

Imperial IPA: History, Brewing Techniques, Style Evolution.

<http://destroy.net/brewing/IIPA.pdf>



Nathan Smith <nate@destroy.net>
The Brewing Network Sunday Session
www.thebrewingnetwork.com
July 6th, 2008



Imperial IPA - Outline

- Introduction
- History
- Commercial Examples
- Example Recipes
- Key brewing points
- Style Evolution
- References



Imperial IPA

Introduction

- Intensely hoppy very strong American Pale Ale.
 - Related to American Barleywine; without big/deep malt flavor and sweetness.
 - Hops at all levels, yet clean, drinkable; not a heavy sipping beer.
 - A showcase for hops, especially new high alpha American varieties.
 - “The SUV of beers” Kevin Pratt, BJCP Grand Master I.
- BJCP category 14C highlights:
- Aroma: Intense hop aroma (citrus, resin, floral, low/no grassy), low clean malt sweetness, low/no esters, **low/no alcohol**. No diacetyl.
- Appearance: Golden amber to medium reddish copper. Clear to **hazy**. Good off-white foam stand.
- Flavor: Strong, complex hop flavor. High to absurdly high hop bitterness balanced with malt backbone. Low to medium clean malt flavor; **low caramel/toast OK**. No diacetyl. **Low/no fruity esters**. Long lingering bitterness in aftertaste. Medium dry to dry finish. **Clean smooth alcohol flavor**. Oak is inappropriate. Slight sulfur OK, not common.
- Mouthfeel: Medium light to medium body. **No hop astringency**. Moderate to high carbonation. Medium to low alcohol warming.
- OG: 1.070-1.090, FG: 1.010-1.020, IBU: 60-120, SRM: 8-15, ABV: 7.5-10%
- **A Style that is still evolving and changing!**



English IPA history 1800s

- First beer brewed specifically for export to India brewed by George Hodgson in London, 1790 (4).
- Hodgson monopolized the India Ale export business until approximately 1820 (4).
- According to legend, a wrecked cargo in 1827 off the port of Liverpool of Bass' East India Pale Ale was rescued and found great favor with the locals thus making it available to the English non-military.
- India Ale Hopping rates probably added up to 45 to 60 IBU's (3).
- Hodgson's India Ale hopped at a rate of 10.5oz. Per US 5 gallons, approximately 70 ounces per US barrel.(4).
- Multiple hop additions and limited contact time were common during wort production: hops only kept in wort for 30 minutes before being removed , 4 separate charges total and a 2 hour boil.
- India Ale in the 1800s was probably a 7-8% beer at the time of export to India.
- Considerable evidence exists in the form of sales receipts and storage manifests that the product was watered down upon arrival before consumption.



Amercan IPA to Imperial IPA

1994-1999

- First modern commercial example from Vinnie Cilurzo. Inaugural brew at Blind Pig in Temecula, CA June 1994. Aged in Oak for 9 months and first served at the brewery's first anniversary. Became an annual anniversary brew thereafter (10).
 - "Our brew was a lower ABV double IPA, only like 6.60%, we doubled the hops and raised the malt by a little. It was so bitter it was like licking the rust off a tin can. With such a low ABV the hops really came through." – Vinnie Cilurzo
- Rouge I2PA debuted at the Oregon Brewer's Festival in 1996.
- Stone Second Anniversary Ale, 1998.
- Eugene, OR 1998 Spring Beer Festival Style: Imperial IPA (10).



Blind Pig 2nd Anniversary 1995



Rogue I2PA 1996



Stone 2nd Anniversary 1998



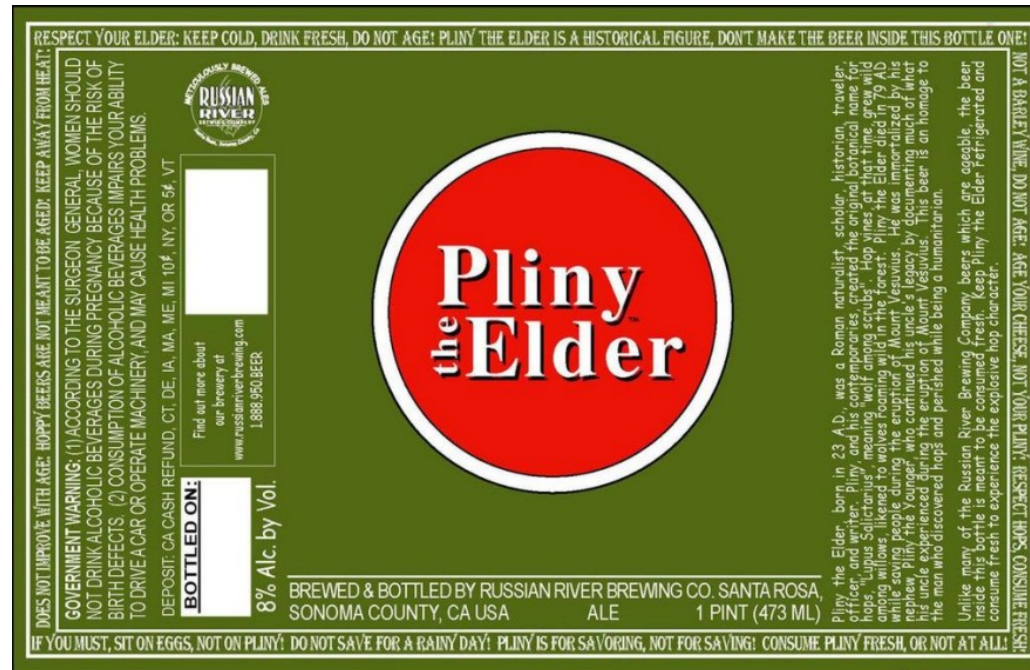
Imperial IPA

GABF Commercial Examples

- 2001 GABF: Steelhead Hopasaurus Rex - Gold, other Strong Ales category
- First appeared as separate GABF category, 40 in 2003.
 - Pizza Port Frank (gold 2003- silver 2004)
 - Russian River Pliny the Elder (GABF gold 2005-2006, Bronze 2007)
 - Moylan's Hopsickle (gold 2007)



Pizza Port Frank, 2003



Russian River Pliny the Elder, 2008



Moylan's Hopsickle 6



Imperial IPA

BJCP examples

- First appeared in the 2004 guidelines, Category 14C.
- Commercial Examples from the 2008 guidelines:
- Three Floyd's Dreadnaught, Avery Maharaja, Bell's Hop Slam, Stone Ruination, Great Divide Hercules Double IPA, Surly Furious, Rogue I2PA, Dogfish Head 90 Minute, Victory Hop Wallop.



Three Floyds Dreadnaught



Dogfish Head 90 Minute
(Original bottle)



Avery Maharaja



Rogue I2PA (current bottle)



Imperial IPA

Example Recipes

- Homebrew take-offs on Pliny the Elder
- Nathan's recipe: on the lower OG/FG end of the style with a Summit kick.
 - http://destroy.net/brewing/461/461_double_IPA_2008.html
- McDole's recipe: on the higher OG/FG end of the style with a Northern Brewer kick.
 - <http://www.maltosefalcons.com/recipes/20060504.php>
- Consider using these as a starting point, then experiment and make it your own.
- Adapt to your own equipment, raw materials, techniques, preferences.
- Lots of room for creativity.



Imperial IPA

Brewing Tips – Water

- Excess Magnesium can cause non hop-derived astringent bitterness.
- Sulfate in moderate amounts can lend a crisp, dry finish. In high amounts, it can have a harsh, salty flavor and negatively impact hop utilization.
- High carbonate water can give an impression of harsh hop bitterness; not to mention negative color impact, poor protein/tannin separation during hot/cold break. Be careful with concentrations exceeding 50ppm.
- Low/moderate Chloride (from CaCl, MgCl) can roundness, fullness on palate. Over 400ppm Cl can have a pasty flavor, over 500ppm it can negatively influence yeast activity.
- If you're adjusting for Ca already, consider CaSO₄, CaCl or a blend of the two.



Imperial IPA

Brewing Tips – Malt and mashing

- 70-80% Base malt: Domestic 2-row pale majority, small amounts of Maris Otter, Vienna, Munich, Pils OK. 1% Wheat OK.
- 5-10% dextrin malts: Domestic Crystal 10-40, Briess Carapils, Experiment with 1-2% Higher kilned crystal (60-80L) or maybe even a touch of a roasted malt. Other possibilities: Victory, amber, speical roast.
- Only 2-row malt, no specialty malts: Rogue I2PA, Dogfish 90 minute.
- “Too much crystal malt muddies up the hop flavors, use lower % of crystal malts for a crisp, clean hop flavor. Crystal malt clashes with bitter hop flavors. 1% crystal malt on the Elder, 0% crystal malt on the Younger” (Vinnie Cilurzo, TBN 8/14/2005 2:01:37).
- 5-15% Simple sugar (corn, turbinado) to dry out the beer, consider a mash temperature that promotes beta-amylase enzyme activity (148-152F).
- Monitor pH carefully to avoid polyphenol extraction during mash & sparge.



Imperial IPA

Brewing Tips – Hop additions

- Hops at all levels
 - Consider: Mash, Sparge (FWH), All stages of the boil, just before cooling (hop back), just after cooling, dry hopping (after fermentation), at serving (dry hopping in tank, Randall).
- Less-common methods
 - Mash hopping and/or First Wort hopping
 - More successful in low hopped beers and with hops that have a high humulene content (9).
 - Suggested hop addition rate for first wort hopping is 30% of the total kettle program (aroma additions) without further adjustment (9).
 - Tom O'Brien – One of the first homebrewers credited with hopping the hot liquor tank.



Hop back, top view
(morebeer.com)



Hop back, side view
(morebeer.com)



Imperial IPA

Brewing Tips – Hop selection

- American high alpha acid recommended for all additions, blend for complexity and consistency.
- For bittering IBUs– Use 70-80% low cohumulone such as Warrior, Magnum or Horizon; 20-30% rough citrus, pepper or pine bittering hop such as Chinook, Columbus for some complexity (Vinnie TBN 8/13/2005 2:00:32)
- Oil content and aromatic quality importance proportional to how late in the process the hop is being used.
- Make hop tea of unknown varieties to evaluate flavor and aroma qualities.
- Don't be afraid to explore. Example: Hersbrucker used in Alpine Brewing Pure Hoppiness.



Imperial IPA - Hop aroma and flavor

<http://destroy.net/brewing/hopref.pdf>

U.S. Hop Characteristics most often associated with IPAs, dry hopping or other hop-forward styles.

Name	% AA	% Beta acids	Cohumulone % of AA	Total Oil %	Carophyllene (as % of oil)	Farnesene (as % of oil)	Humulene (as % of oil)	Myrcene (as % of oil)	Descriptors
Ahtanum	5.7-6.3	5.0-6.5	30-35	0.8-1.2	9-12	0	16-20	50-55	Citrus, resinous, fruity.
Amarillo	8-11	6-7	21-24	1.5-1.9	2-4	2-4	9-11	68-70	Apricot, peach, fruity. In excess: petroleum
Cascade	4.5-6.0	5.0-7.0	35-40	.8-1.5	3-6	4-8	10-16	45-60	Geraniums, alfalfa, citrus, floral.
Centennial	9.5-11.5	3.5-4.5	28-30	1.5-2.5	5	0	11	58	Juicy fruit, Trix, Fruit Loops, fruity, citrus.
Chinook	12-14	3.0-4.0	29-34	1.5-2.5	9-11	0	20-25	35-40	Piney, peppery, spruce, catty.
Columbus/ Tomahawk/ Zeus	14-16	4.5-5.5	30-35	1.5-2.0	8-12	0	15-25	25-45	"dank", onion, garlic, spicy
Crystal	3.5-5.5	4.5-6.5	20-26	1.0-1.5	4-8	0	18-24	40-65	Spicy, peppery, fruity
Glacier	5.5	8.2	11-13	.7-1.6	6.5-10	0	24-36	33-62	Peach
Newport	13.5-17	7.2-9.1	36-38	1.6-3.36	4.5-7	0	9-14	47-54	Apricot, grapefruit, pine, peach
Palisade	5.5-9.5	6-8	24-29	1.4-1.6	16-18	0	19-22	9-10	Grassy, Piney, Apricot
Simcoe	12-14	4-5	15-20	2-2.5	5-8	0	10-15	60-65	Pineapple, grapefruit, "grungy"
Summit	15-19?	?	?	2-2.5	?	?	?	?	Tangerine, onion, dank

- "onion" is a sulfurous aroma associated with dimethyl trisulfide (DTMS) that is found in hops.
- Myrcene- Spicy, petroleum
- Caryophyllene, Farnesene, Humulene - When in oxidized form, associated with Woody, Deep-Rich Resin Like "hoppy" "noble" aroma.

References:

The New Brewer Volume 23, Number 6. "The Eternal Quest for the Ultimate Hop Impact" by Matthew R. Brynildson (p. 22-29) Brewer's Association.

<http://www.yakimachief.com/hopvarieties/hopvar.html>

<http://www.hopunion.com/hopunion-variety-databook.pdf>

<http://www.ratebeer.com/Beer-News/Article-482-1.htm>



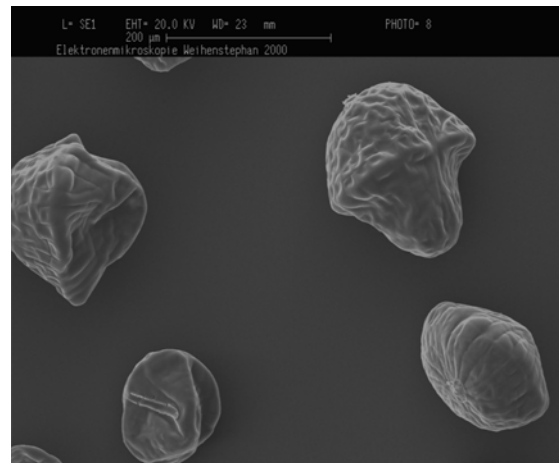
Imperial IPA

Brewing Tips – Hop formats

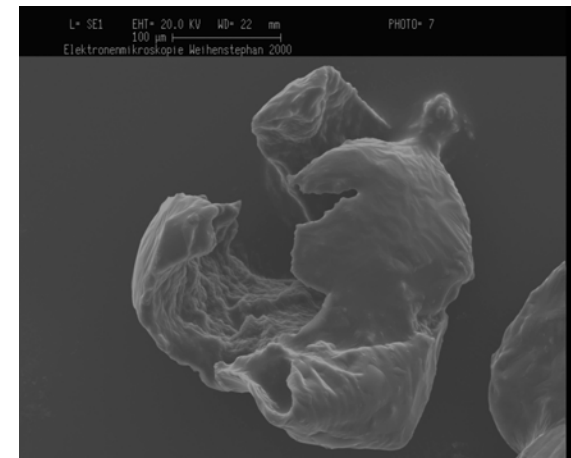
- Flowers – quick deterioration, tough to store, lupulin in purest form – slower release of hop oils, “a little more soft, well rounded” (10).
- Plugs – Middle ground between flowers and pellets. Very few, if any varieties available commonly to homebrewers.
- Pellets – Stable, low oxygen, good storage, pressure during production creates heat, oxidizes some compounds, oil loss. Ruptured lupulin glands, a little more direct & In your face. Quick release of acids and potential volatilization of oils. Pellet hops can oxidize more rapidly than whole (9).



Whole Flower, Split (14)



Non ruptured Lupulin Glands (14)



Ruptured Lupulin Gland (14)



Imperial IPA

Brewing Tips – Hop extract

- Hop extracts Advantages: reduced cost, stored at room temperature, increased utilization, consistency, down stream applications (post fermentation), micro stability. And with modified hop extracts, improved foam characteristics and light stability (9).
- Hop extracts disadvantages: flavor matching, whole hop character (aroma) can be difficult (9).
- World Production % breakdown, 2005 estimate: 35% extracts, 35% pellets, 10% whole hops, 25% isomerized and reduced products (13).



Geir Ove Grønmo, Oslo, Norway
<http://blog.geirove.org>



CO2 hop extract from
<http://www.nzhops.co.nz>



Imperial IPA

Brewing Tips – Dry Hopping

- Dry hopping = extraction of hop oils. Essential for the Imperial IPA style.
- Multiple dry hops, use less at each dry hopping stage, but dry hop more frequently
 - Bigger aroma, Longer lasting aroma, Closer to “sticking your head in a bag of fresh hops” (7).
 - Pliny the Younger – One new dry hop added each week, 4 dry hops total over a 4 week period (7).
- Dry hop after pulling the yeast.
- Dry hop warm (60-68F).
- Russian River – Blend of pellet and flowers, flowers used more commonly at the end of the dry hopping process (7).
- Recirculation or rousing the fermenter during dry hopping to help promote extraction of oils (7).
- Use older hops for hot side and newer hops for cold side (9).
- Pull the hops out of the bottom of the cone in a conical at each dry hopping stage (7).



Imperial IPA

Brewing Tips – Dry Hopping

- You can definitely over dry hop: Harsh, vegetative, tannic flavors and aromas (7).
- More aromatics with a shorter contact time 5-7 days maximum (7).
- Firestone Walker only dry-hops 5 days maximum, Russian River = 5 day dry hop minimum (7).
- For dry hopping suggested that T-45 pellets give lower vegetative matter and the necessary contact time is reduced (9).
- Firestone Walker theory on dry hopping:
 - selection of best (new crop year) aroma varieties;
 - blending hops for consistency and complexity;
 - extraction is better at elevated temperatures;
 - emphasis on low dissolved oxygen (DO);
 - removal of yeast plug prior to dry hopping;
 - rousing with CO₂ to help control DO; short contact time (3-4 days); sanitary technique;
 - blending of beers at finish (9).



Imperial IPA

Brewing tips – Dry hopping

- Dry hopping in the keg
 - Screen or filter on the end of the dip tube.
 - Hooks or handles on the inside of the serving tank to hold a hop bag: Russian River Younger is hopped in the serving tank using this method.
- Post-keg dry hopping = Randall. East Coast vs. West Coast rivalry amongst professional brewers.
 - Build your own from Geir Ove Grønmo, Oslo, Norway
 - <http://blog.geirove.org/2007/03/building-your-own-randall.html>



Corny Keg Lid with hop bag hook (morebeer.com)



Carboy hop weight



Randall

<http://destroy.net/brewing/IIPA.pdf>



Imperial IPA

Hop Chemistry

- Aromatic compounds bound to glucose which may be released later. This process referred to as glucanization. Research by Tom Shellhammer at UC Davis.
- Hops contain thousands of chemicals: During Gas chromatography analysis of hops at 45 minutes of retention time the process is still identifying compounds (Colin, Brewing Network wet hop show 10/21/2007 1:13:00).
- Maximum IBU for a 5% beer = 120ppm = 80IBU (12).
- As alcohol and unfermented carbohydrate in the beer increases, so does the ability of the beer to carry more IBU. Some barley wines may have over 100IBU. (12), Mitch Steele.
- Other considerations: Large amounts of Isoalpha acid adheres to the yeast cell; measured IBU goes up while perceived bitterness goes down due to dissolution of alpha acids (9).
- 5.4 pH for wort and subsequent beer determined as optimal pH for best bitterness character (5.2 for overall stability).
- After 90 minutes of boiling, iso-alpha acids start to break down to Humulonic acid (9).



Imperial IPA

Hop Oils: Flavors and Aromas

- **Monoterpenoids (associated with fresh dry hop aroma) (9)**
 - Myrcene: spicy, petroleum
 - Linalool: floral, citrus
 - Geraniol: floral, rose
 - Limonene: citrus, fruity
 - Terpeneol: woody, resinous
 - Nerolidol: rose, apple, woody
 - Beta-Pinene: spicy, piney
 - Citral: citrus, lemon
 - Cadinene: citrus
- **Sesquiterpenoids (when oxidized, associated with noble hop aroma), woody, resin-like. (9)**
 - Alpha-Humulene
 - Beta-Caryophyllene
 - Beta-Farnesene
 - Humulene Epoxide



Imperial IPA

Fermentation Considerations

- Yeast Selection: Clean, neutral California Ale yeast recommended.
 - Wyeast 1056 or White Labs 001.
- Hop-like fermentation byproducts:
 - Apple ester: Ethyl alcohol + acetic acid = ethyl acetate (13).
 - Pear ester: Hexyl alcohol + acetic acid = hexyl acetate (13).
 - Pineapple ester: Ethyl alcohol + butyric acid = ethyl butyrate (13).
- Limonene from hops and H_2S from fermentation gives a distinct grapefruit aroma. Limonene content = grapefruit aroma intensity in the finished beer. Sierra Nevada Brewing Company (14).



Imperial IPA

Fermentation Schedule

- Example: Russian River WLP001 Fermentation and dry hop schedule (7).
 - White Labs 001 6-7 days primary 68F, seal up the tank, sit for 24 hours.
 - diacetyl rest at 68F, drop the temperature to 52F for 2 days to pull the yeast out. 001 has trouble dropping out at temperatures above 52F.
 - Direct correlation on more aroma and less yeast in solution when dry hopping.
 - Pull as much yeast as has flocculated out of the bottom of the conical, do the first dry hop.
 - shut off glycol to let the temperature slowly rise back up to 68F.
 - 12 day dry hop total on Pliny the Elder; RR IPA = 6 days warm, Elder = 10 days warm.
 - 2 days before transferring, temperature dropped to 32F to get the hops to settle out (IPA and ESB this happens at day 8, Elder, this happens at day 12) (7).



Imperial IPA Evaluation

- Fresh consumption critical to insure that the volatile hop aroma and flavor is present.
- Don't let this beer sit warm, be very careful with light and O2 exposure.
- Mike McDole's 6 week until peak recommendation.
- Minimum of 100mL to get accurate hop interpretation to be able to discern adhumulone/cohumulone bitterness; Corvalis Hop convention/summit (Colin Kaminski. , 10/21/2007 TBN show).



Imperial IPA

Style Evolution - What's next for hoppy beers?

- Small IPAs
 - McDole's Tiny Pliny
 - 21st Amendment Bitter American. 3.6% ABV, 40IBU
- Herb/spice chemical compound flavor matching
 - Rosemary: myrcene, pinene
 - Grains of Paradise: caryophyllene, humulene, linalool
 - Coriander: limonene, pinene, linalool
- New US hops (Ralph Olson, Hop Union, Hop shortage TBN show 9/2007):
 - Glacier (Fuggle-like) – Willamette, Tettnang, Styrian Golding 5.5%AA, Low cohumulone, good yield, high Myrcene.
 - Sterling – Saaz and Mt. Hood hybrid. Saaz-like replacement. 6-9%AA.
 - Apollo – Unknown
 - Palisade (Mild Cascade-like) - Yakima Chief proprietary 5.5-9.5%AA, low myrcene, 20% humulene.
 - Other new hops out of the Simcoe/Ahtanum program at Yakima Chief?
- Non traditional yeast - Belgian Ale Yeast

References

1. 2008 BJCP guidelines, www.bjcp.org
2. Brewer's Association <http://www.beertown.org/events/gabf>
3. London and Country Brewer, Second Edition. Printed for Melliurs Fox at the Half Moon and Seven Stars, Westminster Hall, 1736.
4. Pale Ale, Second Edition. Terry Foster, Brewer's Publications, 1999.
5. Kevin Pratt, Email conversations.
6. Porter Myths and Mysteries Brewery History 112 pp. 31-40 - <http://www.breweryhistory.com/journal/archive/112/bh-112-031.html>
7. The Brewing Network 6/26/2005 Vinnie Cilurzo dry hopping lecture from the Baltimore, MD NHC 2005.
8. Vinnie Cilurzo, Email conversations.
9. The New Brewer Volume 23, Number 6. "The Eternal Quest for the Ultimate Hop Impact" by Matthew R. Brynildson (p. 22-29)
10. The New Brewer Volume 21, Number 1. "Double IPAs Create A Whole New Category In the Humulone Derby" by Jim Parker (p. 28-33)
11. <http://www.homebrewchef.com/ColdFusionDoubleAmarilloIPARecipe.html>
12. "For the Love of Hops" Stan Hieronymus All About Beer Magazine, Volume 24 Number 6, January 2004 <http://www.allaboutbeer.com/features/246doubleIPA.html>
13. "Humulus Lupulus: Hopping for Flavor and Aroma" Matthew R. Brynildson, Michigan Brewers Guild and MBAA District Michigan Winter Conference