Special hop varieties for unique beers – Part 1

TASTING RESULTS | In recent years, an increasing trend towards brewing beers having a unique character has become evident. When selecting the hop variety or the method of hopping such as dry hopping, many brewers nowadays shift the emphasis onto new features. Dry hopping is permitted by the German Purity Law when whole cones, pellets or hop powders are used [1]. The designation "aroma or bitter variety" no longer accurately describes the intended purpose. Bitter varieties have long been used for late additions in the hot section or for cold hopping in order to achieve a specific aroma. A number of new promising varieties were used to produce beers for tasting. This article covers the taste results of over 1500 world-wide individual evaluations.

THE MOST IMPORTANT BREWING CHARACTERISTICS of the used varieties are listed in table 1. The lead conductance value (EBC 7.5) includes alpha-acids (specifically analysed by EBC 7.7) as well as additional hop bitter substances which may also contribute to beer bitterness. The ratio of the two EBC methods provides an indicator of the amount of additional bitter substances which are added together with the alpha-acids. The higher the ratio, the more non-specific bitter substances are added as measured by HPLC, with the alpha addition remaining constant. These generally impart smoother and more harmonious beer bitterness [2].

The relative proportion of cohumulone is a variety-specific parameter which is often directly associated with the quality of bitterness. The opinion that hop varieties with a higher proportion of cohumulone have a negative effect on beer quality was not confirmed in many commercial tests. More recent research increasingly fails to find a direct relationship [3].

Table 1 also shows the ratios of linalool to the respective amount of alpha-acids for each tested variety. Linalool is an indicator of the intensity of hop aroma. Higher concentrations are found in the finished beer in the case of late hopping in the brewhouse. The numbers in table 1 indicate the relative proportion of linalool added to the beer if hopping rate is based on the same total amount of alpha acids. Based on the percieved aroma intensity, this ratio makes a simple and direct comparison possible. To obtain uniform aroma intensity, late hop additions in the hot section based on the linalool content are recommended commercially. Based on the CMA varietal tests, hop addition was based on alpha content in the test results described here [4].

Hop polyphenols are the third important group. The total amount of polyphenols added is again shown as a ratio of the respective amounts of alpha-acids and can again be compared directly for the varieties because the addition of alpha acids remained unchanged.

Standardised brewing

The brews were prepared using the infusion mashing method. Grist was 17 kg/hl

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OVERVIEW OF VARIETIES USED

		Bitter substances			Aroma substances	Polyphenols
		LCV (%)*	EBC (7.5/7.7)	Cohumulone (% rel)**	Linalool (ppm)***/ alpha-acids (%)**	PP (%)****/ alpha-acids (%)**
DEHM	DE Hallertauer Magnum	13.3	1.08	30.3	1.11	0.22
DEHS	DE Hallertauer Herkules	17.7	1.05	38.1	0.67	0.25
USAP	US Apollo (Hopsteiner)	18.0	1.12	26.2	2.09	0.18
USBR	US Bravo (Hopsteiner)	15.9	1.07	31.6	3.57	0.26
USCP	US Calypso (Hopsteiner)	13.0	1.12	38.7	2.09	0.26
USDE	US Delta (Hopsteiner)	5.2	1.16	24.2	6.40	0.60
NZNS	NZ Nelson Sauvin	11.4	1.07	24.7	4.41	0.43

*Method Analytica-EBC 7.5 **Method Analytica-EBC 7.7 ***Method Analytica-EBC 7.12

****AHA method, similar to Method EBC 9.11 (polyphenols in beer)

Table 1

of Pilsner malt. After lautering, the brews were boiled for 60 minutes, followed by a 15-minute whirlpool rest. The bottom-fermenting yeast strain 3478 was used for fermenting. The main fermentation at 10 °C for one week was followed by maturation at the same temperature until a concentration of vicinal ketones below 0.1 mg/l was reached. The beer was then stored for two weeks at 0 °C and bottled immediately after filtration.

Hopping

The hopping recipe was the same in all beers (table 2). Only type 90 pellets were used so that the full spectrum of hop components were added to the beer. The two hop additions were based on bitter components according to EBC 7.5 and calculated to result in 25 bitter units.

Beer analyses

Original gravity of the seven beers ranged from 11.3 to 11.6 w/w while alcohol content varied from 4.7 to 4.9 v/v. Other analysis results such as pH, colour, final attenuation etc. were almost identical in all beers. One could thus assume standardised beers that differed only in the hop variety selected.

Table 3 shows the analysis results of the single hop variety beers in terms of bitterness, hop aroma and polyphenols.

Analysis of bitter units shows a spread of maximum 4.1 BU, concentrations of iso-alpha acids – with the exception of DEHM – hardly differ. Therefore all beers had an almost identical intensity of bitterness.

Some beers were low in linalool. However, due to the less complex beer matrix, even concentrations below 20 µg/l (often described threshold of linalool) were mostly noticed and hop aroma was perceived.

The main quantity of polyphenols is usually contributed by malt. The seven beers show only slight deviations (maximum 17 mg/l) in total polyphenol content.

Taste results

Tastings were carried out in the breweries and various institutes in accordance to their own tasting conditions. A tasting sheet (fig. 1) was provided and used to evaluate the beers. Most parameters were evaluated using a 5-point scale, progression of bitterness was based on predefined graphics. The results presented here summarise at least 215 individual evaluations per test beer from all over the world.

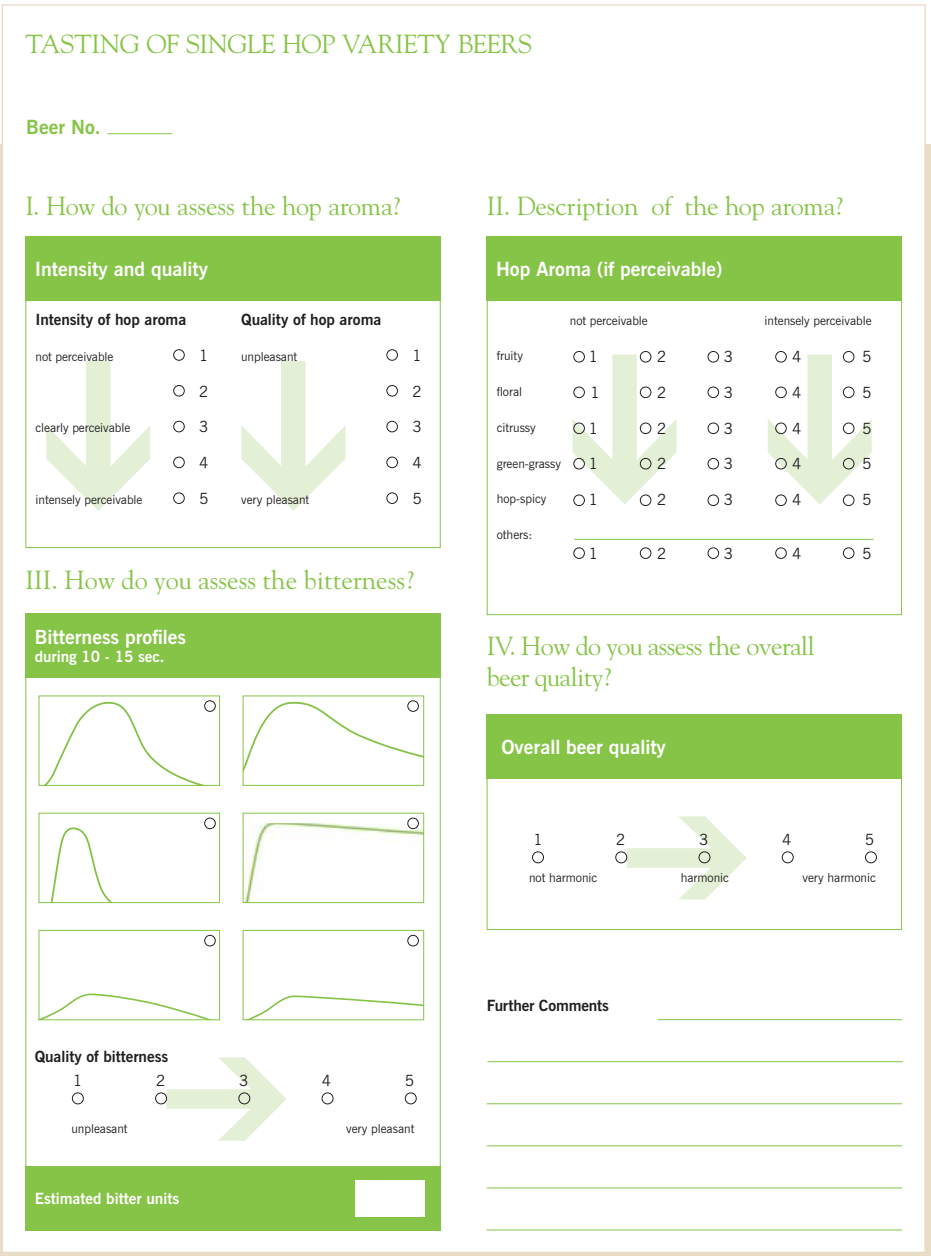

Fig. 1 Hopsteiner tasting scheme

SPLIT HOPPING

	Start of boiling	5 min before end of boiling
Hopping (pellets type 90, 2010 harvest)	60%*	40%*

*based on total alpha quantity

Table 2

BEER ANALYSES

	BU EBC 9.8	Iso-alpha acids (mg/l)*	Iso-cohumulone (% rel)	Linalool (µg/l)**	Polyphenols (mg/l)***
DEHM	24.7	24.5	37.1	10.1	151
DEHS	22.6	21.9	46.5	7.6	137
USAP	24.2	21.2	33.4	9.4	139
USBR	24.0	22.1	39.9	13.9	145
USCP	26.7	21.7	46.4	12.8	134
USDE	24.7	20.9	28.6	26.6	148
NZNS	25.8	21.6	34.5	12.9	148

* Method HHV 29 (in-house method, HPLC) ** Method HHV 05 (in-house method, GC) *** Method Analytica-EBC 9.11

Table 3

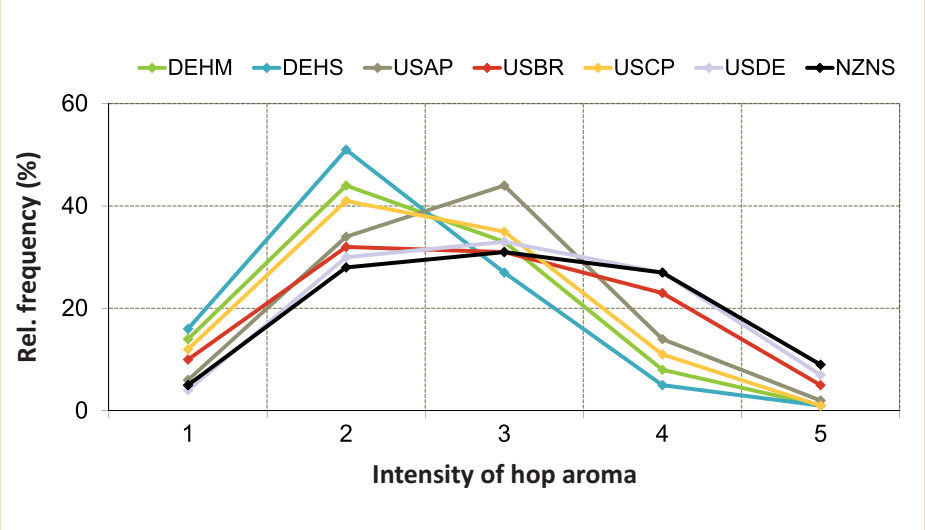

Fig. 2 Intensity of hop aroma

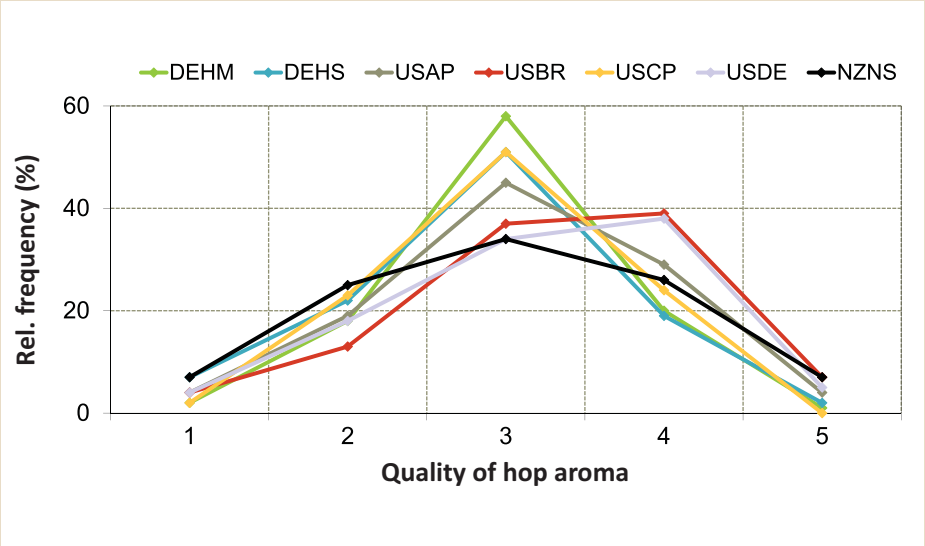

Fig. 3 Quality of hop aroma

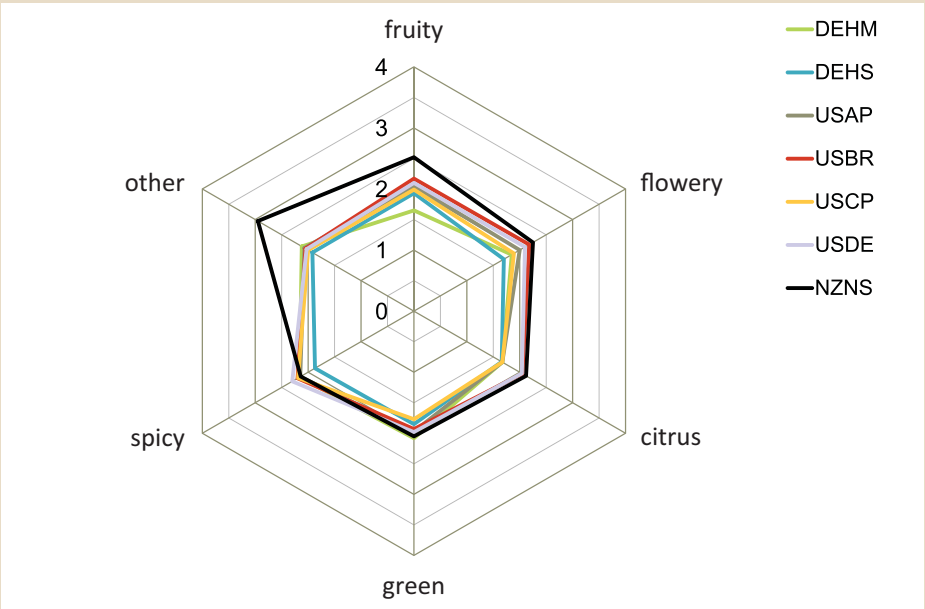

Fig. 4 Descriptions of hop aroma

Hop aroma – intensity and quality

Figure 2 shows the relative frequency of points awarded to each beer for intensity of hop aroma. More than 80 percent of all participants perceived a hop aroma in the particular beers, intensity was mostly mild to medium (at least 60 % awarded 2 and 3 points). The beer from DEHS had the weakest hop aroma, the beers brewed with USBR and NZNS had a clearly more pronounced hop aroma despite relatively low linalool concentrations (table 3). Based on the ratio of linalool to alpha-acids as shown in table 1, the highest concentration was actually expected for the beer brewed with USDE. However, these 26.6 µg/l did not necessarily result in the most intense perception of a hop aroma. This is proof of the fact that, frequently, a large number of aroma substances have synergistic effects that are not reflected in analysis.

With regard to hop aroma quality, USDE and USBR are particularly notable. The aroma of these two beers was mostly described as "pleasant" to "very pleasant" (3 to 5 points). However, the aroma of Nelson Sauvin is a good example for completely different, subjective perceptions of unusual aroma; this is presented graphically by the flat curve in figure 3. When comparing all beers, it can be seen that this beer was the one that most frequently was awarded either 1 point (unpleasant) or 5 points (very pleasant).

When describing the aroma, only NZNS clearly differs from all other beers (fig. 4). On the one hand, all characteristics were always perceived most intensely in this variety while, on the other hand, descriptions such as "tropical-fruity" or even "sulphury off-flavour" were entered in particular under the heading "miscellaneous". The Sauvignon Blanc wine bouquet oftentimes associated with this variety was perceived only in individual instances [5].

With the other varieties, there was no consistent descriptions and/or opinion of the hop aroma among the tasters. Only USBR and USDE were more frequently described as "citrus" and essentially assessed as slightly more intense.

Evaluation of bitterness

Evaluation of bitterness units estimated was relatively uniform for all beers (fig. 5). The DEHS beer, with on average 21.8 BU (analysis: 22.6 BU, table 1), was assessed as being the mildest in sensory terms though

it had the highest relative co-isohumulone amount of 46.5 percent. This is also confirmed by evaluation of bitterness profile (fig. 6). About 25 percent of tasters selected a harmonious bitterness profile with a slightly longer lasting bitterness impression for most beers. This is certainly attributable to the fact that approx. 22 - 26 BU are higher than the bitter intensity many tasters are used to.

At least 70 percent of tasters judged the quality of bitterness as being "harmonious" to "very harmonious" i.e. three to five points for all beers (fig. 7). In the case of a higher cohumulone content of hop variety, it is not a foregone conclusion that the quality of bitterness is perceived as being less pleasant. On average, the USBR beer got the best values. This can be seen in figure 7 when looking at the frequent point scores of four and five points. In terms of the proportion of non-specific bitter substances, no clear relationship to quality of bitterness was found in these tests. Four and five points were awarded with comparable frequency for varieties with both higher and lower amounts of non-specific bittering substances.

Overall beer impression

Figure 8 shows the result of the final question relating to "overall beer impression". It was noted that all beers were awarded both, the lowest and the highest point score several times. Consequently, each beer has fulfilled or has not fulfilled the individual expectation of the taster. It is also worth mentioning that the same beer sample was classified very differently by breweries/taste panels in some instances. It is thus quite difficult to identify definite trends for particular varieties. Still, under these conditions (hop recipe, brewing method etc.), it is obvious that the DEHM and USCP varieties were, on average, judged "good", that DEHS remained slightly behind the average and USDE and that USBR were more frequently judged positively. Beer brewed with USBR got the highest point score of the seven beers.

Summary

The results of this tasting highlight the differences in individual expectations of the taste of a beer. They also show that the choice of hop variety can provide different taste profiles and thus has a major influence on beer character. When brewing beers with an emphasis on hop flavour, both aroma varieties as well as bitter varieties provide interesting perspectives.

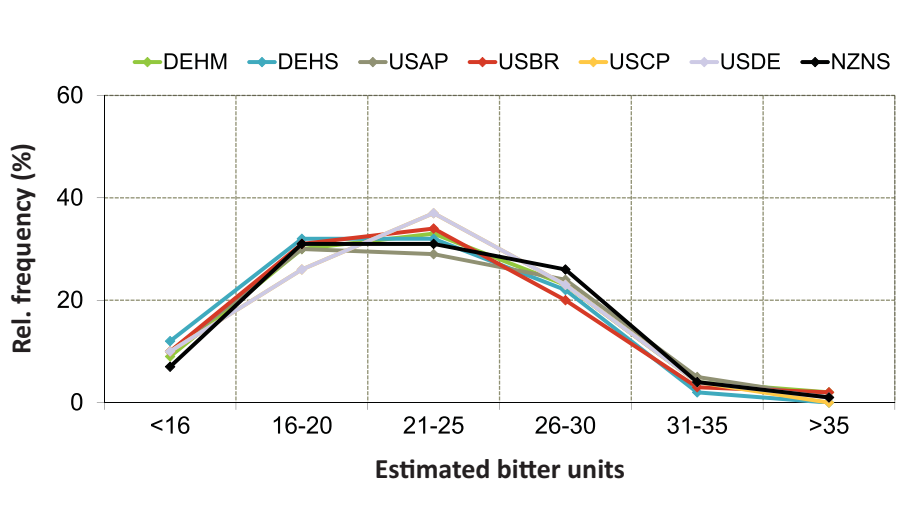

Fig. 5 Estimated bitter units

	DEHM	DEHS	USAP	USBR	USCP	USDE	NZNS
	15	18	17	19	15	23	**23**
	27	16	**27**	**26**	**25**	**26**	19
	12	11	12	11	9	8	12
	13	13	17	11	17	16	17
	18	**28**	13	23	19	15	17
	16	14	14	9	14	12	13

Rel. frequency (%)

Fig. 6 Bitterness profiles

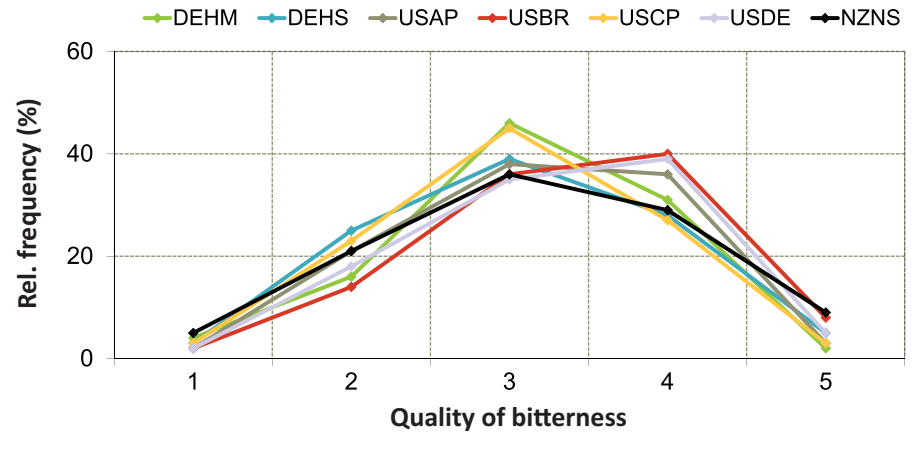

Fig. 7 Quality of bitterness

In Part 2, the tasting results obtained for dry hopped beers using the same varieties will be published. ■

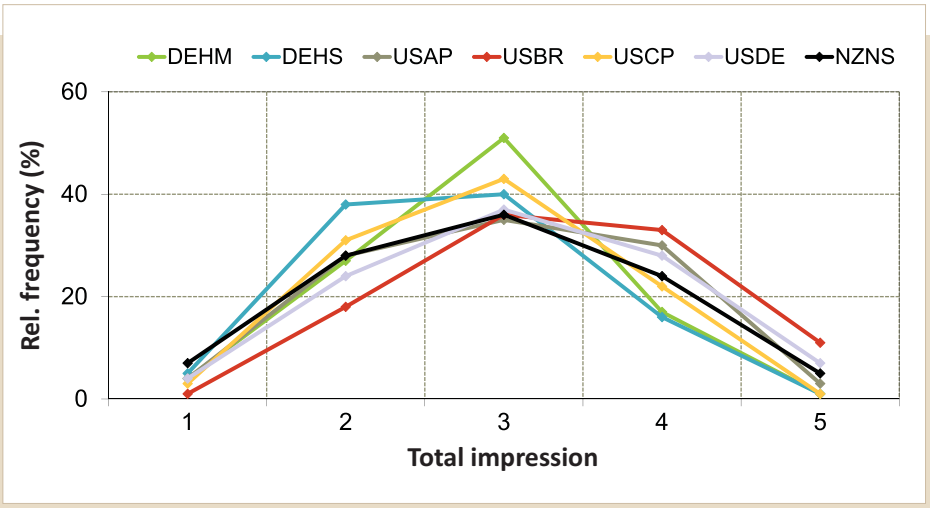

Fig. 8 Total beer impression

Literature

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