Hops Companion

A brewer's guide to hop varieties and hop products

4TH EDITION

HAAS | BarthHaas | HPA

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A brewer's guide to hop varieties and hop products

FOURTH EDITION

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TABLE OF CONTENTS

Welcome to the Fourth Edition of the *Hops Companion*! With Tim Kostelecky's retirement from John I. Haas, Inc., (HAAS®) I have assumed the editorial duties for the Fourth Edition of the guide. Tim has done an exemplary job in creating and shepherding the *Hops Companion* through the three previous editions. I can only hope to emulate Tim's efforts and will strive to maintain the same quality standards that he has set and maintained over the years.

Overall, the goal for the *Hops Companion* remains the same, to provide an easy to use reference guide for hop varieties from around the world. The design of the hop variety pages allows the reader to obtain desired information quickly at a glance. This includes short background descriptions outlining information such as pedigree and flavor characteristics. Hopsessed® aroma icons depict pictorial representations of key hop flavor attributes. In addition, each hop variety page contains a table containing specific bitterness and aroma chemical data.

Each edition of the *Hops Companion* has reflected the changing landscape of the world of hops. Breeding programs have striven to produce hops with flavor profiles that are unique and impactful to meet the needs of a changing beer market. This has resulted in the proliferation of new varieties and the decrease in demand for some legacy hops. Given the limitations of space, not all hop varieties could be included in the *Hops Companion*. Judgement calls based on commercial

appeal or historical significance determined whether a variety was included into this Guide. Certainly, if there is a groundswell of support for an excluded variety, it will be included in the Fifth Edition!

The use of hops in beer is as much an art as it is a science. In recognition of this thought, the title page leads off the *Hops Companion* with a lovely painting of a brewery scene. Thanks go out to my BarthHaas® colleague—Dr. Christina Schönberger—for contributing her creative flair to the book.

Certainly, this edition of the *Hops Companion* could not have come to fruition without the assistance of my valued colleagues. Tim Kostelecky was very helpful in answering my many questions and as a resource for varietal page content. I also want to express my appreciation to Jeff Dailey, Sydney Masovero, Brian Buffin, Jim Ringo and Corrie Van Oostrum for their eagle eyes and their many helpful suggestions. Kudos go out to Renee Bolz, Rob Waldeck, Meredith McKelvey, and Kate Graceffo from Holland-Mark for all of the great work that they did in bringing the Companion to a publication ready format.

Cheers and happy brewing!

Phil Chou, Director of Brewing Solutions

John I. Haas, Inc.
Yakima, Washington USA

Hops and Hop Products

Hops have been a primary ingredient in beer since medieval times. These plant products contribute to key properties such as aroma, taste, bitterness, foam, and shelf life. Leveraging this versatility has enabled brewers to evolve their approaches to using hops. Historically, hops served as a complementary spice and preservative. The craft beer movement, however, ushered in an era of bold, exciting flavors that have captured the hearts and minds of brewers and beer drinkers. In fact, this movement produced titanic shifts in the beer flavor landscape, with hops at the forefront. Brewers are increasingly creative in the use of hops in their recipes in existing beer styles, while also developing new hop-centric beers such as New England India Pale Ales. This heightened interest in flavor even extends to the farm. Hop "aroma" varieties have supplanted bitter cultivars as the majority of planted acreage. In parallel, hop breeding programs are developing new varieties to meet the demand for unique and bold flavor profiles. Further shifts in the craft beer landscape will continue to be driven by brewers, hop breeders, as well as consumers.

Brewers often refer to their "spice rack" of ingredients that allows them to create the flavor profiles they seek in crafting their beers. Among the most important components in this spice rack are hops and hop-derived products—these are key contributors to the pleasurable sensory experience that we derive from beer.

From a botanical perspective, hops have several interesting characteristics. The plant is a perennial climbing bine and grows as separate male and female plants (dioecious). Male plants have no applications in brewing; their primary value is to provide genetic material during the breeding of new hop varieties. Brewing value derives from the cones from the female plant. The cone contains lupulin glands that produce hop resins, which impart the bitterness, aroma, and tastes that brewers seek.

From a brewing perspective, the lupulin glands supply many of the most valued flavor compounds. These glands produce two types of resins. Soft resins are those that are soluble in low boiling hydrocarbon solvents such as hexanes. Hard resins contain compounds that are not soluble in hexanes but are dissolved by more polar solvents such as methanol. One can think of the soft resins as hop "gold mines" where much of the brewing value of hops lies. The compounds most identified with hop flavor—alpha acids and essential oils—are soft resin components. Beta acids are another component of soft resins. These compounds have little inherent brewing value, but have applications in other industries. Hard resins contain chemicals that are associated with alpha and beta acid oxidation products as well as other notable compounds, such as polyphenols and xanthohumol.

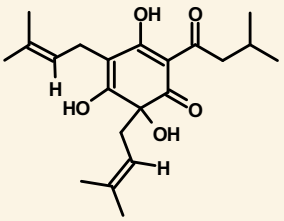
Historically, hops were classified as either bitter or aroma varieties. Bittering hops have high alpha acid concentrations and brewers primarily use them early during kettle boil. Aroma hops have low alpha acid levels with essential oil profiles that produce desirable aroma in beer. These distinctions began to blur as hop breeding programs introduced many new hops that possessed both high alpha acids and pleasing aroma. This prompted the proposal of a new hop category: dual-purpose hops. Nonetheless, such narrowly defined hop designations may not best describe individual varieties given the increasingly creative ways in which brewers use hops.

In fact, even the form in which brewers use hops has shifted. The earliest application of hops to brewing required the whole or hop cone form. Ultimately, this approach is relatively inefficient to deliver bitterness, aroma, and flavor to beer. Brewers' needs therefore prompted the development of a wide variety of hop products, ranging from pre-isomerized pellets to essential oil extracts. Hop products can have specialized or more general applications in the brewing process. For example, brewers primarily use hop extracts in the kettle to impart bitterness. In comparison, pellets find applications in the brewhouse for bitterness, as well as in cold side dry-hopping operations for aroma and taste. All of these forms and uses illustrate the versatility that hops have as a brewing ingredient.

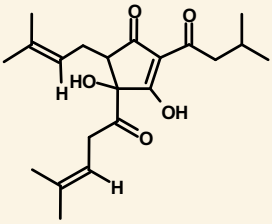
HOP CHEMISTRY

Bittering Compounds

Alpha acids such as humulone provide the primary source for bitterness in beer. However, alpha acids have limited solubility and contribute little bitterness without a key conversion step. During kettle boil, alpha acids undergo isomerization to isoalpha acids, such as isohumulone, that produce the majority of hop-derived bitterness. Hop products are also available that contain pre-isomerized alpha acids such as isopellets and isomerized kettle extract (IKE). Thus, brewers have options as to how they choose to impart bitterness to their beers.



Humulone



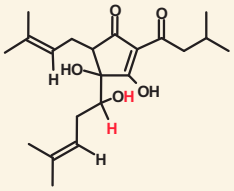
Isohumulone

The most abundant alpha acid in hops is humulone (35–70% of total alpha acids). Other alpha acid components are cohumulone (20–65%), adhumulone (10–15%), prehumulone (1–10%), and posthumulone (1–3%). Humulone and cohumulone are regarded as the key alpha acids in brewing.

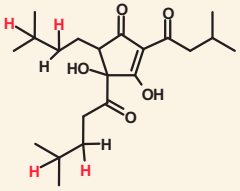
Each of these alpha acids are distinct chemical compounds and have the potential to yield different sensorial perceptions of bitterness. Traditionally, brewers have considered the quality of bitterness derived from isomerized humulone (isohumulone) to be superior to that of isomerized cohumulone (isocohumulone). As a consequence, brewers have sought hops that possess low levels of cohumulone. However, there is compelling evidence in the scientific literature that indicates that isocohumulone does not impart undesirable bitterness to beer.

Brewers also use post-brewhouse advanced or down-stream hop products to impart bitterness to beer. These include *rho*-isoalpha acids, tetrahydroisoalpha acids, and

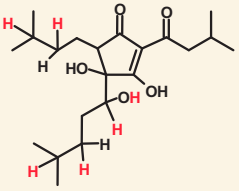
hexahydroisoalpha acids. Compounds such as oxidized alpha and beta acids and polyphenols (tannins) can also impact bitterness perception in beer.



Rho-isohumulone



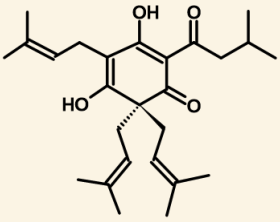
Tetrahydroisohumulone



Hexahydroisohumulone

Beta Acids

Traditionally, brewers considered beta acids such as lupulone as lacking inherent value for brewing. However, the potential of beta acids to contribute to brewing should not be overlooked: applying a series of isolation steps and chemical reactions converts beta acids into isoalpha acids. This processing helps derive value from a class of compounds that otherwise would be of little use in brewing.



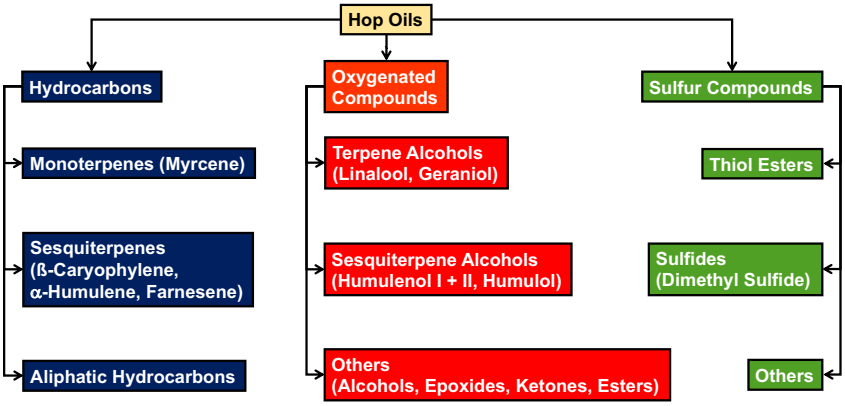
Lupulone

Outside of brewing, beta acids have a diverse set of applications. These compounds have antimicrobial activities against Gram-positive organisms such as *Lactobacillus*. In the sugar and fuel-ethanol sectors, beta acids provide an alternative

to antibiotics to keep microbial loads low during production. The bee-keeping industry faces major challenges from Varroa mites that decimate domesticated bee populations. This problem has implications not only for honey production, but also for agriculture that relies on bees for crop pollination. Beta acids function as effective mitocides when used in bee hives. Relative to other mitocides on the market, beta acid products such as HopGuard® are environmentally friendly and are nontoxic to humans.

Hop Oils

Essential oils are the soft resin component that provides hop aroma and taste to beer. Aroma and taste combine as "flavor." Flavor compounds in hop oil fall in several different classes:



The most abundant chemicals in hop oils are myrcene, humulene, caryophyllene, farnesene, linalool, and geraniol. These compounds are the most typically cited in hop oil chemical analysis reports. Each of these oil components has unique sensory properties.

Myrcene: herbaceous, resinous, green, fresh hop, balsamic

Humulene: piney, woody

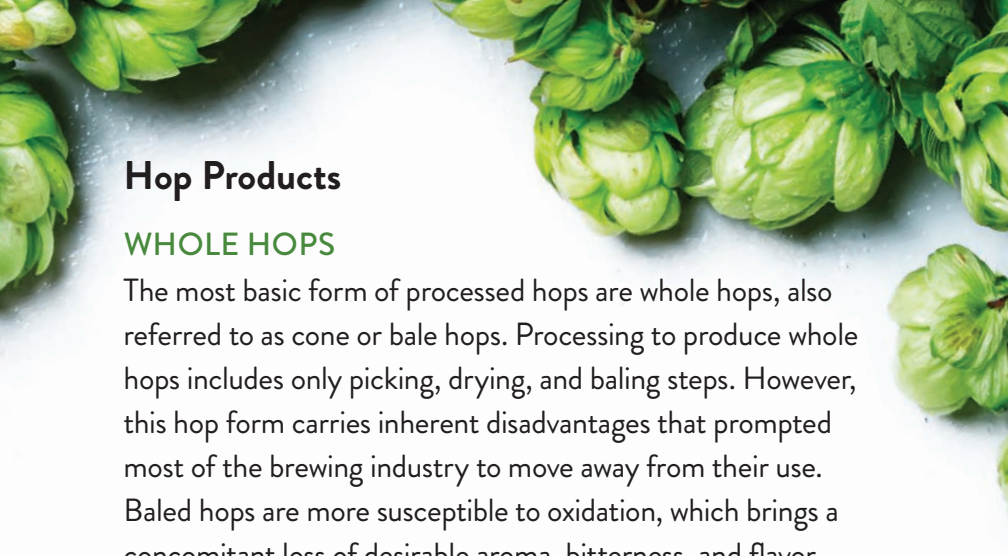
Caryophyllene: sweet, woody, spice, clove, dry

Farnesene: woody, citrus, sweet, green leafy, herbaceous

Linalool: floral, citrus

Geraniol: floral, rose, waxy, fruit

The flavor diversity found in just these most abundant compounds begins to illustrate the complex endeavor of understanding hop flavor. While only a handful of compounds are typically quantified during chemical analysis, hops actually contain hundreds of flavor species. Each individual oil component has distinct organoleptic properties across a wide range of attributes such as citrus, fruity, floral, wood, spice, and vegetal. In addition, synergistic interactions between compounds can enhance and/or deliver different flavors relative to the contribution of individual chemicals. Conversely, flavor molecules can interact in an antagonistic fashion where hop flavor is diminished or undesirable. The bottom line is that there is still much to learn about the intricacies of hop flavor.



Hop Products

WHOLE HOPS

The most basic form of processed hops are whole hops, also referred to as cone or bale hops. Processing to produce whole hops includes only picking, drying, and baling steps. However, this hop form carries inherent disadvantages that prompted most of the brewing industry to move away from their use. Baled hops are more susceptible to oxidation, which brings a concomitant loss of desirable aroma, bitterness, and flavor. Whole hops are also less homogeneous compared to products such as pellets and extracts. Hop bales are bulky, which significantly impacts cost related to storage, shipping, and handling. Improperly dried and monitored bales can present a significant fire hazard during storage. Further, to get the most brewing value from cone hops, specialized brewhouse equipment is needed. Even then, alpha acids utilization is lower relative to other hop products. Despite these challenges, some brewers still prefer whole hops over other hop product forms. This preference is driven by the belief that whole hops deliver more desirable flavor outcomes versus hops that have undergone further processing.

An increasingly popular category of whole hops are those known as fresh, green, or wet hops. After picking, these hops are not subjected to drying or other processing steps. Wet hops impart true-to-type varietal flavors of their dried counterparts, but at different intensity levels. In addition,

wet-hopped beers possess green, grassy, and vegetal notes along with a freshness and vibrancy not found in conventionally hopped beers. Yet, many of the disadvantages of dried whole hops are amplified in wet hops. Degradation rates are faster, thus wet hops must be used within a day or two of harvest. This limits the availability of wet hop beers to during the harvest season. The proportionally higher percentage of water in wet hops necessitates adding corresponding larger masses of hops to achieve bitterness and flavor targets. Specialized equipment or creative repurposing of existing equipment is needed to deal with the large mass and bulk of wet hops. Alpha acids utilization and brewing efficiencies are generally low. In addition, the shelf life of wet-hopped beers is shorter than that of conventional beers due to the rapid loss of fresh hop flavor.

HOP PELLETS

Pellets are the most commonly used hop product in the beer industry. Brewers can apply hops pellets in the same manner as whole hops. Applications range from imparting bitterness through kettle hop additions to flavor enhancement via dry-hopping during cellar operations. Upon addition to wort or beer, hop pellets readily disperse in these matrices to allow for extraction of bitterness, aroma, and/or flavor. The resultant spent hop solids are removed via settling, filtration, and/or centrifugation. A number of pellet products are commercially available.

Type 90 Pellets

The most commonly used hop pellets are those designated as Type 90 (T-90). Dried whole hops are first milled, then extruded through specialized machine dies into pellet form. Historically, the T-90 name described the mass composition of the early pellets produced under this designation. After processing, the pellets typically retained approximately 90% of the original hop mass. Today, mass retention in T-90 pellets is routinely greater than 90%, thus rendering the T-90 designation somewhat inaccurate. T-90 and other pellet types are popular because they offer advantages over whole hops. These include greater homogeneity, longer shelf life, smaller bulk, reduced fire risk, and lower shipping, storage, and handling costs.

Type 45 Pellets

Hops can be processed into pellet forms that are enriched in lupulin concentration. A popular example of concentrated/enriched pellets are the Type 45 (T-45) products. Concentration of hop resins occurs through the removal of a greater proportion of hop vegetative matter relative to T-90 pellets. This requires processing at below-freezing temperatures to mitigate the stickiness of the lupulin glands and facilitate the removal of the green matter. As for T-90 pellets, historical T-45 designations reflected how much of the original hop mass remained in the final product (in effect, 45% of the starting hop mass). Current pellet production practices typically yield greater than 45% of the original mass. This improvement is due to higher alpha acid content in contemporary hop varieties relative to their historical counterparts. This feature requires removal of less vegetative matter to achieve desired alpha acids concentrations. Brewers apply T-45 pellets to the same process points as whole and T-90 hops. However, due to their enriched nature, less mass is required relative to less concentrated hop forms to achieve the same brewing bittering and flavor targets. T-45 pellets also share the same advantages of T-90 pellets compared to whole hops.

LUPOMAX®

In 2020, HAAS® introduced LUPO**MAX**®—a highly consistent, concentrated lupulin pellet designed to deliver

optimized hop flavor. LUPO**MAX** is a varietal-specific, enriched hop pellet that offers consistent year-to-year and lot-to-lot alpha acid levels as well as flavor impact to beer. This consistency is achieved through Haas' exclusive Sensory Plus™ production program. Sensory Plus is sensory-based hop selection coupled with advanced technical analysis. Then, applying proprietary processing steps to the selected hops generates pellets that achieve targeted specifications for each LUPO**MAX** variety. Brewers can use LUPO**MAX** during production in the same manner as T-90 pellets; the recommended application of LUPO**MAX** is through addition to the whirlpool and/or dry-hopping during cellar operations. Because LUPO**MAX** is an enriched pellet, dosage rates are typically 70% of corresponding T-90 hop bills.

Isomerized Hop Pellets

Isomerized hop pellets (isopellets) are an alternative to conventional bittering kettle products, such as cones, T-90 pellets, concentrated pellets, or extract. A major benefit of isopellets is improved bitterness utilization compared to the products mentioned above. Isopellets follow the same general production techniques as T-90 pellets, but with two differences: 1) the addition of small quantities of magnesium oxide to the hop powder before pelletization, and 2) storage of packaged pelletized hops at approximately 50°C for one to two weeks. Under these conditions, the hop alpha acids almost completely isomerize into isoalpha acids.

Isopellets offer a way to directly add isoalpha acids into beer. The primary benefit is reflected in a significant increase in bitterness utilization. As a result, brewers can achieve significant potential savings in ingredient, shipping, and storage costs. Notably, however, the organoleptic properties that isohops impart to beer may not match conventional pellets. Brewers are cautioned to conduct flavor trials to determine the optimal isopellet/conventional pellet replacement rate.

HOP EXTRACT-BASED PRODUCTS

From an economic perspective, the most valuable hop components are the oleoresins in hop lupulin glands. These hop resins contain the bitterness, flavor, and aroma compounds that are important to beer. The most commonly used method

to separate hop resins from the bulk hop vegetative matter is through extraction processes. In addition to organoleptic attributes, hop extracts offer other attractive features and benefits. Compared to whole hops and pellets, extracts have longer shelf lives, are more concentrated, and increase brewing efficiencies. In addition, extracts have greater compositional uniformity versus whole hops. Extracts also offer a degree of flexibility because adjustments to production processes will yield extracts which meet different targeted chemical specifications.

Over the years hop extraction solvents have moved from ethanol and hexanes to carbon dioxide (CO_2), such as liquid carbon dioxide (LCO_2) or supercritical carbon dioxide (SCO_2). The use of CO_2 in hop extractions offers several advantages over conventional solvents. CO_2 is non-toxic, non-flammable, and does not leave trace residues behind. In addition, CO_2 can be removed without the loss of important volatile hop constituents. Both LCO_2 and SCO_2 are effective at extracting the desirable components from hops including alpha acids, beta acids, and essential oils. Extraction of other hop constituents occurs to varying degrees depending upon their solubility in LCO_2 or SCO_2. Polyphenols and waxes do not undergo efficient extraction by CO_2. As a result, these compounds represent only a small proportion of hop extract. For other hop components, solubility in CO_2 is dependent upon the state of the solvent. For example, chlorophyll and other plant pigments are extracted by SCO_2 but not LCO_2.

CO_2 hop extract is sold in different forms. Undiluted resin, usually called pure resin extract, typically contains 30% to 65% alpha acids, depending on the characteristics of the original hops. Alternatively, production processes can standardize resins to specified alpha acids content using corn syrup or other plant syrup as a diluent. Standardized hop extract was once a popular product, but pure resin extract has gradually supplanted this form.

A number of reasons support the use of CO_2 hop extracts in place of other hop kettle products like pellets. These include:

1. They are the most stable form of hop product. Pure resin extracts can be stored for several years at ambient temperature with negligible loss of brewing value.

2. Utilization of hop extracts in the kettle is better than with traditional types of kettle hops.

3. Hop extracts are extremely uniform. The processing plant carefully adjusts alpha acids content to customer specifications for optimum consistency.

4. Shipping, storage weight, and volume are substantially reduced as only the extract material (typically 20-25% of the original hop material for high alpha hops) is retained and packaged.

FLEX® POURABLE BITTERING PRODUCT

FLEX® represents the next stage in the evolution of extract-based hop products. As an alternative to cones or pellets for kettle bittering applications, FLEX offers several benefits. The product is 100% hop-derived and presents no labelling issues when used in beer. Comprising 65% alpha acids, FLEX is the most concentrated alpha product currently available on the market. FLEX flows freely at ambient temperatures and does not require preheating or specialized dosing equipment. Dosing rate calculations follow the same format used for CO_2 extract. Alpha acid utilization during brewing is typically 10–20% (relative) greater when compared to pellets. Brewers should consider this feature in calculating brewing recipes where FLEX replaces pellets. The lack of vegetative matter in FLEX also confers additional efficiency gains when replacing pellets. For example, when using hop pellets, brewers can expect to lose 10 L of wort or beer for every kg of pellets used. These losses are minimized when FLEX is used in place of pellets. FLEX provides the added benefit of generating less solid waste, reducing waste handling costs and increasing brewery sustainability.

CO_2 EXTRACT & FLEX DOSING CALCULATIONS

Dosing calculations must accommodate the differences inherent across the types of hop products. The below formula may aid in calculating conventional CO_2 extract and FLEX dosing levels based on bitterness targets. Notably, equipment and techniques can vary considerably between breweries. As such, no single formula is sufficiently robust to account for all situations. If needed, HAAS sales or technical personnel will provide assistance with dosing calculations for specific brewing conditions.

When replacing hop pellets with conventional extract or FLEX, we recommend that brewers reduce the alpha acids kettle dosage by 10% to 20% (typically alpha utilization is increased by about 5% absolute, e.g., from 25% to 30%).

The basic calculation for hop dosing:

kg product to dose = (hL x ppm) / (%U x %conc)

- **hL** = Final beer volume in hectoliters (1 bbl = 1.174 hL)
- **ppm** = ppm isoalpha acids desired in final beer; roughly relates to bitterness units
- **%U** = Estimated percent utilization = (isoalpha acids in beer / alpha acids dosed) x 100
- **%conc** = Percent concentration of alpha acids in hop product

Example:

100 bbl finished beer, 40 ppm IAA desired, 30% utilization, 45% alpha acids in extract

([100 x 1.174] x 40) / (30 x 45) = 4696 / 1350 = 3.48 kg **extract** to dose

ISOMERIZED KETTLE EXTRACTS

Similar in concept to isopellets, these are hop-based extract products where the primary bittering components consists of pre-isomerized isoalpha acids. These products are known as isomerized kettle extracts (IKEs). Under controlled conditions, heating a mixture of pure resin CO_2 extract and magnesium salts (e.g., magnesium carbonate) will produce IKE. This process achieves conversion of alpha to isoalpha acids at greater than 95% efficiency. Of note, under these reaction conditions, hop oil composition may undergo changes that can impact beer flavor.

The use of IKE obviates the need for kettle isomerization of alpha acids. Bypassing this step results in increased bitterness utilization, with total values in the range of 45–55%. Brewers may apply IKE at any time during kettle boil. However, late-boil additions may influence beer aroma due to the hop oils present in IKE.

INCOGNITO®

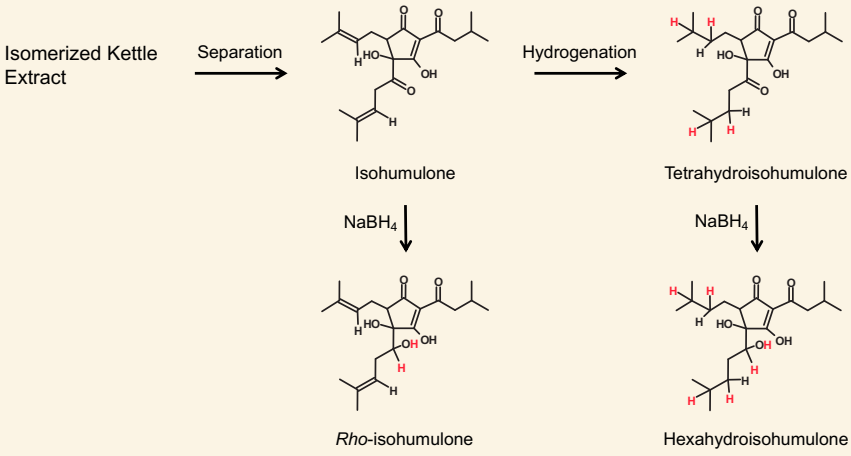
INCOGNITO® is a flowable variety-specific extract of hops offered by HAAS. This product provides enhanced hop flavor and aroma to beer while enabling reductions in hop pellet use. The recommended application point for INCOGNITO is during hot-side additions to the whirlpool. With INCOGNITO, brewers can reduce pellet dry-hopping and still produce beers with robust hop aroma. Similar to FLEX, INCOGNITO contains no hop solids and eliminates wort losses associated with hop pellet liquid absorption. As a general rule of thumb, 1 g/L of INCOGNITO is approximately equivalent to 5.8 g/L of pellets. Given the diversity of equipment and brewing

techniques across the industry, we recommend conducting small-scale brewing trials to assess INCOGNITO's performance under specific conditions. Brewers can calculate dosage based on the comparison to pellet dosage above or on INCOGNITO oil content. Alpha acids are a component of INCOGNITO and contribute to beer bitterness. Expect 2–10% alpha acid utilization depending upon timing of addition, temperature, and other whirlpool factors.

POST-FERMENTATION BITTERING PRODUCTS

Other available products give brewers added process flexibility. These include isoalpha, *rho*-isoalpha, tetrahydroisoalpha, and hexahydroisoalpha acids. Isoalpha acids are isolated from IKE through a series of extraction steps. Depending upon the chemistry applied, isoalpha acids can be converted into *rho*-isoalpha, tetrahydroisoalpha, or hexahydroisoalpha acids. A simplified process based on isohumulone appears in the diagram on page 22. Potential applications for these products include increased bittering efficiency, bitterness augmentation, light-stable bittering, foam stabilization, and antimicrobial activity.

HAAS offers all of these products under the specific trade names Isohop® (isoalpha acids), Redihop® (*rho*-isoalpha acids), Tetrahop Gold® (tetrahydroisoalpha acids), and Hexahop Gold®/Hexahop 95® (hexahydroisoalpha acids). The features and benefits of each of these hop acids are outlined below.



Isohop®

Products based on isoalpha acids are more efficient at bittering beer relative to alpha acids-based offerings. Isohop® differs from isopellets and IKE in that alpha acids, beta acids, and waxes are not present in significant quantities. This product is sold as a 30% w/w aqueous solution of isoalpha acids in the form of potassium salts. Isohop is typically used post-fermentation to achieve International Bitterness Units (IBU) targets either as a part of the original hopping bill or to adjust bitterness in off-specification beer. From an economic standpoint, Isohop offers a number of attractive features and benefits. High utilization levels (60–90%) and the lack of vegetative matter offer increased production efficiencies. Isohop also has antimicrobial activity against Gram-positive bacteria and contributes to foam stability.

Redihop®

Light-struck character in beer primarily derives from the light-induced degradation of isoalpha acids. To inhibit this transformation, isoalpha acids are converted into light-stable analogs such as *rho*-isoalpha acids. The HAAS *rho*-isoalpha acids product is sold as Redihop®. Redihop is a 30% w/w aqueous solution of *rho*-isoalpha acids that imparts bitterness to beer while being resistant to light struck reactions. From a bitterness quality standpoint, Redihop contributes a pleasant and smooth bitterness when used in the brewing process. Relative to isoalpha acids, tasters perceive *rho*-isoalpha acids to be approximately 70% as bitter. Redihop also has antimicrobial activity.

Tetrahop Gold®

Tetrahydroisoalpha acids are another class of hop-derived compounds that can be used as light-stable bittering agents in beer. The bitterness perception of tetrahydroisoalpha acids are approximately 1.0 to 1.7 times that of isoalpha acids. Tetrahop Gold® is a 9% w/w aqueous formulation of tetrahydroisoalpha acids. In addition to providing light-stable bittering, Tetrahop Gold enhances beer foam in post-fermentation applications and has antimicrobial activity.

Hexahop Gold® and Hexahop 95®

A third class of isoalpha acid derivatives that are resistant to light-struck reactions are the hexahydroisoalpha acids. Similar to tetrahydroisoalpha acids, hexahydroisoalpha acids

improves foam stand and cling and has antimicrobial properties. Hexahop Gold® is a 10% w/w aqueous solution made up of 50% hexahydroisoalpha acids and 50% tetrahydroisoalpha acids. This product imparts smooth and clean bitterness to beer and is 1.0 to 1.3 times as bitter as isoalpha acids. Hexahop 95® is an aqueous 30% w/w mixture of 95:5 hexahydroisoalpha acids/tetrahydroisoalpha acids. From a sensory standpoint, Hexahop 95 provides clean, smooth bitterness at 1.0 to 1.1 times the bitterness intensity of isoalpha acids. The recommended application points for Hexahop Gold and 95 are post-fermentation and before final filtration.

DRY-HOP REPLACEMENT PRODUCTS

SPECTRUM

Dry-hopping is an important tool that enables brewers to impart desirable and impactful flavors to beer. The operational consequences for dry-hopping are the concomitant decreases in volume yields. As mentioned earlier, 10 L of beer is lost for every kg of hop vegetative matter that is added to a process step. Clearly, there is a need for an innovative product that delivers dry-hop flavor with minimal beer loss. Spectrum was developed to address these needs. It is a varietal-specific product that is available in popular varieties such as Citra® and Mosaic®. Compositionally, this liquid hop product is 100% hop-derived with no additives or non-aqueous solvents.

Spectrum contains no vegetative matter, thus eliminating beer loss through absorption on to hop solids. It can be applied at any

point during the brewing process, but the recommended usage is in cellar dry-hopping operations. No specialized dosage equipment is needed for the addition of Spectrum to process tanks. A general replacement range of T-90 pellets by Spectrum is 1:5 to 1:8 (w/w, Spectrum:T-90). When used in beer, Spectrum offers consistent, true-to-varietal hop flavor. In addition to brewing efficiency gains, Spectrum will not induce hop creep, is oxygen-free and poses no microbiological threat to your beers. Other benefits offered by Spectrum include reduced solid waste and lower shipping/storage costs.

POST-FERMENTATION AROMA PRODUCTS

PHA® Products

Ideally, brewers can enhance beer aroma by adding hop oils during post-fermentation unit operations. In practice this is difficult to accomplish—pure hop oils have poor solubility in aqueous solutions. To address this challenge, BarthHaas® offers a line of beer-soluble hop oil products: PHA Classics, Varietals, and Topnotes.

PHA production requires applying a series of proprietary extraction and distillation steps to hops to achieve specific aroma targets. PHAs are water-soluble and formulated to deliver consistent, specified hop aroma within each of the product lines. In addition, PHAs do not impart bitterness to beer and are light-stable. The PHA Classics impart specific aroma attributes like citrus, woody, or spicy. While PHA Classics are not varietal-specific, PHA Varietal and Topnote

versions are available in popular varieties. These products have specific applications: PHA Varietals provide late-hopping aroma, while PHA Topnotes provide dry-hopping character.

Miscellaneous Notes

This publication describes over 150 different hop varieties. Each page presents a specific hop and contains information on pedigree, flavor descriptions, and analytical chemistry data on key compounds.

PEDIGREE

Similar to the human condition, "nature" and "nurture" play significant roles in the flavors that hops bring to beer. On the "nature" side, breeders seek to produce plant crosses that perpetuate the positive traits of both parents. In a few cases, serendipitous discoveries revealed that hops of unknown parentage (e.g., Amarillo® VGXP01 c.v.) deliver unique and desirable flavors. Older European landrace varieties, such as Hallertau, were not developed via modern breeding practices. Instead, their unique characteristics evolved as a result of regional growing practices and local environmental factors. Ultimately, "nurture" factors such as agronomic practices and brewing techniques significantly influence how genetic characteristics related to flavor are expressed.

FLAVOR

Hops were traditionally categorized according to their primary application: bitterness or aroma. As alpha acids levels rose across many new cultivars, these distinctions became less clear. The newer hops can impart not only bitterness, but also significant amounts of desirable aroma attributes to beer. This trend led to coining the term "dual-purpose" to describe these hops.

On top of these developments, the craft beer revolution influences how brewers and beer drinkers regard hops. Brewers are increasingly creative in using hops to impart bold, desirable, and sometimes unconventional flavors in beer. They seek hops based on extensive knowledge of what is currently in the market in addition to a willingness to experiment with new varieties. In turn, consumers have developed a sophisticated understanding of hop varieties and flavor.

Given this landscape, it is unnecessary and somewhat limiting to assign a hop to one particular category. Hop flavor is an interplay between bitterness, taste, and aroma and is not based on a single factor. In some cases one of these factors predominates, but never to the exclusion of the others. As such, in this edition of the *Hops Companion* we have not labelled hop varieties as bittering, aroma, or dual purpose.

For each hop included in this guide, varietal flavor descriptions are based on whole hops that have been harvested and dried. There is a general correlation between whole hop flavor and its expression in beer. However, a word of caution is warranted;

there are instances where desirable sensory attributes expressed by hop cones in the field did not translate to beer.

For more information regarding hop aroma contribution to beer and specific aroma characterizations of many of the world's hop varieties, an excellent resource is *The Hop Aroma Compendium – A Flavour Guide*, published by BarthHaas GmbH & Co. KG - available at www.barthhaas.com.

HOP AROMA STANDARDS

HAAS, in collaboration with BarthHaas, developed a sensory lexicon specifically tailored to hop flavor. The language centers on 12 sensory categories: floral, citrus, sweet fruit, green fruit, berry & currant, cream caramel, woody aromatic, menthol, herbal, spicy, green-grassy, and vegetal. Each category encompasses a set of descriptors that provide reference points and anchors that are comprehensive and in line with user experiences. For example, sweet fruits comprises banana, watermelon, honeydew melon, peach, apricot, passion fruit, lychee, dried fruit, plum, pineapple, cherry, kiwi, mango, and guava as defining descriptors. In addition, graphical icons represent each sensory category. When used as part of the sensory description of hops, particular flavor attributes can be ascertained at a glance.

The sensory icons depicted on each varietal page describe the flavor of that hop. Inclusion of the icons are meant to provide quick visual references to help readers rapidly identify hops of interest.

FLORAL

Elderflower, chamomile blossom, lily of the valley, jasmine, apple blossom, rose, geranium, carnation, lilac, lavender

CITRUS

Grapefruit, orange, lemon, lime, bergamot, lemon grass, ginger, tangerine

SWEET FRUIT

Banana, watermelon, honeydew melon, peach, apricot, passion fruit, lychee, dried fruit, plum, pineapple, cherry, kiwi, mango, guava

GREEN FRUIT

Pear, quince, apple, gooseberry, white wine grapes

BERRY & CURRANT

Cassis, blueberries, raspberries, blackberries, strawberries, cassis (black currant), red currant, wild strawberries, cranberries

CREAM CARAMEL

Butter, chocolate, yogurt, honey, cream, caramel, toffee, coffee, tonka, vanilla

WOODY AROMATIC

Tobacco, cognac, barrique, leather, woodruff, incense, myrrh, resin, cedar, pine, earthy

MENTHOL

Mint, lemon balm, camphor, menthol, wine yeast

HERBAL

Lovage, thuja, basil, parsley, tarragon, dill, fennel, thyme, rosemary, marjoram, green tea, black tea, mate tea, sage

SPICY

Pepper, chilli, curry, juniper, aniseed, nutmeg, liquorice, clove, gingerbread, fennel seeds

GREEN-GRASSY

Green-grassy, fresh cut grass, hay, tomato leaves, green peppers, nettle

VEGETAL

Celery stock, celery root, leek, onion, artichoke, garlic, wild garlic

HOP VARIETY DATA SOURCES

Association for the Development of Hop Agronomics (ADHA), Moxee WA USA

BarthHaas GmbH & Co. KG, Nuremberg Germany

Bohemia Hops, Žatec Czechia

British Hop Association, Kent England

CLS Farms, Moxee WA USA

Comptoir Agricole Breeding Program, Strasbourg France

Hop Breeding Company, Yakima WA USA

Hop Growers of America, Moxee WA USA

Hop Products Australia, Hobart Australia

Hop Research Institute, Co., Ltd., Žatec Czechia

Hopsteiner, Inc., New York USA

PolishHops, Karczmiska Poland

Prof. Waclaw Dabrowski Institute of Agriculture and Food Biotechnology, Warsaw Poland

John I. Haas, Inc., Yakima WA USA

New Zealand Hops Limited, Nelson New Zealand

Select Botanicals Group LLC, Yakima WA USA

Slohops, Prebold Slovenija

USDA Agricultural Research Service, USA

Verband Deutscher Hopfenpflanzer e.V. - Wolnzach, Germany

Yakima Chief Hops, Inc., Yakima WA USA

ZA Hops, LLC, Fort Collins CO USA

HOP VARIETIES LISTED BY COUNTRY OF ORIGIN

AUSTRALIA

CANADA

CZECHIA

FRANCE

GERMANY

GERMANY (cont.)

JAPAN

NEW ZEALAND

POLAND

SERBIA

SLOVENIA

SOUTH AFRICA

SOUTH AFRICA (cont.)

UK

USA

USA (cont.)

USA (cont.)

USA (cont.)

ADEENA™

ADHA 1940 c.v.

Adeena™ ADHA 1940 c.v. was commercially released by the Association for the Development of Hop Agronomy (ADHA) in 2020. This cultivar is the progeny of a Summit female and an ADHA 34/95/57 male. Agronomically, Adeena was selected for its excellent yields, disease, and pest resistance. Adeena is described as bringing gentle, delicate, and New World noble flavors to beer.

Generic herbal, celery seed, lavender, lemon, pine.

Alpha (%)	3.5-5.5
Beta (%)	3.0-4.6
Cohumulone (% of Alpha Acids)	34-38
Total Oil (ml/100g)	0.8-1.1
Myrcene (% of Total Oil)	27.3-29.4
Humulene (% of Total Oil)	31.3-45.4
Caryophyllene (% of Total Oil)	14.6-21.9
Farnesene (% of Total Oil)	4.3-6.6
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

ADMIRAL

Bred at the Wye College to complement the variety Target. Admiral was derived from Challenger and Northdown breeding lines. It grows vigorously and produces high alpha.

HERBAL

SWEET FRUIT

CITRUS

Tea, ripe kiwi, lemony.

Alpha (%)	13-16
Beta (%)	4-6
Cohumulone (% of Alpha Acids)	37-45
Total Oil (ml/100g)	1.0-1.7
Myrcene (% of Total Oil)	45
Humulene (% of Total Oil)	23-26
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	2
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

SOUTH AFRICA

AFRICAN QUEEN

African Queen is a South African bred aroma hop designed to perform well with the shorter day-lengths of the growing region. It originated from a diploid seedling from a cross between experimental 91J7/25 and a South African male 94US2/118.

BERRY & CURRANT | SWEET FRUIT | CITRUS

Blueberry, melon, lemongrass.

Alpha (%)	10-17
Beta (%)	4-6
Cohumulone (% of Alpha Acids)	22-27
Total Oil (ml/100g)	0.7-1.5
Myrcene (% of Total Oil)	25-29
Humulene (% of Total Oil)	21-30
Caryophyllene (% of Total Oil)	10-13
Farnesene (% of Total Oil)	5-7
Linalool (% of Total Oil)	< 1
Total Polypenols (%)	—

AGNUS

The name Agnus arose from the Latin translation of Berárnek, the surname of a Czech hop breeder. Released in 2001, it is characterized by relatively high beta acids for a higher alpha variety. Agnus is derived from hybrid progenies of Bor, Sládek, Saaz, Northern Brewer, Fuggle and other breeding material.

FLORAL

WOODY AROMATIC

SPICY

Lavender, lovage, leather, tobacco.

Alpha (%)	9.0-12.0
Beta (%)	4.0-6.5
Cohumulone (% of Alpha Acids)	29-38
Total Oil (ml/100g)	2.0-3.0
Myrcene (% of Total Oil)	40-55
Humulene (% of Total Oil)	15-25
Caryophyllene (% of Total Oil)	9-15
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	0.3-0.5
Total Polypenols (%)	4.0-5.5

AHTANUM®

Ahtanum® is a cultivar named after the district in which it is grown near Yakima. Ahtanum was developed through the Yakima Chief Ranches breeding program and has an appealing aroma with exceptionally floral notes. It is used for its aromatic properties and moderate bittering.

WOODY AROMATIC | FLORAL | CITRUS

Cedar, generic floral, grapefruit.

Alpha (%)	3.5-6.5
Beta (%)	4-6
Cohumulone (% of Alpha Acids)	0-34
Total Oil (ml/100g)	0.5-1.7
Myrcene (% of Total Oil)	45-55
Humulene (% of Total Oil)	15-22
Caryophyllene (% of Total Oil)	9-12
Farnesene (% of Total Oil)	0-1
Linalool (% of Total Oil)	0.4-0.6
Total Polypenols (%)	–

AKOYA™

Akoya™ (Experimental #99/268) is an early harvest variety released by Hopsteiner in 2019. It is a daughter of a cross between Zenith and a Hopsteiner male. The hop has a flavor profile that is characterized by herbal, tea, spice, and fruit notes. It displays resistance to mildew, wilt, and drought stress.

Tea, pepper, generic green fruits.

Alpha (%)	9-10
Beta (%)	4-5
Cohumulone (% of Alpha Acids)	27-30
Total Oil (ml/100g)	1.5-2.0
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	0.6-0.8
Total Polypenols (%)	4-5

ALTUS™

Altus™ (Experimental #07270) is a 2020 release from the Hopsteiner breeding program as a late harvest cultivar. The hop's parentage is Apollo and Wye Target. Altus offers sensory notes of resin, tangerine, herbal, and grass.

Spicy, resinous, tangerine.

Alpha (%)	15.0-18.5
Beta (%)	4.0-5.2
Cohumulone (% of Alpha Acids)	26-29
Total Oil (ml/100g)	3.0-4.4
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	0.1-0.3
Linalool (% of Total Oil)	0.9-1.2
Total Polypenols (%)	—

AMARILLO®

VGXP01 c.v.

Amarillo® is a variety derived from open-pollination and introduced by Virgil Gamache Farms Inc., in Washington State. The hop is characterized by mid to high alpha and low cohumulone content. Amarillo typically provides flavors of ripe, sweet citrus like tangerine and lemon, with stone fruits, melon, and wildflowers.

CITRUS

SWEET FRUIT

FLORAL

Tangerine, lemon, apricot, melon, wild flowers.

Alpha (%)	8.0-11.0
Beta (%)	6.0-7.0
Cohumulone (% of Alpha Acids)	21-24
Total Oil (ml/100g)	1.5-1.9
Myrcene (% of Total Oil)	68-70
Humulene (% of Total Oil)	9-11
Caryophyllene (% of Total Oil)	2-4
Farnesene (% of Total Oil)	2-4
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

APOLLO™

This super high alpha variety was developed through the Hopsteiner Breeding Program and released in 2006. It is resistant to powdery and downy mildew. Apollo™ has very high alpha, good storage stability and low cohumulone. Added late into the brew boil, it imparts citrus and pine notes.

CITRUS

WOODY AROMATIC

Lime, grapefruit, pine.

Alpha (%)	15-19
Beta (%)	5.5-8.0
Cohumulone (% of Alpha Acids)	24-28
Total Oil (ml/100g)	0.8-2.5
Myrcene (% of Total Oil)	30-55
Humulene (% of Total Oil)	20-35
Caryophyllene (% of Total Oil)	14-20
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

ARAMIS

Aramis is a family member of the most important aroma hop variety in the Alsace region—the traditional Strisselspalt. It was established to create a similar aroma profile to Strisselspalt, but with increased and more stable bitter potential. It was bred from a 2002 cross between Strisselspalt and English Whitbread Golding.

Spicy and mild notes, slightly citrus and herbal.

Alpha (%)	5.5-7.5
Beta (%)	3-4.5
Cohumulone (% of Alpha Acids)	20-22
Total Oil (ml/100g)	1.2-1.6
Myrcene (% of Total Oil)	38-41
Humulene (% of Total Oil)	19-21
Caryophyllene (% of Total Oil)	–
Farnesene (mg/100g)	2-4
Linalool (mg/100g)	10-16
Total Polypenols (%)	–

GERMANY

ARIANA

Ariana is an aroma variety developed at the Hop Research Center in Hüll from a 2010 cross between the Hercules bitter variety and a wild male hop. Ariana usually refers to a female first name.

SWEET FRUIT | BERRY & CURRANT | FLORAL | CITRUS

Passion fruit, pineapple, black currant, jasmine, tangerine.

Alpha (%)	10.0-13.0
Beta (%)	4.5-6.0
Cohumulone (% of Alpha Acids)	40-42
Total Oil (ml/100g)	1.6-2.4
Myrcene (% of Total Oil)	47.0-57.6
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	0.5-0.6
Total Polypenols (%)	2.9-3.3

AURORA

This aroma variety was bred at the Slovenian Institute of Hop Research and Brewing. Aurora was derived from English Northern Brewer and Slovenian germplasm. Aurora has an intense and pleasant hoppy aroma and exhibits a very good storage stability. Beer prepared with this variety has been shown to have good organoleptic scores with an intense and pleasant hop note. The yield of alpha acids is very good when brewing with this variety.


CITRUS


SPICY

FLORAL

Bergamot, lemongrass, aniseed, generic floral.

Alpha (%)	7.2-12.6
Beta (%)	2.7-4.4
Cohumulone (% of Alpha Acids)	22-26
Total Oil (ml/100g)	0.9-1.6
Myrcene (% of Total Oil)	35-53
Humulene (% of Total Oil)	20-27
Caryophyllene (% of Total Oil)	4-8
Farnesene (% of Total Oil)	6-9
Linalool (% of Total Oil)	0.6-1.0
Total Polypenols (%)	–

AZACCA®

ADHA 438 c.v.

Azacca® ADHA 438 c.v. is named for the Haitian god of agriculture. It was developed through the ADHA (Association for the Development of Hop Agronomy) in Yakima. Azacca is a high alpha, high oil variety which exhibits a complex range of fruit, spice, and wood aromas.

SWEET FRUIT

CITRUS

WOODY AROMATIC

GREEN-GRASSY

Ripe mango, papaya, pineapple, Valencia orange, grapefruit, pine resin, fresh grass.

Alpha (%)	14-16
Beta (%)	4.0-5.5
Cohumulone (% of Alpha Acids)	38-45
Total Oil (ml/100g)	1.6-2.5
Myrcene (% of Total Oil)	46-55
Humulene (% of Total Oil)	14-18
Caryophyllene (% of Total Oil)	8-12
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

BAČKA

Bačka (pronounced batch-ka) is an old land race variety from the Serbia region registered with the USDA dating back to 1956. However, some sources believe it was derived from populations grown toward the end of the 19th century. Bačka-named hops were available in the market before the First World War. In some circles, Bačka is considered to be a noble aroma variety.

SPICY

Noble.

Alpha (%)	2.0-5.0
Beta (%)	4.0-7.4
Cohumulone (% of Alpha Acids)	25
Total Oil (ml/100g)	0.60
Myrcene (% of Total Oil)	50
Humulene (% of Total Oil)	24
Caryophyllene (% of Total Oil)	12
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

BARBE ROUGE

Barbe Rouge is a recently developed variety through the Comptoir Agricole breeding program. The hop is of French parentage from the Alsace region of which Strisselspalt is one.

BERRY & CURRANT

CITRUS

Red currant, cassis, strawberry, orange, lime.

Alpha (%)	7.5-9.5
Beta (%)	3.5-4.6
Cohumulone (% of Alpha Acids)	25-28
Total Oil (ml/100g)	1.8-2.2
Myrcene (% of Total Oil)	52-58
Humulene (% of Total Oil)	17-21
Caryophyllene (% of Total Oil)	–
Farnesene (mg/100g)	0-3
Linalool (mg/100g)	12-16
Total Polypenols (%)	–

BOADICEA

Boadicea is a dwarf variety bred as a general purpose variety with moderate alpha, good flavor and aphid resistance. It was bred from an open pollination of a second-generation female from a wild Japanese source. The grandfather of Boadicea is also the father of First Gold and Pioneer. Boadicea was named after a Celtic warrior queen who resisted the Roman invasion centuries ago.

Orchard fruits, pine, tobacco, peppermint, licorice.

Alpha (%)	7-10
Beta (%)	3-4
Cohumulone (% of Alpha Acids)	26
Total Oil (ml/100g)	1.4-2.0
Myrcene (% of Total Oil)	33
Humulene (% of Total Oil)	20
Caryophyllene (% of Total Oil)	–
Farnesene (% of Total Oil)	5
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

BOBEK

Bobek is a diploid hybrid cross between Northern Brewer and Slovenian male germplasm, derived from the same family as Aurora. It has very good agronomic traits and processes well. The variety has also been known as Styrian Golding B.


VEGETAL


GREEN-GRASSY


CITRUS


MENTHOL

Artichoke, hay, lemon, sage.

Alpha (%)	3.5-7.8
Beta (%)	4.0-6.1
Cohumulone (% of Alpha Acids)	28-34
Total Oil (ml/100g)	0.7-4.0
Myrcene (% of Total Oil)	49-57
Humulene (% of Total Oil)	13-19
Caryophyllene (% of Total Oil)	4-6
Farnesene (% of Total Oil)	4-7
Linalool (% of Total Oil)	0.9-1.3
Total Polypenols (%)	—

BOHEMIE

Bohemie was bred from Saaz and Sládek, and released in 2010 by the Hop Research Institute Co., Ltd., in Zatec, Czechia. The variety yields better than Saaz and has firm hop cones which makes it easy to pick. The hop was derived from hybrid progenies of Sládek and breeding material with origin in Saaz.


SPICY

FLORAL


CITRUS

Generic spicy, floral, citrus.

Alpha (%)	5.0-8.0
Beta (%)	6.0-9.0
Cohumulone (% of Alpha Acids)	23-26
Total Oil (ml/100g)	1.0-1.5
Myrcene (% of Total Oil)	30-45
Humulene (% of Total Oil)	17-23
Caryophyllene (% of Total Oil)	7-10
Farnesene (% of Total Oil)	1-3
Linalool (% of Total Oil)	0.50-0.75
Total Polypenols (%)	3.5-4.5

BOR

Bor, which means pine, was registered as a dual-purpose variety in 1994. It was named after the pine woods, which are typical for a region in Czechia. The hop was derived from Northern Brewer.

Mild baking spice, generic floral, citrus.

Alpha (%)	6.0-9.0
Beta (%)	3.0-5.5
Cohumulone (% of Alpha Acids)	22-27
Total Oil (ml/100g)	1.2-2.0
Myrcene (% of Total Oil)	40-55
Humulene (% of Total Oil)	25-40
Caryophyllene (% of Total Oil)	9-14
Farnesene (% of Total Oil)	< 1.0
Linalool (% of Total Oil)	0.2-0.3
Total Polypenols (%)	3.5-5.0

BOUCLIER

Bouclier was bred from a 2005 cross between the French Strisselspalt and a British male plant grown in Wye, Kent, UK. Also part of its genealogy are Wye Challenger, Early Bird Golding and Northern Brewer. The name Bouclier is French for "shield."

CITRUS HERBAL SPICY

Fruity esters, lemon, generic herbal, lovage.

Alpha (%)	3.8-6.0
Beta (%)	2.3-3.3
Cohumulone (% of Alpha Acids)	—
Total Oil (ml/100g)	1.1-1.6
Myrcene (% of Total Oil)	38
Humulene (% of Total Oil)	34
Caryophyllene (% of Total Oil)	—
Farnesene (mg/100g)	—
Linalool (mg/100g)	7.8
Total Polypenols (%)	—

UNITED KINGDOM

BRAMLING CROSS

Bred from a crossing in 1927
by Professor Salmon at Wye,
of a Bramling (one of the traditional
Golding varieties) with a male seedling
from a Canadian Manitoban wild hop.

Chrysanthemum, grapefruit, caramel, vanilla, gooseberry.

Alpha (%)	6-8
Beta (%)	2.3-3.5
Cohumulone (% of Alpha Acids)	34
Total Oil (ml/100g)	0.7-1.2
Myrcene (% of Total Oil)	36
Humulene (% of Total Oil)	25
Caryophyllene (% of Total Oil)	15-19
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

BRAVO™

Bravo™ is a second generation super high alpha variety developed by the Hopsteiner Breeding Program and released in 2006. It has good resistance to powdery mildew.

CITRUS | SWEET FRUIT | FLORAL

Orange, candied lime, stone fruit, generic floral.

Alpha (%)	14.0-17.0
Beta (%)	3.0-5.0
Cohumulone (% of Alpha Acids)	29-34
Total Oil (ml/100g)	1.6-2.4
Myrcene (% of Total Oil)	25-50
Humulene (% of Total Oil)	18-20
Caryophyllene (% of Total Oil)	10-12
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

FRANCE

BREWERS GOLD

Professor E.F. Salmon of Wye College in Kent, England, was responsible for breeding the variety Brewers Gold. This hop is well known all over the world and has been used in many international breeding programs. This is due to its moderate alpha acid content, high yield, and vigorous growth. It was developed from an open pollination of the wild Canadian Manitoba BB1 hop. Brewers Gold has been grown in the Alsace region of France since the late '60s.


BERRY & CURRANT


HERBAL


CITRUS


SPICY

Black currant, tea, lemon, lovage.

Alpha (%)	4.5-6.5
Beta (%)	2.5-3.5
Cohumulone (% of Alpha Acids)	36-45
Total Oil (ml/100g)	0.8-1.8
Myrcene (% of Total Oil)	40-50
Humulene (% of Total Oil)	20-30
Caryophyllene (% of Total Oil)	10-15
Farnesene (mg/100g)	–
Linalool (mg/100g)	4
Total Polypenols (%)	–

BRU-1™

The experimental variety, BRU-1™ was developed through Brulotte Farms in the Yakima Valley. This hop exemplifies the bold flavor of new American aroma varieties.

SWEET FRUIT

GREEN FRUIT

GREEN-GRASSY

Pineapple, pear, apple, fresh cut grass.

Alpha (%)	13.0-15.0
Beta (%)	8.0-10.0
Cohumulone (% of Alpha Acids)	35-37
Total Oil (ml/100g)	1.5-2.0
Myrcene (% of Total Oil)	50-55
Humulene (% of Total Oil)	7-8
Caryophyllene (% of Total Oil)	9-11
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

GERMANY

CALLISTA

Developed at the Hop Research Center in Hüll, and formerly named 2010/008/033 during trials. This high beta-acids hop variety is derived from German hop material from the famous Tradition variety. Callista has many meanings, but it is most commonly defined as “most beautiful (feminine)” in Greek.

Strawberry, orange, passion fruit, pear, caramel.

Alpha (%)	2.0-5.0
Beta (%)	5.0-10.0
Cohumulone (% of Alpha Acids)	15-22
Total Oil (ml/100g)	1.4-2.1
Myrcene (% of Total Oil)	54.0-63.5
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	1.3
Total Polypenols (%)	4.1-6.2

CALYPSO™

Calypso™ is a diploid hop developed from the Hopsteiner breeding program. It exhibits pleasant fruity characteristics. Calypso is resistant to powdery and downy mildews.

GREEN FRUIT | SWEET FRUIT

Pear, apple, tropical fruit, melon.

Alpha (%)	12.0-14.0
Beta (%)	5.0-6.0
Cohumulone (% of Alpha Acids)	40-42
Total Oil (ml/100g)	1.6-2.5
Myrcene (% of Total Oil)	30-45
Humulene (% of Total Oil)	20-35
Caryophyllene (% of Total Oil)	9-15
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

UNITED STATES

CASCADE

Cascade was developed in the United States Department of Agriculture (USDA) breeding program at Oregon State University and released in 1972. It is characterized by its dark green elongated cone. For many years, Cascade was the definitive hop of American craft brews. It was obtained by crossing an English Fuggle with a male plant derived from the Russian variety, Serebrianka.

Floral, grapefruit, pine resin.

Alpha (%)	4.5-7.0
Beta (%)	4.8-7.0
Cohumulone (% of Alpha Acids)	33-40
Total Oil (ml/100g)	0.7-1.4
Myrcene (% of Total Oil)	45-60
Humulene (% of Total Oil)	8-13
Caryophyllene (% of Total Oil)	3-6
Farnesene (% of Total Oil)	3-7
Linalool (% of Total Oil)	—
Total Polypenols (%)	4.5-4.9

CASHMERE

Cashmere was developed and released though the Washington State University USDA hop breeding program in 2013. It is a daughter of a Cascade male and a female line that includes Northern Brewer.


CITRUS

SWEET FRUIT


HERBAL

Lemon, lime, ripe melon, stone fruit, thyme.

Alpha (%)	7.7-9.1
Beta (%)	3.5-4.5
Cohumulone (% of Alpha Acids)	22-24
Total Oil (ml/100g)	1.2-1.4
Myrcene (% of Total Oil)	39-42
Humulene (% of Total Oil)	26-29
Caryophyllene (% of Total Oil)	12-13
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

SLOVENIA

CELEIA

Celeia is a triploid hybrid from a cross of auto-tetraploid Savinjski Golding and the 105/58 hybrid between Aurora (Super Styrian) and a Slovenian wild hop. Celeia is also known as Styrian Golding C.

CITRUS MENTHOL HERBAL

Lemon, lime, peppermint, thyme, tea.

Alpha (%)	3.0-6.5
Beta (%)	2.0-3.3
Cohumulone (% of Alpha Acids)	26-29
Total Oil (ml/100g)	1.5-3.6
Myrcene (% of Total Oil)	26-40
Humulene (% of Total Oil)	18-23
Caryophyllene (% of Total Oil)	8-9
Farnesene (% of Total Oil)	3-7
Linalool (% of Total Oil)	0.6-1.2
Total Polypenols (%)	—

CENTENNIAL

Named after the Washington State centennial anniversary in 1989. Centennial arose from the USDA hop breeding program at Washington State University in 1974 and released in 1990. Its genetic composition is 3/4 Brewers Gold, 3/32 Fuggle, 1/16 East Kent Golding, 1/32 Bavarian and 1/16 unknown.


CITRUS

SWEET FRUIT


WOODY AROMATIC

FLORAL

Orange, lime, cherry, pine resin, orange blossom.

Alpha (%)	9.5-11.5
Beta (%)	3.4-4.5
Cohumulone (% of Alpha Acids)	29-30
Total Oil (ml/100g)	1.5-2.5
Myrcene (% of Total Oil)	45-55
Humulene (% of Total Oil)	10-18
Caryophyllene (% of Total Oil)	5-8
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

CHINOOK

Chinook was developed by the USDA breeding program in Washington State and released in 1985. Originally released as a high alpha variety, Chinook has gained favor in craft brewing with its distinctive aroma. This cultivar takes its name from a Native American tribe indigenous to the region around Washington State. The female parent is one of the English Goldings.

CITRUS | SWEET FRUIT | WOODY AROMATIC | SPICY

Grapefruit, apricot, pine resin, juniper.

Alpha (%)	12.0-14.0
Beta (%)	3.0-4.0
Cohumulone (% of Alpha Acids)	29-35
Total Oil (ml/100g)	1.7-2.7
Myrcene (% of Total Oil)	35-40
Humulene (% of Total Oil)	18-23
Caryophyllene (% of Total Oil)	9-11
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

CITRA®

HBC 394 c.v.

Citra® brand HBC 394 c.v. is a hop variety released in 2008 by the Hop Breeding Company (a joint venture between John I. Haas, Inc. and Yakima Chief Ranches). It possesses unique and highly favored flavor characteristics. Citra originated from a cross between Hallertauer Mittelfrüher and a father derived from U.S. Tettnang. It was released in 2008.

SWEET FRUIT | CITRUS | FLORAL

Mango, grapefruit flesh, lime zest.

Alpha (%)	11.0-13.0
Beta (%)	3.5-4.5
Cohumulone (% of Alpha Acids)	22-24
Total Oil (ml/100g)	2.2-2.8
Myrcene (% of Total Oil)	60-65
Humulene (% of Total Oil)	11-13
Caryophyllene (% of Total Oil)	6-8
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	1-2
Total Polypenols (%)	4.5-5.5

CLUSTER

Cluster is one of the oldest varieties grown in the U.S. The rootstock origin is uncertain. Until the late 1970s, Cluster was one of only a few varieties grown in the U.S. and dominated the farm acreage. Alpha content is medium, aroma is strong and storage stability of the alpha acids is excellent. The variety grows with good vigor and cone production.

FLORAL | SWEET FRUIT | CITRUS

Lilac, apricot, lemon.

Alpha (%)	5.5-8.5
Beta (%)	4.5-5.5
Cohumulone (% of Alpha Acids)	37-43
Total Oil (ml/100g)	0.4-0.8
Myrcene (% of Total Oil)	45-55
Humulene (% of Total Oil)	15-18
Caryophyllene (% of Total Oil)	6-7
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

COLUMBUS

Columbus, Tomahawk® and Zeus (CTZ) are super high alpha varieties. They share the same female parent as Nugget making them at least half sisters to Nugget. The CTZ varieties are currently used almost extensively for beer bittering.


CITRUS


SPICY


VEGETAL

SWEET FRUIT

Lemon, black pepper, green onion, mango.

Alpha (%)	15.0-17.0
Beta (%)	4.5-5.0
Cohumulone (% of Alpha Acids)	28-32
Total Oil (ml/100g)	2.5-3.5
Myrcene (% of Total Oil)	50-60
Humulene (% of Total Oil)	12-18
Caryophyllene (% of Total Oil)	9-11
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

COMET

Comet is a hop variety with relatively high alpha content and provides a wild American aroma. It was released as a high alpha hop from the USDA hop breeding program in 1975 primarily for production in Washington and Idaho. Comet has become a popular variety to grow in Germany.

CITRUS

BERRY & CURRANT

SWEET FRUIT

Mandarin, lemongrass, black currant, apricot, pineapple.

Alpha (%)	9.4-12.4
Beta (%)	3.0-6.1
Cohumulone (% of Alpha Acids)	40-45
Total Oil (ml/100g)	1.4-3.3
Myrcene (% of Total Oil)	40-65
Humulene (% of Total Oil)	1-2
Caryophyllene (% of Total Oil)	5-7
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

CONTESSA™

Contessa™ (Experimental #04190) is a noble aroma-type cultivar released by the Hopsteiner breeding program. It originated from a cross between Fuggle and Cascade. Contessa is a low alpha hop and is described as having floral, pear, and tea aroma attributes.

HERBAL FLORAL GREEN FRUIT

Green tea, floral, light pear.

Alpha (%)	3-5
Beta (%)	5.0-7.4
Cohumulone (% of Alpha Acids)	29-32
Total Oil (ml/100g)	0.8-1.9
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	4.0-5.5
Linalool (% of Total Oil)	0.9-1.0
Total Polypenols (%)	—

CRYSTAL

Crystal is a triploid variety developed from the German aroma hop variety Hallertauer Mittelfrüh with lineage contributions from Cascade, Brewer's Gold and Early Green. Released in 1993 from the USDA breeding program, Crystal has become popular in U.S. craft brewing as a triploid Hallertauer type. It is a half-sister of Mt. Hood and Liberty.

WOODY AROMATIC | FLORAL | SPICY

Cedar, myrrh, chamomile, nutmeg.

Alpha (%)	4.0-6.0
Beta (%)	5.0-6.7
Cohumulone (% of Alpha Acids)	20-26
Total Oil (ml/100g)	0.8-2.1
Myrcene (% of Total Oil)	40-65
Humulene (% of Total Oil)	18-24
Caryophyllene (% of Total Oil)	4-8
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

DANA

Dana, also known as Extra Styrian Dana, is a dual-purpose hop variety. It was bred from German Hallertau Magnum and Slovenian genetic hop material at the Slovenian Institute of Hop Research and Brewing. The variety gives good agronomic yields and bitter potential.

Juniper, orange, pear, wild garlic.

Alpha (%)	12.5-18.8
Beta (%)	4.2-6.0
Cohumulone (% of Alpha Acids)	30-34
Total Oil (ml/100g)	2.4-3.9
Myrcene (% of Total Oil)	42-60
Humulene (% of Total Oil)	15-22
Caryophyllene (% of Total Oil)	6-8
Farnesene (% of Total Oil)	6-9
Linalool (% of Total Oil)	0.5-1.0
Total Polypenols (%)	–

DELTA™

Delta™ is a variety released in 2009 from the Hopsteiner hop breeding program. Developed from a cross between a Fuggle mother and a male derived from Cascade. It shows good resistance to downy mildew and moderate resistance to strains of powdery mildew.

WOODY AROMATIC

CITRUS

Tilled earth, ginger, lime.

Alpha (%)	5.5-7.0
Beta (%)	5.5-7.0
Cohumulone (% of Alpha Acids)	22-24
Total Oil (ml/100g)	0.5-1.1
Myrcene (% of Total Oil)	25-40
Humulene (% of Total Oil)	30-40
Caryophyllene (% of Total Oil)	9-15
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

DR. RUDI

This triploid variety was previously released by the New Zealand Horticultural Research Centre as "Super Alpha" in 1976. It was renamed Dr. Rudi in 2012 to honor the New Zealand breeder/horticulturist who is considered the father of New Zealand's hop program. The variety was once classified "super" alpha, but by today's standards, it's moderate. Dr. Rudi was derived from a Smoothcone mother and open pollination.

WOODY AROMATIC

CITRUS

Pine resin, lime pith, lemongrass.

Alpha (%)	10-12
Beta (%)	7-8.5
Cohumulone (% of Alpha Acids)	33
Total Oil (ml/100g)	1.3
Myrcene (% of Total Oil)	29.2
Humulene (% of Total Oil)	33.2
Caryophyllene (% of Total Oil)	10.1
Farnesene (% of Total Oil)	0.5
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

EAST KENT GOLDING (EKG)

East Kent Golding was developed from a wild Canterbury Whitebine variety in late 1700s. Kent is a region in England, home to Canterbury, where this variety was brought to the market in 1790. Recognized as having the most typical English aroma with the best flavor, historically coming from East Kent.

Citrus, artichoke, gingerbread, woodruff.

Alpha (%)	4-6
Beta (%)	1.9-3
Cohumulone (% of Alpha Acids)	25-30
Total Oil (ml/100g)	0.4-0.8
Myrcene (% of Total Oil)	25
Humulene (% of Total Oil)	36
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

ECLIPSE®

04-337-016 c.v.

A new, big-hitting flavor hop bursting with sweet mandarin, zesty citrus peel and fresh pine needles. Eclipse® was created by the Hop Products Australia (HPA) breeding program in 2004 and commercialized in 2020. Its ancestry is a cross pollination of high alpha Australian and North American hops.

CITRUS

WOODY AROMATIC

Sweet mandarin, citrus peel, fresh pine needles.

Alpha (%)	15.7-17.9
Beta (%)	5.9-9.0
Cohumulone (% of Alpha Acids)	33-37
Total Oil (ml/100g)	1.7-1.9
Myrcene (% of Total Oil)	35.5-49.0
Humulene (% of Total Oil)	0.6-1.6
Caryophyllene (% of Total Oil)	6.1-12.1
Farnesene (% of Total Oil)	0.2
Linalool (% of Total Oil)	0.6
Total Polypenols (%)	–

EKUANOT®

HBC 366 c.v.

Ekuanot® HBC 366 c.v. was commercially released in 2014 as "Equinox" by the Hop Breeding Company (HBC) in Yakima. It was subsequently renamed due to trademark issues. The variety has high alpha acids and essential oil content and is known for its vibrant yellow color during its early growth in the spring. The diversified and pronounced aroma characteristics, extremely high oil content, and tight cone structure makes Ekuanot a very unique hop variety.

GREEN-GRASSY | SWEET FRUIT | CITRUS | FLORAL

Green pepper, papaya, lime, apple blossom.

Alpha (%)	14.5-15.5
Beta (%)	4.5-5.5
Cohumulone (% of Alpha Acids)	32-38
Total Oil (ml/100g)	2.5-4.5
Myrcene (% of Total Oil)	30-45
Humulene (% of Total Oil)	12-20
Caryophyllene (% of Total Oil)	8-12
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

EL DORADO®

El Dorado® was released by CLS Farms, LLC of Moxee, Washington in 2010. Little information is available about its pedigree, but it is believed to be derived from a *neomexicanus* subspecies of *Humulus lupulus*.

Mandarin, pear, apricot, watermelon, wintergreen.

Alpha (%)	13-17
Beta (%)	6.4-8.0
Cohumulone (% of Alpha Acids)	28-33
Total Oil (ml/100g)	2.5-3.3
Myrcene (% of Total Oil)	55-60
Humulene (% of Total Oil)	10-15
Caryophyllene (% of Total Oil)	6-8
Farnesene (% of Total Oil)	0-1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

ELIXIR

Elixir is a new and exciting hop variety developed in the legendary growing region of Alsace, France. It was developed through the Comptoir Agricole breeding program in France. Elixir possesses moderate alpha and has a complex fruity aroma.

Pepper, orange, strawberry, jasmine, sandalwood.

Alpha (%)	4.6-6.5
Beta (%)	5.8-6.6
Cohumulone (% of Alpha Acids)	26-27.4
Total Oil (ml/100g)	1.85
Myrcene (% of Total Oil)	65.5
Humulene (% of Total Oil)	1.4
Caryophyllene (% of Total Oil)	2.15
Farnesene (mg/100g)	1-2
Linalool (mg/100g)	6
Total Polypenols (%)	—

ELLA™

01-220-060 c.v.

Ella™ is a versatile hop developed through the Hop Products Australia (HPA) breeding program (part of BarthHaas Group). It grows vigorously, producing moderately large, dense cones.

SWEET FRUIT

SPICY

Cantaloupe, mango, anise.

Alpha (%)	13.4-19.2
Beta (%)	5.2-7.5
Cohumulone (% of Alpha Acids)	33.0-40.0
Total Oil (ml/100g)	1.2-2.3
Myrcene (% of Total Oil)	34-40
Humulene (% of Total Oil)	16-19
Caryophyllene (% of Total Oil)	5.9-14.1
Farnesene (% of Total Oil)	0.1-0.5
Linalool (% of Total Oil)	0.4-0.6
Total Polypenols (%)	—

ENDEAVOUR

Endeavour is a dwarf variety bred from a cross made in 2002 between a seedling of Cascade and a granddaughter of Target. This variety imparts unique English flavor notes.


BERRY & CURRANT


SPICY


CITRUS

SWEET FRUIT

Blackberry, gingerbread, bergamot, lemon, watermelon.

Alpha (%)	8-10.5
Beta (%)	3.8-5.3
Cohumulone (% of Alpha Acids)	30-36
Total Oil (ml/100g)	1.1-1.7
Myrcene (% of Total Oil)	27-37
Humulene (% of Total Oil)	3-10
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	5-8
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

ENIGMA®

02-016-008 c.v.

Enigma® was created by the Hop Products Australia (HPA) breeding program in 2002 and commercialized in 2013. Its ancestry is a cross pollination of Swiss Tettnang and North American hops. Technically, Enigma is a descendant of Tettnanger, but has a range of flavors more characteristic to that found in a North American hop.

GREEN FRUIT

SWEET FRUIT

BERRY & CURRANT

White wine grape, cantaloupe, raspberry, red currant.

Alpha (%)	16.7-19.4
Beta (%)	5.2-7.1
Cohumulone (% of Alpha Acids)	37-43
Total Oil (ml/100g)	1.9-2.8
Myrcene (% of Total Oil)	23-30
Humulene (% of Total Oil)	12-19
Caryophyllene (% of Total Oil)	6-8
Farnesene (% of Total Oil)	9-11
Linalool (% of Total Oil)	0.1-0.5
Total Polypenols (%)	–

EUREKA!™

Eureka!™, formerly known as Experimental Hop 05256, is a variety developed by the Hopsteiner hop breeding program. Its pedigree includes Apollo and Merkur. This hop produces a very high alpha content approaching 20%.

BERRY & CURRANT | HERBAL | WOODY AROMATIC

Black currant, blackberry, strong tea, pine resin.

Alpha (%)	17.0-19.9
Beta (%)	4.6-6.0
Cohumulone (% of Alpha Acids)	28-30
Total Oil (ml/100g)	2.5-4.4
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	0.6-1.0
Total Polypenols (%)	4.5-5.0

EXTRA STYRIAN DANA

Bred for a dual purpose (bitter and aroma), Dana offers an intense hoppy aroma and a robust bitterness.

Juniper, orange, wild garlic, pear.

Alpha (%)	12.5-18.8
Beta (%)	4.2-6.0
Cohumulone (% of Alpha Acids)	30-34
Total Oil (ml/100g)	2.4-3.9
Myrcene (% of Total Oil)	42-60
Humulene (% of Total Oil)	15-22
Caryophyllene (% of Total Oil)	6-8
Farnesene (% of Total Oil)	6-9
Linalool (% of Total Oil)	0.5-1.0
Total Polypenols (%)	–

FIRST GOLD

First Gold is a dwarf variety derived from a daughter of Whitbread Golding and a male dwarf variety. It is used as both a general kettle hop and also for late and dry-hopping in all types of beer. First Gold has excellent aroma qualities and much of the flavor character of Whitbread Golding seems to have been retained.


HERBAL


BERRY & CURRANT

CREAM CARAMEL


CITRUS

Marjoram, strawberry, yogurt, orange marmalade.

Alpha (%)	6.5-10
Beta (%)	3-4.5
Cohumulone (% of Alpha Acids)	32-35
Total Oil (ml/100g)	0.7-1.7
Myrcene (% of Total Oil)	30-38
Humulene (% of Total Oil)	20
Caryophyllene (% of Total Oil)	–
Farnesene (% of Total Oil)	1.5-3
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

FUGGLE

Named after the Kent grower that introduced it in 1875, Fuggle has been revered ever since as the classic aroma hop for British Bitters and Pale Ales. The variety is often used in combination with Goldings. Fuggle has typical English aroma whose robust character contributes nicely to beer flavor. Sometimes it is used as a distinctive dry hop.

WOODY AROMATIC

FLORAL

MENTHOL

Potting soil, tobacco, floral, spearmint.

Alpha (%)	3.5-6.5
Beta (%)	2-4
Cohumulone (% of Alpha Acids)	27-33
Total Oil (ml/100g)	0.7-1.1
Myrcene (% of Total Oil)	25-30
Humulene (% of Total Oil)	30-38
Caryophyllene (% of Total Oil)	–
Farnesene (% of Total Oil)	6-8
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

GALAXY®

94-203-008 c.v.

Galaxy® was created by the Hop Products Australia (HPA) breeding program in 1994 and commercialized in 2009. Its ancestry is a cross pollination of high alpha Australian and Perle hops. Galaxy is a late maturing seedless cultivar.

SWEET FRUIT | CITRUS

Passion fruit, peach, complex citrus.

Alpha (%)	13.0-18.5
Beta (%)	6.1-11.6
Cohumulone (% of Alpha Acids)	32-43
Total Oil (ml/100g)	1.9-2.9
Myrcene (% of Total Oil)	32-56
Humulene (% of Total Oil)	1-2
Caryophyllene (% of Total Oil)	7.0-14.7
Farnesene (% of Total Oil)	2.8-5.1
Linalool (% of Total Oil)	0.5-1.0
Total Polypenols (%)	—

GALENA

The name Galena is from the ancient Roman term for the mineral galenite which occurs in the soils of Oregon. Galena, a daughter of Brewers Gold, is a bitter variety developed by the USDA breeding program in Idaho and released in 1978.


CITRUS

SWEET FRUIT


GREEN-GRASSY

Grapefruit, white peach, alfalfa.

Alpha (%)	11.5-13.5
Beta (%)	7.2-8.7
Cohumulone (% of Alpha Acids)	36-40
Total Oil (ml/100g)	0.9-1.3
Myrcene (% of Total Oil)	55-60
Humulene (% of Total Oil)	10-13
Caryophyllene (% of Total Oil)	3-5
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

GLACIER

Glacier is a hop with well balanced bittering properties and a pleasant aroma profile. It was released from the Washington State University USDA breeding program in 2000. The variety was selected for its low cohumulone content and good yield potential. Glacier is a daughter of French Strisselspalt.

HERBAL | CITRUS | WOODY AROMATIC

Sage, rosemary, fresh ginger, cedar.

Alpha (%)	3.3-9.7
Beta (%)	5.4-9.7
Cohumulone (% of Alpha Acids)	11-13
Total Oil (ml/100g)	0.7-1.6
Myrcene (% of Total Oil)	33-62
Humulene (% of Total Oil)	24-36
Caryophyllene (% of Total Oil)	6-10
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

GOLDING

U.S. Goldings are the descendants of the well-known English variety, East Kent Goldings. They were first cultivated in British Columbia and then made their way to Washington State and Oregon in the early 1990s. There are agronomic challenges in growing Goldings, but the "typical" English aroma profile continues to fuel demand for this hop.

CREAM
CARAMEL

SPICY

FLORAL

Honey, cardamom, sweet pea.

Alpha (%)	4-6
Beta (%)	2-3
Cohumulone (% of Alpha Acids)	25-28
Total Oil (ml/100g)	0.4-1.0
Myrcene (% of Total Oil)	25-35
Humulene (% of Total Oil)	35-45
Caryophyllene (% of Total Oil)	13-16
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

GERMANY

HALLERTAU BLANC

Hallertau Blanc is a German variety bred at Hüll and is a daughter of Cascade. It was released in 2012 as one of the varieties which have been bred and commercialized in response to demand from the craft beer industry's desire for bold tastes and differentiating flavors.

GREEN FRUIT | BERRY & CURRANT | CITRUS

White grapes, cassis, lemongrass, grapefruit.

Alpha (%)	9.0-11.0
Beta (%)	4.0-7.0
Cohumulone (% of Alpha Acids)	22-26
Total Oil (ml/100g)	1.5-1.8
Myrcene (% of Total Oil)	70
Humulene (% of Total Oil)	0-3
Caryophyllene (% of Total Oil)	0-2
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	3-5.9

HALLERTAU MAGNUM

This high alpha variety was bred in 1980 at Hüll Hop Research Center in Germany. Hallertau Magnum is known for its extremely large and heavy cones. It produces good yields, and like many of the Hüll varieties, Hallertauer Magnum has a high tolerance to disease. Magnum is a daughter of U.S. Galena.


CITRUS


GREEN-GRASSY


MENTHOL


GREEN FRUIT

Lemon, green pepper, spearmint, apple.

Alpha (%)	11-16
Beta (%)	5-7
Cohumulone (% of Alpha Acids)	21-29
Total Oil (ml/100g)	1.6-2.6
Myrcene (% of Total Oil)	30-45
Humulene (% of Total Oil)	30-45
Caryophyllene (% of Total Oil)	8-12
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	0.2-0.7
Total Polypenols (%)	2-3

GERMANY

HALLERTAU MITTLEFRÜH

This is a classic German landrace variety with fine aroma and low bitter content. Because of its high susceptibility to wilt, Hallertau Mittelfrüh had suffered from a dramatic decrease in cultivation in the 1990s, but with an increasing demand and availability of virus-free plant material, Hallertau Mittelfrüh is again a popular variety.

HERBAL FLORAL WOODY AROMATIC

Sage, rosemary, lavender, pine.

Alpha (%)	3.0-5.5
Beta (%)	3.0-5.0
Cohumulone (% of Alpha Acids)	18-28
Total Oil (ml/100g)	0.7-1.3
Myrcene (% of Total Oil)	20-28
Humulene (% of Total Oil)	45-55
Caryophyllene (% of Total Oil)	10-15
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	0.7-1.1
Total Polypenols (%)	4.0-5.0

HALLERTAU TAURUS

Released in 1995, Taurus is a high alpha German variety bred at the Hüll Research Center. It has a noble, aromatic bitter quality with small and very compact cones which allows clean, mechanical picking and easy drying of the hop.

SPICY

SWEET FRUIT

CREAM CARAMEL

Pepper, ripe banana, chocolate.

Alpha (%)	12.0-17.0
Beta (%)	4-6
Cohumulone (% of Alpha Acids)	20-25
Total Oil (ml/100g)	0.9-1.4
Myrcene (% of Total Oil)	30-50
Humulene (% of Total Oil)	23-33
Caryophyllene (% of Total Oil)	6-11
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	1.0-1.5
Total Polypenols (%)	3-4

HARMONIE

Harmonie was registered in 2004 and has a high beta to alpha relative content. Current acreage is limited but it has shown very good quality for its contribution to pilsner beer aroma in Czechia. Its name comes from the "harmonious structure of hop resins."

Banana, apricot, crème caramel, green tea.

Alpha (%)	5.0-8.0
Beta (%)	5.0-8.0
Cohumulone (% of Alpha Acids)	17-21
Total Oil (ml/100g)	1.0-2.0
Myrcene (% of Total Oil)	30-45
Humulene (% of Total Oil)	15-25
Caryophyllene (% of Total Oil)	6-11
Farnesene (% of Total Oil)	< 1.0
Linalool (% of Total Oil)	0.7-1.2
Total Polypenols (%)	3.5-4.5

HBC 472 c.v.

HBC 472 c.v. has a special flavor profile that has generated interest amongst brewers. This experimental Hop Breeding Company (a joint venture between John I. Haas, Inc. and Yakima Chief Ranches), variety touts a combination of cream, vanilla, and wood flavor, along with citrus. In beer, the flavor has been described as "coconut," "barrel aged," and "whiskey." HBC 472 c.v. can be used in a myriad of beer styles, because its flavor synergizes well with both malt flavors and hop flavors.

WOODY AROMATIC | CREAM CARAMEL | CITRUS

Oak, bourbon barrel, coconut, vanilla, orange.

Alpha (%)	7.0-10.0
Beta (%)	7.0-9.0
Cohumulone (% of Alpha Acids)	–
Total Oil (ml/100g)	1.5-2.5
Myrcene (% of Total Oil)	35-45
Humulene (% of Total Oil)	1-5
Caryophyllene (% of Total Oil)	25-30
Farnesene (% of Total Oil)	4-6
Linalool (% of Total Oil)	0-1
Total Polypenols (%)	–

HBC 522 c.v.

HBC 522 c.v. is an experimental varietal first bred by the Hop Breeding Company (HBC) in 2006. It is a cross between a female Columbus and an experimental male 986-2. HBC 522 c.v. has been described as similar to Centennial and Cascade, with a mix of floral, citrus (especially orange and grapefruit), and pine needles.

CITRUS FLORAL WOODY AROMATIC

Bitter orange, grapefruit, jasmine, pine needles.

Alpha (%)	9.5-12
Beta (%)	4.5-5.5
Cohumulone (% of Alpha Acids)	22-26
Total Oil (ml/100g)	1.4-2.3
Myrcene (% of Total Oil)	36.9
Humulene (% of Total Oil)	13.2
Caryophyllene (% of Total Oil)	8.44
Farnesene (% of Total Oil)	0.52
Linalool (% of Total Oil)	0.64
Total Polypenols (%)	–

HBC 586 c.v.

HBC 586 c.v. is an experimental hop cultivar developed by the Hop Breeding Company (HBC). This cultivar resulted from a hybrid pollination of two experimental hop varieties. When used as a whirlpool addition or dry-hop addition, HBC 586 c.v. delivers a large medley of fruit flavors associated with tropical fruits. The fruity flavors of HBC 586 c.v. has been described as mango, guava, lychee, citrus, with slight sulfur and herbal notes. Many find HBC 586 c.v. to have fruit flavors that are special and new to the world of hops.

SWEET FRUIT | BERRY & CURRANT | SPICY | CITRUS

Fruit salad, mango, lychee, berries, fresh-cut pepper, mandarin orange.

Alpha (%)	12.0-13.0
Beta (%)	7.5-8.5
Cohumulone (% of Alpha Acids)	38-41
Total Oil (ml/100g)	1.2-2.5
Myrcene (% of Total Oil)	40-50
Humulene (% of Total Oil)	14-22
Caryophyllene (% of Total Oil)	7-15
Farnesene (% of Total Oil)	0-1
Linalool (% of Total Oil)	0-1
Total Polypenols (%)	–

HBC 630 c.v.

HBC 630 c.v. is an experimental hop cultivar developed by the Hop Breeding Company (HBC). This experimental variety was bred from a 2008 cross between two experimental hop varieties. HBC 630 c.v. is complex and fruity, with sweet fruit (cherry) and berry (raspberry) character. In addition, sweet candy-like esters and lactones combine to give creamy notes of banana and peaches.

SWEET FRUIT | BERRY & CURRANT | CREAM CARAMEL

Cherry, banana, peach, raspberry jam, crème caramel, coconut.

Alpha (%)	13.6-14.0
Beta (%)	5.6-6.3
Cohumulone (% of Alpha Acids)	22-26
Total Oil (ml/100g)	2.5-3.0
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

HBC 1019 c.v.

HBC 1019 c.v. is an experimental variety bred by the Hop Breeding Company (HBC). It arose from a 2016 cross between two HBC developmental varieties. Agronomically, it is a high yielding cultivar with a desirable early harvest window. HBC 1019 c.v. has a potent but pleasing mix of citrus, tropical and stone fruits. With notes of coconut, Valencia oranges, caramelized bananas, peaches, and honeydew melon, HBC 1019 c.v. is reminiscent of dark rum and daiquiris.

SWEET FRUIT | CITRUS | CREAM CARAMEL

Honeydew melon, peaches, tropical fruit, candy, coconut, orange.

Alpha (%)	10-12
Beta (%)	8-9
Cohumulone (% of Alpha Acids)	22-24
Total Oil (ml/100g)	1.3-2.2
Myrcene (% of Total Oil)	38.9
Humulene (% of Total Oil)	10.6
Caryophyllene (% of Total Oil)	7.2
Farnesene (% of Total Oil)	0.4
Linalool (% of Total Oil)	0.5
Total Polypenols (%)	–

GERMANY

HERKULES

True to its name, Herkules is a robust, high-yielding, high bittering hop cultivar tolerant to various diseases. As a daughter of Taurus it was released in 2006 by the Hüll Hop Research Center. Herkules has excellent brewing quality combined with very good storage stability.

CITRUS

SWEET FRUIT

MENTHOL

Orange, lemongrass, honeydew, melon, lemon balm, peppermint.

Alpha (%)	12.0-17.0
Beta (%)	4.0-5.5
Cohumulone (% of Alpha Acids)	32-38
Total Oil (ml/100g)	1.6-2.4
Myrcene (% of Total Oil)	30-50
Humulene (% of Total Oil)	30-45
Caryophyllene (% of Total Oil)	7-12
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	0.3-0.8
Total Polypenols (%)	3-4

HERSBRUCKER

This traditional German variety, also known as Hersbrucker Spät, is from the Hersbrucker growing area. It was once considered a successor to Hallertauer Mittelfrüh. This hop exhibits a fine noble aroma but sometimes displays a very low alpha content. Hersbrucker has good tolerance to diseases.

Lemon balm, orange, black tea, marjoram.

Alpha (%)	1.5-4.0
Beta (%)	2.5-6.0
Cohumulone (% of Alpha Acids)	17-25
Total Oil (ml/100g)	0.5-1.0
Myrcene (% of Total Oil)	15-30
Humulene (% of Total Oil)	20-30
Caryophyllene (% of Total Oil)	8-13
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	0.5-1.0
Total Polypenols (%)	5-6

HORIZON

A diploid high alpha hop, Horizon was a USDA selection of a cross made in Oregon in 1970 and released in 1997. It is a half sister of Nugget with a breeding line that includes Brewers Gold, Early Green hops and a USDA experimental variety. It is notably low in cohumulone with high myrcene content.

FLORAL | WOODY AROMATIC | CITRUS

Lilac, pine resin, fresh-cut ginger.

Alpha (%)	10.2-16.5
Beta (%)	4.6-9.0
Cohumulone (% of Alpha Acids)	17-22
Total Oil (ml/100g)	1.25-2.60
Myrcene (% of Total Oil)	60-70
Humulene (% of Total Oil)	8-10
Caryophyllene (% of Total Oil)	5-6
Farnesene (% of Total Oil)	2
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

HÜLL MELON

Hüll Melon is one of the German varieties released in 2012. It was bred from a Cascade mother at the Hüll Hop Research Center. It is one of the recent cultivars bred and commercialized in response to demand from the craft beer industry's desire for bold tastes and differentiating flavors.

SWEET FRUIT


BERRY & CURRANT

FLORAL


SPICY

Melon, peach tea, strawberry, geranium, aniseed.

Alpha (%)	7-8
Beta (%)	6-8
Cohumulone (% of Alpha Acids)	25-30
Total Oil (ml/100g)	0.8-2.1
Myrcene (% of Total Oil)	26-42
Humulene (% of Total Oil)	10-20
Caryophyllene (% of Total Oil)	5-10
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	0.2-0.3
Total Polypenols (%)	3.0-4.6

IDAHO 7™

Primarily an aroma contributor and originally known as 007 The Golden Hop. Idaho 7™ is a high alpha hop that also contributes pleasing flavor attributes to beer. It was released in 2015 by Jackson Hop Farm in Wilder, ID.

SWEET FRUIT

WOODY AROMATIC

CITRUS

Guava, apricot, pine resin, lemon, orange pith.

Alpha (%)	13-15
Beta (%)	4-5
Cohumulone (% of Alpha Acids)	30-40
Total Oil (ml/100g)	1.0-1.6
Myrcene (% of Total Oil)	45-55
Humulene (% of Total Oil)	10-20
Caryophyllene (% of Total Oil)	5-10
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	0.5-1.0
Total Polypenols (%)	–

IDAHO GEM™

Idaho Gem™ was found and is marketed by Idaho's Gooding Farms. This varietal has relatively high alpha and levels of sweet fruity flavor.

SWEET FRUIT | CITRUS | HERBAL

Pineapple, cherry candy, grapefruit, green tea.

Alpha (%)	11-14
Beta (%)	5-7
Cohumulone (% of Alpha Acids)	40-45
Total Oil (ml/100g)	1.3-2
Myrcene (% of Total Oil)	61.32
Humulene (% of Total Oil)	17.66
Caryophyllene (% of Total Oil)	0.03
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

POLAND

IUNGA

Iunga was released in 2004 from the Institute of Soil Science and Plant Cultivation (IUNG) in Pulawy, Poland as a high alpha variety. There is disagreement in its pedigree in that some reports have it bred from Northern Brewer and Marynka, yet others say it's a cross between Lubelski and a Yugoslavian male hop.

SWEET FRUIT | CITRUS | CREAM CARAMEL

Pineapple, peach, citrus, honey.

Alpha (%)	8-12.5
Beta (%)	5-7
Cohumulone (% of Alpha Acids)	29-34
Total Oil (ml/100g)	1.5-2.5
Myrcene (% of Total Oil)	40-55
Humulene (% of Total Oil)	30-40
Caryophyllene (% of Total Oil)	8-11
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

IZABELLA

Izabella was developed in the late 1980s from a cross of Lubelski and a Yugoslavian male hop. The cross was initially targeted as a high-alpha variety, but because of its low bittering potential, the cultivar languished for years. However, the craft beer boom and Izabella's aroma character has resurrected the variety.

CITRUS

WOODY AROMATIC

Generic citrus, pine.

Alpha (%)	4.7-6.0
Beta (%)	2-3
Cohumulone (% of Alpha Acids)	–
Total Oil (ml/100g)	1.3
Myrcene (% of Total Oil)	54.4
Humulene (% of Total Oil)	18
Caryophyllene (% of Total Oil)	8.7
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

JARRYLO™

Jarrylo™ (pronounced Jar-ril-low) was developed and released by the ADHA (Association for the Development of Hop Agronomy). The name is derived from the Slavic god of fertility and springtime. Her mother is Summit and the father is ADHA 75-2.

SWEET FRUIT | CITRUS | SPICY

Overripe banana, pear, orange, allspice.

Alpha (%)	15-17
Beta (%)	6.0-7.5
Cohumulone (% of Alpha Acids)	34-37
Total Oil (ml/100g)	3.6-4.3
Myrcene (% of Total Oil)	40-55
Humulene (% of Total Oil)	15-18
Caryophyllene (% of Total Oil)	8-11
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

KAZBEK

Kazbek was a selection from hybrid progenies of breeding material originating from Russian wild hops. Released in 2008, the name Kazbek is from the highest peak within the middle of the Caucasus mountain range in Czechia.


CITRUS

SWEET FRUIT


BERRY & CURRANT

CREAM CARAMEL

Orange, peach, passion fruit, raspberry, chocolate.

Alpha (%)	5.0-8.0
Beta (%)	4.0-6.0
Cohumulone (% of Alpha Acids)	35-40
Total Oil (ml/100g)	0.9-1.8
Myrcene (% of Total Oil)	40-55
Humulene (% of Total Oil)	20-35
Caryophyllene (% of Total Oil)	10-15
Farnesene (% of Total Oil)	< 1.0
Linalool (% of Total Oil)	0.3-0.5
Total Polypenols (%)	3.5-4.5

LEMON DROP™

Lemon Drop™ (previously known as Experimental 01210) is a distinctive variety developed through the Hopsteiner hop breeding program. It was derived from a Cascade mother and USDA 19058 father. Lemon Drop has an alpha content similar to Cascade.

Lemon, mint, green tea, subtle melon.

Alpha (%)	5.0-7.0
Beta (%)	4.0-6.0
Cohumulone (% of Alpha Acids)	28-34
Total Oil (ml/100g)	1.5-2.0
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	6-7
Linalool (% of Total Oil)	0.4-0.6
Total Polypenols (%)	4.0-4.5

LIBERTY

Liberty is a triploid variety bred from a cross between a female Hallertau Mittelfrüh and a downy mildew resistant German male hop. The cultivar was bred in 1983 at the USDA program at Oregon State University and released in the U.S. in 1991. Of the four U.S. triploid Hallertau varieties released during that time, Liberty most closely resembles Hallertau Mittelfrüh.

FLORAL | CITRUS | WOODY AROMATIC

Delicate floral, lemon, myrrh.

Alpha (%)	3-5
Beta (%)	3-4
Cohumulone (% of Alpha Acids)	24-30
Total Oil (ml/100g)	0.6-1.2
Myrcene (% of Total Oil)	20-40
Humulene (% of Total Oil)	35-40
Caryophyllene (% of Total Oil)	9-12
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

LORAL®

HBC 291 c.v.

Loral® was bred by the Hop Breeding Company and released in 2016. Its experimental designation was HBC 291. Loral's mother is U.S. Glacier and her grandmother the long established French noble aroma variety Tardif de Bourgogne. The father is a son of the Nugget variety. Loral is characterized by having numerous small, dense cones with moderate alpha acids.

Violet, lily, fennel frond, lemon.

Alpha (%)	10-12
Beta (%)	4.5-5.5
Cohumulone (% of Alpha Acids)	21-23
Total Oil (ml/100g)	1.5-2.5
Myrcene (% of Total Oil)	37-39
Humulene (% of Total Oil)	23-25
Caryophyllene (% of Total Oil)	6-8
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	1.0-1.4
Total Polypenols (%)	–

LOTUS™

Lotus™ is a variety released by Hopsteiner. It is from a long lineage that starts with Eastern Gold, a Japanese variety, from 1930. A number of different hops were involved in subsequent crosses. These included Apollo, Cascade, a USDA male, and a daughter from the open pollination of a wild *neomexicanus* hop.

Orange, vanilla, blackberry, tropical fruits.

Alpha (%)	13.0-17.0
Beta (%)	5.5-6.0
Cohumulone (% of Alpha Acids)	33-39
Total Oil (ml/100g)	1.5-2.5
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	0.2-0.4
Total Polypenols (%)	—

POLAND

LUBLIN (LUBELSKI)

Originating from the Saaz hop, this variety is a Pulawy bred variety with very fine aroma characteristics. Today, Lublin is cultivated in the Polish growing regions of Lublin, Poznan and Opole. It is of average alpha and hectare yield, however, better than that of Saaz. Lublin has a good tolerance to diseases and grows on light to medium heavy soils.

Juniper, curry, cinnamon, bergamot, geranium, dill.

Alpha (%)	3.0-4.5
Beta (%)	3-4
Cohumulone (% of Alpha Acids)	25-28
Total Oil (ml/100g)	0.5-1.1
Myrcene (% of Total Oil)	22-29
Humulene (% of Total Oil)	30-40
Caryophyllene (% of Total Oil)	6-11
Farnesene (% of Total Oil)	10-14
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

MAGNAT

Magnat is a high alpha variety developed by the Institute of Soil Science and Plant Cultivation (IUNG) in Poland and was released in 2012. It is a daughter of German Magnum, from which its name is derived. Magnat has high yields and a favorable late maturity.

CITRUS | WOODY AROMATIC | FLORAL | HERBAL

Lemon zest, generic woody, chamomile, oregano, chives.

Alpha (%)	11-16
Beta (%)	3-7
Cohumulone (% of Alpha Acids)	—
Total Oil (ml/100g)	1.0-2.0
Myrcene (% of Total Oil)	30-50
Humulene (% of Total Oil)	19
Caryophyllene (% of Total Oil)	7.2
Farnesene (% of Total Oil)	—
Linalool (ul/100g)	11
Total Polypenols (%)	—

GERMANY

MANDARINA BAVARIA

Mandarina Bavaria is a German hop with a pleasant fruitiness and very distinctive tangerine and citrus notes. The variety is a Cascade daughter which was bred at Hüll and released in 2012.

CITRUS

SWEET FRUIT

BERRY & CURRANT

Lime, lemon, pineapple, strawberry, cassis.

Alpha (%)	7-10
Beta (%)	4-7
Cohumulone (% of Alpha Acids)	31-35
Total Oil (ml/100g)	1.5-2.2
Myrcene (% of Total Oil)	up to 71
Humulene (% of Total Oil)	5-15
Caryophyllene (% of Total Oil)	1-5
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	up to 0.3
Total Polypenols (%)	2.3-2.7

MARYNKA

Marynka was bred in Poland from a Brewers Gold mother and Slovenian father hop, and registered in 1988. It is also characterized by a very high level of beta acids. Marynka has strong aroma characteristics and good resistance to most pests and diseases.

SPICY

CITRUS

WOODY AROMATIC

Licorice, aniseed, lemon, grapefruit, earthy.

Alpha (%)	9-12
Beta (%)	10.2-13.0
Cohumulone (% of Alpha Acids)	26-33
Total Oil (ml/100g)	1.8-2.2
Myrcene (% of Total Oil)	28-31
Humulene (% of Total Oil)	26-33
Caryophyllene (% of Total Oil)	11-12
Farnesene (% of Total Oil)	1-3
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

MCKENZIE™

C-148 c.v.

Commercially launched in 2021, McKenzie™ is the first variety released by the West Coast Hop Breeding Company (WCHB) of Aurora, Oregon. WCHB is a co-operative organization of six Oregon growers, founded by Pat Leavy (Oregon Hop House) and Fred Geschwill (F&B Farms). McKenzie, like all hops from WCHB, was bred specifically for the climate and agronomy of Oregon, maximizing the local terroir. McKenzie is described as a bright and fruity mixture of classic varieties like Fuggles and Centennial.

CITRUS | SWEET FRUIT | WOODY AROMATIC | HERBAL

Grapefruit, lemon, nectarine, melon rind, pine resin, thyme.

Alpha (%)	10.3
Beta (%)	8.7
Cohumulone (% of Alpha Acids)	—
Total Oil (ml/100g)	2.3
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

MEDUSA™

Medusa™ is an aroma hop released by CLS Farms in Washington. It is derived from the *Humulus lupulus neomexicanus* subspecies originating in the New Mexico region. A characteristic of Medusa is the occurrence of multiple heads on its hop cones, hence the name.

SWEET FRUIT

CITRUS

Guava, melon, apricot, lemon.

Alpha (%)	3
Beta (%)	6.5
Cohumulone (% of Alpha Acids)	–
Total Oil (ml/100g)	0.7
Myrcene (% of Total Oil)	54.6
Humulene (% of Total Oil)	9.1
Caryophyllene (% of Total Oil)	14.0
Farnesene (% of Total Oil)	1.6
Linalool (% of Total Oil)	0.6
Total Polypenols (%)	–

MERIDIAN®

Meridian® was introduced by Indie Hops in Oregon. The variety was propagated in 2012 from plant material of unknown origin that showed promising brewing qualities. After evaluations for agronomic stability and disease resistance, it was commercialized as Meridian in 2015.

Tropical fruit, mixed berry, lemon, spearmint.

Alpha (%)	5-6.5
Beta (%)	7-8
Cohumulone (% of Alpha Acids)	50.1
Total Oil (ml/100g)	1.1-1.6
Myrcene (% of Total Oil)	40-64.4
Humulene (% of Total Oil)	9-17.6
Caryophyllene (% of Total Oil)	4-8
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

MILLENNIUM®

Millennium® is a high alpha variety developed through the John I. Haas, Inc., breeding program and released in 2000. With Nugget as the mother, this triploid variety exhibits the same powdery mildew resistance as Nugget. Its brewing profile is comparable to that of Nugget and Columbus-type varieties.

WOODY AROMATIC

FLORAL

CITRUS

MENTHOL

Cedar, tobacco, lilac, lime, lemongrass, sage.

Alpha (%)	14.5-16.5
Beta (%)	4.3-5.3
Cohumulone (% of Alpha Acids)	28-32
Total Oil (ml/100g)	1.8-2.2
Myrcene (% of Total Oil)	30-40
Humulene (% of Total Oil)	23-27
Caryophyllene (% of Total Oil)	9-12
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

MISTRAL

Mistral is a French variety released by the Comptoir Agricole breeding program in 2016. It has medium alpha content and is recognized for its subtle aroma profile.

CITRUS | SWEET FRUIT | GREEN FRUIT

Orange, melon, muscat.

Alpha (%)	6.5-8.5
Beta (%)	3.1-3.8
Cohumulone (% of Alpha Acids)	30-39
Total Oil (ml/100g)	0.8-1.5
Myrcene (% of Total Oil)	50-65
Humulene (% of Total Oil)	9.5-17.0
Caryophyllene (% of Total Oil)	–
Farnesene (mg/100g)	27-34
Linalool (mg/100g)	4-7
Total Polypenols (%)	–

MONROE

Monroe is a German-grown hop that was developed from U.S. wild hop lineage. Its red fruit/berry forward character is evocative of the hop's namesake, Marilyn Monroe in a red dress.

SWEET FRUIT

CITRUS

BERRY & CURRANT

Morello cherry, orange syrup, raspberry.

Alpha (%)	2.8-2.9
Beta (%)	6.5-7.5
Cohumulone (% of Alpha Acids)	—
Total Oil (ml/100g)	up to 0.95
Myrcene (% of Total Oil)	up to 37
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	up to 1
Total Polypenols (%)	4.4-4.8

MOSAIC®

HBC 369 c.v.

Mosaic® is an aroma hop variety developed by the Hop Breeding Company (HBC) and released in 2012. Mosaic® is the daughter of YCR 14 Simcoe® and a Nugget-derived male.

CITRUS

SWEET FRUIT

BERRY & CURRANT

Tangerine, lime, peach, passion fruit, blueberry.

Alpha (%)	11.5-13.5
Beta (%)	3.2-3.9
Cohumulone (% of Alpha Acids)	24-26
Total Oil (ml/100g)	1-1.5
Myrcene (% of Total Oil)	47-53
Humulene (% of Total Oil)	13-16
Caryophyllene (% of Total Oil)	5-8
Farnesene (% of Total Oil)	0
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

MOTUEKA™

Motueka™ is a triploid hop developed at the New Zealand Institute for Plant and Food Research. It is a cross of Saaz and a New Zealand breeding selection.

CITRUS | SWEET FRUIT | HERBAL

Lime zest, mojito, lemongrass, stone fruit nectar, banana, basil.

Alpha (%)	6.5-7.5
Beta (%)	5.0-5.5
Cohumulone (% of Alpha Acids)	28-30
Total Oil (ml/100g)	0.6-1.0
Myrcene (% of Total Oil)	45-50
Humulene (% of Total Oil)	2-6
Caryophyllene (% of Total Oil)	1-3
Farnesene (% of Total Oil)	10-14
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

MOUNT HOOD

Mt. Hood is an aroma variety released in 1989 from the USDA breeding program in Oregon. The variety is a triploid daughter of Hallertau Mittelfrüh and a sister to Liberty, with analytical data similar to both.

Juniper, tarragon, lemongrass.

Alpha (%)	4-7
Beta (%)	5-8
Cohumulone (% of Alpha Acids)	21-23
Total Oil (ml/100g)	1.2-1.7
Myrcene (% of Total Oil)	30-40
Humulene (% of Total Oil)	30-38
Caryophyllene (% of Total Oil)	13-16
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	0.5-0.7
Total Polypenols (%)	—

MOUNT RAINIER

Mt. Rainier was released in 2008 through the USDA hop breeding program at Oregon State University. The inspiration for the name came from one of the many active volcanoes that are located in Washington State. It is the daughter of German Magnum and a USDA male hop. The hop combines noble, Hallertau-like aroma characteristics with citrus and licorice notes.

Geranium, lilac, lemon, black licorice.

Alpha (%)	5-8.1
Beta (%)	5-7
Cohumulone (% of Alpha Acids)	21-24
Total Oil (ml/100g)	0.2-2.2
Myrcene (% of Total Oil)	47-54
Humulene (% of Total Oil)	9-14
Caryophyllene (% of Total Oil)	4-7
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

NEW ZEALAND

MOUTERE™

Moutere™ Brand HORT0605 is a New Zealand-bred triploid variety developed at the New Zealand Institute for Plant and Food Research. It was bred from the cross of a New Zealand variety Southern Cross with a selected New Zealand male. Moutere was commercially released in 2015.

SWEET FRUIT

CITRUS

Tropical fruits, passion fruit, grapefruit.

Alpha (%)	17.5-19.5
Beta (%)	8.0-10.0
Cohumulone (% of Alpha Acids)	26
Total Oil (ml/100g)	1.7
Myrcene (% of Total Oil)	22.2
Humulene (% of Total Oil)	15.2
Caryophyllene (% of Total Oil)	5.8
Farnesene (% of Total Oil)	0.3
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

NELSON SAUVIN™

Nelson Sauvin™ is a triploid dual-purpose variety developed through the HortResearch hop breeding program in New Zealand. It was bred from the New Zealand variety Smoothcone and released in 2000.

GREEN FRUIT | CITRUS | SWEET FRUIT

White wine, gooseberry, grapefruit, mango, lychee, melon.

Alpha (%)	12-13
Beta (%)	6-8
Cohumulone (% of Alpha Acids)	22-26
Total Oil (ml/100g)	1.0-1.2
Myrcene (% of Total Oil)	21-23
Humulene (% of Total Oil)	35-37
Caryophyllene (% of Total Oil)	10-12
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

NEWPORT

Newport, released in 2002, was developed through the USDA program at Oregon State University. This cultivar has multiple disease resistance and possesses high alpha and beta acid levels. It is a descendant from a cross of Hallertauer Magnum and USDA male 58111. Newport has excellent yields and is resistant to both powdery and downy mildews.

CITRUS

WOODY AROMATIC

Generic citrus, leather, balsamic.

Alpha (%)	13.5-17
Beta (%)	7.2-9.1
Cohumulone (% of Alpha Acids)	36-38
Total Oil (ml/100g)	1.6-3.4
Myrcene (% of Total Oil)	47-54
Humulene (% of Total Oil)	9-14
Caryophyllene (% of Total Oil)	1-7
Farnesene (% of Total Oil)	0-1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

NORTHERN BREWER

GERMANY

Northern Brewer was an English hop that was bred in 1934. Its pedigree can be traced to a cross between a female American wild hop and an English father. Today, Northern Brewer is grown in the U.S., U.K., and Germany with Germany being the primary growing region.

WOODY AROMATIC

MENTHOL

Pine, tobacco, lemon balm.

Alpha (%)	8-10
Beta (%)	3-5
Cohumulone (% of Alpha Acids)	27-33
Total Oil (ml/100g)	1.5-2
Myrcene (% of Total Oil)	25-45
Humulene (% of Total Oil)	35-50
Caryophyllene (% of Total Oil)	10-20
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

NUGGET

Nugget is a high alpha variety originally developed through the USDA program at Oregon State University. The cross was initially made in 1970 but ended up being registered much later in 1984. The cultivar is tolerant to a wide range of soil conditions and thus grows vigorously in all areas. Nugget is also grown in the German Hallertau region but produces somewhat lower alpha content there. Nugget is a daughter of Brewers Gold.

Fresh-crushed herbs, grapefruit zest, stone fruit, pineapple, resin.

Alpha (%)	11.5-14
Beta (%)	3.0-5.0
Cohumulone (% of Alpha Acids)	22-30
Total Oil (ml/100g)	0.9-1.3
Myrcene (% of Total Oil)	27-42
Humulene (% of Total Oil)	16-19
Caryophyllene (% of Total Oil)	7-10
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	0.5-1.0
Total Polypenols (%)	–

OPAL

Opal is a German hop developed at the Hüll Research Center as a daughter of Hallertau Gold. The hop exhibits excellent aroma characteristics combined with a moderate alpha acid concentration.


SPICY


WOODY AROMATIC


CITRUS

SWEET FRUIT

Aniseed, fresh pepper, cognac, bergamot, apricot.

Alpha (%)	5.0-8.0
Beta (%)	3.5-5.5
Cohumulone (% of Alpha Acids)	13-17
Total Oil (ml/100g)	0.8-1.3
Myrcene (% of Total Oil)	20-45
Humulene (% of Total Oil)	30-50
Caryophyllene (% of Total Oil)	8-15
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	1.0-1.5
Total Polypenols (%)	3-5

NEW ZEALAND

PACIFICA™

Pacifica™ was bred by the New Zealand Plant & Food Hop Research Centre and released in 1994. It is a triploid variety that arose from the open pollination of Hallertau Mittlefrüh. In beer, Pacifica displays Old World noble flavors as well as New World citrus and fruit attributes.

CITRUS | SWEET FRUIT | FLORAL | SPICY

Orange marmalade, noble spice.

Alpha (%)	5.0-6.0
Beta (%)	6.0
Cohumulone (% of Alpha Acids)	25
Total Oil (ml/100g)	1
Myrcene (% of Total Oil)	12.5
Humulene (% of Total Oil)	50.9
Caryophyllene (% of Total Oil)	16.7
Farnesene (% of Total Oil)	0.2
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

PAHTO®

HBC 682 c.v.

Pahto® is a super-alpha hop cultivar with a very mild and pleasant aroma, high yield with a very high alpha content, good storage stability and resistance to hop powdery and downy mildew. Pahto was developed for hot side and early kettle additions to efficiently deliver bitterness to beer. When used as a bittering hop, Pahto provides a very neutral flavor to beer, and a pleasant bitterness. The aroma profile of the hop cone is described as herbal, earthy, woody, and resinous with some fruit.

SWEET FRUIT | HERBAL | FLORAL | WOODY AROMATIC

Melon, thyme, lily of the valley, resin, potting soil.

Alpha (%)	17.0-20.0
Beta (%)	4.5-6.0
Cohumulone (% of Alpha Acids)	–
Total Oil (ml/100g)	1.0-2.5
Myrcene (% of Total Oil)	48-52
Humulene (% of Total Oil)	13-15
Caryophyllene (% of Total Oil)	4-6
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	0-1
Total Polypenols (%)	–

PALISADE®

Palisade® is an aroma variety bred in the U.S. by Yakima Chief Ranches. It is popular in brewing for its aromatic properties and moderate bittering and has good resistance to powdery mildew. Palisade appears to be named after a hop field enclosure used in cultivation to facilitate the climbing hop. The cultivar is a result of open pollination.

SWEET FRUIT | FLORAL | GREEN-GRASSY

Apricot, clean floral, fresh-cut grass.

Alpha (%)	6.5-9.5
Beta (%)	6-8
Cohumulone (% of Alpha Acids)	26-30
Total Oil (ml/100g)	0.8-2
Myrcene (% of Total Oil)	45-55
Humulene (% of Total Oil)	10-20
Caryophyllene (% of Total Oil)	8-14
Farnesene (% of Total Oil)	0.1-1
Linalool (% of Total Oil)	0.2-0.6
Total Polypenols (%)	–

PEKKO®

Named after the Finnish god of field and crops, Pekko® is a recent release from the Association for the Development of Hop Agronomy (ADHA) breeding program in the Yakima Valley. Previously known as ADHA 871, her mother is ADHA 538 with open pollination.


CITRUS


MENTHOL

SWEET FRUIT

FLORAL

Lemon grass, eucalyptus, sage, pineapple, banana, lilac, chamomile.

Alpha (%)	13-16
Beta (%)	3.5-4.3
Cohumulone (% of Alpha Acids)	27-30
Total Oil (ml/100g)	2.1-2.7
Myrcene (% of Total Oil)	46-55
Humulene (% of Total Oil)	12-15
Caryophyllene (% of Total Oil)	11-13
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

GERMANY

PERLE

The combination of good alpha acids content with desirable aroma gave rise to Perle's popularity. High yields and good tolerance to most diseases make this variety attractive also for growers. Bred from the variety Northern Brewer, Perle was released in 1978 and is well established in Germany. Perle has also been grown in the U.S. in both Washington and Oregon.

Marjoram, peppermint, lime, pear.

Alpha (%)	4-9
Beta (%)	2.5-4.5
Cohumulone (% of Alpha Acids)	29-35
Total Oil (ml/100g)	0.5-1.5
Myrcene (% of Total Oil)	20-35
Humulene (% of Total Oil)	35-55
Caryophyllene (% of Total Oil)	10-20
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	0.2-0.6
Total Polypenols (%)	3-5

PILGRIM

Pilgrim is a bitter-type variety. It was developed by Wye Hops Ltd., and gained European Plant Variety Rights in 2006. It has very good resistance to wilt disease and is being planted in areas where this disease is present, often replacing 'Wye Target.' Bred from Yeoman in the late 1990s, Pilgrim is high in alpha and rich in oils.


MENTHOL


HERBAL


CITRUS

Peppermint, marjoram, lime.

Alpha (%)	9-13
Beta (%)	4-5
Cohumulone (% of Alpha Acids)	35
Total Oil (ml/100g)	1-1.8
Myrcene (% of Total Oil)	30-35
Humulene (% of Total Oil)	21-25
Caryophyllene (% of Total Oil)	–
Farnesene (% of Total Oil)	0.3
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

GERMANY

POLARIS

Polaris is a German variety which has an intense aroma and a refreshing note, described by some as mint drop. The variety was bred at the Hüll Research Center from a Hüll breeding line and released in 2012.


MENTHOL

SWEET FRUIT


CITRUS


WOODY AROMATIC

Mint, pineapple, bergamot, woodruff.

Alpha (%)	18-24
Beta (%)	5-6.5
Cohumulone (% of Alpha Acids)	22-28
Total Oil (ml/100g)	2.4-4.4
Myrcene (% of Total Oil)	up to 50.3
Humulene (% of Total Oil)	20-35
Caryophyllene (% of Total Oil)	8-13
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	up to 0.2
Total Polypenols (%)	2.6-2.7

PREMIANT

Premiant is a Czech dual-purpose hop variety selected from hybrid progenies of the Saaz variety and other breeding material. It was registered in 1996 and has good agronomic yield. The hop was named after traditional Czech "premium" lager.

SWEET FRUIT

CITRUS

FLORAL

CREAM CARAMEL

Passion fruit, lemon grass, jasmine, lavender, chocolate.

Alpha (%)	7.0-10.0
Beta (%)	3.5-5.5
Cohumulone (% of Alpha Acids)	18-23
Total Oil (ml/100g)	1.0-2.0
Myrcene (% of Total Oil)	35-45
Humulene (% of Total Oil)	25-40
Caryophyllene (% of Total Oil)	9-13
Farnesene (% of Total Oil)	1-3
Linalool (% of Total Oil)	0.4-0.7
Total Polypenols (%)	4.0-5.0

PRIDE OF RINGWOOD

Pride of Ringwood was bred by Carlton and United Breweries in 1953 at their Ringwood Research Station in Melbourne, Victoria. This cultivar was bred by open pollination of a female related to the English cultivar Pride of Kent, grown commercially since the 1960s.

CITRUS | WOODY AROMATIC | HERBAL

Ginger, cedar, pine resin, earth, tarragon, mate tea.

Alpha (%)	8.6-11.0
Beta (%)	4.0-8.0
Cohumulone (% of Alpha Acids)	25-34
Total Oil (ml/100g)	1.0-2.0
Myrcene (% of Total Oil)	30-41
Humulene (% of Total Oil)	1.6-3.0
Caryophyllene (% of Total Oil)	10-12
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

PROGRESS

Progress is a daughter of Whitbread Golding and OB79. The variety was developed at Wye College and released for commercial growing in 1964. It was bred as a Fuggle replacement. Its aroma profile and alpha content is ideally suited to British style beers.

BERRY & CURRANT

CREAM CARAMEL

SPICY

Cassis, cream, honey, coriander.

Alpha (%)	6-7.5
Beta (%)	2-3.3
Cohumulone (% of Alpha Acids)	33
Total Oil (ml/100g)	0.8-1.0
Myrcene (% of Total Oil)	29
Humulene (% of Total Oil)	36-42
Caryophyllene (% of Total Oil)	–
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

RAKAU™

Rakau™ is a triploid variety that was developed by the New Zealand Plant & Food Hop Research Centre. When first released in 1983 the cultivar was known as AlphAroma. It was re-released in 2007 as Rakau. The hop is described as having unique fruit flavors with strong stone fruit character.

SWEET FRUIT | CITRUS | GREEN FRUIT

Apricot, fig, pineapple, orange, white wine grapes.

Alpha (%)	10.0-11.0
Beta (%)	5.0-6.0
Cohumulone (% of Alpha Acids)	24
Total Oil (ml/100g)	2.15
Myrcene (% of Total Oil)	56
Humulene (% of Total Oil)	16.3
Caryophyllene (% of Total Oil)	5.2
Farnesene (% of Total Oil)	4.5
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

RELAX

Originally bred as a hop for tea, Relax has a remarkably low alpha content but with high beta. Relax was developed from a breeding line from the Hüll Research Center in Germany.

WOODY AROMATIC | SWEET FRUIT | FLORAL | CITRUS

Cognac, leather, melon, lychee, rose hip, lavender, lemongrass.

Alpha (%)	0.3-1.5
Beta (%)	10-15
Cohumulone (% of Alpha Acids)	—
Total Oil (ml/100g)	1-1.3
Myrcene (% of Total Oil)	17-30
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	0.3-0.5
Total Polypenols (%)	—

RIWAKA™

85.6-23 c.v.

Riwaka™ was released by the New Zealand Plant & Food Hop Research Centre in 1997. It is a triploid variety with Saaz and New Zealand parentage. As is true for all New Zealand varieties, Riwaka is free of hop diseases such as powdery mildew.

SWEET FRUIT

CITRUS

Passion fruit, grapefruit.

Alpha (%)	4.5-6.5
Beta (%)	4.0-5.0
Cohumulone (% of Alpha Acids)	32
Total Oil (ml/100g)	1.5
Myrcene (% of Total Oil)	68
Humulene (% of Total Oil)	9
Caryophyllene (% of Total Oil)	4
Farnesene (% of Total Oil)	1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

SAAZ

Saaz is the famous aroma landrace variety originating in the Czech area of the same name. It is considered by many as the world standard for a fine noble aroma hop. Since 1952, Saaz has been cultivated into nine separate clones, the last being in 1993.

Bergamot, honey, woody, chamomile tea, spicy.

Alpha (%)	2.5-4.5
Beta (%)	4.0-6.0
Cohumulone (% of Alpha Acids)	23-26
Total Oil (ml/100g)	0.4-0.8
Myrcene (% of Total Oil)	25-40
Humulene (% of Total Oil)	15-30
Caryophyllene (% of Total Oil)	6-9
Farnesene (% of Total Oil)	14-20
Linalool (% of Total Oil)	0.4-0.6
Total Polypenols (%)	5.5-7.0

SAAZ LATE

Saaz Late is a Czech selection bred from parents with origins in the Saaz region. The variety was released in 2010 from the Hop Research Institute Co., Ltd., in Czechia.

SWEET FRUIT


CITRUS


BERRY & CURRANT

FLORAL

Passion fruit, lemon, raspberry, blackberry, chamomile tea.

Alpha (%)	3.5-6.0
Beta (%)	4.0-6.5
Cohumulone (% of Alpha Acids)	20-25
Total Oil (ml/100g)	0.5-1.0
Myrcene (% of Total Oil)	25-35
Humulene (% of Total Oil)	15-25
Caryophyllene (% of Total Oil)	6-9
Farnesene (% of Total Oil)	15-20
Linalool (% of Total Oil)	0.2-0.4
Total Polypenols (%)	5.0-6.0

SABRO®

HBC 438 c.v.

Sabro® brand HBC 438 was developed by the Hop Breeding Company and released in 2018. Her pedigree is the result of a unique cross pollination of YCR 123, a female *neomexicanus* hop. Sabro imparts a strong and complex fruit flavor to beer. Its flavor is notable for its complexity of fruity and citrus attributes, including distinct tangerine, coconut, tropical and stone fruit. In addition, there is a pronounced cream character and secondary flavors of vanilla, cedar, dill, and mint.

Tangerine, tropical fruit, stone fruit, coconut.

Alpha (%)	12.0-16.0
Beta (%)	4.0-7.0
Cohumulone (% of Alpha Acids)	—
Total Oil (ml/100g)	2.5-3.5
Myrcene (% of Total Oil)	40-55
Humulene (% of Total Oil)	10-15
Caryophyllene (% of Total Oil)	15-20
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	0-1
Total Polypenols (%)	—

SANTIAM

Santiam is an American hop that contains noble hop characteristics similar to German grown Tettnanger. Released in 1997, this hop is tolerant to downy mildew but susceptible to powdery mildew.

Floral, herbal, black pepper.

Alpha (%)	5.5-7.0
Beta (%)	7.0-8.5
Cohumulone (% of Alpha Acids)	20-22
Total Oil (ml/100g)	1.3-1.7
Myrcene (% of Total Oil)	30-45
Humulene (% of Total Oil)	20-25
Caryophyllene (% of Total Oil)	5-8
Farnesene (% of Total Oil)	13-16
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

SAPHIR

Saphir was developed as an aroma variety at the Hop Research Center in Hüll, Germany and released in 2002. At that time, Saphir differed considerably from other German aroma varieties due its fruity character.

Juniper, lemongrass, bergamot, strawberry, black tea.

Alpha (%)	2-4.5
Beta (%)	4-7
Cohumulone (% of Alpha Acids)	12-17
Total Oil (ml/100g)	0.8-1.4
Myrcene (% of Total Oil)	25-40
Humulene (% of Total Oil)	20-30
Caryophyllene (% of Total Oil)	9-14
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	0.8-1.3
Total Polypenols (%)	4-5

CANADA

SASQUATCH®

Sasquatch® was discovered as a wild hop by Hops Connect in Pemberton, British Columbia. It is Canada's first proprietary, patented hop. The Sasquatch name is evocative of the mountainous terrain it was found in as well as the large cones the plant produces. The cultivar is grown in Leamington, Ontario & Chilliwack, BC.

FLORAL | CITRUS | CREAM CARAMEL | GREEN-GRASSY

Apple blossom, orange, cream, hay.

Alpha (%)	7.3
Beta (%)	8.2
Cohumulone (% of Alpha Acids)	34.6
Total Oil (ml/100g)	0.8
Myrcene (% of Total Oil)	60.1
Humulene (% of Total Oil)	13.7
Caryophyllene (% of Total Oil)	5.9
Farnesene (% of Total Oil)	8.3
Linalool (% of Total Oil)	0.1
Total Polypenols (%)	—

SIMCOE®

Simcoe® is a dual-purpose hop bred by Yakima Chief Ranches in Yakima, Washington. It was released and trademarked in 2000.

CITRUS

SWEET FRUIT

WOODY AROMATIC

Grapefruit, stone fruit, passion fruit, bubblegum, earth, pine.

Alpha (%)	11.5-15
Beta (%)	3-4.5
Cohumulone (% of Alpha Acids)	0-21
Total Oil (ml/100g)	0.8-3.2
Myrcene (% of Total Oil)	40-50
Humulene (% of Total Oil)	15-20
Caryophyllene (% of Total Oil)	8-14
Farnesene (% of Total Oil)	0-1
Linalool (% of Total Oil)	0.5-0.9
Total Polypenols (%)	—

SLÁDEK

Registered in 1994, Sládek is a hybrid variety of Saaz-type with excellent impact on hoppy taste and aroma of beer. It is a late harvest cultivar with high yield. The hop was selected from hybrid progenies of Northern Brewer and Saaz. The name Sládek is Czech for "brewer."

SWEET FRUIT | BERRY & CURRANT | CITRUS

Passion fruit, strawberry, cassis, grapefruit, peach.

Alpha (%)	4.5-8.0
Beta (%)	4.0-7.0
Cohumulone (% of Alpha Acids)	23-30
Total Oil (ml/100g)	1.0-2.0
Myrcene (% of Total Oil)	35-50
Humulene (% of Total Oil)	20-40
Caryophyllene (% of Total Oil)	9-14
Farnesene (% of Total Oil)	< 1.0
Linalool (% of Total Oil)	0.15-0.30
Total Polypenols (%)	3.5-5.0

SMARAGD

In English, Smaragd translates to emerald. Smaragd is tough to pronounce but it's a fine German hop variety. It has good disease resistance characteristics but some susceptibility to powdery mildew. The cultivar was developed at the Hop Research Center at Hüll Germany and is a daughter of Hallertau Gold.


SPICY


WOODY AROMATIC


HERBAL

FLORAL

Licorice, cognac, tarragon, chamomile.

Alpha (%)	4-6
Beta (%)	3.5-5.5
Cohumulone (% of Alpha Acids)	13-18
Total Oil (ml/100g)	0.4-0.8
Myrcene (% of Total Oil)	20-40
Humulene (% of Total Oil)	30-50
Caryophyllene (% of Total Oil)	9-14
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	0.9-1.4
Total Polypenols (%)	4-6

GERMANY

SOLERO™

Solero™ (Experimental #243/42) is a late harvest variety developed by the Hopsteiner. It is a daughter of a Cascade female and a Hopsteiner male. The aroma of Solero is fruit forward with tropical, passion fruit, and mango attributes.

SWEET FRUIT

Tropical fruit, mango, passion fruit.

Alpha (%)	9.0-10.0
Beta (%)	5.0-6.0
Cohumulone (% of Alpha Acids)	35-45
Total Oil (ml/100g)	1.5-2.0
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	0.2-0.5
Total Polypenols (%)	—

SORACHI ACE

Sorachi Ace was developed in 1984 for Sapporo Breweries, Ltd., from a cross of Brewer's Gold, Saaz, and male Beikei No. 2. The name "Sorachi" is derived from a sub-prefecture of Hokkaido, Japan. This variety has good yields and resistance to mildew, wilt and botrytis. It has relatively high alpha and oil content. Sorachi Ace is currently grown in limited quantities in the U.S.

CITRUS HERBAL SWEET FRUIT

Over-ripe orange, lemon grass, dill, lychee.

Alpha (%)	12-16
Beta (%)	6-8
Cohumulone (% of Alpha Acids)	20-25
Total Oil (ml/100g)	1-1.5
Myrcene (% of Total Oil)	40-45
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	0.5-0.8
Total Polypenols (%)	—

SOUTHERN AROMA

Southern Aroma is a South African bred aroma hop designed to perform under the daylight hour constraints of the region. It originated from a diploid seedling of a cross between Saaz and Hallertau Mittelfrüh. Southern Aroma is described as having classic noble hop character with a fruity backdrop.

FLORAL | CITRUS | BERRY & CURRANT | SWEET FRUIT | WOODY AROMATIC

Wildflowers, lemon zest, black currant, mango, pine resin.

Alpha (%)	3.6-6.1
Beta (%)	4-6
Cohumulone (% of Alpha Acids)	16-22.6
Total Oil (ml/100g)	0.6-0.8
Myrcene (% of Total Oil)	18.3-20
Humulene (% of Total Oil)	23-30
Caryophyllene (% of Total Oil)	10-13.9
Farnesene (% of Total Oil)	0.6-1.6
Linalool (% of Total Oil)	< 1
Total Polypenols (%)	—

SOUTHERN PASSION

Southern Passion is a South African bred aroma hop derived from a diploid crossing of Saaz and Hallertauer parentage. This is a versatile hop that offers a complex and unique set of flavors.

SWEET FRUIT


BERRY & CURRANT


CITRUS

FLORAL

Passion fruit, guava, black currant, tangerine, grapefruit, calendula.

Alpha (%)	5-12
Beta (%)	4-6
Cohumulone (% of Alpha Acids)	16.6-20.2
Total Oil (ml/100g)	0.7-1.3
Myrcene (% of Total Oil)	20-35
Humulene (% of Total Oil)	17-35
Caryophyllene (% of Total Oil)	8-13
Farnesene (% of Total Oil)	1-3
Linalool (% of Total Oil)	< 1
Total Polypenols (%)	—

SOUTHERN PROMISE

Southern Promise was released in South Africa in 1992. This variety is adapted to the short day-length in the southern tip of Africa. It is a cross of Southern Brewer and a Slovenian male variety. Southern Promise is relatively high in alpha with good aromatic qualities.

WOODY AROMATIC

Woody, earthy.

Alpha (%)	9.5-11.5
Beta (%)	3.6-5.4
Cohumulone (% of Alpha Acids)	20-22
Total Oil (ml/100g)	0.7-1.1
Myrcene (% of Total Oil)	20-23
Humulene (% of Total Oil)	22-28
Caryophyllene (% of Total Oil)	8-10
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

SOUTHERN STAR

Southern Star was released in 2001 in South Africa. It is a variety adapted to the region's short day-length and is a cross between Outeniqua and a South African male OF2/93. Southern Star is high in alpha for a variety grown in this area and has a relatively high farnesene content.

Tangerine, pineapple, watermelon, blueberries, pine resin.

Alpha (%)	12-18
Beta (%)	4-6
Cohumulone (% of Alpha Acids)	25-30
Total Oil (ml/100g)	1.4-1.7
Myrcene (% of Total Oil)	27.5-38.9
Humulene (% of Total Oil)	21.9-32.8
Caryophyllene (% of Total Oil)	11.2-14.6
Farnesene (% of Total Oil)	4.5-12
Linalool (% of Total Oil)	< 1
Total Polypenols (%)	—

SOVEREIGN

Sovereign is a hedgerow variety bred at Wye College in 1995 from an open pollination of a seedling of Pioneer. It was selected for its good aroma, often likened to that of Fuggles.

SWEET FRUIT

GREEN FRUIT

SPICY

Cherry, quince, gingerbread, fresh-cut hot peppers.

Alpha (%)	4.5-6.5
Beta (%)	2.1-3.1
Cohumulone (% of Alpha Acids)	26-30
Total Oil (ml/100g)	0.6-1.0
Myrcene (% of Total Oil)	25-30
Humulene (% of Total Oil)	21-26
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	3-5
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

SPALT SPALTER

Spalt Spalter is a German landrace variety with a fine aroma comparable to Tettnanger. This hop belongs to the Saaz range and is cultivated exclusively in the region around Spalt. It has good resistance to wilt and other diseases.

Black pepper, oak barrel, woodruff, ripe banana, tonka bean, black tea.

Alpha (%)	2.5-5.5
Beta (%)	3-5
Cohumulone (% of Alpha Acids)	22-29
Total Oil (ml/100g)	0.5-0.9
Myrcene (% of Total Oil)	20-35
Humulene (% of Total Oil)	20-30
Caryophyllene (% of Total Oil)	8-13
Farnesene (% of Total Oil)	12-18
Linalool (% of Total Oil)	0.5-0.8
Total Polypenols (%)	5-6

GERMANY

SPALTER SELECT

Spalter Select was developed from Hüll Hop Research Center breeding stock. Its fine aroma and high farnesene content are typical of Spalt-type hops. This variety grows quickly and develops a very strong "head." Spalter Select is characterized by a good tolerance to diseases like wilt and downy mildew.


CITRUS


WOODY AROMATIC


HERBAL

FLORAL

Citrus, woody, black tea, chamomile blossoms.

Alpha (%)	3-6.5
Beta (%)	2.5-5
Cohumulone (% of Alpha Acids)	21-27
Total Oil (ml/100g)	0.6-0.9
Myrcene (% of Total Oil)	20-40
Humulene (% of Total Oil)	10-22
Caryophyllene (% of Total Oil)	4-10
Farnesene (% of Total Oil)	15-22
Linalool (% of Total Oil)	1-1.5
Total Polypenols (%)	4-5

STERLING

Sterling is a cultivar with a complex pedigree that includes Saaz, Cascade, Brewers Gold, Early Green and an unknown variety. Released in 1998, Sterling is moderately resistant to downy and powdery mildews.


HERBAL


CITRUS


SPICY

Tarragon, orange blossom, lemon pepper.

Alpha (%)	6-9
Beta (%)	4-6
Cohumulone (% of Alpha Acids)	22-28
Total Oil (ml/100g)	1.3-1.9
Myrcene (% of Total Oil)	44-48
Humulene (% of Total Oil)	19-23
Caryophyllene (% of Total Oil)	5-7
Farnesene (% of Total Oil)	11-17
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

STRATA™

Strata™ was the first variety released from the Indie Hops breeding program in 2009. Formerly known as X-331, it was the result of an open pollination of a Perle mother in an Oregon experimental hop yard. Strata has strong disease resistance and vigorous growth.

SWEET FRUIT | BERRY & CURRANT | MENTHOL

Melon, bubblegum, strawberries, fresh-rubbed sage.

Alpha (%)	12.1
Beta (%)	5.3
Cohumulone (% of Alpha Acids)	21
Total Oil (ml/100g)	2.3-3.5
Myrcene (% of Total Oil)	52-65
Humulene (% of Total Oil)	22-30
Caryophyllene (% of Total Oil)	5-12.5
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

STRISSELSPALT

Strisselspalt is a major aroma hop of the Alsace area of France near Strasbourg. It is a fine example of a noble-aroma type hop from Europe. Strisselspalt has low cohumulone and typically a very low alpha content.

Thyme, carnation, generic spicy, lemongrass.

Alpha (%)	1.8-2.5
Beta (%)	4-4.7
Cohumulone (% of Alpha Acids)	20-23
Total Oil (ml/100g)	0.6-0.8
Myrcene (% of Total Oil)	35-52
Humulene (% of Total Oil)	12.5-21
Caryophyllene (% of Total Oil)	6.1-10.2
Farnesene (mg/100g)	1.0
Linalool (mg/100g)	7
Total Polypenols (%)	—

SLOVENIA

STYRIAN CARDINAL

Styrian Cardinal was bred at the Slovenian Institute of Hop Research and Brewing in Žalec. It was derived from unspecified European and American germplasms. This variety has a high alpha-acids content with complex fruity, floral, and herbal aroma notes.

Marjoram, orange, geranium, pineapple.

Alpha (%)	10.0-15.0
Beta (%)	3.2-4.6
Cohumulone (% of Alpha Acids)	31-37
Total Oil (ml/100g)	3.0-4.0
Myrcene (% of Total Oil)	40-50
Humulene (% of Total Oil)	15-22
Caryophyllene (% of Total Oil)	8-11
Farnesene (% of Total Oil)	5-7
Linalool (% of Total Oil)	0.6-1.0
Total Polypenols (%)	5.3-6.3

STYRIAN EAGLE

Styrian Eagle was developed at the Slovenian Institute of Hop Research and Brewing in Žalec. It was bred from unspecified European and American germplasms.

Menthol, banana, peach, red berries, hay, lemon.

Alpha (%)	12.5-17.5
Beta (%)	3.5-5.5
Cohumulone (% of Alpha Acids)	20-23
Total Oil (ml/100g)	2.5-3.9
Myrcene (% of Total Oil)	52-60
Humulene (% of Total Oil)	0.9-2.1
Caryophyllene (% of Total Oil)	4.2-7.0
Farnesene (% of Total Oil)	6.5-9.5
Linalool (% of Total Oil)	0.3-0.5
Total Polypenols (%)	3.6-4.6

STYRIAN EUREKA

Styrian Eureka arose from the breeding program at the Slovenian Institute of Hop Research and Brewing in Žalec. Styrian Eureka was derived from unspecified traditional Slovenian and foreign hop germplasms.

Muscat, geranium, blueberry, strawberry, mango.

Alpha (%)	11.0-17.0
Beta (%)	3.5-5.0
Cohumulone (% of Alpha Acids)	21-25
Total Oil (ml/100g)	2.5-4.0
Myrcene (% of Total Oil)	50-60
Humulene (% of Total Oil)	17.0-23.0
Caryophyllene (% of Total Oil)	5.0-7.0
Farnesene (% of Total Oil)	0.1-0.4
Linalool (% of Total Oil)	0.7-0.9
Total Polypenols (%)	3.5-4.5

STYRIAN GOLD

Styrian Gold was bred to improve the agronomic values of the traditional Savinjski Golding and released in 2009. The hop is valued for its noble flavor characteristics.


HERBAL


GREEN-GRASSY

CREAM CARAMEL

Oregano, basil, hay, nettle, honey.

Alpha (%)	3.5-6.5
Beta (%)	3.5-5.9
Cohumulone (% of Alpha Acids)	28-35
Total Oil (ml/100g)	1.3-2.3
Myrcene (% of Total Oil)	38-47
Humulene (% of Total Oil)	19-22
Caryophyllene (% of Total Oil)	5-10
Farnesene (% of Total Oil)	6-10
Linalool (% of Total Oil)	1.3-2.3
Total Polypenols (%)	—

STYRIAN SAVINJSKI GOLDING

Styrian Savinjski Golding, also known as Savinjski Golding, is a traditional Slovenian variety. It originated from the English variety Fuggle, which was brought to Slovenia in the early 19th century. This variety is known for its noble hop aroma and pleasant bitterness.

Green tea, nettle, peppermint, lemon, lemongrass.

Alpha (%)	2.8-6.1
Beta (%)	1.8-4.1
Cohumulone (% of Alpha Acids)	27-33
Total Oil (ml/100g)	0.3-1.7
Myrcene (% of Total Oil)	25-38
Humulene (% of Total Oil)	29-38
Caryophyllene (% of Total Oil)	9-12
Farnesene (% of Total Oil)	6-8
Linalool (% of Total Oil)	0.1-0.2
Total Polypenols (%)	–

STYRIAN WOLF

Styrian Wolf is another in the line of cultivars that have been developed by the Slovenian Institute of Hop Research and Brewing. Crosses of unspecified European and American germplasms were utilized in the breeding of this hop. It is reported to have a very intense aroma.

Thyme, geranium, chili pepper, anise, melon.

Alpha (%)	13.5-18.5
Beta (%)	5.0-6.0
Cohumulone (% of Alpha Acids)	22-23
Total Oil (ml/100g)	3.0-4.5
Myrcene (% of Total Oil)	60-70
Humulene (% of Total Oil)	5.0-9.0
Caryophyllene (% of Total Oil)	2.0-3.0
Farnesene (% of Total Oil)	4.5-6.5
Linalool (% of Total Oil)	0.8-1.3
Total Polypenols (%)	4.7-5.7

UNITED STATES

SULTANA™

Sultana™ is a high-alpha hop with very high essential oil content. It was developed through the Hopsteiner hop breeding program in Yakima and was formerly know as Hopsteiner Experimental 06277 and Denali®. The pedigree is 50% Nugget, 25% Zeus and 25% USDA 19058m.

SWEET FRUIT | WOODY AROMATIC | CITRUS

Pineapple, pine, citrus.

Alpha (%)	13-15
Beta (%)	4-5
Cohumulone (% of Alpha Acids)	22-26
Total Oil (ml/100g)	2.5-4
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	0.6-1
Total Polypenols (%)	2.5-3.0

SUMMIT®

Summit® is a dwarf high-alpha variety bred by the ADHA (Association for the Development of Hop Agronomy) in the U.S. Released in 2003, it has high alpha acid content, excellent storage stability and powdery mildew resistance.

Wild garlic, grapefruit, tangerine, oregano.

Alpha (%)	16-19
Beta (%)	3-6
Cohumulone (% of Alpha Acids)	26-33
Total Oil (ml/100g)	1.5-2.5
Myrcene (% of Total Oil)	30-50
Humulene (% of Total Oil)	15-25
Caryophyllene (% of Total Oil)	10-15
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

SUPER GALENA™

Super Galena™ is a high alpha variety developed by the Hopsteiner breeding program and released in 2006. It has relatively high content of both alpha and beta acids; a good bittering hop with pleasant aroma. It is a result of open pollination.

Grass, spicy.

Alpha (%)	13.0-16.0
Beta (%)	8.0-10.0
Cohumulone (% of Alpha Acids)	35-40
Total Oil (ml/100g)	0.8-2.5
Myrcene (% of Total Oil)	—
Humulene (% of Total Oil)	—
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	0-1
Linalool (% of Total Oil)	0.3-0.6
Total Polypenols (%)	—

SUPER PRIDE

The Australian Super Pride is a seedless bittering variety with moderately high levels of alpha acids. It was bred at Rostrevor Hop Gardens in Australia. Derived from the famous Pride of Ringwood, Super Pride has been the backbone of Australia's bittering since the late 1990s.

SWEET FRUIT | CITRUS | WOODY AROMATIC

Dried fruit, bergamot, resin.

Alpha (%)	12.3-16.9
Beta (%)	5.2-10.7
Cohumulone (% of Alpha Acids)	24.0-30.0
Total Oil (ml/100g)	1.3-2.7
Myrcene (% of Total Oil)	17-44
Humulene (% of Total Oil)	1-2
Caryophyllene (% of Total Oil)	3.4-9.8
Farnesene (% of Total Oil)	0.0-0.1
Linalool (% of Total Oil)	0.2-0.7
Total Polypenols (%)	—

POLAND

SYBILLA

Sybilla is a Polish hop derived from a cross of Lubelski and Slovenian Styrian Golding. It was released by the Institute of Soil Science and Plant Cultivation (IUNG) Pulawy in 1996. Subsequently, in 2004-2006, hop latent viroid-free seedlings of Sybilla were produced. Its aroma is described as mild and distinctive.

CREAM
CARAMEL

WOODY
AROMATIC

CITRUS

Chocolate, barrel, tobacco, orange, lemon.

Alpha (%)	5-8
Beta (%)	3.0
Cohumulone (% of Alpha Acids)	28.6
Total Oil (ml/100g)	2
Myrcene (% of Total Oil)	50.9
Humulene (% of Total Oil)	17.4
Caryophyllene (% of Total Oil)	8.4
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

TAHOMA

This is a USDA aroma variety developed though Washington State University and released in 2013. A daughter of Glacier, Tahoma has moderate alpha and low cohumulone content. Tahoma is the Native American name for Washington state's highest peak, Mr. Rainier.

CITRUS

WOODY AROMATIC

Lemon, pine resin.

Alpha (%)	7.2-8.2
Beta (%)	8.5-9.5
Cohumulone (% of Alpha Acids)	15-17
Total Oil (ml/100g)	1.0-2.0
Myrcene (% of Total Oil)	67-72
Humulene (% of Total Oil)	9-11
Caryophyllene (% of Total Oil)	2.9-3.5
Farnesene (% of Total Oil)	0-1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

NEW ZEALAND

TAIHEKE®

The cultivar leading to Taiheke® Brand was originally developed in the USDA breeding program in the 1950s (USDA 56013). Taiheke was released commercially through USDA-ARS in 1972. Its parentage is English Fuggle with a male selection believed to be a cross of Fuggle and the Russian variety Serebrianka.

CITRUS

SWEET FRUIT

Grapefruit, lime, tropical fruit.

Alpha (%)	6-8
Beta (%)	5.0-5.5
Cohumulone (% of Alpha Acids)	37
Total Oil (ml/100g)	1.1
Myrcene (% of Total Oil)	53.6
Humulene (% of Total Oil)	14.5
Caryophyllene (% of Total Oil)	5.4
Farnesene (% of Total Oil)	6
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

TALUS™

HBC 692 c.v.

Talus™ is an experimental hop cultivar that was developed by the Hop Breeding Company (HBC). The hop delivers big aromas of pink grapefruit, citrus rinds, dried roses, pine resin, tropical fruits and sage. These unique and impactful aromas remain throughout the brewing process.

CITRUS

FLORAL

WOODY AROMATIC

Pink grapefruit, dried roses, pine resin.

Alpha (%)	8.1-9.5
Beta (%)	8.3-10.2
Cohumulone (% of Alpha Acids)	34-39
Total Oil (ml/100g)	2.0-2.7
Myrcene (% of Total Oil)	40-50
Humulene (% of Total Oil)	16-21
Caryophyllene (% of Total Oil)	9-13
Farnesene (% of Total Oil)	0-1
Linalool (% of Total Oil)	0-1
Total Polypenols (%)	—

GERMANY

TETTNANGER

The Tettnanger variety, which is also known as Tettnang Tettnanger, is a traditional and indigenous hop from the Saaz group. It is mainly cultivated around Tettnanger in the Lake Constance region of Germany. This location provides favorable climate and sandy clay soils that promotes the production of fine hop aroma. This variety has a good tolerance to plant diseases. Tettnanger is widely used in lager beer styles.

FLORAL | WOODY AROMATIC | CREAM CARAMEL | CITRUS

Lily of the valley, cognac, chocolate, bergamot.

Alpha (%)	2.5-5.5
Beta (%)	3-5
Cohumulone (% of Alpha Acids)	22-28
Total Oil (ml/100g)	0.5-0.9
Myrcene (% of Total Oil)	20-35
Humulene (% of Total Oil)	22-32
Caryophyllene (% of Total Oil)	6-11
Farnesene (% of Total Oil)	16-24
Linalool (% of Total Oil)	0.4-0.9
Total Polypenols (%)	5-6

TOMAHAWK®

Columbus, Tomahawk® and Zeus (CTZ) are super high alpha varieties. They share the same female parent as Nugget making them at least half sisters to Nugget. The CTZ varieties are currently used almost extensively for beer bittering.

Lemon, black pepper, green onion, mango.

Alpha (%)	15.0-17.0
Beta (%)	4.5-5.0
Cohumulone (% of Alpha Acids)	28-32
Total Oil (ml/100g)	2.5-3.5
Myrcene (% of Total Oil)	50-60
Humulene (% of Total Oil)	12-18
Caryophyllene (% of Total Oil)	9-11
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

TOPAZ™

TC-85-70 c.v.

Topaz™ was created by the Hop Products Australia (HPA) breeding program in 1985 and commercialized in 1997. Its ancestry is a cross pollination of high alpha Australian and Wye College hops, which provides an interesting mix of English, European and North American heritage.

BERRY & CURRANT

GREEN FRUIT

SWEET FRUIT

WOODY AROMATIC

Blackberry, cassis, gooseberry, lychee, tobacco, pine resin.

Alpha (%)	16.2-20.1
Beta (%)	4.9-6.7
Cohumulone (% of Alpha Acids)	47.0-53.0
Total Oil (ml/100g)	1.3-1.8
Myrcene (% of Total Oil)	18.0-53.0
Humulene (% of Total Oil)	8.9-16.6
Caryophyllene (% of Total Oil)	6.7-12.5
Farnesene (% of Total Oil)	0.0-0.9
Linalool (% of Total Oil)	0.5-0.9
Total Polypenols (%)	—

TRADITION

Tradition is a variety bred and released at Hüll Research Center in 1993. The hop is a cross between Hallertau Gold and a Hüll experimental variety. It is characterized by its fine aroma and moderate bitter content and can be compared to Hallertauer Mittelfrüh. Tradition stands out due to good yields which remain relatively stable even in difficult growing years.

SWEET FRUIT

BERRY & CURRANT

CITRUS

Apricot, peach, cassis, orange.

Alpha (%)	4.0-7.0
Beta (%)	3.0-6.0
Cohumulone (% of Alpha Acids)	24-30
Total Oil (ml/100g)	0.5-1.0
Myrcene (% of Total Oil)	17-32
Humulene (% of Total Oil)	35-50
Caryophyllene (% of Total Oil)	10-15
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	0.7-1.2
Total Polypenols (%)	4-5

UNITED STATES

TRIPLE PEARL

Released by the United States Department of Agriculture-Agricultural Research Service breeding program in 2013. Triple Pearl is a daughter of a triploid Perle mother and unknown diploid male. The lineage includes Northern Brewer and Hallertau.

CITRUS | SPICY | SWEET FRUIT | WOODY AROMATIC

Orange, pepper, melon, pine resin.

Alpha (%)	10.3-11.2
Beta (%)	3.3-4.2
Cohumulone (% of Alpha Acids)	39-55
Total Oil (ml/100g)	1.1-1.8
Myrcene (% of Total Oil)	39-55
Humulene (% of Total Oil)	7-11
Caryophyllene (% of Total Oil)	3-5
Farnesene (% of Total Oil)	—
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

TRISKEL

Triskel is a French hop cultivar developed in 2006 from a cross between Strisselspalt and English Yoeman. The name "Triskel" was inspired by triskelion, the symbol of the Gauls, ancestors of the modern French people.

Wild flowers, stone fruits, caramel.

Alpha (%)	3-5
Beta (%)	4-5.5
Cohumulone (% of Alpha Acids)	20-23
Total Oil (ml/100g)	1.2-2
Myrcene (% of Total Oil)	55-60
Humulene (% of Total Oil)	13-16
Caryophyllene (% of Total Oil)	–
Farnesene (mg/100g)	0-1
Linalool (mg/100g)	10-15
Total Polypenols (%)	–

TRIUMPH

Triumph is a public variety released by the USDA in collaboration with Pacific Northwest growers in 2019. The hop was first grown at the Corvallis, Oregon USDA hop research facility and was named after an English motorcycle brand. It is descended from crosses utilizing Nugget, Brewers Gold, East Kent Goldings, and Hallertau Mittelfrüh.

SWEET FRUIT | CITRUS | WOODY AROMATIC

Peach, bubblegum, lime, orange, pine.

Alpha (%)	10.6-11.4
Beta (%)	3.34-3.95
Cohumulone (% of Alpha Acids)	22-26
Total Oil (ml/100g)	1.07-1.15
Myrcene (% of Total Oil)	25-40
Humulene (% of Total Oil)	28.0-33.6
Caryophyllene (% of Total Oil)	8.6-9.5
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	>1
Total Polypenols (%)	–

ULTRA

Ultra was bred through the USDA Oregon State University hops research program in 1983. It is a triploid variety derived from a tetraploid Hallertau Mittelfrüh and a Saaz-type male diploid genotype. It is half-sister to Mt. Hood, Liberty and Crystal. Released in 1995, Ultra has lower alpha than many U.S. aroma varieties.

FLORAL

SPICY

Dried flowers, mild spice.

Alpha (%)	3-5
Beta (%)	4-5
Cohumulone (% of Alpha Acids)	25-30
Total Oil (ml/100g)	1.3-1.5
Myrcene (% of Total Oil)	30
Humulene (% of Total Oil)	30-40
Caryophyllene (% of Total Oil)	12-14
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

AUSTRALIA

VIC SECRET™

00-207-013 c.v.

Vic Secret™ was created by the Hop Products Australia breeding program in 2000 and commercialized in 2013. English, European, and North American hops figure prominently in Vic Secret's heritage. The variety was developed through breeding with high alpha Australian and Wye College hops.

SWEET FRUIT

WOODY AROMATIC

CITRUS

Passion fruit, pineapple, pine, ginger.

Alpha (%)	15.1-21.8
Beta (%)	6.4-8.1
Cohumulone (% of Alpha Acids)	51.0-56.0
Total Oil (ml/100g)	2.1-2.8
Myrcene (% of Total Oil)	31.0-46.0
Humulene (% of Total Oil)	9.4-12.2
Caryophyllene (% of Total Oil)	9.8-10.7
Farnesene (% of Total Oil)	0.0
Linalool (% of Total Oil)	0.7
Total Polypenols (%)	—

WAI-ITI™

Wai-Iti™ is a triploid hop developed through the New Zealand Plant and Food Research Centre and released in 2011. It is a granddaughter of USDA Liberty and a Hallertau Mittelfrüh triploid. Wai-Iti exhibits low alpha, moderate essential oils and low cohumulone.

SWEET FRUIT

CITRUS

Fresh peaches, ripe apricot, lime.

Alpha (%)	2.5-3.5
Beta (%)	4.5-5.5
Cohumulone (% of Alpha Acids)	22-24
Total Oil (ml/100g)	1.6
Myrcene (% of Total Oil)	30
Humulene (% of Total Oil)	28
Caryophyllene (% of Total Oil)	9
Farnesene (% of Total Oil)	13
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

WAKATU™

Formerly New Zealand Hallertau and renamed Wakatu™ in 2011. The variety was originally released in 1988 from the New Zealand Hop Research program. It is a triploid derived from Hallertau Mittelfrüh and open pollination. Wakatu is a classic style hop with a near 1:1 alpha-beta ratio.

FLORAL CITRUS

Mild floral, lime zest.

Alpha (%)	6.5-8.5
Beta (%)	8.5
Cohumulone (% of Alpha Acids)	28-30
Total Oil (ml/100g)	1
Myrcene (% of Total Oil)	35.5
Humulene (% of Total Oil)	16.8
Caryophyllene (% of Total Oil)	8.2
Farnesene (% of Total Oil)	6.7
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

WARRIOR®

Warrior® is a high alpha variety developed by Yakima Chief Ranches. It has high agronomic yields and exhibits a moderate tolerance to powdery mildew. Warrior is characterized by a low cohumulone content and very good storage stability.

Tangerine, honeysuckle, sweet basil.

Alpha (%)	15.5-18
Beta (%)	4-5.5
Cohumulone (% of Alpha Acids)	25-28
Total Oil (ml/100g)	1-2.5
Myrcene (% of Total Oil)	40-50
Humulene (% of Total Oil)	12-18
Caryophyllene (% of Total Oil)	8-12
Farnesene (% of Total Oil)	0.1-1
Linalool (% of Total Oil)	0.2-0.5
Total Polypenols (%)	—

WHITBREAD GOLDING VARIETY

Bred in 1911 on land owned by Whitbread. Not a true Golding, but similarly aromatic. Bred from Bates Brewer, Whitbread Golding Variety was selected as a seedling and planted extensively during the 1950s, when Verticillium Wilt started to encroach on the Fuggles and Goldings.

SPICY

SWEET FRUIT

Licorice, fig, banana, apricot.

Alpha (%)	5-7.5
Beta (%)	2.5-3.5
Cohumulone (% of Alpha Acids)	37
Total Oil (ml/100g)	0.8-1.2
Myrcene (% of Total Oil)	24-27
Humulene (% of Total Oil)	38-42
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	1-2
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

WILLAMETTE

Willamette, the triploid daughter of Fuggle, was released as a U.S. aroma variety in 1976 from the U.S.D.A. breeding program in Oregon. The variety is characterized by a low alpha acids content, mild aroma similar to Fuggle, and average agronomic yields. Until the recent expansion of robust aroma varieties in the U.S., Willamette was a major American aroma variety.

WOODY AROMATIC | SPICY | HERBAL

Cedar, incense, anise, marjoram.

Alpha (%)	4.0-6.0
Beta (%)	3.5-4.5
Cohumulone (% of Alpha Acids)	30-35
Total Oil (ml/100g)	1.0-1.5
Myrcene (% of Total Oil)	30-40
Humulene (% of Total Oil)	20-27
Caryophyllene (% of Total Oil)	7-8
Farnesene (% of Total Oil)	5-6
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

WYE CHALLENGER

Wye Challenger was developed at Wye College from a cross made in 1963 between Northern Brewer and Target. It was released for commercial growth in 1971. Wye Challenger combines good aroma with moderate bittering levels. Used to good effect for both bittering and late aromas in many classic British Bitters and Pale Ales.

SWEET FRUIT


MENTHOL

CREAM CARAMEL


WOODY AROMATIC

Banana, eucalyptus, vanilla, cognac.

Alpha (%)	6.5-9
Beta (%)	3.2-4.2
Cohumulone (% of Alpha Acids)	20-25
Total Oil (ml/100g)	1-1.5
Myrcene (% of Total Oil)	30
Humulene (% of Total Oil)	25
Caryophyllene (% of Total Oil)	–
Farnesene (% of Total Oil)	1
Linalool (% of Total Oil)	–
Total Polypenols (%)	–

WYE TARGET

Bred at Wye College and released in 1976, Wye Target is a very widely grown British hop. It was bred from Challenger and has a subtle, pleasant aroma. A flexible hop that may be used to effectively bitter a wide variety of both Ales and Lagers.

WOODY AROMATIC

CREAM CARAMEL

Tobacco, cognac, caramel, vanilla.

Alpha (%)	8.5-13.5
Beta (%)	4-5.7
Cohumulone (% of Alpha Acids)	37
Total Oil (ml/100g)	1.2-1.8
Myrcene (% of Total Oil)	45
Humulene (% of Total Oil)	17
Caryophyllene (% of Total Oil)	—
Farnesene (% of Total Oil)	<1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

YAKIMA GOLD

Yakima Gold was developed through the USDA hop breeding program at Washington State University and released in 2013. It is a cross of an Early Cluster and a wild Slovenian male hop with a moderate alpha content.

CITRUS

SPICY

Grapefruit, lemongrass, curry.

Alpha (%)	8.8-10.5
Beta (%)	4.3-5.0
Cohumulone (% of Alpha Acids)	21-23
Total Oil (ml/100g)	1.9-2.3
Myrcene (% of Total Oil)	45-50
Humulene (% of Total Oil)	21-25
Caryophyllene (% of Total Oil)	6-8
Farnesene (% of Total Oil)	9-10
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

ZAPPA™

Zappa™ was introduced by
CLS Farms in Moxee, Washington.
It was derived from a wild *neomexicanus*
hop in New Mexico.

SWEET FRUIT | MENTHOL | SPICY

Passion fruit, Fruity Pebbles™, tea tree, aniseed.

Alpha (%)	6-8
Beta (%)	8-9
Cohumulone (% of Alpha Acids)	–
Total Oil (ml/100g)	1.8-2.5
Myrcene (% of Total Oil)	64.4
Humulene (% of Total Oil)	4.6
Caryophyllene (% of Total Oil)	8.6
Farnesene (% of Total Oil)	–
Linalool (% of Total Oil)	0.8
Total Polypenols (%)	–

ZEUS

Columbus, Tomahawk® and Zeus (CTZ) are super high alpha varieties. They share the same female parent as Nugget making them at least half sisters to Nugget. The CTZ varieties are currently used almost extensively for beer bittering.

Lemon, black pepper, green onion, mango.

Alpha (%)	15.0-17.0
Beta (%)	4.5-5.0
Cohumulone (% of Alpha Acids)	28-32
Total Oil (ml/100g)	2.5-3.5
Myrcene (% of Total Oil)	50-60
Humulene (% of Total Oil)	12-18
Caryophyllene (% of Total Oil)	9-11
Farnesene (% of Total Oil)	< 1
Linalool (% of Total Oil)	—
Total Polypenols (%)	—

THE FOURTH EDITION OF THE BREWER'S GUIDE TO HOPS

A comprehensive listing and description of global hop varieties as well as information on the various choices of hop products, including traditional forms and specialized advanced products.

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