

# Influences of the new high alpha hop variety Herkules on beer quality

Marc Kusche<sup>1</sup>, Georg Stettner<sup>1</sup>, Andreas Stephan<sup>1</sup>,  
Willi Mitter<sup>2</sup>, Dietmar Kaltner<sup>2</sup>

<sup>1</sup>Bitburger Braugruppe GmbH, Bitburg, Germany; <sup>2</sup>Simon H. Steiner, Hopfen, GmbH Hopsteiner, Mainburg, Germany

E-Mail: dr.marc.kusche@bitburger-braugruppe.de

## Introduction

Herkules is a new high alpha hop variety which is the recent result of extensive breeding work in Hüll, Germany. With a yield of about 2 300 kg/ha and a good resistance to diseases Herkules shows good agronomical attributes. The new variety has an alpha content of 12-17 % and a high cohumulone amount of 32-38 % of alpha acids (1). In the past the sensory impact of high cohumulone contents on beer taste and quality of bitterness was discussed with opposed opinions. Different views also exist on the behaviour of bitter compounds during ageing of the beer. (2, 3, 4, 5, 6, 7).

The aims of this study were to evaluate the new hop variety Herkules compared with a low cohumulone containing strain and to analyse the behaviour of alpha- and iso-alpha-acids and humulone during beer ageing.

Therefore Herkules was tested versus Merkur, another high alpha hop variety (10-14 %) with low cohumulone content (17-22 %). Resulting beers were compared by sensory analysis after light exposure, fresh, after 3 and 6 months of storage. Beers were analysed chemically after bottling and after storage of 6 months at 28 °C.

## Methods

### Beer production

The studies were carried out in triplicate in a 20 hectolitre pilot plant at Bitburger Brauerei. A standard 2-mash decoction procedure was used to produce Pilsner type beers from 300 kg barley malt. The whole hop addition (8.8 g alpha-acids/hl) occurred at the beginning of boiling. Herkules was added as a type 90 pellet and Merkur as type 45. Data of the added hop products are shown in table 1. The boiling time was 60 minutes at 102 °C with a subsequent whirlpool rest of 20 minutes at an average temperature of 95 °C. Fermentation, maturation and storage were carried out in 10 hl cylindro-conical tanks. The fermentation/maturation temperature was kept at 10 °C until diacetyl was < 0.1 mg/l (ca. 13 days); the storage temperature was held at -1.5 °C for at least 8 days. The beers were filtered with kieselguhr on a plate and frame type filter and not stabilised. Subsequent bottling was done on a pilot filling machine achieving total O<sub>2</sub> values of continuously < 0.2 mg/l.

### Analysis

All analyses were carried out in the central laboratory of Bitburger Braugruppe.

Alpha and beta acids of hop pellets were analysed according to EBC methods 7.5 and 7.7. Iso-alpha acids in wort and beer were determined by HPLC with UV detection at 270 nm after sample preparation by solid phase extraction with cartridges of Phenomenex Strata C18-E.

### Sensory

The beer samples were tasted after light exposure, freshly and after 3 and 6 months of storage at 28 °C by at least 15 trained test persons in the Bitburger sensory laboratory. The sensory test was a comparative flavour profile analysis with a determination of off-flavours and bitterness/mouth feel. Intensities of odor and taste attributes were scored on the following scale: 0 = not perceivable; 9 = very intensive. Statistics consisted in an application of Student-t test and analysis of variances.

Table 1: Data hop products

		Merkur	Herkules
α-acids	%	14.72	15.30
Cohumulone	%	2.97	5.01
n-ad-humulone	%	10.63	8.97
α-acids by HPLC	%	13.60	13.98
Colupolone	%	3.23	3.04
n-ad-lupolone	%	3.89	2.52
β-acids by HPLC	%	7.12	5.56
Cohumulone of humulone	%	21.8	35.8
Colupolone of lupolone	%	45.4	54.7

## Results & Discussion

Figure 1: Sensory test of fresh beers

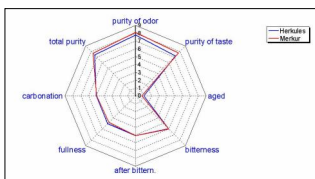


Figure 2: Sensory test after light exposure

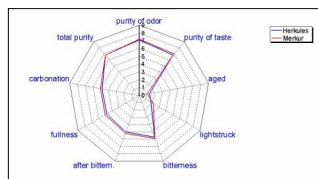


Figure 3: Sensory test after 3 months storage at 28 °C

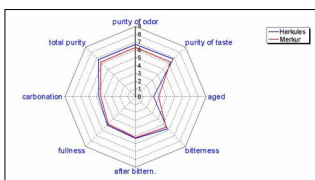


Figure 4: Sensory test after 6 months storage at 28 °C

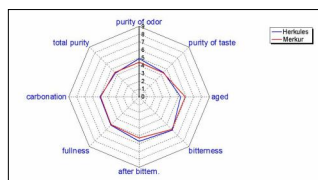


Table 2: Herkules

	fresh	After 6 months	Δ	Δ (%)
BU	EBC 34	30	4	12.6
iso-alpha-acid	mg/l 38.19	29.47	8.72	22.8
Alpha-acid	mg/l 1.54	0.3	1.24	78.3
Humulone	mg/l 39	30	9	23.7
iso-alpha-acid	%	96.2	98.9	

Table 3: Merkur

	fresh	After 6 months	Δ	Δ (%)
BU	EBC 33	29	4	14.0
iso-alpha-acid	mg/l 35.10	27.71	7.39	21.1
Alpha-acid	mg/l 1.30	0.3	1.00	76.9
Humulone	mg/l 36	28	8	22.2
iso-alpha-acid	%	96.5	98.9	

Table 4: Beer analyses

	Merkur	Herkules
Apparent extract	% 2.54	2.56
Apparent degree of att.	% 77.5	77.3
Alk. w/v	% 4.63	4.61
Original extract	% 11.29	11.26
OH	4.89	4.89
Foam (Nibem)	± 275	276

### Sensory

The sensory tests of fresh, 3 and 6 months old product and after light exposure did not show any significant differences. After 3 and 6 months the beers brewed with Herkules tended to result in a better evaluation. The higher cohumulone content of the variety Herkules did not lead to a negative sensory impression.

### Analytical results

Beer analyses showed that the brews are comparable in the analytics. No significant differences could be detected in the standard tests. Foam measurement did not differ, either.

Bitter units of the trial beers were at the same level, but the products brewed with Herkules showed a higher iso-alpha-acid content compared with Merkur samples. There seems thus to be a considerable contribution of non-iso-alpha-acids to the BU value in Merkur than in Herkules. Alpha-acid tended to be higher in beers brewed with Herkules.

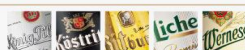
During ageing of the beers the alpha-acid content approached a value of 0.3 mg/l for both hop varieties. The absolute reduction of BUs for Merkur and Herkules beers were the same but the decrease of iso-alpha-acid in the products brewed with Herkules was about 1.4 mg/l higher. Still the total amount of iso-alpha-acid in these beers was higher compared to the reference after 6 months.

### Conclusion

The hop varieties Merkur and Herkules showed distinctive variations in their cohumulone amount. This attribute did not result in a significant sensory difference neither after light exposure nor in fresh, 3 and 6 months old product. The cohumulone content did not have an effect on the quality characteristics of the beer. Different amounts of iso-alpha content in the products could be detected, whereas beer brewed with Herkules showed higher values in fresh and 6 months old beer. Hence the new hop variety Herkules, with its economic benefits (crop and alpha acid content), can be an alternative to other high alpha hop varieties.

### References

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