Companies, Farmers, and Hop Brokers
  – Occurring in all major hop growing regions
Some new hop varieties
Southern Hemisphere Hops

• Nelson Sauvin:
  – Positives: Dank, dank, dank. Wine-like, citrus and resin
  – Negatives: very bitter on the finish. (??, ok, how is this a negative?)
  – Overall: huge hop, very favorable.

• Motueka:
  – Positives: Intense herbal, lemon, peach, spicy/coriander, citrus and pineapple
  – Overall: Interesting hop flavors!
European Hops

• Strisselspalt:
  – Positives: Herbal, cedar, very tea like, raspberry/blueberry, lemongrass, lots of fruit,
  – negatives: earthy, menthol, bitterness lingers.
  – Overall: Surprising in complexity and intensity of flavors. Some really liked this hop, others not so much.

• Sterling (Saaz/Mt Hood parentage). Actually grown in USA
  – Positives: light pine, spicy, citrus and resin
  – Negatives: Slight woody and drying.
  – Overall: Surprisingly intense and very nice. "pure" hop.
Citrus
Dankness
Floral
Garlic/Onion
Grassy
Spicy
Stone Fruit
Tropical Fruit
Berry
Woody/Tobacco
Piney/Resiny
Earthy

Comptoir Agricole Organic Premiant
Mean
Standardized Value
MERKUR:
Orange, Rosey, Nectarine, Melon, Garlic, Dank, Onion, Orange, Skunk Weed, Dank, Tobacco, Ashy, Citrus, Garlic X2, Onion, Woody, Peppery, Sharp Finish
HERKULES
Over the Top Citrus, Orange Juice, Skunky, Orange X2, Earthy X2, Peppermint, Lemon, Rose, Fruity, Berry, Piney, Pepper, Woody, Grassy X2, Nelson Like, Garlic X2, Mango, Tropical Fruit, Dank, Intense, Resin, Onion, Woody, Mint
HERSBRUCKER
Big Grapefruit, Lemon, Rosey, Peach, Apricot X2, Mango, Melon, Blueberry, Resin, Black Pepper, Tobacco, Mushroom, Grassy, Nectarine X2, Rose Petal, Plum, Geraniums, Herbal, Citrus Zest, Woody, Lots of Stone Fruit, Stone Fruit X2, Spicy Aroma X2, Minty, Tobacco, Classic Hop
**HALLERTAU BLANC**

Alpha: 10.5%

Aroma — Flowery-fruity aroma. Passion fruit, grapefruit, gooseberry and pineapple

2 1/2 oz Raw Hop (71 grams)

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**HUELL MELON**

Alpha: 7.2%

Aroma — Fruity aroma. Strawberry and honeydew melon nuances

2 1/2 oz Raw Hop (71 grams)

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**MANDARINA BAVARIA**

Alpha: 8.5%

Aroma — Fruity aroma, intense mandarin and citrus note

2 1/2 oz Raw Hop (71 grams)
Hallertau Blanc
Comments: Peppermint (X2), tobacco, fruit (X4), stone fruit, mango, grapefruit, peach, melon, vanilla ice cream, mango, coconut (X2), delicious, peppers, dank (X2), mild, elegant, citrus, floral, flowers, herbs, pine, spice, refreshing, lychee, grapefruit.
Mandarina Bavaria
Comments:
Peach, berries, stone fruit (X2), woody (X3), skunk, cigar, earth (X2), dusty, peach, melon, citrus (X2), white wine, lipton tea w/lemon, kiwi, peppery, interesting, pleasant, mango, tangerine, honey, raspberry, bay leaf.
Huell Melon
Comments:
Melon (X2), passion fruit, pine sap, peach, cantalope, honey dew, pleasant fruit, fruit mid-palate, hay, resiny, not a lot of fruit, pungent melon, surprisingly intense, woodiness, tropical punch, earthy tones (X2), flowery, apricot.
English Hops

- **EKG-**
  - **Positives:** Blend of earthy and light citrus. Classic
  - **Negatives:** lack of intensity. A bit harsh
  - **Overall:** Classic English Hop

- **Target-**
  - **Positives:** Orange/tangerine, earthy, intense flavor, well rounded
  - **Negatives:** aromatics a bit mild, Resiny finish, grassy.
  - **Overall:** Sophisticated English hop with nice citrus notes.

- **Pilgrim-**
  - **Positives:** Intense resiny, earthy, herbal, orange citrus, lemon tea
  - **Negatives:** toffee, Woody, Lunch meat/salty.
  - **Overall:** Intense hop with classic English hop flavors. Some interesting potential.
English Hops

- **Sonnet**
  - **Positives:** Peach, orange, lemon, pine, peppery, melon
  - **Negatives:** grassy
  - **Overall:** Fresh, clean, very pleasant hop with mild blend of flavors.

- **Admiral**
  - **Positives:** Floral, pine, light orange, lemon and grapefruit, coconut, soft, earthy
  - **Negatives:** Wet grass, menthol, Butyric, vegetal
  - **Overall:** Nice hop providing some classic and complex English flavors.

- **Sovereign**
  - **Positives:** Melon, earthy, honey, berry, grapey, tea, pear
  - **Negatives:** Sulfury, mild, bitter end
  - **Overall:** Unique twist on classic English hop character. Interesting fruit flavors. Good for use in English ales.
New American hop varieties

- Citra- **Positives:** Dank, citrusy, resiny. Citrus a blend of grapefruit and tangerine, apricot. **Negatives:** Dank, trace onion. Overall: Great hop with big, intense flavors! Nice blend of citrus fruits.
- Calypso- **Positives:** Cherry, berries, pear, fresh, citrus-lemon and orange, herbal, mellow. **Negatives:** slight woody, too mild? Overall: Pleasing hop flavors, but not as intense as some.
- El Dorado- Spicy, minty and lemony
- Steiner 01210 (Lemon drop)
- Steiner 06300 (Orange Chocolate)
Citrus
Dankness
Garlic/Onion
Grassy
Earthy
Woody/Tobacco
Spicy
Floral
Stone Fruit
Tropical Fruit
Berry
Piney/Resiny
Hop Union Amarillo
Mean
Standardized Value
MOSAIC
HBC 366
Like! Very fruity, mangos and peaches. Peachy, nice spice, ripe citrus flowers. Peach. Nice! Tropical fruit, soft, peaches, very strong. 😊 Interesting and unique, low resin, strong fruit. One of the favorites of the set.
BELMA
Floral, fruit, lemon cleaner, grapefruit (X2), nectarine, earth, dust, mint, wintergreen, grape, Welch’s grape juice, mango, peaches, Fruit Stripe gum, nutty, over-ripe stone fruit, wine-like, strong berry-raspberry, blueberry, grape juice, less citrus, melon, berry, tropical, orange, soil, peppery, strawberry.
Cascade from 2 fields
Hopping Schedules in the brewhouse

Traditional

• Bitter:
  – Largest addition
  – Usually 1-2 varieties
  – Often not highly aromatic

• Flavor:
  – Late boil addition
  – Typically 1-2 varieties
  – More aromatic varieties

• Aroma
  – Whirlpool rest addition
  – 1-2 varieties
  – Highly aromatic

New/Old way

• Bitter:
  – Very little to none, except 1\textsuperscript{st} wort hopping
  – Extract instead of pellets or whole hops

• Flavor
  – Very large addition
  – Many varieties
  – End of boil

• Aroma:
  – Very large addition
  – Many varieties
  – Highly aromatic!
Hop Bursting vs. “Traditional” hopping

• Majority of wort bitterness comes from late stage additions
• Results in a more refined bitterness (?)
• Longer lasting, more complex hop aromatic
Dry-Hopping Techniques

Traditional
• One or two varieties
• Total 0.25-1 pound/bbl
• 5-14 days residence

New School
• Many varieties
• Multiple short stages
  – All flavor extracted within 36 hours?
  – 5-7 days
• Total addition-2-3 lbs/bbl
Dry-Hop considerations

• Temperature of beer-warmer = more flavor extraction
• Absence of yeast
• Use of hop oils to augment dry-hop aroma and flavor
• Beer loss when using massive hop additions, multiple dry-hops
Pale American-Belgo Style Ales

Pale styles of this beer are gold to light brown in color. Chill haze may be evident. They are either 1) non-Belgian beer types portraying the unique characters imparted by yeasts typically used in fruity and big Belgian-Style ales or are 2) defined Belgian-style beers portraying the unique character of American hops. – These beers are unique beers unto themselves. Yeast derived characters such as banana, berry, apple, sometimes coriander spice-like and/or smoky-phenolic characters should be portrayed with balance of hops and malt character when fermented with such yeast. American hop aroma, flavor and bitterness not usually found in traditional Belgian-styles will have a medium to very high aroma, flavor and bitterness character. Color falls in the blonde to amber range. Esters should be at medium to high levels. Diacetyl should not be evident. Sulfur-like yeast character should be absent. No Brettanomyces character should be present. An ale which exhibits Brettanomyces character would be classified as “American-style Brett Ale." A statement by the brewer that could include information such as style being elaborated upon, and other information about the entry with regard to flavor, aroma or appearance, is essential for fair assessment in competitions. Beers with Brettanomyces may be subcategorized under this category.

Original Gravity (ºPlato) Varies with style • Apparent Extract/Final Gravity (ºPlato) Varies with style • Alcohol by Weight (Volume) Varies with style • Bitterness (IBU) Varies with style • Color SRM (EBC) 5- 15 (10-30 EBC)
Belgian IPA brewing Tips

• Pick hops that complement the yeast flavors.
  – Amarillo, NZ hops-tropical fruit
  – Citrusy hops can get overwhelmed
  – Garlicky hops can clash
• Watch bitterness levels and quality of bitterness
• Use lower fermentation temperatures to promote isoamyl acetate (banana) production instead of 4-Vinyl Guiacol (clove)
• Will this beer age better than one fermented with American yeast????
Imperial IPA

Imperial or double India pale ales range from gold to chestnut red/brown in color. Chill haze is allowable at cold temperatures and hop haze is allowable at any temperature. Imperial or Double India Pale Ales have medium to high malt character. Hop character reflects very high hop bitterness, flavor and aroma. Hop character should be fresh and lively and should not be harsh in quality. The style may use any variety of hops. Alcohol content is medium-high to high and notably evident. These beers have a high level of fruity esters. Imperial or double India pale ales have medium-high to full body. Diacetyl should not be perceived. The intention of this style of beer is to exhibit the fresh and bright character of hops. Oxidative character and aged character should not be present.

**Original Gravity (ºPlato)** 1.075-1.100 (18.2-23.7 ºPlato) ● **Apparent Extract/Final Gravity (ºPlato)** 1.012-1.020 (3-5 ºPlato) ● **Alcohol by Weight (Volume)** 6.0-8.4% (7.5-10.5%) ● **Bitterness (IBU)** 65-100 ● **Color SRM (EBC)** 5-16 (10-32 EBC)
Double/Imperial IPA Brewing Tips

• Little to no specialty malts.
  – 5% max
• Blend in English Pale Malt to get malt complexity
• Mash rest at 149-153°F to maximize fermentability
  – Alcohol adds body and perception of sweetness!
• Brewing sugars are OK!
• Hop everywhere! Don’t be timid
Black IPA

American-style black ales are very dark to black. The perception of caramel malt and dark roasted malt flavor and aroma is at a medium level. High astringency and high degree of burnt roast malt character should be absent. Hop bitterness is perceived to be medium-high to high. Hop flavor and aroma is medium-high. Fruity, floral and herbal character from hops of all origins may contribute character. American-style black ale has medium body.

Original Gravity (ºPlato) 1.056-1.075 (14-18.2 ºPlato) • Apparent Extract/Final Gravity (ºPlato) 1.012-1.018 (3-4.5 ºPlato) • Alcohol by Weight (Volume) 5-6% (6 - 7.5%) • Bitterness (IBU) 50-70 • Color SRM (EBC) 35+ (70+ EBC)
Black IPA

• Dehusked black malt at 4-6% of grain bill.
  – Weyermann Carafa Special II or III
  – Briess Midnight Wheat
• Minimal specialty malts otherwise
• Avoid chocolate or black malt
• Brewing sugars are OK!
• Use double IPA hopping techniques (regardless of gravity)
Session IPA

• Lower gravity pale beers using IPA or Double IPA hopping rates
• Typically <4.5% abv by volume
• Hop Bursting works well here!
• Higher mash temperature
• Some dextrin malts OK to increase body
• Don’t overdo the crystal malt
WIT IPA

• Belgian wit with American IPA hopping regime
• Coriander and Orange peel can play well with hops
  – Depends on the hop variety-emphasize citrusy
• Experiment with other botanicals
India Pale Lager

- IPA hop profile in a lager
- Similar to hoppy/Imperial Pilsner?
- Hop varieties-2 approaches
  - American “traditional” IPA hops
  - Traditional European lager hops-or some of the newer varieties
- Abv strength can vary.
Other trends in IPA

• Smoked IPA
  – Oskar The G’rauch
• Adding Botanicals-flavor matching
  – Lemon verbena
  – Citrus peel-lemon zest, orange zest, grapefruit, tangerine
  – Lavender
  – Hibiscus
  – Dandelion
  – Coriander
  – Grains of paradise
  – Lemon thyme, rosemary
• Adding Fruits
  – Mango
  – Peppers: Jalapeno, Habanero
  – Berries: Blueberries
  – Peach or apricot
Odd ingredients in IPA

• Coffee
  – Use citrusy hops
  – Add coffee post boil and/or post fermentation
  – Aleman/Two Brothers/Stone Dayman Coffee IPA
    • 0.9lbs/bbl (0.46 oz/gallon) unground coffee whirlpool,
    • same addition rate, but coarsely ground post ferment-2 days aging on coffee, cold.

• Coconut:
  – Use tropical hops-Amarillo, Citra, Helga
  – Add coconut post boil and/or post fermentation
  – Robert Masterson/Ryan Reschan/Rip Current/Stone R&R Coconut IPA
    • 2lbs /bbl (1.1 oz/gallon) brewhouse
    • Same addition rate

• Tea leaves:
  – Add in brewhouse? Watch for increase in astringency and chill haze
  – Add post ferment
  – Baird/Ishii/Stone Japanese Green Tea IPA
    • No brewhouse tea addition
    • 1.5 lbs/bbl (0.77 oz/gallon) post ferment cold steep-3-4 days
  – Flavored teas are fun
Final thoughts

• Don’t be timid with late hopping and dry-hopping!
  – 1-2 lbs/bbl (0.5-1 oz/gallon), or more!
• Remember the classic American hops (Cascade, Centennial, Sterling, Cluster) these are excellent hops for IPA
• Blending lots of hops can make for amazing beers
• Don’t be afraid to try botanicals or unusual hops in your IPA