



# HOP

## BIOTRANSFORMATION

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There are a lot of trendy words thrown around in the beer world these days – almost all of them exclusively related to hops. Dry Hopped? Wet Hopped? Cryohops? DDH? BBC? Another of these words commonly used is “biotransformation”, particularly in the case of New England IPAs. This is reportedly one of the key aspects to the tropical juicy flavours we enjoy while sipping on these now seemingly ubiquitous beers.

The buzz around biotransformation reminds me a lot of the buzz around “gluten”, and yet whenever most people are asked about gluten – what it is exactly is and where it comes from – they tend to be a little hazy on the details. So that got me thinking – what exactly is biotransformation and what sort of flavours can we expect from it?

It turns out that biotransformation can refer to two different but sometimes interrelated things. Biotransformation in this context requires two things: hops and yeast. In short, all we are really talking about is hop-derived flavour compounds being altered by yeast. To achieve this, yeast can take two different approaches depending on the compound.

### ENZYMATIC PATHWAY

It is possible for yeast to cleave off hop flavour compounds that are bound to other non-aromatic compounds with the help of an enzyme called  $\beta$ -glucosidase. An example of this would be:

Linalool-glucoside (a non-volatile odourless compound)  $\rightarrow$  Linalool (lavender/rose/bergamot) + Glucose (sugar)

This action requires a yeast strain that is capable of producing  $\beta$ -glucosidase (most yeast strains don't) to cleave the sugar from hop flavour compound. One example of a strain that does produce  $\beta$ -glucosidase is Lallemand's New England strain (which is coincidentally one of best yeast strains for brewing these super juicy NEIPAs). It should be noted that some *Brettanomyces* strains are also capable and can in fact be more active at cleaving – that is separating the sugar and flavour molecules – than a normal *Saccharomyces* strains like New England. However, *Brettanomyces* strains may also produce the typical flavours of 4-Ethylphenol (barnyard/funk).

### CHEMICAL PATHWAY

Yeast can also cause the complete chemical modification of a hop flavour compound from one to another. Some of the most common examples of this occurring in beer include:

- Geraniol (geraniums/rose petals/floral)  $\rightarrow$   $\beta$ -citronellol (citrus/citronella candle/green fresh)
- Linalool (lavender/rose/bergamot) to  $\alpha$ -terpineol (lite citrus/woody/earthy)

Now that we understand that there

are both enzymatic and chemical pathways, we can see how they might interact. Sequential changes can happen in biotransformation whereby a Linalool-glucoside is enzymatically broken into Linalool + Glucose, the Linalool is then chemically changed to  $\alpha$ -terpineol.

If you would like to know more about biotransformation and NEIPAs I'd highly recommend listening to the Master Brewers Association of the Americas (MBAA) podcast episodes 104 and 119.🎧

### IMPRESSIVE TRANSFORMATIONS

Biotransformation is not limited to hops and yeast. It can occur with multiple other flavour compounds within the beer. For example, Butyric acid can be chemically changed to Ethyl butyrate by *Brettanomyces*. Now, reading that sentence doesn't really sound exciting, does it? However, when it's placed in the context of flavours it's quite a dramatic change. Butyric acid is commonly described as baby vomit/rancid while Ethyl butyrate is described as pineapple/tropical - not a bad transformation indeed!