HOP CHEMISTRY

Beer. It has four core ingredients: water, malted barley, hops and yeast. These ingredients are united to give us one of the most revered and diverse alcoholic beverages of all time. Hundreds of biological and chemical processes need to work together in harmony during its production and the complexity doesn't end there.

The crystal clear glass used to serve beer in its cold, foamy, and fizzy glory is made possible by advances in science, which not only allows for the production of the pint glass, but the beer as well. Increasingly, hops are becoming the central focus for those who are aiming to create a new and unique flavor in today's craft brewing scene.

Off Flavors

By understanding the chemical structure of beer, we can create so many different flavors—good and bad.

Here are some examples of tried "off flavors" and their chemical structures, that are perhaps best to stay away from.

Cheesy
isovaleric acid

Eggs
hydrogen sulfide

Banana
isoamyl acetate

Skunk
3-methyl-2-butene-1-thiol

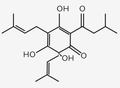
Green Apples
acetaldehyde

Butter
2,3-butanedione

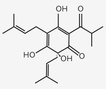
Alpha-acids

An important class of compounds found within hops are the so-called alpha-acids. These degrade when heated (via an isomerization) to produce iso-acids, which are intensely bitter. The most important of these are...

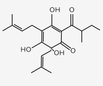
Humulone



Cohumulone

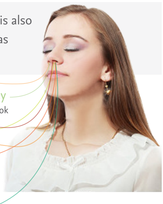


Adhumulone



Aroma

Hops are not just added to beer to make it taste bitter. It is also highly valued for the characteristic floral and citrus aromas that it imparts.



Citrus
Cascade, Centennial

Spicey
Mt Hood, Chinook, Styrian Goldings, Willamette

Woody
Northern Brewer

Piney
Chinook

Fruity
Hallertauer Hersbrucker, Northern Brewer, Willamette

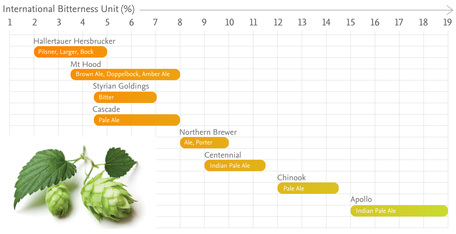
Herbal
Willamette

Floral
Centennial. Hallertauer Hersbrucker, Mt Hood, Wilamette

Bitterness

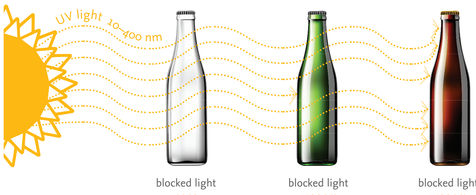
The alpha acid "rating" on hops indicates the amount of alpha acid as a percentage of total weight of the hop. Hops with a higher alpha acid content will contribute more bitterness than a lower alpha acid hop when using the same amount of hops. High alpha acid varieties of hops are more efficient for producing highly bitter beers.

The term 'India Pale Ale' (IPA) was given to the beer that comforted the British people during the long trips they made to India via Africa. They needed a beer that would not spoil during the trip and the extra hops were added for this purpose. This is also why IPA beer is characteristically more bitter than other types of beer.



Preservation

Colored bottles have been shown to limit the problems with 'light struck' or 'skunky' beer, caused by UV light. This is characterized by the formation of 3-methyl-2-butene-1-thiol (MBT), which is also found in the infamous secretions of skunks.



Clear bottles offer **no** protection

Brown bottles **reduce** breakdown of alpha acids, reacting with sulfur to make 3-methyl-2-butene-1-thiol (skunky smell)

Green bottles have **limited** preservation capabilities. After WWII, Europe ran out of brown bottles due to the war effort.

High-end producers started using green bottles to differentiate themselves from clear glass, and the trend stuck.

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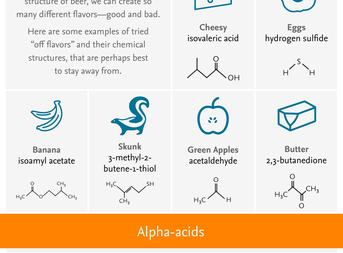

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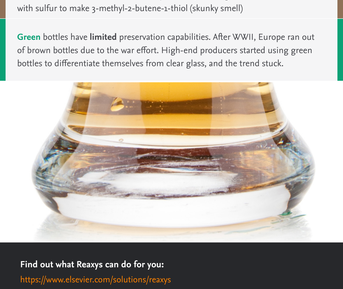

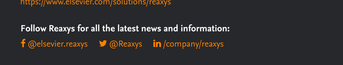

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