

Charlotte Beer Babes Presents: Malt & Hop Petting Zoo

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Malts: Base vs Specialty:

- **Base Malt:** The larger percentage of a grain bill used to make a beer. These malts provide enzymes to convert malt starches into sugars. Provides extra enzymes to convert specialty malts/adjuncts without enough enzymes of their own to convert into sugars. Includes: Pale Malt, Pilsner Malt, Vienna Malt, Munich Malt, Rye Malt, & Wheat Malt. 2-Row vs 6-Row: Differentiates based on the formation of corns on the barley stalk rows.

- **Specialty Malt:** Smaller percentage of a grain bill used to make a beer. These malts are cracked & steeped to release the sugars and flavor compounds. The color of a beer typically comes more from the Specialty Malts. Includes: Roasted Malts, Chocolate Malt, Crystal/Caramel Malts, Smoked and/or Peated Malt, Acidulated Malt

Petting Zoo Malts:

- **Amber Malt:** This roasted malt gives off a biscuit flavor and is used in brown, Belgium and British ales. The color is 15-25L.
- **Aromatic Malt:** This kilned malt is used in mostly Belgium brews. It has a very strong flavor and deep color of 15-25L.
- **Acidulated Malt:** Acidulated Malt is a pale malt (color: roughly 3 to 6 EBC/1.7 to 2.8 SRM) that has been subjected to a lactic acid fermentation after kilning and a second finishing drying cycle. The lactic-acid bacteria reside naturally in the malt. The purpose of acidulated malt is to reduce the pH value of the mash. Proper mash pH (5.4 to 5.6) helps assure the enzymatic performance on which the brewer relies to break down gums, proteins, and starches. It also leads to proper wort pH, which affects yeast performance during fermentation and the final flavor profile of the resulting beer. Every 1% of acidulated malt (by weight) of the total grain bill reduces the mash-pH by 0.1 point. In highly alkaline mashes, acidulated malt can make up as much as 10% of the grain bill.
- **Belgian Pils:** A European base two-row malt with a very light color of 1-2L. Very easy to use and ideal for all-grain brewing.
- **Biscuit Malt:** This Belgium malt gives off a biscuit and toasty finishing flavor. Creates a medium brown color. Must be mashed with malts that have extra diastatic powder. 20-25L
- **Black Barley:** Roasted unmalted barley that has a dry stout flavor. 550+L
- **Black Malt (Patent):** Malted barley used in gives you a strong roasted flavor used in stouts, porters, and dark lagers. Use sparingly. 600+L
- **Brown Malt:** A rarely used grain that imparts a spicy and smoky flavor commonly found in brown ales and stouts. 75-150L
- **Crystal/Caramel Malts:** These malts add the a beers color, mouth feel, and imparts a nutty or caramel flavor. The intensity depends on the SRM ratings from 10-120L.
- **CaraMunich:** This caramelized malt contains no enzymes and adds a caramel aroma and deep color as well as increasing the fullness of the beer. 50-75L
- **CaraPils:** A dextrin malt used to increase head retention, body, and foam stability. 2L
- **Chocolate Malt:** A Roasted malt that is very pungent and gives off a very dark color. It adds a nutty chocolaty taste to dark beers. 300-450L
- **English Pale Malt:** Like the name suggests, the most common malt for English ales. Offers superior extract and easy conversion. 2.5-3.5L
- **Flaked Barley:** An unmalted malt used in stouts and German lagers to improve head retention, creaminess and body. Has a grainy taste and does not affect color. 2L
- **Flaked Maize:** A adjunct used to increase alcohol. Used in light beers. Does not affect color, and for the most part, flavor.
- **Flaked Oats:** Used in stouts and Belgium ale to create smoothness. Counteracts hard water. Does not affect color.
- **Flaked Rye:** Used with highly modified malts to deliver a dry, crisp, strong flavor. Not typically used in standard beer varieties. 1-3L
- **Flaked Wheat:** Used to increase body and head retention in moderate amounts (4-6 ounces) with other highly modified malts. 2.7L
- **Honey Malt:** Adds a honey sweetness to any beer and lacks any bitter flavors. Does not add any color.
- **Lager Malt:** A low temperature kilned malt which results in a light colored beer and mild flavor. The base malt for many beers and used in conjunction with specialty malts. 1-2L
- **Munich Malt:** A base malt that provides a grainy and malty flavor and aroma. It tends to be sweeter than pale malt and results in an amber color. 10L
- **Pale Ale Malt:** The base for many ales and lagers. High in enzymes and proteins. 2.5-4L
- **Pilsner Malt:** Two-row from either Germany, Belgium, or Eastern Europe. This grains has fewer enzymes than American six-row, but easily mashed. Light color with a distinct malty flavor. 1-2L
- **Red Malts:** Aromatic malt rich in melanoidins. It is recommended for dark beers to enhance color and aroma. A special malting program is used to ensure the right flavor and aroma through controlled Maillard reaction. Flavor of Red Ale Malt is malty and bitter but also roasted and nutty flavors can be found with long lasting linger. Red Ale Malt is also slightly acidic. The amyolytic activity of Red Ale Malt is low.
- **Roasted Barley:** Used in stouts, Irish ales, and porters, this malt gives off a sweet and dry flavor that is less intense than black malt. Adds a reddish color to the beer and aids in head retention. 300-550L

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- **Rye Malts:** A bread grain used to add a dry rye flavor to beers. Hard to mash because of its lack of husk material, so the use of rice hulls is recommended. 2-5L
- **Smoked Malt:** Adds a sweet smoky flavor to the beer. Can be used in various Scottish Ales and porters. 5L
- **Special B:** A dark Belgium caramel malt that also contributes the most flavor and color. The caramel taste has been described as raisiny, woody, and prune. Contributes a dark brown color. 100-220L
- **Torrified Grains (Wheat and Rice):** Used to improve head retention and mouth feel. 1-1.5L
- **Victory Malt:** This grain lends a brown coloring to beer along with toasty biscuit notes. Used in darker ales and lager. 3-7L
- **Vienna Malt:** The main flavoring malt in Oktoberfest, Marzen, and Vienna style beers. An aromatic malt that has a full malty flavor and dark amber color. 3-10L
- **Wheat Malt:** Used as one of the main grains in wheat beers or can be used in other style beers to aid in head retention, yeast activity, and mouth feel. 2L
- **Biess 2-Row Malt:** Biess Brewers 2-Row is a fantastic base malt that can be used for all beer styles. Biess 2-row contributes a clean, sweet, and slightly malty character along with a light straw color. Biess Brewers Malt is malted in Wisconsin in small batches and is an excellent fit for all ales. Use this the same as you would any 2-row base malt and expect amazing results in your glass. Use as a base malt for all beer styles.
- **Pale 6-Row American Rahr Malt:** Rahr Standard 6-Row is a light-colored base malt made from a blend of North American 6-Row barley varieties. 6-row barley has a much higher protein content and enzymatic power than 2-row barley. Inclusion of Standard 6-Row is therefore very advantageous for recipes calling for large proportions of specialty malts, wheat malts, or adjuncts, which have little or no enzymatic power themselves. 6-row barley is also used to match historical beer styles from settings where 2-row barley was not widely available. High proportions of 6-row barley may necessitate the use of adjuncts or require protein rests in mashing.
- **Maris Otter Malt:** Maris Otter is a traditional English barley variety long considered the pinnacle of barley malts for use in British style beers. This pale base malt is described as malty and slightly sweet, and is easy to malt and mash due to its low nitrogen content and excellent enzymatic activity.
- **Belgian Pale Malt:** Fully modified pale ale malt from Belgian two-row barley, easily converted by a single temperature mash. It is a good all-purpose pale malt, and great in Belgian ales.
- **Compare the 2-Row vs 6-Row vs Maris Otter**
- **Compare the Belgian Pils vs Vie**
- **Compare the Cherrywood Smoked vs Beech Smoked vs Mesquite Smoked Malts vs Peated Malts**
- **Compare the American vs English Chocolate Malts**
- **Compare the Wheat vs White Wheat vs Red Wheat vs Midnight Wheat**
- **Compare the Brown Malt and the Coffee Brown Malt**
- **Compare Roasted Barleys/Chocolate Malts/Carafo/Caramunich/Blackprinz Malts to each other**

Hops Oils, Acids, and Regions:

- **Bittering:** During longer boil times hop oils evaporate, so they're added at beginning of boil to impart bitterness.
- **Aroma:** During shorter boil times and dry hopping, hop oils don't evaporate as much, so get the non-bitter aspects of the hops during shorter boil times and/or flameout/dry-hopping additions.
- **Alpha Acid:** Basis of bittering; quick breakdown: Humulone, Cohumulone, Adhumulone, Posthumulone, Prehumulone.
- **Beta Acid:** Slow breakdown: Lupulone, Colupulone, Adlupulone.
- **Hop Oils:** Main source of flavor and aroma from hops; provide non-bitter tastes/aromas for hops.
 - o **Myrcene:** natural organic compound that is classified as a hydrocarbon. In thyme, bay, parsley, lemongrass, cannabis. Used in the perfume industry. An essential hop oil and the most plentiful hydrocarbon of the hop oils. Like other essential oils, it develops in the hop cone's lupulin gland and is formed throughout the entire hop cone maturation phase. The amount of myrcene continues to rise with ripening, while the amounts of beta caryophyllene and humulene do not. The percentage of myrcene, serves as an indicator of the hop's ripeness. The ratio of humulene to caryophyllene, on the other hand, can serve as a varietal indicator. Myrcene levels are typically 50% or more of the total oils at harvest time. Myrcene has a green and freshly herbaceous aroma that is distinctively "hoppy." It has the lowest odor threshold—13 ppb—of the main hydrocarbons in hop oil, and is, therefore, the most potently aromatic.
 - o **Co-Humulone:** one of five alpha acid analogs in hop resin. Most hop analyses will specifically show a cohumulone percentage. This is because brewers believe iso-cohumulone contributes a rougher, harsher quality of bitterness than other iso-alpha acids. Traditional aroma hops tend to be low in cohumulone, whereas some bittering varieties have higher levels. Because brewers tend to associate low cohumulone with a finer quality of bitterness, hop breeders are favoring new cultivars with low cohumulone levels. When hops oxidize, alpha acids, including cohumulone, change their molecular makeup, producing isobutyric acid, which has a distinctive rancid, sour, cheesy odor.
 - o **Humulene:** the characteristic terpene of hops, named after the scientific name for hops, *Humulus lupulus*, it's an isomer of Caryophyllene. Key part of hops that gives the "hoppy" aroma. It's been found to possess anti-inflammatory properties, and is being studied. The concentration of humulene varies among different varieties of the plant but can be

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up to 40% of the essential oil. Humulene and its reaction products in the brewing process of beer gives many beers their “hoppy” aroma. Noble hop varieties have been found to have higher levels of humulene, while other bitter hop varieties contain low levels.

- **Caryophyllene:** one of the oils that help to give black pepper its spiciness. Gives a strong dry wood, pepper, earthy flavor, and an herbal character. This compound has been seen to reduce inflammation & been in anti-cancer studies. Used in the perfume industry.
- **Farnesene:** refers to a set of six closely related chemical compounds which all are sesquiterpenes. Farnesene is a component of the hydrocarbon fraction of hop oil. The presence or absence of farnesene is a distinguishing feature for some hops. In many German varieties, farnesene is completely absent; while in Czech Saaz, German Tettnanger & Sterling, it is present in high levels, at roughly 10% to 20% of total oils. Farnesene has a woody, herbal, citrus aroma, sometimes described as floral. Because farnesene is hydrophobic and volatile, the compound itself is usually not found in beer unless the beer has been dry hopped with a variety that contains farnesene—and even then it is present in only very small amounts. However, high levels of farnesene in hops generally correlate well with pleasant, noble-type hop aroma in beer.

Petting Zoo Hops:

- **Mosaic Hops:** Released in 2012 by the Hop Breeding Company, LLC, Mosaic hops feature complex but clean flavor characteristics and are known for their triple-use profile encompassing bittering, flavor and aroma. They have high alpha acids but low cohumulone which makes them pleasantly hoppy, carrying flavors of mango, pine, citrus and herbs and aromas of tropical and stone fruit. Mosaic is the first daughter of Simcoe and Nugget as has been humorously referred to by some as “Citra on steroids”.

Alpha Acid Composition	11.5%-13.5%	Humulene Oil Composition	13%-16%
Beta Acid Composition	3.2%-3.9%	Caryophyllene Oil	5%-8%
Co-Humulone Composition	24%-26%	Farnesene Oil	None
Myrcene Oil Composition	47%-53%	Substitute Hops	Citra

- **Saaz Hops:** Officially registered in 1952, the original Saaz, or Czech Saaz as it is sometimes known, has established itself as a staple variety for brewers and dates back more than 700 years. Originating in Zatec, Bohemia (now part of the Czech Republic) it is an esteemed red-bine variety that is now grown around the world. New Zealand in particular has embraced Saaz, breeding several descendants including the popular Motueka and Riwaka varieties (B & D Saaz, respectively).

Alpha Acid Composition	2%-4.5%	Humulene Oil Composition	15%-30%
Beta Acid Composition	4%-6%	Caryophyllene Oil	6%-9%
Co-Humulone Composition	23%-28%	Farnesene Oil	14%-20%
Myrcene Oil Composition	25%-40%	Substitute Hops	Sterling, Lubelska-Pulawy, Moteuka, Centennial, Amarillo

- **Lemondrop Hops:** Equipped with the elusive true-lemon character, Lemondrop hops boast fantastic lemony-citrus aroma for late kettle additions or dry hopping. Originally released by HopSteiner in 2012 as Experimental #01210, this Super Cascadian hop has a unique combination of fruity and herbal notes. Aroma: Citrus,Floral,Fruity,Herbal, lemon, green tea, light melon.

Alpha Acid Composition	5%-7%	Humulene Oil Composition	56%-58%
Beta Acid Composition	4%-6%	Caryophyllene Oil	9.5%
Co-Humulone Composition	28%-34%	Farnesene Oil	6%-7%
Myrcene Oil Composition	46%	Substitute Hops	Cascade, Mandarina Bavaria, Centennial

- **Fuggle Hops:** The Fuggle hop originates in England and was first discovered in 1861 in a hop yard owned by George Stace in Kent. Some 14 years later it was officially named and introduced by Richard Fuggle of Benchley in 1875. Similar to a Styrian Golding, is noted for its distinct European aroma and has enjoyed a long, versatile run. At its peak nearly 100 years ago Fuggle was known as a dual-use hop, however it’s now more prominently used for its aroma. Aroma: Woody, earthy, pleasant vegetal.

Alpha Acid Composition	2.4%-6.1%	Humulene Oil Composition	26.6%
Beta Acid Composition	2.1%-2.8%	Caryophyllene Oil	9.1%
Co-Humulone Composition	25%-29%	Farnesene Oil	4.3%

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Myrcene Oil Composition	43.4%	Substitute Hops	Willamette, Styrian Golding, Tettninger, Newport
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- **Saphir Hops:** Released in 2002, Saphir features elements of spice and fruit amid refined citrus notes of tangerine. It is considered well suited to Belgian Whites as well as Pilsners and German Lagers. Bred at the Hop Research Center in Hüll, the initial goal of its creators was to produce a more commercially viable alternative to Hallertau Mittelfrüh through increased disease resistance and the retention of Hallertau's noble characteristics. In that capacity, Saphir would most certainly be considered a success! Aroma: Sweet citrus aromas with hints of tangerine.

Alpha Acid Composition	2%-4.5%	Humulene Oil Composition	20%-30%
Beta Acid Composition	4%-7%	Caryophyllene Oil	9%-14%
Co-Humulone Composition	12%-17%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	25%-40%	Substitute Hops	Hallertau, Hallertau Tradition, Spalter Select

- **New Zealand Wakatu Hops:** Wakatu, or Hallertau Aroma as it is sometimes known, is a New Zealand triploid hop with a lot going for it. 2/3 Hallertauer Mittelfrüher and 1/3 New Zealand male, it was released in 1988 from the New Zealand Institute for Plant and Food Research's hop breeding program. Its nicely balanced oil profile gives it an understated floral aroma atop pungent fresh lime. Considered largely dual-use, it can be added at any stage of the boil right and dry hopped with success. It has also been noted for its impressive flavor stability. Aroma: Floral, lime.

Alpha Acid Composition	6.5%-8.5%	Humulene Oil Composition	17%
Beta Acid Composition	8.5%	Caryophyllene Oil	8%
Co-Humulone Composition	28%-30%	Farnesene Oil	6.7%
Myrcene Oil Composition	36%	Substitute Hops	Hallertauer Mittelfrüher

- **Tettanger Hops:** Selected from an old German landrace, Tettninger is grown the world over. Swiss, US and Australian varieties can be found on the market today though some foreign versions labeled "Tettninger" are actually a hybridized mix with Fuggle and not considered a true Tettninger hop. Tettninger is grown around its native village of Tettngang in southwest Germany and in small quantities near lake Konstanz in Switzerland. Tettninger has notably more farnesene content giving it a soft spiciness and a subtle, balanced, floral and herbal aroma. It is also great as a dual-use hop, and considered by many as being particularly well suited to European lagers and pilsners. Aroma: Balanced floral and herbal aromas with some spiciness.

Alpha Acid Composition	3%-5.8%	Humulene Oil Composition	20.4%
Beta Acid Composition	2.8%-5.3%	Caryophyllene Oil	6.2%
Co-Humulone Composition	24%	Farnesene Oil	11.3%
Myrcene Oil Composition	40.6%	Substitute Hops	Saaz, Spalt, Santiam, Spalter Select, Tettninger (US)

- **Centennial Hops:** Centennial owes its existence to a mix of Brewer's Gold, Fuggle, East Kent Golding and Bavarian hops. Developed in 1974 and released in 1990, Centennial was pioneered by Charles (Chuck) Zimmerman and S.T. Kenny at Washington State University. It is at times referred to as super Cascade because of its similar citric characteristic. Centennial is a much-celebrated hop in its versatility with its depth of bitterness and forward aroma — two characteristics that balance each other beautifully. It is well suited to Pale Ales and IPAs with its high alpha content and is floral in both flavor and aroma. Aroma: Earthy and floral with an element of citrus.

Alpha Acid Composition	9.5%-11.5%	Humulene Oil Composition	10%-18%
Beta Acid Composition	3.5%-4.5%	Caryophyllene Oil	5%-8%
Co-Humulone Composition	28%-30%	Farnesene Oil	1%
Myrcene Oil Composition	45%-55%	Substitute Hops	Chinook, Galena, Nugget, Zeus, Columbus, Cascade (US)

- **Challenger Hops:** Released to the public in 1972, Challenger hops were developed at Wye College from varieties Northern Brewer and German Zattler. It accounted for a significant percentage of the hops grown in the UK during the 1980's and 1990's. Challenger features decent bitterness and a floral aroma and as such are considered fine for bittering or for dry hopping. Aroma: smooth with balanced floral characteristics, some citrus and a dash of spice.

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Alpha Acid Composition	6.5%-9%	Humulene Oil Composition	25%-32%
Beta Acid Composition	3.2%-4.5%	Caryophyllene Oil	8%-10%
Co-Humulone Composition	20%-25%	Farnesene Oil	1%-3%
Myrcene Oil Composition	30%-42%	Substitute Hops	Perle (US), Northern Brewer, Admiral

- **French Strisselspalt Hops:** Strisselspalt hails from the Alsace region of France around Strasbourg and is likely related to German Spalt and/or Hersbrucker hops. Thought to be an old land race, its acreage is dwindling due to its inherent low yield but it survives largely on the back of a strong domestic demand for the variety. Aroma: Pleasant continental-style aroma, herbal, floral, spicy, citrus, fruit.

Alpha Acid Composition	1.8%-5.7%	Humulene Oil Composition	12%-32%
Beta Acid Composition	2.5%-6%	Caryophyllene Oil	8%-10.3%
Co-Humulone Composition	20%-27%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	35%-52%	Substitute Hops	Liberty, Hallertau, Mt Hood, Crystal, Hersbrucker

- **Huell Melon Hops:** Relatively new on the market, Hüll Melon made its debut in 2012. A daughter of Cascade (US), it has some interesting flavor characteristics not commonly associated with hops. It is noted to be intensely fruity with flavors and aromas of honeydew melon and strawberry. Aroma: Intensely fruity, flavors and aromas of honeydew melon, strawberry.

Alpha Acid Composition	6.9%-7.5%	Humulene Oil Composition	10%-20%
Beta Acid Composition	7.3%-7.9%	Caryophyllene Oil	5%-10%
Co-Humulone Composition	25%-30%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	36%	Substitute Hops	Cascade

- **Mandarina Bavaria Hops:** Daughter of Cascade (US), Hallertau Blanc and Hüll Melon, Mandarinina Bavaria originated in Hüll, Germany and was released to the brewing masses in 2012. It is useful for both flavor and aroma and imparts slightly sweet notes of tangerine and citrus, especially when used for dry hopping. Aroma: Tangerine, Citrus.

Alpha Acid Composition	8.5%-10.5%	Humulene Oil Composition	5%
Beta Acid Composition	5%-6.5%	Caryophyllene Oil	2%
Co-Humulone Composition	33%	Farnesene Oil	1%
Myrcene Oil Composition	70%	Substitute Hops	Columbus, Nugget, Cascade (US)

- **Crystal Hops:** It's woody, green, floral and fruity with herb and spice notes of cinnamon, nutmeg and black pepper. Extremely versatile, it's even used for its notable aromatic qualities in IPAs and Bitters despite its low alpha acid content. First bred in 1983, it has an interesting lineage with roots extending back to Hallertau, Cascade, Brewer's Gold and Early Green. Aroma: Woody, floral and fruity with spice notes of cinnamon, nutmeg and black pepper.

Alpha Acid Composition	2.8%-4.4%	Humulene Oil Composition	26%
Beta Acid Composition	5.8%-7%	Caryophyllene Oil	7%
Co-Humulone Composition	21%-26%	Farnesene Oil	Trace Amounts
Myrcene Oil Composition	47%	Substitute Hops	Liberty, Mount Hood, German Hallertau, Ultra, Strisselspalter, Hersbrucker

- **East Kent Goldings Hops:** East Kent Golding is often thought of as the ultimate English hop. Grown exclusively in Kent, England and descended from Canterbury Whitebine, it is a centuries old variety. Despite claims to the contrary, it is identical to Canterbury Golding. Canterbury is a town in East Kent and the hop was first brought to market there in 1790. The variety began to be known primarily as East Kent Golding in 1838. Aroma: lavender, spice, honey and notes of thyme. Flavor-wise it is earthy and mildly bittering with a sweet, silky, honey-like character. East Kent Golding is considered to be the quintessential English hop, long held as one of the island's favorites for ales and pale ales.

Alpha Acid Composition	5%-6%	Humulene Oil Composition	27%
Beta Acid Composition	2%-3%	Caryophyllene Oil	9%

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Co-Humulone Composition	29%	Farnesene Oil	0%-1%
Myrcene Oil Composition	42%	Substitute Hops	Whitbread Golding, Progress, Fuggle, First Gold

- **Enigma Hops:** Enigma® is a new, exciting hop bred and released by the Hop Products Australia program of the Barth-Haas Group. It is a cross between Tettnanger and an unnamed North American variety, but displays in a wholly unique manner. It is juicy with red fruits like raspberries and red currants, but what sets it apart from other varieties are the white wine notes (similar to Nelson Sauvin), that is most often described as crisp and refreshing "Pinot Gris". Aroma: Crisp flavours of white grape, tart redcurrant and sweet rockmelon, with a complexity where different aspects shine depending on dose rate and addition time. Late additions or dry hopping really maximize the flavour and aroma outcomes.

Alpha Acid Composition	16.7-19.4%	Humulene Oil Composition	12.4%-18.8%
Beta Acid Composition	5.2%-7%	Caryophyllene Oil	6.3%-8%
Co-Humulone Composition	37%-43%	Farnesene Oil	9.2%-11.4%
Myrcene Oil Composition	23%-33%	Substitute Hops	Nelson Sauvin

- **Azacca Hops:** Azacca® was named after the Haitian god of agriculture. It is big in Alpha Acids (14-16%) and has a bright and refreshing aroma with juicy mango, tropical fruits, and citrus. Azacca® is a dual-purpose hop that produces sensational single-hopped beers. Try whirlpooling with Azacca® after flameout to maximize the juicy flavors and sweet aroma. Aroma: Fresh citrus, lemon, piney, tropical fruit

Alpha Acid Composition	14%-16%	Humulene Oil Composition	14%-18%
Beta Acid Composition	4%-5.5%	Caryophyllene Oil	8%-12%
Co-Humulone Composition	38%-45%	Farnesene Oil	< 1%
Myrcene Oil Composition	46%-55%	Substitute Hops	Citra, Galaxy, and Mandarinina Bavaria

- **Chinook Hops:** Chinook hops are suitable for any stage of the boil. They're not only a natural for American-style Pale Ales and IPAs, but they also find their way into seasonal ales, barley wine and some porters and stouts. The variety is a cross between Petham Golding and a USDA male and features a pine-like, spicy bouquet with robust flavors of grapefruit. Aroma: Bouquet of pine and spice, grapefruit.

Alpha Acid Composition	12%-14%	Humulene Oil Composition	18%-25%
Beta Acid Composition	3-4%	Caryophyllene Oil	9%-11%
Co-Humulone Composition	29%-34%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	35%-40%	Substitute Hops	Galena, Eroica, Nugget, Bullion, Columbus, Northern Brewer, Target

- **Magnum Hops:** Magnum is fast becoming a brewing favorite in Europe and towards being one of the most widely grown high alpha varieties in the US. Used predominately as a base bittering hop it features an exceptional growth rate, yield and superlative storage stability and is said to result in squeaky clean bitterness and subtle citrus-like flavors. Originally created at the German Hop Institute in Hull, Magnum was released to the brewing world in 1980 and has since been recognized as being most suited to pale ales and lagers where a clean bitterness is desired. It is the result of a cross between Galena and an unnamed German male variety. Aroma: Clean bitterness, subtle citrus flavors.

Alpha Acid Composition	12%-14%	Humulene Oil Composition	34%-40%
Beta Acid Composition	4.5%-5.5%	Caryophyllene Oil	8%-12%
Co-Humulone Composition	24%-25%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	30%-35%	Substitute Hops	Hallertauer Taurus, Columbus, Nugget

- **Galaxy Hops:** Descended from German variety Perle, Galaxy® is a unique Australian breed of hops that has the distinction of sporting the highest percentage of essential oils in the industry. It has an amazing citrus, peach and passionfruit aroma, especially when used as a late addition. The flavor is often quite intense upon production but mellows as it matures. Galaxy® enjoyed her first commercial production in 2009 after nine years of testing and quickly became popular both in Australia and overseas. Aroma: Citrus, peach and passionfruit aromas.

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Alpha Acid Composition	11%-16%	Humulene Oil Composition	1%-2%
Beta Acid Composition	5%-6.9%	Caryophyllene Oil	7%-9%
Co-Humulone Composition	32%-42%	Farnesene Oil	2%-4%
Myrcene Oil Composition	33%-67%	Substitute Hops	Citra®, Amarillo®, Centennial

- **Loral Hops:** Hop Breeding Company (HBC) released Loral, purported to balance the earthy and floral characteristics of noble varieties with elements more common among popular new world hops. Loral®, formerly known as HBC 291, provides a more traditional yet unique hop character, providing the floral and herbal notes one would expect from a fine noble aroma hop. Its mother is the U.S. developed aroma variety Glacier; the grandmother being the long-established European noble aroma variety known as Tardif de Bourgogne originating in the Bourgogne region of Eastern France. The father is a son of the U.S. developed Nugget variety. Aroma: Tropical fruit, stone fruit, citrus, resinous, spicy/herbal.

Alpha Acid Composition	10%-12%	Humulene Oil Composition	17.8%-25%
Beta Acid Composition	4.5%-5.5%	Caryophyllene Oil	5%-8%
Co-Humulone Composition	21%-24%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	37%-39%	Substitute Hops	Glacier, Nugget, Strisselspalt

- **Hallertau Blanc Hops:** Hallertau Blanc, daughter of Cascade, was released to the world in 2012. Established on the Hüll farm in the German Hallertau region, it was grown primarily for use in American-style Ales. Hallertau Blanc's flavor profile is said to be fruity, with wine-like qualities of gooseberry and grass, similar to that of Sauvignon Blanc. It also features a complex aroma profile with notes of cassis and elderflower in addition to grapes, grapefruit and lemongrass. Other notes detected in trials have been passionfruit, pineapple and gooseberry. Aroma: Flavors of white-wine and fruit, aromas of cassis, elderflower, grapes, grapefruit and lemongrass.

Alpha Acid Composition	9%-12%	Humulene Oil Composition	0%-3%
Beta Acid Composition	4.5%-6%	Caryophyllene Oil	0%-2%
Co-Humulone Composition	22%-26%	Farnesene Oil	0%-3.5%
Myrcene Oil Composition	50%-75%	Substitute Hops	Nelson Sauvignon

- **Sabro Hops:** Sabro® brand HBC-438 was developed by the Hop Breeding Company and released in 2018. Sabro is an aroma hop that is notable for its complexity of fruity and citrus flavors. It imparts distinct tangerine, coconut, tropical fruit, and stone fruit aromas, with hints of cedar, mint, and cream. Sabro's pedigree is the result of a unique cross pollination of a female neomexicanus hop. Aroma: Tangerine, coconut, tropical & stone fruits, creamy character, vanilla, cedar, dill, and mint.

Alpha Acid Composition	12%-16%	Humulene Oil Composition	10%-15%
Beta Acid Composition	4%-7%	Caryophyllene Oil	15%-20%
Co-Humulone Composition	20%-24%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	40%-50%	Substitute Hops	Citra®, Mosaic, Strata, Ekuanot

- **Idaho 7 Hops:** Idaho 7™ is the first hop release from Jackson Farms just outside of Boise. This hop is ripe with zesty tangerine flavor that is reminiscent of marmalade. Its uniqueness shows up as a pleasant herbal character that melds with the citrus to come across like fine earl grey tea. 007 is a dual-purpose hop. Aroma: tangerine, guava, apricot, pine, resinous.

Alpha Acid Composition	13%-15%	Humulene Oil Composition	10%-20%
Beta Acid Composition	4%-5%	Caryophyllene Oil	5%-10%
Co-Humulone Composition	30%-40%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	45%-55%	Substitute Hops	Citra, Loral, El Dorado

- **HBC 586 Hops:** HBC 586 is an experimental hop variety from the Hop Breeding Company, which is a joint venture between John I. Haas and Yakima Chief Ranches. It is the result of a hybrid pollination of the mother YCR 21 and male #01239-2. The aroma of HBC 586 has been described as "a large medley of fruit flavors... Mango, guava, lychee, citrus, with slight sulfur and herbal notes." Aroma: mango, pepper, orange, guava, lychee,

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Alpha Acid Composition	12%-13%	Humulene Oil Composition	14%-22%
Beta Acid Composition	7.5%-8.5%	Caryophyllene Oil	7%-15%
Co-Humulone Composition	35%-40%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	40%-50%	Substitute Hops	Ariana, Calypso, Idaho Gem, BRU-1, Lotus, Comet

- **Citra Hops:** released to the brewing world in 2008. Now one of the most coveted high-impact aroma hops in the US, particularly among craft brewers, it boasts a complex lineage that includes the likes of Hallertau Mittelfrüh (father), Tettninger (US), Brewer's Gold and East Kent Golding. Gene Probasco is credited with having first bred Citra in 1990. Citra, as the name implies, has a strong citrusy profile. This is largely credited to its very high myrcene content. It has an extraordinary flavor profile of grapefruit, lime and tropical fruits but despite its high alphas, brewers often warn against its use for bittering, which is considered by some to be harsh and undesirable. Aroma: Citrus, grapefruit, lime, tropical fruits, harsh bitterness.

Alpha Acid Composition	10%-15%	Humulene Oil Composition	7%-12%
Beta Acid Composition	3%-4.5%	Caryophyllene Oil	5%-8%
Co-Humulone Composition	20%-35%	Farnesene Oil	1%
Myrcene Oil Composition	60%-70%	Substitute Hops	Simcoe®, Cascade (US), Centennial, Mosaic®

- **Cashmere Hops:** Developed by Washington State University and released in 2013, Cashmere is the result of a marriage of Cascade and Northern Brewer. Fortuitously, it features alpha acids higher than that of Cascade. A good dual-purpose hop, Cashmere showcases flavors lemon, lime and melon, exhibits a smooth bitterness and is mildly aromatic with a subtle herbal bouquet. Aroma: Smooth bitterness, herbal aroma, flavors of lemon, lime and melon.

Alpha Acid Composition	7.7%-9.1%	Humulene Oil Composition	26%-29%
Beta Acid Composition	3.3%-7.1%	Caryophyllene Oil	12%-13%
Co-Humulone Composition	22%-24%	Farnesene Oil	1%
Myrcene Oil Composition	39%-42%	Substitute Hops	Cascade

- **Millennium Hops:** Millennium was, unsurprisingly, released in the year 2000. Emanating from the John I. Haas Breeding Program, Millennium hops are directly descended from Nugget and are considered similar in many ways to Columbus. They were born largely out of a desire for greater disease resistance and storage stability. Aroma: Mild, herbaceous, elements of resin.

Alpha Acid Composition	14.5%-16.5%	Humulene Oil Composition	23%-27%
Beta Acid Composition	4.3%-5.3%	Caryophyllene Oil	9%-12%
Co-Humulone Composition	28%-32%	Farnesene Oil	1%
Myrcene Oil Composition	30%-40%	Substitute Hops	Columbus, Nugget, Summit™, CTZ

- **El Dorado Hops:** El Dorado is a relatively new kid on the block. Created by Moxee Valley-based CLS Farms, LLC in 2008, it was released to the public in 2010. A product of the Yakima Valley's cooler climate, it features a uniquely fruity flavor profile in addition to desirable bittering and aromatic properties. High vigor, high alpha acids, lots of oils and resins, good storage stability and an exceptional yield also make this, on paper at least, an outstanding commercial variety. It exhibits bold tropical fruit flavors, said to be reminiscent of pineapple and mango, in addition to a resinous back note. On the nose, it imbues aromas of pear, watermelon, stone fruits and even candy. Aroma: Flavors of tropical fruit, pineapple, mango. Aromas of pear, watermelon, stone fruit and candy.

Alpha Acid Composition	13%-17%	Humulene Oil Composition	10%-15%
Beta Acid Composition	7%-8%	Caryophyllene Oil	6%-8%
Co-Humulone Composition	28%-33%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	55%-60%	Substitute Hops	Galena, Simcoe

- **Galena Hops:** Super alpha Galena is one of the most widely used bittering hop varieties in the US and is also an excellent dual-use hop. Galena's fruity flavor profile really kicks with clean and agreeable notes of citrus. Some brewers have noted its

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better when boiled in smaller quantities and that later additions bring forth stronger aromas of blackcurrant. Directly descended from Brewer's Gold, Galena was brought about via open pollination and was officially selected in 1968 by agricultural scientist Richard R. Romanko in the state of Idaho. Aroma: fruity.

Alpha Acid Composition	12%	Humulene Oil Composition	10%-15%
Beta Acid Composition	7.5%	Caryophyllene Oil	3%-6%
Co-Humulone Composition	39%	Farnesene Oil	Trace amounts
Myrcene Oil Composition	55%-60%	Substitute Hops	Nugget, Columbus, Zeus, Chinook, Pride of Ringwood, Eroica, Newport, Cluster, Brewers Gold

- **Belma Hops:** Belma® hops are a recent addition from Hops Direct and Puterbaugh Farms in the Yakima Valley, released in 2012. Belma has been tested as a dual-use hop and found to have an ambrosial mix of orange, melon, strawberry and pineapple with a slight hint of grapefruit. Backing that up, OSU created a Pale Malt with Belma which carried those same aroma and flavor characteristics. Aroma: Notes of orange, melon, strawberry, pineapple, hint of grapefruit, berry, currant.

Alpha Acid Composition	8%-12.1%	Humulene Oil Composition	Unknown, varies
Beta Acid Composition	4%-8%	Caryophyllene Oil	Unknown, varies
Co-Humulone Composition	34%-38%	Farnesene Oil	Unknown, varies
Myrcene Oil Composition	65%-68%	Substitute Hops	Huell Melon, Pacific Gem