



# The Northern Craft Brewers

**"We Live We Brew"**



## Beer Flavours: Hops

Ian Priddey

When I first started growing Cascade in 1998, few people in England had heard of this floral, piney flavoured USA variety. Now many breweries are producing ales featuring Cascade and proudly showcasing the flavour of this variety, along with other hop named beers in a manner similar to how new world wine producers have marketed single grape variety wines.

Hops are the flowers of the female of the plant *Humulus lupulus*, which is a member of the Cannabinaceae family and is thus related to a certain other "herb", although the resins in the two are very different! Commercially British hops are mainly grown in Kent, Herefordshire and Worcestershire, with small areas in some other counties in the South and Midlands. Internationally the major growing and exporting countries are Germany and the USA, both of which produce very different types of hops to most of those grown in Britain, with high bittering and citrusy aroma hops predominating in the US and traditional lager aroma hops in Germany. Growing hops in Yorkshire is pushing the northern geographical limits of their production area, but can still be done successfully in most years, although most commercial growers would not want to risk this challenge.

When hops are boiled in the wort derived from the mash, a number of reactions take place. Not only is the wort sterilized by the temperature but hops contain certain anti-bacterial properties that can help with preserving the beer. In relation to their contribution to beer flavours we are most interested in the resin and oil content of hops which contribute a balancing bitterness to the sweet malt, plus the hop flavour and aroma that are an important part of the sensory enjoyment of the beer.

With the exception of a few "green-hopped" beers, the fresh hops are dried in a kiln. Depending on variety and growing conditions they may contain about 5 to 24% total resins, which is what produces bitterness in the beer. The resins are divided into soft and hard resins but it is the soft ones that are of interest to us and these are categorized as Alpha Acids, Beta Acids and uncharacterized soft resins.

The Alpha Acids are most important for contributing bitterness and account for between about 3 to 15% of the hops' dried weight. Alpha Acids are subdivided into Humulone, Cohumulone and Adhumulone, the proportion of which varies by variety. Some hop varieties, particularly some of the newer American ones, have high levels of Alpha Acids and in particular a high proportion of Cohumulone, which some people think contributes to a harsh and unpleasant level of bitterness. However the Alpha Acids are not easily soluble in wort and have to be boiled for around 60 to 90 minutes in order for them to become isomerized and go into solution. Now chemistry is admittedly not my strong point but as I understand it, the physical process of boiling changes the order in which their molecules are arranged, such that they will go into solution as isomerized alpha acids (often shortened to iso-alpha acids). Unfortunately these iso-alpha acids are unstable and easily converted into an unpleasant flavour by light of certain wavelengths, including those present in sunlight and



# **The Northern Craft Brewers**

**"We Live We Brew"**



fluorescent lights. This is why beer is traditionally packaged in brown bottles and stored in the dark. Hop extracts are available which do not react with light and are safe to be packaged in clear glass but will mainly be used by the larger breweries. However most small brewers producing the sort of beers CAMRA members and home brewers enjoy will be using traditional hops whole or pelletised hops and if the beer is in clear or green glass and near fluorescent light or sunlight, it may taste "skunky". This is one reason why canned beer is becoming more popular with many smaller breweries.

The level of bitterness is measured in International Bitterness Units, often called IBUs or BUs. An IBU is 1 mg of iso-alpha acid in 1 litre, or 1 ppm. The threshold at which this bitterness can be detected is about 10 mg/l, 10 ppm, or 10 IBUs – a level about that of American Budweiser. As a rough guide mild ales may be in the 14 to 30 IBU range with bitters more like 25 to 40 IBU's. As a bit of a "Hop Head" I am reminded of my American T-shirt with the logo, "Life begins at 40 (IBUs)". A traditional India Pale Ale, for example Bass Pale Ale from 1896, has been quoted as being 7% ABV and 87 IBU's. However the actual level of iso-alpha acid is not necessarily correlated with the perceived level of bitterness, as other factors, such as the types of malt used, level of tannin and residual sweetness, can influence how bitter it tastes. Another note of caution; larger breweries quoting IBU levels will have had this analysed in a laboratory and be quoting an actual level. Small breweries and home brewers in particular, are probably quoting a calculated (estimated) level of IBU and the actual and estimated levels can differ widely, 50% or more is possible, so if you think or know it is an estimated level, treat with a pinch of salt.

The essential oils only make up between 0.1 and 3% of the hops' weight but more than 250 chemical compounds appearing in beer have been traced to the essential oils although only a few dozen play a major role in hop flavour and aroma. So the chemistry is complex and it is thought that the flavour sensations are created by a group of flavour-active components acting individually as well as synergistically. The major classes of essential oils consist of oxygen-free hydrocarbons, oxygenated products and sulphur containing compounds. These essential oils are very volatile and will boil off during the length of time needed for the alpha acids to go into solution. Hence it is common practice to add hops for about the last 15 minutes of the boil for flavour and at the end of the boil, or even by "dry-hopping" in the cask, to add hop aromas.

The most important group is the oxygen-free hydrocarbons of myrcene, humulene, caryophyllene and farnesene. Myrcene is often the most commonly occurring oil. Especially in hops most likely to be used for bittering purposes, with lower levels in hops used for aroma. Myrcene is linked to floral or flowery characteristics in the aroma of the finished beer, as well as some citrus and piney impressions. Humulene levels tend to vary inversely with myrcene and are generally more associated with hops used for their aroma properties, such as Saaz. The aroma is usually describes as elegant with an herbal or spicy characteristic. Caryophyllene and farnesene account for a minor percentage of the oils and although not so well understood, tend to be more associated with European hop characteristics, rather than the more American flavours derived from myrcene.