

More than 20-year-old assumption about beer aroma disproved

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Hops-derived constituents not only increase shelf-life and bitterness of beer, but can also significantly influence aroma. An important hop odorant is linalool, which has a floral and citrus-like scent.

Under the leadership of the Leibniz Institute for Food Systems Biology at the Technical University of Munich, a team of scientists has now

disproved a roughly 20-year-old assumption about this odorant. The new study contributes to a better understanding of changes in [beer](#) bouquet during the brewing process and beer aging.

Two molecular variants of the odorant linalool are found in hops and beer: the enantiomers (R)- and (S)-linalool. Both molecules consist of the same number and type of atoms, and show the same connectivity. Nevertheless, they have a different spatial structure and differ like an image from its mirror image. This "small" but nevertheless crucial difference is also reflected in different odor intensities of the molecules.

In addition, it has long been known that beer aroma changes during the brewing process and storage because, among other things, part of the (R)-linalool predominant in hops is converted to (S)-linalool.

Previously, based on a 1999 paper, researchers assumed that the odor threshold concentration of (R)-linalool is about a factor of 80 lower than that of (S)-linalool. Put simply, they assumed that (R)-linalool has a much stronger influence on beer aroma than its mirror-image counterpart. However, [reliable data](#) on the odor thresholds of both substances were lacking.

Preparative method optimized

To close this knowledge gap and enable more precise predictions of changes in beer aroma, the team led by brewing and beverage technologist Klaas Reglitz and food chemist Martin Steinhaus from the Leibniz Institute first optimized a preparative method. In close cooperation with the Research Center Weihenstephan for Brewing and Food Quality, the researchers thus succeeded for the first time in isolating enantiomerically pure (S)-linalool.

Having the pure substance available in sufficient quantities was an

indispensable prerequisite for determining the specific odor threshold concentrations of the two odorant variants in water and unhopped beer using a trained sensory panel. This was essential because only (R)-linalool is commercially available as a pure substance.

As the team showed, the thresholds of (R)- and (S)-linalool in water were 0.82 and 8.3 micrograms per kilogram, respectively. In unhopped beer, the team determined thresholds of 6.5 micrograms per kilogram for (R)-linalool and 53 micrograms per kilogram for (S)-linalool.

Influence of (R)-linalool overestimated

"Our results thus confirm the previously postulated higher odor potency of (R)-linalool. However, they also refute the previous assumption that the odor threshold concentrations of the two enantiomers differ extremely. Instead, the study shows that the difference is only about eight to tenfold," says Martin Steinhaus, head of Section I and the Food Metabolome Chemistry Research Group at the Leibniz Institute.

First author Klaas Reglitz adds, "The conversion of (R)- to (S)-linalool thus does not have as great an influence on beer aroma as has long been assumed. Thanks to our study, we now better understand how and why the aroma changes during storage."

Linalool is an important constituent in many [essential oils](#), often as a major component. It is found in various spice plants such as coriander, star anise, hops, nutmeg, ginger, basil and many others. Linalool is used both as a component of essential oils and as a pure compound for flavoring purposes.

The common hop (*Humulus lupulus*) is mainly used for beer production. For brewing, the cones of the female hop plants are used. In 2022, the hop acreage in Germany was approximately 20,600 hectares, which is

roughly one-third of the world's acreage. Germany is thus one of the leading hop producers and plays a significant role in global exports. With an export volume of 26,648 tons, Germany tops the list of hop exporting countries. At the same time, Germany is also one of the most important destination countries for the international hop trade.

The research is published in *BrewingScience*.

More information: Reglitz, K. et al, Enantiospecific determination of the odour threshold concentrations of (R)- and (S)-linalool in water and beer. *BrewingScience* (2023). [DOI: 10.23763/BrSc23-07reglitz](https://doi.org/10.23763/BrSc23-07reglitz).
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