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News Release

Freising-Weihenstephan, 29 June 2009

Molecular sensory perception for Pilsner lovers

TUM food chemists discover bitter taste receptors for full-bodied beer delight

"Yuck, bitter!" – this instinctive reaction is a legacy of our evolution. Many toxic substances taste bitter to the human tongue. But so do many food products and beverages: Campari, bitter chocolate and beer would all be bland and boring without their distinctive bitter touch. Prof. Thomas Hofmann and his research team from the Technische Universität München (TUM) have now discovered how cool lagers, effervescent Pilsners or smooth weissbiers unfold their unmistakable and delicate bitter taste.

Whether enjoyed in a bier garden or with freshly barbequed meat, a cold beer on a hot summer day is a divine treat. The bitter substances in beer contribute significantly to this pleasure. They form when hops are added to the wort during the brewing process and enhance the appealing taste of the beverage. The TUM food chemists took a close look at 15 of these substances in hops and beer. Prof. Thomas Hofmann and his colleagues from the Chair of Food Chemistry and Molecular Sensory Science successfully identified three receptors in the human tongue that initially signal the bitter taste of beer to the brain – thereby ensuring a wonderful and refreshing sensation.

The TUM researchers, in collaboration with the Deutsches Institut für Ernährungsforschung (Prof. Wolfgang Meyerhof), investigated the interaction of bitter substances in beer with the associated receptor proteins, both in vitro and via taste tests. To identify the receptors that mediate the bitter taste of beer, the researchers cultivated liver cells in which the each of the 25 human bitter taste receptors were expressed. These special cells served as beer taste receptors in the laboratory: the researchers added various hops bitter substances, both individually and in combination, to cultures of each of these special cells. Exactly three of the bitter taste receptors – hTAS2R1, hTAS2R14 and hTAS2R40 – reacted with a perfect fit to the individual bitter substances. Thus, it is precisely these receptors that are selectively activated when we drink beer. The other 22 receptors do not react.

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Yet, what precisely happens in the mouth of a beer drinker could not be answered by this laboratory experiment alone. That is why, in a second phase, the researchers called on trained tongues in a scientifically evaluated taste test. Each of the taste testers had trained their perception of taste for at least two years, standardizing specifically their sense of bitter tastes. This was important to guarantee an objective and reproducible sensory analysis. Before starting the experiment, the testers put on nose plugs to suppress their perception of aromas, so as not to influence their sense of taste.

Then came show time: but instead of a tasty mug of beer or a cold glass of Pilsner, the taste testers were presented with 15 different bitter substances found in hops – ultrapure and dissolved in an alcoholic solution. They were, at least, allowed to immediately spit out the bitter samples, similar to the procedure during wine degustation. The taste testers evaluated successively stronger concentrations of each substance since Prof. Hoffmann wanted to determine both the perception thresholds and the concentration dependencies of the individual bitter substances in humans to compare these with the cell experiment data.

As it turned out, the taste buds of the testers were less sensitive to bitter substances than the taste receptor cells in the test tube. Mass spectrometry analyses of oral samples taken after drinking beer provided the explanation. Apparently some of the bitter substances are absorbed by the mucous membrane of the oral cavity and salivary proteins, reducing the effective concentration of the bitter substances that activate taste receptors in the oral cavity. “Clearly the identified taste receptors, together with adsorption phenomena in the oral cavity, are responsible for the perceived bitterness of beer,” says Prof. Hofmann. Who knows: maybe that is exactly why we find the taste of beer so enticing.

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Literature:

Intelmann, D.; Batram, C.; Kuhn, Ch.; Haseleu, G.; Meyerhof, W.; Hofmann, T. (2009): Three TAS2R Bitter Taste Receptors Mediate the Psychophysical Responses to Bitter Compounds of Hops (Humulus lupulus L.) and Beer. J. Chemosensory Percept., in press; DOI 10.1007/s12078-009-9049-1

Available online at
http://www.springerlink.com/content/120904/?Content+Status=Accepted

Background:

This project was funded in part by the Deutsche Forschungsgemeinschaft and the Fonds der Chemischen Industrie. The used hops samples were supplied by the Hallertauer Hopfenveredelungsgesellschaft mbH in Mainburg.