Chemical components:
All results have been compiled by the "Arbeitsgruppe Hopfenanalyse", or Hops Analysis Working Group (German acronym: AHA). The AHA is an association of laboratories of the hop industry and state institutions and is the most authoritative body for hops analysis worldwide. The AHA performs the most important preparatory work for the European Brewery Convention (EBC). The results are based on varying amounts of data. While harvests are analyzed in their entirety for α-acids, for example, only a small number of data are available for other components. In addition to absolute values given as % weight/weight as is (% w/w), for example, significant components are also indicated as a proportion of the α-acids.

While previous varietal summaries have contained ratios such as that of α- to β-acids, it is much more sensible to indicate the reverse ratio of β- to α-acids. This gives a much clearer impression of the ratio between important valuable components and the α-acids. As far as possible, official analysis methods were used and are specified.

The following data in particular are included:

- α-acids – Method according to EBC 7.4 (lead conductance value); annual publication of the AHA; average over many years; for new varieties with fewer harvests, the average is calculated based on the number of harvests. Values in % w/w.
- β:α – Ratio of β- to α-acids determined according to EBC 7.7 (HPLC); β-acids are an important positive indicator of associated bittering components.
- cohumulone – Relative % of α-acids; method EBC 7.7.
- polyphenols – Currently, there is a non-specific photometric method from the AHA that is similar to the beer method EBC 9.11. Values in % w/w. The AHA is currently developing an HPLC method, for which some findings have already been published.
- polyphenols:α – Ratio polyphenols to α-acids (EBC 7.4): Values in %:%, so dimensionless.
- xanthohumol – Most important hop polyphenol; analysis according to EBC 7.7 (HPLC of bitter acids); values in % w/w; the 2 digits after the decimal point result from the calculated mean.
- xanthohumol:α – Ratio xanthohumol to α-acids (EBC 7.4): Values in %:%, so dimensionless.
- total oil – Distillation method (EBC 7.10): Values in ml / 100 g, in steps of 0.05 ml / 100 g for values < 1.0 ml / 100 g and in steps of 0.1 ml for values > 1.0 ml / 100g. The data refer to freshly harvested samples, as hop oil is subject to extensive post-harvest losses due to its volatility.
- particulars in oil – The following compounds are measured according to method EBC 7.12 (gas chromatography):
  - β-caryophyllene: humulene: dimensionless ratio
  - farnesene in 3 groups: > 10% fraction of total oil
    < 3% fraction of total oil
    < 0.5% fraction of total oil
  - linalool: important indicator of hop aroma in beer, values in mg / 100 g as is
  - myrcene: deliberately omitted due to high volatility and unreliable data
- linalool:α – Ratio linalool to α-acids (EBC 7.4): Values in mg linalool per g α-acids (mg/g).

The **storage stability** is based on observations of degradation of α-acids in hop cones during storage while exposed to air. The values are derived from the work of Forster, Biendl, and Schmidt (Brauwelt International 2005/IV), as well as studies by the AHA. The assessment is only relative and expressed as good, average or low. The classification for the new varieties Smaragd, Opal and Saphir is provisional.

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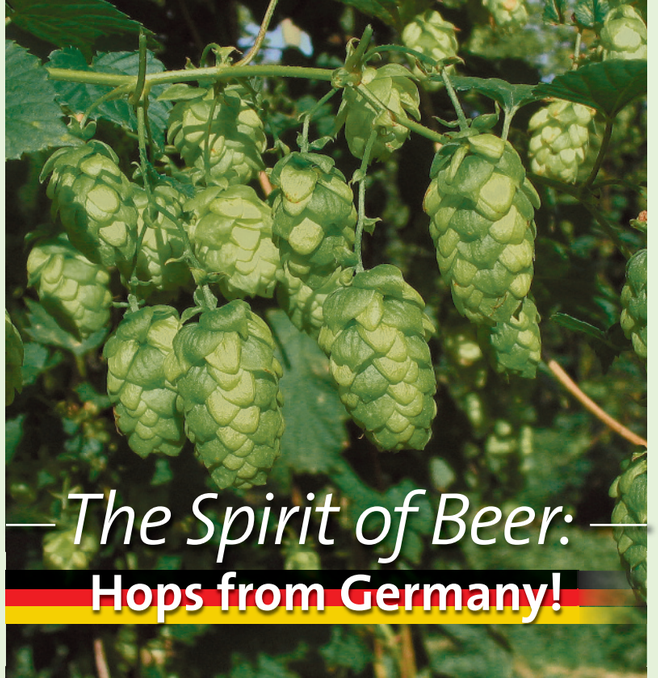

2010 Pocket Guide to German Hop Varieties

The range of available hop varieties undergoes constant change as breeding programs bring forth new varieties and older ones are displaced. The purpose of this guide is to categorize new varieties and to enable systematic comparisons and descriptions among varieties. It depicts a total of 16 hop varieties cultivated in Germany. The ten aroma varieties are composed of four classic land varieties and six Hüller cultivars (Hop Research Center Hüll/Bavaria). Of the six bitter varieties, one originates from England, one from the US, and the remaining four are Hüller cultivars.

A variety description encompasses three fundamental aspects:

- Agronomic properties, in the guide restricted to the two most important characteristics – yield and disease resistance
- Chemical components including bittering compounds, aromatic compounds, and polyphenols
- Sensory evaluation

As sensory description based on standardized terminology is currently not possible, a subjective description of aroma impressions is not included. The perception, specific desires, and personal philosophy of the individual brewer are decisive.

All numbers are averages over many years excluding the normal deviations resulting from influences of crop year, weather, geographic location, etc. The data for 14 varieties are derived exclusively from the Hallertau, whereas data for local land varieties Spalter and Tettnanger originate from their particular production areas of Spalt and Tettnang.

Agronomic characteristics:

- Yield in kg/ha. The data reflect official harvest numbers and are based on a 10-year average where applicable.
- Resistance to wilt, powdery mildew and downy mildew is described as very low, low, moderate, good or very good, the assessment performed by the Bavarian State Research Center for Agriculture (LfL).

Classification of the Major German Aroma Hop Varieties

Variety	Spalter	Tettnanger	Hallertauer Mittelfrüher	Hersbrucker Spät	Perle	Hallertauer Tradition	Spalter Select	Saphir	Opal	Smaragd
Abbreviation	SP	TE	HA	HE	PE	HT	SE	SR	OL	SD
Bitter Substances										
α-acids (EBC 7.4)	4.1	4.0	4.1	3.1	7.4	6.2	5.1	4.1	7.9	5.9
β:α (EBC 7.7)	1.3	1.4	1.3	2.4	0.7	0.8	1.0	1.9	0.8	0.9
cohumulone (EBC 7.7)	24	25	21	20	30	26	23	15	15	15
Polyphenols										
polyphenols (AHA)	5.3	5.2	4.6	4.4	4.1	4.3	4.9	4.5	3.7	4.5
polyphenols:α	1.3	1.3	1.1	1.4	0.6	0.7	1.0	1.1	0.5	0.8
xanthohumol (EBC 7.7)	0.34	0.29	0.27	0.21	0.55	0.41	0.42	0.37	0.41	0.32
xanthohumol:α	0.083	0.073	0.066	0.069	0.074	0.066	0.082	0.090	0.051	0.054
Aroma Substances										
total oil (EBC 7.10)	0.60	0.60	0.85	0.75	1.30	0.70	0.70	1.10	0.95	0.90
β-caryophyllene:humulene	0.28	0.29	0.29	0.48	0.31	0.28	0.40	0.43	0.34	0.30
farnesene (EBC 7.12)	> 10	> 10	< 3	< 0.5	< 0.5	< 0.5	> 10	< 0.5	< 3	< 3
linalool (EBC 7.12, mg/100g)	4	4	6	5	4	7	8	10	11	10
linalool:α	1.0	1.0	1.5	1.6	0.5	1.1	1.6	2.4	1.4	1.7
Storage Stability	average	average	average	low	good	good	low	average	average	average
Yield (kg/ha)	1200	1300	1250	1750	1850	1950	2000	2000	1900	1900
Resistance to Diseases										
wilt	very good	very good	very low	medium	very good	good	very good	very good	good	good
downy mildew	low	low	very low	very low	very good	very good	very good	low	very good	good
powdery mildew	good	good	good	low	low	good	low	good	good	low

Classification of the Major German Bitter Hop Varieties

Variety	Northern Brewer	Nugget	Hallertauer Magnum	Hallertauer Taurus	Hallertauer Merkur	Herkules
Abbreviation	NB	NU	HM	TU	MR	HS
Bitter Substances						
α-acids (EBC 7.4)	9.2	11.3	13.9	15.9	13.3	15.9
β:α (EBC 7.7)	0.6	0.4	0.5	0.3	0.5	0.3
cohumulone (EBC 7.7)	27	29	27	23	20	36
Polyphenols						
polyphenols (AHA)	3.9	3.4	2.6	3.1	4.2	3.5
polyphenols:α	0.4	0.3	0.2	0.2	0.3	0.2
xanthohumol (EBC 7.7)	0.61	0.68	0.47	0.89	0.37	0.73
xanthohumol:α	0.066	0.060	0.034	0.056	0.028	0.046
Aroma Substances						
total oil (EBC 7.10)	1.50	1.70	2.40	2.00	2.20	1.80
β-caryophyllene:humulene	0.34	0.47	0.28	0.29	0.29	0.30
farnesene (EBC 7.12)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
linalool (EBC 7.12, mg/100g)	4	10	8	19	13	8
linalool:α	0.4	0.9	0.6	1.2	1.0	0.5
Storage Stability	good	good	good	good	good	good
Yield (kg/ha)	1600	2200	2000	2000	2000	2700
Resistance to Diseases						
wilt	very good	low	very good	good	very good	good
downy mildew	low	very low	good	low	good	low
powdery mildew	low	low	very low	very low	very good	low