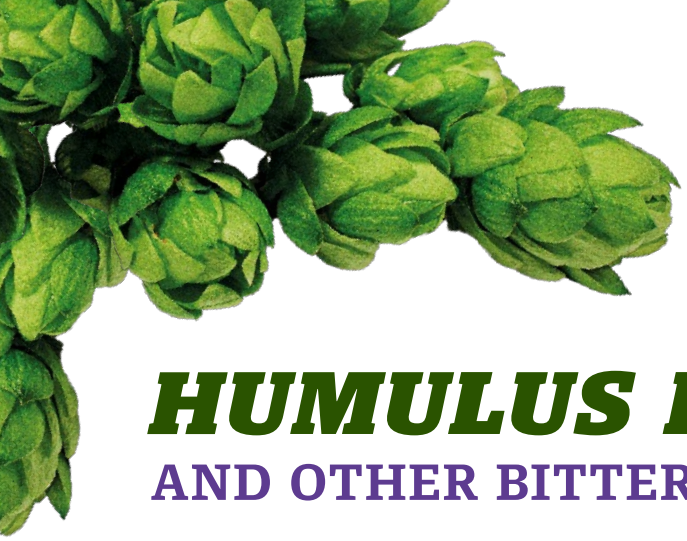


BarthHaas®

HUMULUS LUPULUS
AND OTHER BITTER TRUTHS

Bitterness values all over the place

When all (well, nearly all) beers were bottom-fermented, pale and filtered crystal clear, their BU (bitterness unit) values ranged between 10 and 30, and the sensory impression correlated with the iso-alpha acid content, it was easy to check their bitterness. Photometric analysis became the method of choice. For example, EBC 9.8: here, the absorption capacity of the beer is measured at a wavelength of 275 nanometres and converted (with the aid of an empirical factor – as a rule 50) into the corresponding IBU (International Bitterness Unit) value. The fact that this unspecific method also measures what doesn't taste bitter is scarcely relevant for the sparkling, mildly hopped lagers that dominate the beer world in terms of volume to this day.

The entire beer world? Not quite. In recent years a tiny proportion of world beer production has been brewed and hopped differently. Initiated by the craft beer movement, extremely-hopped and, above all, dry-hopped beers have been gaining market share – and, at the same time, sending bitterness values all over the place.

In addition to the iso-alpha acids from the boil, they contain bitter-tasting reactive products from the soft resins as a result of dry hopping. As the malt framework of these beers is also often quite different, the bitterness units measured can turn out like ballpark figures. In an internal study we found the measured bitterness unit values in quite differently dry-hopped beers to be both higher and lower than the sum of the individual substances measured by means of HPLC. What a shambles!

It is rather reassuring, though, to have a specific method by means of which you can at least be sure of what you're measuring. With this in mind, towards the end of last year the American Society of Brewing Chemists (ASBC) and the European Brewery Convention (EBC) jointly released a new method for determining the bitter compounds in dry-hopped beers.[1] The long name "EBC 9.5 and ASBC Beer-23-G" stands for a method of high-performance liquid chromatography (HPLC) that separates the various bitter compounds and quantitatively measures them as individual substances – in this case, not only iso-alpha acids but also humulinones, oxidised alpha acids and alpha acids. Those who can afford to have expensive HPLC equipment in their labs can measure the quantities of bitter acids in milligrams per litre of beer.

However, these measurements tell us little about the flavour. This is because our sensory perception of the various bitter compounds varies greatly, as the following examples show:

- Humulinones: Algazzali et al. identified a sensory bitterness for humulinones equal to 66 per cent of iso-alpha acids. In other words, 15.2 mg of humulinone tastes as bitter as 10 mg of iso-alpha acid.[2]

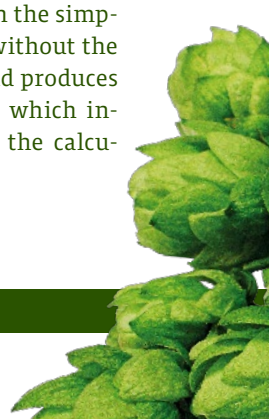
- Alpha acids: Here, there is less certainty. Alpha acids can hardly be found in solution in beer above 14 mg/L, and even at that level of concentration, their contribution to bitterness is probably negligible.

- Hulupones: These are oxidation products of beta acids and are as much as 84 per cent as bitter as iso-alpha acids. However, they are only found in small quantities in dry-hopped beers.

Using the new method, it is possible to combine the data to arrive at a meaningful IBU value by means of the following simple formula:

Calculated bitterness =
mg iso-alpha acids + (0.66 x mg humulinones)

In a further study, Hahn et al. found that even the simple sum of iso-alpha acids plus humulinones (without the factor) can achieve a very good correlation and produces an even better result if the alcohol content, which intensifies perceived bitterness, is included in the calculation.[3]



Bitterwerte außer Rand und Band

The truth of the matter, therefore, is this: in dry-hopped beers in particular, bitterness cannot be checked. Bitterness is determined not only by the quantity of bitter compounds, but also by other flavour carriers – not to mention the fact that bitterness perception follows a saturation curve. Measured bitterness units lying above 50 IBU produce hardly any increase in perception of intensity.

The good news: those who nevertheless want to explain the bitterness in their beer to consumers can take a more basic approach by doing so using sensory terms – thus elegantly avoiding the need for expensive HPLC kit and laborious calculations of correlations with sensory perception. Bitterness intensity can be shown quite simply, for example, on a scale of 0 to 10, which is intuitively understandable. The quality of bitterness can be described equally simply: from "delicate" to "lingering" to "strong", for example. Using a panel of trained tasters, it would even be possible to define comparable values. And consumers find categories and descriptions more useful than numbers anyway.

[1] https://europeanbreweryconvention.eu/new-international-method-on-bitter-compounds-in-dry-hopped-beers/

[2] Algazzali, V. A.; Shellhammer, T. H. Bitterness Intensity of Oxidized Hop Acids: Humulinones and Hulupones. J. Am. Soc. Brew. Chem. 2016, 74 (1), 36–43.

[3] Christina D. Hahn, Scott R. Lafontaine, Cliff B. Pereira, and Thomas H. Shellhammer, Evaluation of Nonvolatile Chemistry Affecting Sensory Bitterness Intensity of Highly Hopped Beers, Journal of Agricultural and Food Chemistry 2018 66 (13), 3505–3513DOI: 10.1021/acs.jafc.7b05784