



It's a Bine, Not a Vine—Literary Review of Hop Varieties

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Abstract

Hops (the flowers of the *Humulus lupulus* plant) are an important and essential part of the beer brewing process as well as in the taste and fragrance of the final product. During the brewing process, hops are isomerized into alpha and beta acids that balance out the sweetness of the malt by providing bitterness, measured in International Bittering Units (or IBUs) or aroma respectively. Based on geographical location or strain of hop grown, the flower can provide numerous different flavor and aroma profiles, as well as essential oils, flavonoids, and antimicrobial properties. In addition, the time and temperature at which hops are added during the brewing process can dramatically change the taste or smell of the beverage produced. The flavors and aromatic properties in each kind of hop also contribute to the style of beer produced. Some varieties are better than others (or should be completely avoided) for some beer styles, but a few of them can also be used interchangeably, as arranged on the Flavor Profile Wheel of Hops Varieties. These findings led to the creation of this diagram to help give a visual showcase of how hops could be classified.

Introduction

Hops are the flowers of the *Humulus lupulus* plant and are the balancing agent to the sweetness of the malt. Qualities of hops include bittering, aroma, and flavoring profiles. Unboiled hops are only mildly bitter. There are two main types of hops, bittering and aroma. Some flavors from hops might be: grassy, floral, citrus, lemon, grapefruit, earthy, piney, fruity, and nutty. During the brewing process, hops are isomerized into alpha and beta acids. The alpha acids are responsible for most of the beer's bitterness. The degree of bitterness in a beer is controlled by the degree to which alpha acids are isomerized during the boil. Beta acids are mostly used for aroma contributions. Hops can come in three types:

- Fresh Hops:** whole cone hops that have been recently harvested (up to a week)
- Dried Hops:** whole cone hops that have been dried to preserve oils and resins (most popular in craft beers)
- Pellet Hops:** crushed, concentrated hop flowers that have been formed into pellets (most user friendly)

Isomerization

α -acids, β -acids, and essential oils are all desired components of the *Humulus lupulus* plant. When hops are added to boiling wort, α -acids such as humulone, thermally degrade to their iso- form. Isomerized α - acids induce bitter flavoring for the beer, as well as providing a slight antibiotic effect against gram positive bacteria. Unlike α -acids, β -acids do not isomerize during the wort boiling process. β -acids, such as lupulone, leisurely oxidize during the fermentation and storage phases of the brewing process. Isomerized α -acid bitterness disintegrates during storage, since β - acids emerge during the later stages of the brewing process; they provide a more biting bitter flavor. Hops have certain flavor profiles ranging from citrusy, woody, spicy, or fruity. The essential oils aspect of the hops is where these different scents lie. Adding hops in to the early stages of boiling wort degrades all essential oils. So, dry hops are added to the end stages of boiling wort or after the wort is cooled to harness the scents in the beer.

Isomerization

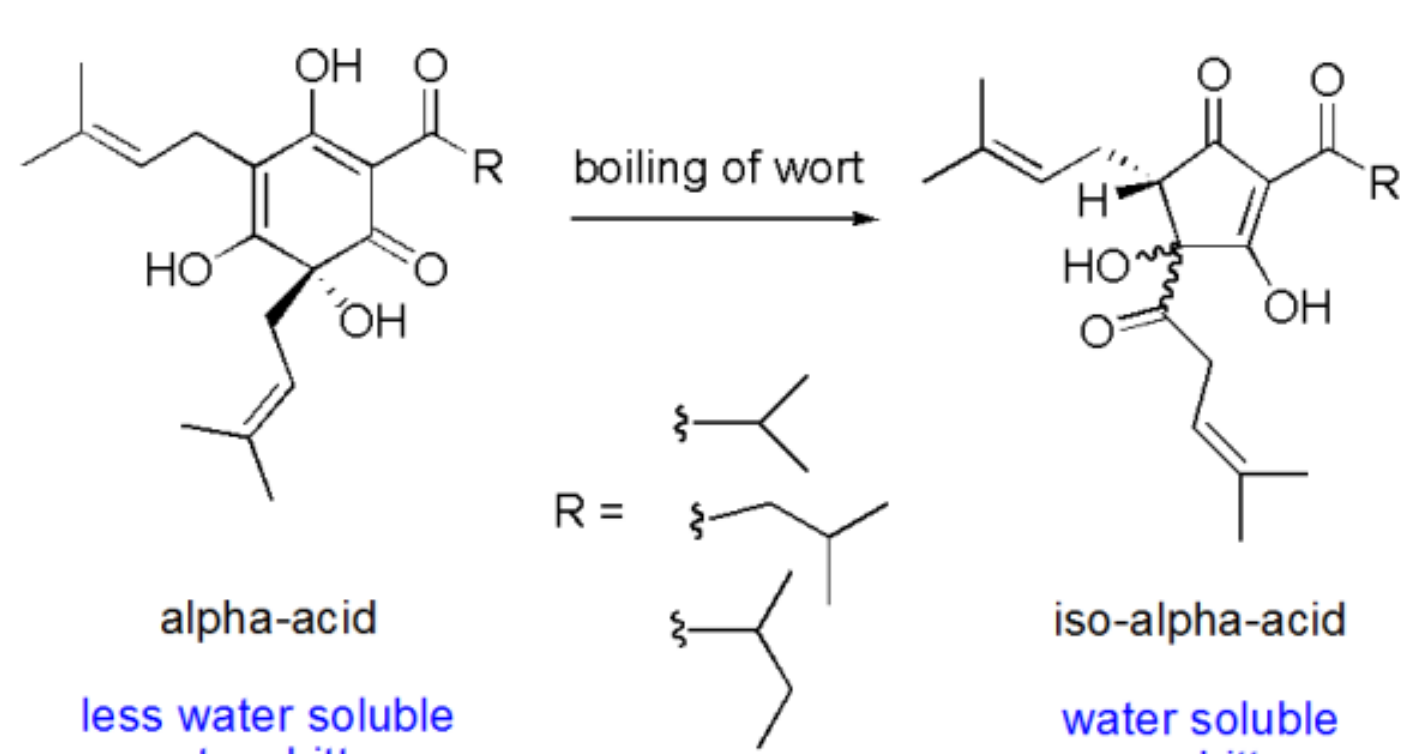


Fig 1: Process of isomerization

Flavor Profile Wheel for Hop Varieties

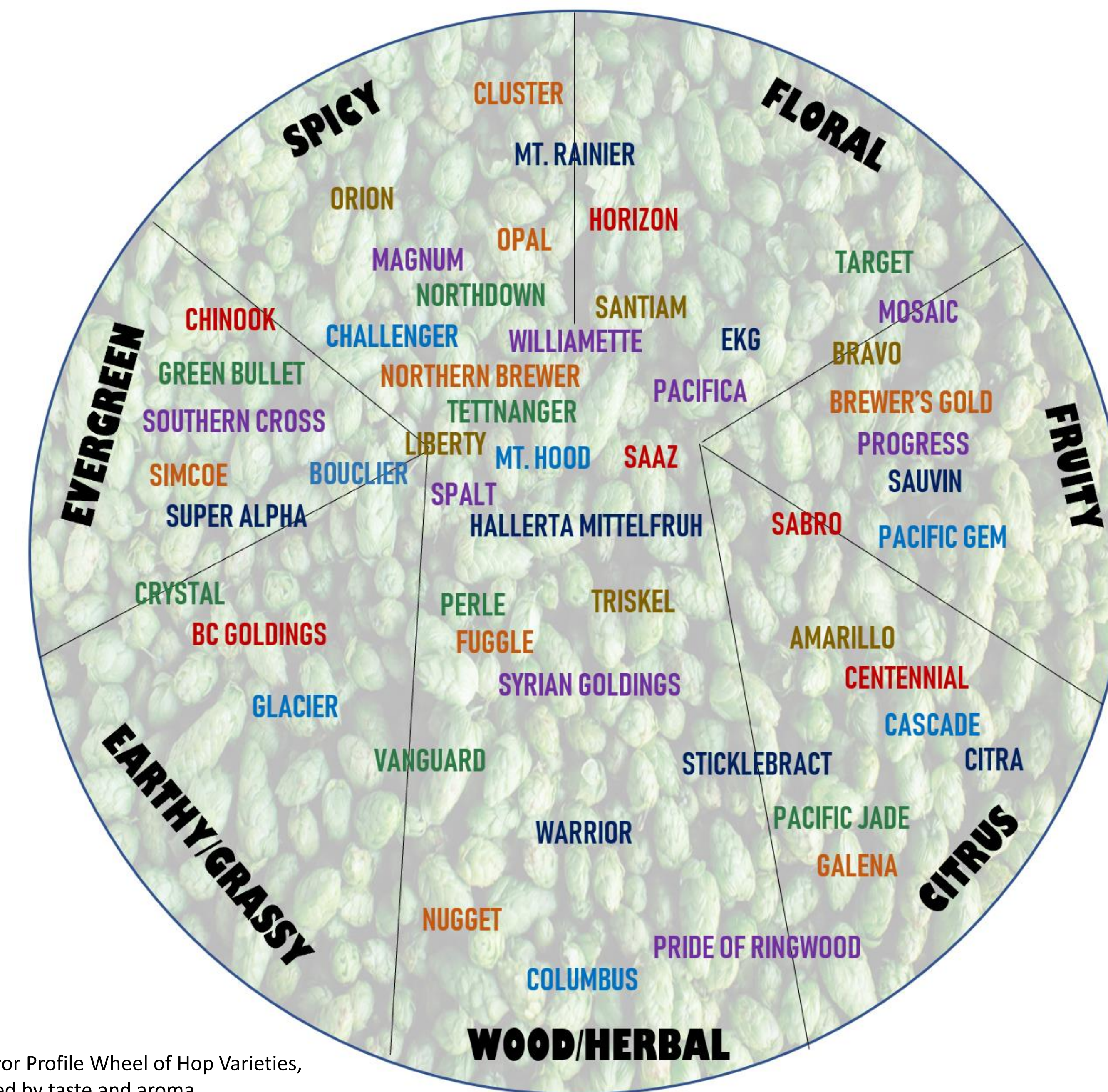


Fig 1: Flavor Profile Wheel of Hop Varieties, categorized by taste and aroma

Specific Hop Examples

Cascade:

“Developed by Jack Horner and his team at Oregon State University. Ever since the development Cascade hops has become one of America’s most popular hops. Currently represents 10% of all hops grown in the US. Cascade was originally developed through open pollination of English variety Fuggle and the Russian variety Serebrianka and is named after the Cascade Range, mountains that run from northern California all the way north to British Columbia, Canada” (“Cascade (US),” 2018).
Beer Styles: American Pale Ale, IPA
Aroma Notes: Grapefruit, Floral, Pine
Alpha Acids: 5.5-9%
Beta Acids: 6-7.5%
Country of Origin: Washington, United States

Bravo:

This hop variety is fairly new, developed in 2006 by Hopsteiner Breeding Program. It’s known for its sweet, floral, and citrusy aroma profile, and it is an excellent bittering variety.
Beer Styles: Pale Ale, IPA, Barley Wine
Aroma Notes: Orange, Vanilla
Alpha Acids: 15-18%
Beta Acids: 3.5-5.5%
Country of Origin: United States

Mt. Rainier:

Unsurprisingly, the Mt. Rainier is in fact named after the popular active volcano in the state of Washington. It was “born out of the USDA-ARS hop breeding program in collaboration with Oregon State University” (“Mount Rainier,” 2018). It is a cross between a Magnum hop and a USDA male hop. Mt. Rainier hops are used as both an aromatic and a bittering agent.
Beer Styles: Lager, American Ale, Porter
Aroma Notes: Lemon, Cedar, Grass, and Tea
Alpha Acids: 5.0-9.4%
Beta Acids: 5.0-7.0%
Country of Origin: United States

Fuggle:

“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. Today however, as other higher alpha acid varieties have become more prevalent, it’s now more prominently used for its aroma” (“Hop Varieties,” 2019).
Beer Styles: English Style Bitter, Stout, Brown Ale, Porter, Pale Ale
Aroma Notes: Green tea, mint, grass, floral
Alpha Acids: 3-5.6%
Beta Acids: 2-3%
Country of Origin: United Kingdom

Mosaic:

Developed by Hop Breeding Company in 2012, has high alpha acids and a wide variety of flavors and aromas (hence the term “Mosaic”). Derived from a cross of a female Simcoe and male Nugget hop. Very fruity.
Beer Styles: IPA, Pale Ales, Stouts
Aroma Notes: Blueberry, Tangerine, Papaya, Rose, Blossom, Bubble Gum
Alpha Acids: 10.5-14%
Beta Acids: 3-4.5%
Country of Origin: United States

Anatomy of a Hop

It is important to note that hops grow on a bine, not a vine. Below is definitions for a bine as well as the various parts of the hop flower.

Bine: This is similar to a vine, except the stem circles around the object it is climbing to hold on. A vine uses tendrils that wrap around objects for support.

Strig: The base of the hop where the hop connects to the plant. Specifically, the strig connects to the petiole (the little “stems” connecting leaves to a stem), which is attached to the stem of the bine.

Bract: This is essentially a modified leaf. Another good example of a bract is the colorful “petals” of a poinsettia. For hops, think of the bract as a sort of outer protective husk.

Bracteole: Bracteoles are harder to define, but they are essentially secondary bracts underneath the outer bracts. They provide inner support and structure while protecting the lupulin glands underneath.

Lupulin glands: These are what you are really seeking in hops. These are small yellow sacs that are full of many chemicals including the essential oils, alpha acids, and beta acids that everyone is so interested in.



Fig 1: Hops garden. Plants are supported by netting or cables so the bines can attach and grow upwards

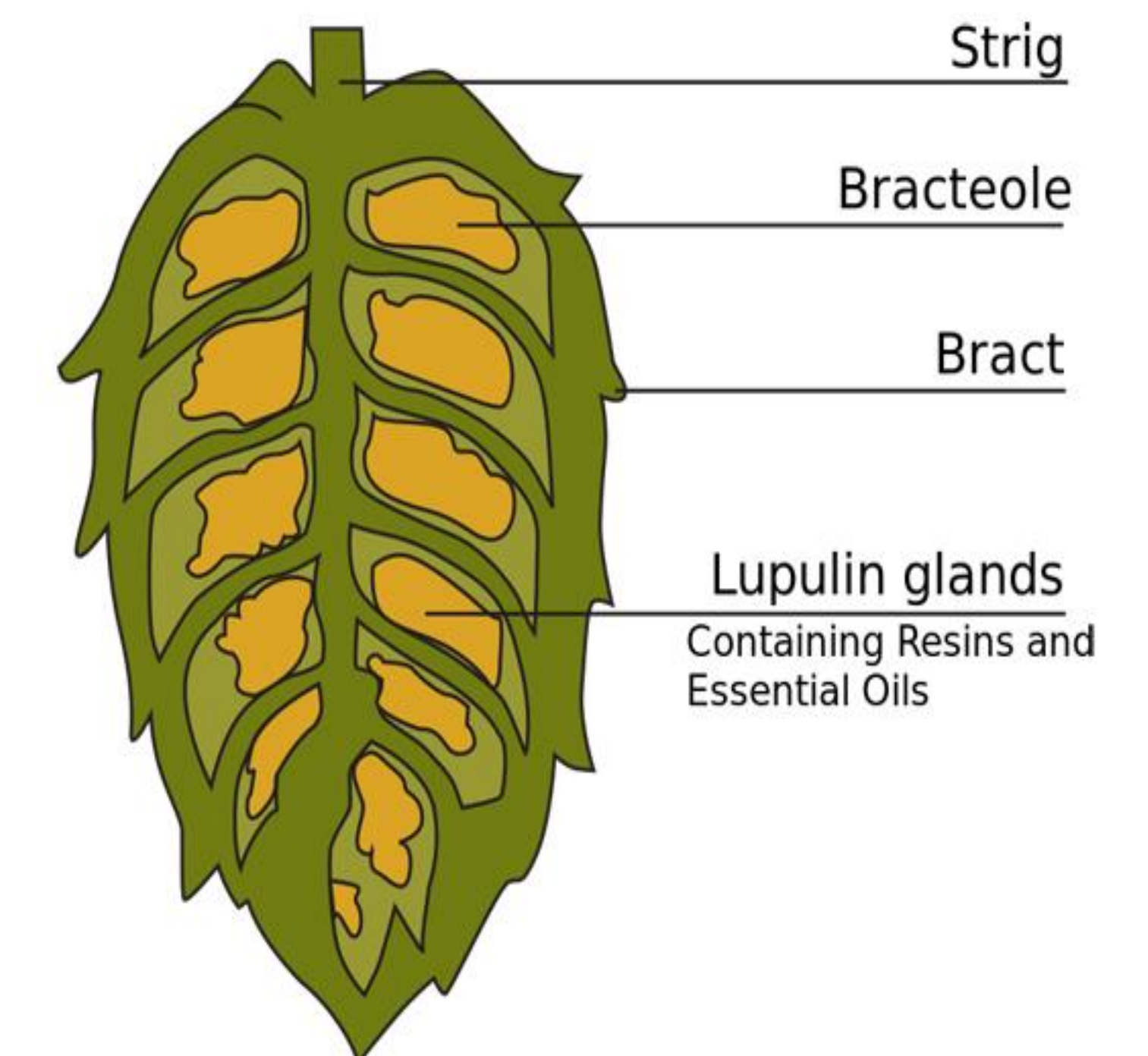


Fig 2: Diagram of a hop

Conclusions

Based on the research completed, a diagram was created after categorizing the hops varieties on their flavor and aroma profiles to allow for a visual understanding of their characteristics and how they can be used interchangeably.

Acknowledgements

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