

THE CHEMISTRY OF BEER



MILLING

Dried barley added and ground



MASHING

Water added to produce wort



BREWING

Hops added, mixture boiled



COOLING

Mixture cooled to around 10-20°C



FERMENTING

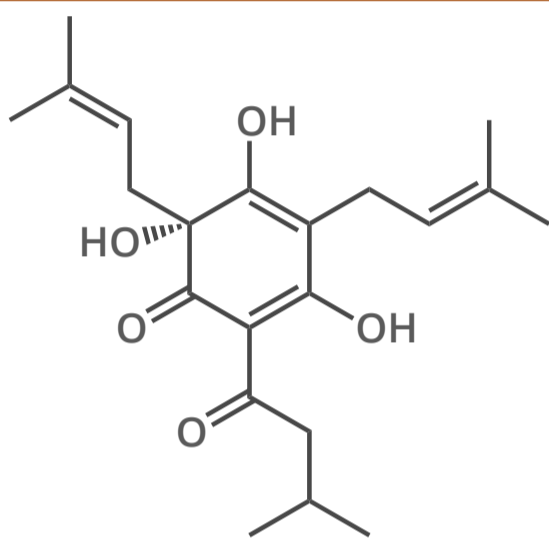
Yeast added, alcohol produced



MATURING

Left to mature then filtered & bottled

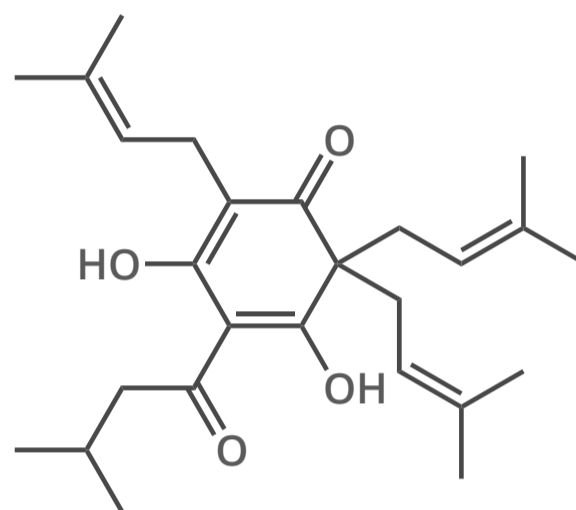
ALPHA ACIDS



HUMULONE

Found in the hops used for brewing; they degrade and form iso-alpha acids, which contribute bitterness. The five main alpha acids are humulone, cohumulone, adhumulone, posthumulone & prehumulone. Humulone is the primary alpha acid in the majority of hops.

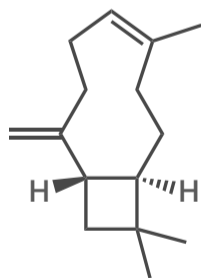
BETA ACIDS



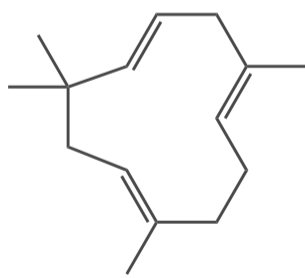
LUPULONE

Beta acids also originate from hops, and add bitterness during fermentation of the beer as they are slowly oxidised. They are considered to have a harsher bitterness than alpha acids. The ratio of alpha acids to beta acids varies from hop to hop, with different ratios preferred by different brewers.

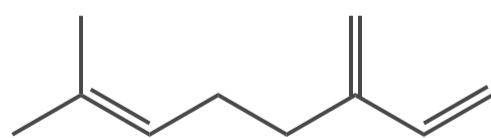
ESSENTIAL OILS



CARYOPHYLLENE



HUMULENE



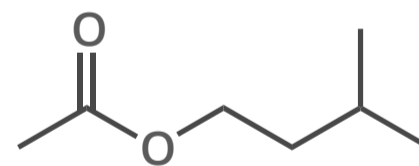
MYRCENE

These contribute the majority of hop flavour and aroma. As they are volatile, they were traditionally obtained by adding hops late in the brewing stage, although modern techniques vary. Though there are 3 key oils, there are 22 known to give aroma and flavour, and over 250 in hops in total.

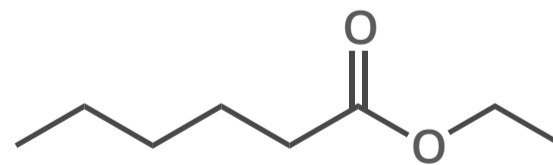


OVER
800
DIFFERENT
COMPOUNDS

ESTERS



ISOAMYL ACETATE (BANANA AROMA)



ETHYL HEXANOATE (APPLE AROMA)

Esters are formed via the reaction of alcohol in beer with organic acids and a molecule called acetyl coenzyme from the hops. They contribute fruity flavours to beers. Different styles of beer require different levels of esters; their production is controlled in ways including the yeast used and fermentation temperature.

