Well-rounded sensory evaluation

TASTING TOOL | Both the multifaceted aroma of new hop varieties and the increasing popularity of dry-hopped beers mean that the definition of the sensory characterisation of how hops influence beer aroma and beer flavor needs to be revised. The Hopsteiner flavor wheel has been developed with a view to dealing with this issue. To clarify the processes of sensory perception during beer tasting, the article gives an overview of the principles of the human olfactory and gustatory perception.

IN FOOD CONSUMPTION, "flavor" summarises the combination of olfactory, gustatory, temperature-conditional and/or trigeminal and haptic impressions [12].

Olfactory perception

The sense of smell is responsible for the perception of volatile substances by olfactory receptors (olfactory cells). The intake of fragrances occurs on the one hand via the mucous membrane in the roof of the nose (orthonasally) and, on the other hand, retronasally by chewing food in the mouth. A cluster of fine cilia at the very tip of the sensory nerve cells (olfactory cells) extend into the nasal cavity, surrounded by a mucous membrane in which odours are released. The cilia membrane contains the G-protein-coupled receptors responsible for olfactory perception. Olfactory cells are reproduced from basal cells throughout a lifetime [7].

Authors: Dr. Christina Schmidt and Sandro Cocuzza, Hopsteiner, Mainburg, Germany

Gustatory perception

In contrast, flavors are generally non-volatile, polar and water-soluble compounds which are perceived by receptors on the tongue. The gustatory papilla on the surface of the tongue are divided into 3 types, depending on their shape. These are fungal papilla with 3 - 5 taste buds which are defined as the actual gustatory organs. There are further forms such as the ridge papilla with approximately 100 taste buds and also the leaf papilla with slightly more than 50 taste buds [8]. So far it has been possible to detect specific receptors for the following gustatory qualities: sweet, salty, sour, bitter and umami. The signal transduction for the perception of the various gustatory qualities is extensive, as it is based on fundamentally varied processes. In addition to this, further trigeminal perceptions such as astringent, sharp, biting and cooling are known [8, 11].

Bitterness

The human perception of bitterness is imparted by the hTAS2R receptor family with approximately 25 G-protein-coupled receptors (GPCRs) [2-6, 11]. So far it has only been possible to assign the respective bitter receptors to a few key bitter substances in foodstuffs. Molecular biological studies show that the iso-α-acids found in beer activate the three bitter taste receptors hTAS2R1, hTAS2R14 and hTAS2R40 [10].

Sensory impressions

The use of hops for brewing beer is extremely important, not only due to the characteristic bitterness originating from hop ingredients, but also, partly, because hop ingredients influence aroma, microbiological stability, foam and haze. The contribution of hop aroma and flavor substances to beer needs to be carefully assessed, not only analytically, but also using sensory tests to evaluate intensity and quality. The human senses serve best as a measuring instrument to this end. Depending on the challenge, there are numerous sensory testing procedures which can be used. An expert tasting panel is essential. Regular participant training ensures a wide cross-section of aroma references as well as the incorporation of the most diverse foodstuffs such as fruits and spices.

Characteristics of hop aroma

So far the assessment of hop aroma in beer has mostly been limited to attributes such as "fruity", "floral", "citrus", "green-grassy", "hop-spicy" and "other particularly noticeable notes" such as the tasting scheme developed by the CMA (Centrale Marketing Gesellschaft der deutschen Agrarwirtschaft, a marketing association for German agriculture) for hop aromatic beers, known as the CMA-Scheme [12].

The breeding of new hop varieties with a multitude of aromas, especially in conjunction with dry hopping, called for the increase and modification of descriptors for the sensory evaluation of the influence of hops when carrying out sensory evaluation of beer. The Hopsteiner flavor wheel presented in figure 1 for hop aroma incorporates the following impressions: "citrus", "fruity", "floral", "herbal", "spicy", "resinous" "sugar-like" and "miscellaneous". Each individual category includes several sub-divisions such as mandarin (for "cit-

rus"), honeydew melon or passion fruit (for "fruity"), white wine or glacier mint (for "miscellaneous") and far more. The denomination "hoppy" (see "spicy") refers to noble hop aromas such as those typified by varieties such as Hallertauer Mittelfrüher or the Saazer family. These impressions are valued on a scale of 0 - 5 and are to be found in the hops and also in the respective beer product, depending on the timing of hop addition and the quantity of hops dosed. Results of beer sensory analyses performed using this sensory evaluation tool follow in BRAUWELT International no. 4, 2014.

Already in 1979 *Meilgaard* et al. [1] elaborated on uniform terminology and a summary of superordinate and subordinate definitions in the shape of a beer flavor wheel designed to simplify the procedure of the sensory evaluation of beer. *Schmelzle's* beer aroma wheel is an update of Meilgaard's beer flavor wheel. This beer aroma wheel contains a total of 96 attributes facilitating a sensory evaluation of aroma, flavor and texture, but without being restricted only to the characterisation of hop aroma [9].

Both the assessment of aroma impressions and also the quality of bitterness measured on a scale of 0 - 5 are used to describe the total influence of hops. Perceived bitterness (BU) is a further factor which is taken into consideration. The evaluation of aroma using the flavor wheel, combined with personal impressions, round off the sensory evaluation (fig. 2).

Conclusion

Hops offer a multitude of possibilities to create unusual beers and the flavor wheel presented here serves as a tasting tool for sensory evaluation for the influence of hops on beer aroma and beer taste. The descriptors defined in the flavor wheel are a basis of communication for the evaluation of various beers for both unskilled and experienced tasters. Basic information of human olfactory and gustatory perception delivers an insight into the processes during sensory evaluation. ■

Bibliography

1. Meilgaard, M. C.; Dalgliesh, C. E.; Clapperton, J. F.: "Beer Flavor Terminology", J. Am. Soc. Brew. Chem., volume 37, 1979, pp. 47-52.
2. Adler, E.; Hoon, M. A.; Mueller, K. L.; Chandrashekar, J.; Ryba, N. J. P.; Zucker, C. S.: "A novel family of mamma-

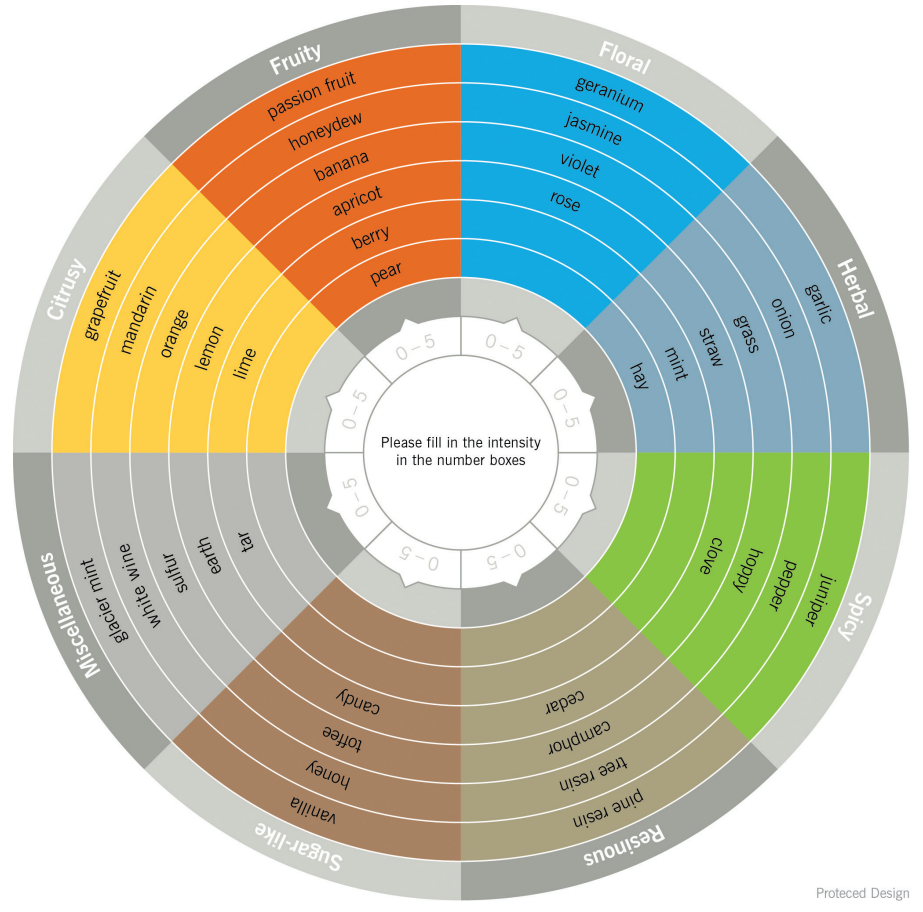

Fig. 1 Hopsteiner Flavor Wheel

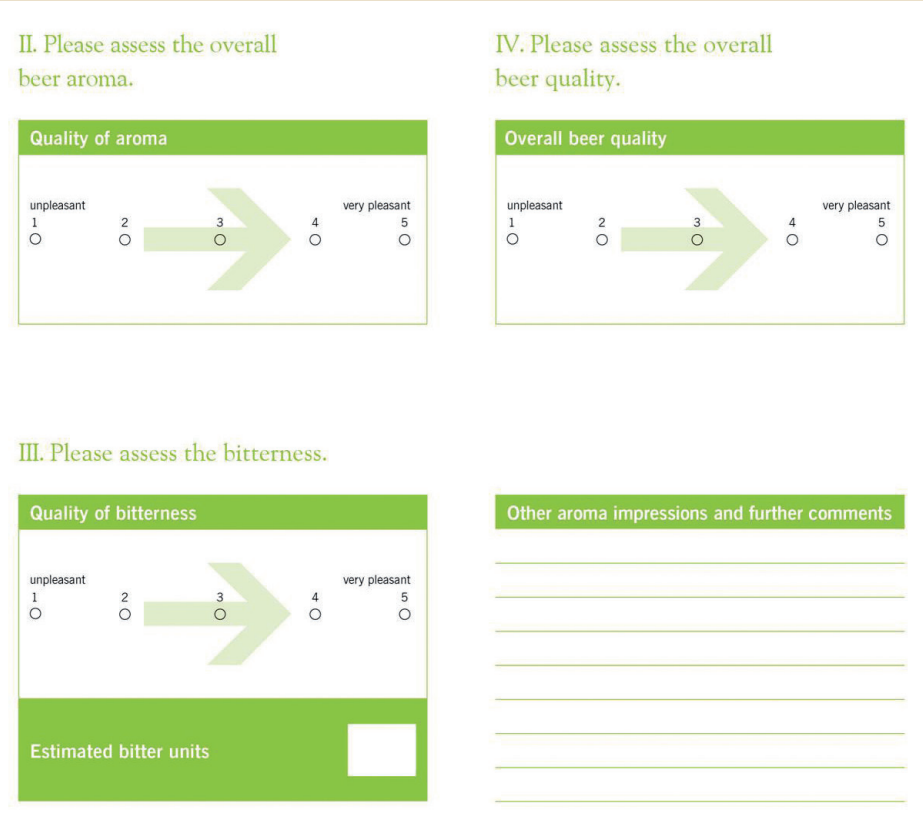

Fig. 2 Tasting scheme

lian taste receptors" Cell, volume 100, 2000, pp. 693-702.
3. Matsunami, H.; Montmayeur, J.-P.; Buck, L. B.: "A family of candidate taste receptors in human and mouse". Nature, volume 404, 2000, pp. 601-604.
4. Bufe, B.; Hofmann, T.; Krautwurst, D.; Raguse, J.-D.; Meyerhof, W.: "The human TAS2R16 receptor mediates bitter taste in response to β-glucopyranosides" Nat. Genet., volume 32, 2002, pp. 397-401.
5. Pronin, A. N.; Tang, H.; Connor, J.; Keung, W.: "Identification of ligands for two human bitter T2R receptors" Chem. Senses, volume 29, 2004, pp. 583-593.
6. Behrens, M.; Meyerhof, W.: "Bitter taste receptors and human bitter taste perception" Cell. Mol. Life Sci., volume 63, 2006, pp. 1501-1509.
7. Hildebrandt, G.: "World of Taste. Basic principles of food sensory analysis". DLG-publisher, Frankfurt on the Main, 2008, in German.
8. Bajec, M. R.; Pickering, G. J.: "Astringency: Mechanisms and Perception". Crit. Rev. Food Sci. Nutr., volume 48, 2008, pp. 858-875.
9. Schmelzle, A.: "The Beer Aroma Wheel", BrewingScience, volume 62, 2009, pp. 26-32.
10. Intelmann, D.; Batram, C.; Kuhn, C.; Haseleu, G.; Meyerhof, W.; Hofmann, T.: "Three TAS2R bitter taste receptors mediate the psychophysical responses to bitter compounds of hops (*Humulus lupulus L.*) and beer". Chem. Percept., volume 2, 2009, pp. 118-132.
11. Chaudhari, N.; Roper, S.: "The cell biology of taste". J. Cell Biol., volume 190, 2010, pp. 285-296
12. MEBAK – Method collections, Volume sensory analysis, 2013, pp. 9, 155-156, in German.