The spirit of beer
Hops from Germany
Hop varieties from Germany
> Aroma evaluation of hops
> Summery of varieties:
  - Hallertauer Mittelfrüher
  - Spalter
  - Tettnanger
  - Hersbrucker Spät
  - Hallertauer Tradition
  - Spalter Select
  - Perle
  - Saphir
  - Smaragd
  - Opal
  - Hallertauer Magnum
  - Hallertauer Taurus
  - Hallertauer Taurus
  - Hallertauer Merkur
  - Herkules
  - Nugget
  - Northern Brewer

Brewing trials
> Characterising the aroma and taste profiles

Certification of hops

Independent Quality Control

Hop Research Centre Hüll

Hop Service Centre Wolnzach

Addresses & services of the CMA and additional important addresses
“Hopland” Germany / Hop Products
Brewing tradition goes back to 736

Wherever beer is produced in the world – it is the hops which give the beer its soul and which are responsible for the unmistakeable aroma, the characteristic bitter taste, formation of froth and its keeping quality.

Even the ancient Babylonians and Egyptians held hops in their wild form in high esteem as the aromatic additive for brewing beer. The German hop-growers look back on an over 1200-year hop-growing tradition. Origin and beginning are not known with absolute certainty. Presumably the hop culture in Central Europe began between the 5th and 6th century. The oldest evidence for hop production in Germany can be traced back to the year 736 A.D. In 860 A.D. hop yards were mentioned in documents for Gründl near Nandlstadt/Hallertau.

When the art of brewing began in monasteries around 1000 A.D. the quality of the beer improved. Monks cultivated the hops in the monastery gardens as remedies with calming and styptic effects; presumably the monks were the first to recognize the special significance hops had for the brewing process. From then onwards monastery breweries and the administrators of the royal courts devoted themselves to its cultivation. With the development of the brewing trade and finally through the promulgation of the Purity Law in 1516 which stipulated that hops are an ingredient of beer, the hop production made a significant upswing.

In the Middle Ages the focus was on Northern Germany; an important brewing industry came into being in the regions which belonged to the Hanseatic League. Hops were merchandise for the Hansa towns. The first big hop-growing area in Southern Germany developed around the town of Spalt.
Quality was already an issue at an early stage: In order to protect the reputation of their hops, certain towns were given the right to seal the hops when marketing them: in 1538 the Eichstätt Prince-Bishop awarded the first German hop seal to the town of Spalt; an example which all the hop communities of repute followed one after the other. In 1929 the Hop Provenance Law was passed. It stipulated that hop seals were a binding commitment for all German production regions, therefore establishing the outstanding reputation of German seal hops worldwide.

Today German hops are grown in the production regions of Tettnang (Baden-Württemberg), Elbe-Saale (Thuringia, Saxony, Saxony-Anhalt), Baden-Bitburg (Rhineland-Palatinate) as well as in Spalt and the Hallertau (Bavaria). The Hallertau is the largest single hop-growing region in the world. Above all the naturally favourable climate and soil conditions contribute to the importance of German hop production.

**Competence relating to commerce and processing**

Only a third of the annual crop is used by German breweries. About two thirds are marketed worldwide. In the second half of the 19th century German hops were already being exported to the most remote corners of the world. The central terminal was the hop market in Nuremberg, which influenced hop prices throughout the world. With the start of the railway Nuremberg became a Central European railway junction. Know-how and business intelligence accumulated here. Big, financially strong wholesale firms with far-reaching business connections organised the purchasing, hop treatment, marketing and transportation – in 1858 there were 25 hop merchants based in Nuremberg, in 1895 there were as many as 364. About 30 big trading firms controlled the market and they competed for nearly 95% of the turnover.

Besides the traffic-related conditions technical changes also played a part in hop preservation and storage. The hop merchants had to ensure that the hops could be transported over great distances by applying suitable preparation and packaging techniques without the hops losing their aroma. In 1858 the Nuremberg hop market was the first to be permitted to sulphurize hops, which made it possible to keep them for several years without considerable impairment in quality. This permission put the Nuremberg hop market a good step ahead of the other markets. In particular the invention of the refrigerator by Carl von Linde contributed to enabling hops to be stored over a longer period of time. Up until 1900 Nuremberg remained the most important hop market in the world. At this time the German Reich accounted for 34.8% of the total hop acreage in the world, 28.1% of the world production of hops was harvested here.
Up until the 1960s the brewers solely wanted cone hops to brew their beer. Nowadays less than 5% of the annual hop crop are used as natural hops, more than 95% are processed into pellets or extract – hops in concentrated form – and vacuum-packed. They take up less storage space and keep longer than cone hops. The competence of German firms in refining hops is unique in the whole world.

Many of the important hop-trading and –processing firms are resident in Germany. The worldwide hop-trading firms with their hop-processing facilities and research laboratories have set up premises in the largest single production region in the world – the Hallertau – in order to be in direct contact with the hop-growers.

In the “Haus des Hopfens” in Wolnzach, the only service centre nationwide for the hop-growers (refer to Chapter Hop Service Centre Wolnzach) there are the offices of the trade associations of the German hop-growers: “German Hop Growers Assn.”, “Hallertau Hop Ring”, “Hallertau Hop Growers Assn.”, “Jura Producer Group for Quality Hops”, as well as the “Hop Producer Cooperative” and the “State Research Institute for Agriculture – Hops Dept.”.

And the leading scientific brewing and agrarian institutions of the Technical University of Munich-Weihenstephan in Freising as well as the Hop Research Centre in Hüll are not far away.
Successful research
When in 1926 the peronospora fungal disease destroyed almost the whole crop in the Hallertau, the German brewing industry in Hüll near Wolnzach founded the “Society for Hop Research” and the Hop Research Centre, among whose tasks it is to develop methods for controlling pests and developing modern production techniques.

In addition the Hop Research Centre in Hüll is well-known for its breeding successes. Up until the middle of the 20th century only one hop variety was grown in the production regions – the so-called traditional variety, which was named after the production region (Hallertauer, Hersbrucker, Spalter, Tettnanger).

As the hop requirements for the breweries had increased by the end of the 1950s, the hop acreage was expanded. As the picking and drying facilities available at the time were inadequate, the harvesting time had to be extended. So the Hop Research Centre also developed new varieties under the aspect of different harvesting times. In addition to this, the aim is to breed varieties which on the one hand meet the requirements of the hop-farmers regarding pest- and disease-resistance, good production properties as well as high yields and on the other hand which possess the outstanding brewing quality the brewing industry requires. These are on the one hand the meanwhile world-famous aroma varieties, e.g. Perle, Hallertauer Tradition and Spalter Select, which combine extremely fine aroma with optimum production properties and particularly resistance to various diseases. In cooperation with the hop-growers and hop merchants the Hüll hop-breeders have also developed the so-called high-alpha varieties such as Hallertauer Magnum and Hallertauer Taurus and successfully launched them on the market. These have a very high bitter content of 12-17% alpha-acids, which give the beer its bitter taste and stabilize the foam.

The latest research work regarding the tannin xanthohumol, which is solely present in the lupulin glands of the hops, is also evidence of German competence in the field of hops and beer. In tests xanthohumol was seen to have a particularly wide variety of positive health properties. Initial in-vitro studies indicated that xanthohumol may have an antcarcinogenic effect and a grow-inhibiting effect on certain tumour cells.
Hop Products
For a long time hops have been used as cone hops in brewing beer. At the same time the hop dosage was always subject to the natural quantitative fluctuations of the hop components.

In the twentieth century with the beginning of the industrial manufacturing of hop products in the 1960s, the breweries increasingly switched over to their use. The majority of the hops are processed in their natural state to hop pellets or hop extracts which are dosed in wort boiling.

Another part of the hops is processed to products with isomerised bitter acids or to hop-oil products (refer to family tree on right). Except in the brewhouse the latter are also added at later points during brewing such as e.g. during the filtration. This is why they are listed under the generic term Downstream Products.

On the other hand the xanthohumol-enriched hop products are the logical consequence from the physiologically very promising research findings so far available on xanthohumol and other flavonoids.

Today more than 95% of the hops worldwide are used in the form of products. Their advantage lies in better storage stability, their good homogeneity, greater efficiency as well as their easier dosage compared with cone hops.
Leaf hops (cone hops)

Conventional hop products

- hop pellets (type 90)
- Lupulin-enriched hop pellets (type 45)
- CO₂ hop extract
- Ethanol hop extract

Special hop products
- Hop Oils (separated according to fractions)
- Xanthohumol-enriched products
- Tannin extracts
- Beta extract products (Beta-acids with hop oils)

Isomerized hop products
- ISO extract
  For use following the fermentation (Downstream)
- Rho-extract
  Product stable to light
- Tetra extract
  Product stable to light
- Hexa extract
  Product stable to light
- Isomerized hop pellets*
- Isomerized kettle extract (IKE/PIKE)*
- Light-stable isomerized kettle extract*

*for use in the brewhouse
Procedure steps in the production

1. **Preparation:**
   Arranging the hop lots ready for processing.

2. **Depositing:**
   When deposited the hops are mixed from the various lots.

3. **Drying:**
   Hops finally dried in a hop kiln.

4. **Cleaning:**
   Separating foreign bodies, waste and metal residues.

5. **Deep freezing:**
   Leaf hops are deep-frozen at temperatures from approx. -30°C up to -40°C, by which the hop resin forfeits its stickiness.

6. **Milling:**
   Grinding the deep-frozen, brittle hops.

7. **Sieving:**
   In several successive sieving steps the hop powder is separated into lupulin and bracteole fractions. In this way the concentration of hop bitter compounds is considerably increased. Grinding and sieving is carried out at temperatures below -20°C.
8 **Standardising:**
At the customer’s wish the hop powder is generally set at a specific alpha-acid content. This is possible by dosing the leaf fraction to the bitter compound fraction, which analytically is monitored extremely accurately.

9 **Homogenising:**
The hop powder is thoroughly homogenised in the mixer and again checked analytically before pelletising.

10 **Pelletising:**
Compressing the hop powder into hop pellets in a pellet press.

11 **Cooling:**
Cooling the hop pellets directly after pelletising.

12 **Packaging:**
Filling the hop pellets into foil bags and cartons.

**Inspection:**
The processing is subject to official inspection. The packed product is certified as required by law.

Lupulin-enriched hop pellets (type 45) are generally standardised to a specific bitter content. They contain the total lupulin and hence the natural bitter acids and aroma substances of the cone hops which are relevant to brewing. In a refrigerated state the product has good storage stability.
Hop pellets (type 90)

Procedure steps in the production

1. Preparation:
   Arranging the hop lots for processing.

2. Depositing:
   When deposited the hops are mixed from the various lots.

3. Drying:
   Final drying of the hops in a hop kiln.

4. Cleaning:
   Separating foreign bodies, waste and metal residues,

5. Milling:
   Grinding the hops to hop powder in a mill.

6. Pelletisation:
   Compressing the hop powder to hop pellets in a pellet press.
7 **Cooling:**
Cooling the hop pellets directly after pelletisation.

8 **Packaging:**
Filling the hop pellets from a buffer silo into foil bags and cartons.

**Inspection:**
The processing is subject to official inspection. The packed product is certified as required by law.

Hop pellets (type 90) contain the hop components in the same natural composition as the cone hops. Due to processing the product is more homogeneous and due to packaging in a refrigerated state has good storage stability.
**Procedure steps in the production**

The hops are pelletised prior to making CO\(_2\) hop extract. These hop pellets are filled into the extraction vessels. Extraction is carried out in a cyclic process.

1. **Starting the extraction:**
   Liquid CO\(_2\) is brought to the required operating point (pressure, temperature) by means of a pump and a heat exchanger.

2. **Extraction:**
   The CO\(_2\) flows through the hop pellets and releases hop oils and resins from the hop pellets.

3. **Decrease in pressure:**
   The pressure is reduced.

4. **Evaporation:**
   In order to compensate for cooling caused by relieving pressure the CO\(_2\) is evaporated in a heat exchanger.

5. **Separation:**
   The hop extract is separated from the gaseous CO\(_2\).
6 Condensation:
The CO₂ is liquefied in a condenser.

7 Cyclic process:
The liquefied CO₂ is recycled.

8 Homogenising:
The hop extract is homogenised in a collecting tank.

9 Packaging:
The pure hop extract obtained is usually filled directly. At the customer’s wish it is filled into drums or bulk packs which are used in automatic dosing units.

Inspection:
The processing is subject to official inspection. The packed product is certified as required by law.

With the appropriate pressure the CO₂ works as a non-polar extraction agent. It dissolves the soft resins and essential oils from the lupulin in the hops. In a refrigerated state the natural pure resin extracts obtained have very good storage stability.
Procedure steps in the production

1. **Extraction:**
   The coarsely milled leaf hops with the waste and metal residues removed are mixed with ethyl alcohol. An extractor is charged with this mixture and an alcoholic solution is gained in the classic reverse flow procedure. This solution contains the whole spectrum of hop bitter compounds as well as a part of the tannins.

2. **Evaporation:**
   Solid particles are completely separated from the alcoholic solution via a centrifuge. Afterwards a concentration of the solution is obtained in an evaporator at low evaporation temperatures and under high vacuum.
3 **Homogenising:**
The hop extract is homogenised in a collecting tank.

4 **Filling / Packaging:**
The pure resin extract obtained is usually filled directly. At the customer’s wish it is filled into drums or bulk packs which are used in automatic dosing units.

**Inspection:**
The processing is subject to official inspection. The packed product is certified as required by law.

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**Ethanol-Extract - Chart showing the production**

Ethanol as a means of extraction releases the soft and hard resins as well as the essential oils from the lupulin in the hops. The natural pure resin extracts obtained have very good storage stability.
Hop varieties from Germany

Aroma evaluation of hops

Summery of varieties:
- Hallertauer Mittelfrüher
- Spalter
- Tettnanger
- Hersbrucker Spät
- Hallertauer Tradition
- Spalter Select
- Perle
- Saphir
- Smaragd
- Opal
- Hallertauer Magnum
- Hallertauer Taurus

Brewing trials

Characterising the aroma and taste profiles
For the first time an aroma appraisal was conducted for all the German hop varieties available on the market — even the new ones — in order to convey the specific features of the various hops even better.

During several sessions at the hop-trading firms (Joh. Barth & Sohn, Hopsteiner and HVG) four samples of differing provenience were taken and evaluated from each of the leaf hops.

Experienced hop inspectors conducting an aroma test in the Hopsteiner laboratory: (from left) Martin Schäffl-Pichlmaier (Hopsteiner), Stefan Stanglmair (Joh. Barth & Sohn), Herbert Ehrmaier (former breeder), Richard Schmid (Hopsteiner), Erhard Gagger (Hopfenpflanzerverband), Anton Lutz (Hüll breeder), Josef Reith (HVG)
The spirit of beer – Hops from Germany

Appraisal of hop aroma

The assessment was based on standard criteria which had been determined in complex test series during the spring: On the one hand the intensity of typical hop aromas such as “flowery”, “citrous”, “fruity”, “current-like”, “sweet” and “spicy”. On the other hand the overall impression from “harmonious to pungent”, from “long-lasting to quickly disappearing” and from “mild to intensive”. The aroma appraisal was conducted by selected representatives from the hop-trading firms Joh. Barth & Sohn, Hopsteiner and HVG, the Hop-Growers Association and the Research Centre in Hüll – all of them “hop noses” with many years of experience in assessing hops.

**Headspace Gaschromatogramme (variety “Magnum”)**

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene

Scientific evaluation of the hop components – here taking the example of the variety “Magnum”

- myrcene (1)
- linalool (2)
- beta-caryophyllene (3)
- aromadendrene (4)
- humulene (5)
- farnesene (6)
- beta-selinene (7)
- alpha-selinene (8)
16 VARIETIES of German Hops

The spirit of beer
Hops from Germany
Brewing trials
Characterising the aroma and taste profiles
In order to complete the characterisation of the hop varieties described in the CMA Variety Portfolio on hand with regard to their agronomic, analytical and sensory properties, in 2005 brewing trials were conducted in an experimental brewery in 2hl scale. Furthermore a documented brewing process was used which will also allow newly authorized varieties in the future to be brewed according to this procedure and the results to be included in the Variety Portfolio.

**Raw commodities**
Water with a low residual alkalinity was used with a very pale, extract strong pilsner malt. With a gentle mashing method this resulted in a very light beer with only a slight malt flavour, which is the basic requirement for an optimum assessment of the hops used. Representative, pure variety pellets, type 90 of the 2004 crop were used for the hopping. Where this was not possible due to the amount being too small, ground leaf hop samples were used. In each case the bottom yeast was obtained fresh from a brewery.

**Brewing process**
The pilsner malt ground on a two-roll mill was mashed in an infusion mashing process (refer to diag. below) and drawn off in a lauter tun (first wort and 7 after worts). Following that, the wort obtained was atmospherically boiled for 85 minutes in the coppers by means of an internal boiler. The hop dosage was calculated according to alpha-acid and was made in consideration of the yields known in the experimental brewery. 60% were dosed at the beginning of the boil and to obtain a distinct hop aroma 40% were dosed in the whirlpool.
At the same time hop varieties were treated equally, otherwise the contribution a bitter dosing can make to the beer aroma compared with an aroma dosing can hardly be evaluated.

After a 20-minute rest in the whirlpool the wort was cooled to 7 °C, aerated and pitched with 20-25 million cells/ml. After 7 days primary fermentation at 8 °C it was piped with residual extract and maturation was carried out at 14 °C. When the attenuation limit and diacetyl degradation had been reached, it was refrigerated to 1 °C and stored for 3 weeks.

Filtration was by means of a kieselgur horizontal filter with following membrane filter candles (1.2 and 0.45 µm). Bottling was in 0.5 litre disposable bottles with double pre-evacuation and levelling correction with pure CO₂.

**Analytics**
The beers produced in this way were subject to a beer analysis (original gravity, alcohol, degree of attenuation, pH, CO₂ content, foam etc.), in order to ensure the comparability of the trials. Furthermore the hop-specific analysing criteria – bitter compounds, xanthohumol and iso-xanthohumol content, total polyphenols and linalool content were analysed and stated in the supplement “Brewing trials” for each respective variety in the Variety Portfolio.

**Sensory evaluation**
The beers were assessed sensorily by experienced tasters in the hop industry. The tasters were thoroughly trained for this task using a specially developed taster sheet (illustrated overpage). At the same time particularly the intensity of the hop aroma in smell and taste was assessed as well as the intensity and harmony of the bitterness.

For the evaluation of the aroma impressions they mainly fell back on the terminology used in the hop evaluation, by which the descriptors “fruity”, “flowery”, “citrusy” and “hoppy” (spicy like fresh hops) were adopted. In addition the descriptor “herbal” (in the positive sense of herbal) was adopted.

A sweet taste in the beer usually comes from malt or otherwise inadequate fermentation and a currant aroma in beer is known to be linked with aging. Therefore an assessment was omitted with regard to these impressions.

For the aroma impressions the evaluation of these tasting results was shown separately for smell and taste in the spider diagrams, the bitterness was shown in a bar chart.
### I. Hop aroma

<table>
<thead>
<tr>
<th>Smell</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruity</td>
<td>not trace somewhat perceptible distinct intensive</td>
</tr>
<tr>
<td>Flowery</td>
<td>not trace somewhat perceptible distinct intensive</td>
</tr>
<tr>
<td>Citrusy</td>
<td>not trace somewhat perceptible distinct intensive</td>
</tr>
<tr>
<td>Herbal</td>
<td>not trace somewhat perceptible distinct intensive</td>
</tr>
<tr>
<td>Hoppy</td>
<td>not trace somewhat perceptible distinct intensive</td>
</tr>
</tbody>
</table>

### II. Description of the hop aroma

<table>
<thead>
<tr>
<th>Smell</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruity</td>
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<td>Flowery</td>
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<tr>
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<td>not trace somewhat perceptible distinct intensive</td>
</tr>
<tr>
<td>Hoppy</td>
<td>not trace somewhat perceptible distinct intensive</td>
</tr>
</tbody>
</table>

### III. Bitterness

<table>
<thead>
<tr>
<th>Overall intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>not trace somewhat perceptible distinct intensive</td>
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</tbody>
</table>

### IV. Tasting Variety Portfolio

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Appropriate to Type</th>
<th>Strong</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

### Brewing Trials

<table>
<thead>
<tr>
<th>Beer No.:</th>
<th>Date:</th>
<th>Name:</th>
</tr>
</thead>
</table>
Hallertauer Mittelfrüher

**Characteristics**

**Bitter substances**
- alpha-acids: 3.0 – 5.5 % *
- beta-acids: 3.0 – 5.0 % *
- cohumulone: 18 – 28 %
- colupulone: 36 – 44 %

**Polyphenols**
- total content: 4.0 – 5.0 % *
- xanthohumol: 0.2 – 0.3 % *

**Aroma substances**
- total oil: 0.7 – 1.3 % *
- myrcene: 20 – 28 %
- linalool: 0.7 – 1.1 %
- beta-caryophyllene: 10 – 15 %
- aromadendrene: < 0.2 %
- humulene: 45 – 55 %
- farnesene: < 1 %
- beta-selinene: 1.0 – 1.5 %
- alpha-selinene: 1.0 – 1.5 %

**Resistance to disease:**
- wilt: very low
- downy mildew: low
- powdery mildew: average

**Ripening time:**
- early

**Storage stability:**
- average

**Average yield:**
- 1,250 kg/ha

**Very fine aroma variety**
- average bitter value
- very good aroma
- average storage stability

**Headspace Gaschromatogramme**

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene
The aroma variety Hallertauer Mittelfrüher is the traditional local variety in the Hallertau. As it is highly susceptible to wilt the yields fluctuate. Therefore it is a risk to plant it on new sites which are threatened by wilt.
1. Beer Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>6.2 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>13.0 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.3 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>22.5 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>25 EBC-BU</td>
</tr>
<tr>
<td>iso-xanthohumol</td>
<td>0.62 mg/l</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>0.02 mg/l</td>
</tr>
<tr>
<td>linalool</td>
<td>84 µg/l</td>
</tr>
<tr>
<td>total polyphenols</td>
<td>247 mg/l</td>
</tr>
</tbody>
</table>

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Hallertauer Mittelfrüher can be distinguished in beer by an intensive, pleasantly harmonic bitterness. In smell it has a distinctly flowery as well as fruity-hoppy aroma, whereas in taste the hoppy tang is more prevalent.

4. Sensory Evaluation of the Bitterness
Spalter

Characteristics

Bitter substances
alpha-acids  2.5 – 5.5 % *  
beta-acids   3.0 – 5.0 % * 
cohumulone   22 – 29 % x  
colupulone   40 – 45 % x  

Polyphenols
total content  5.0 – 6.0 % *  
xanthohumol  ca.0.3 % *

Aroma substances
total oil  0.5 – 0.9 % *  
myrcene  20 – 35 % x  
linalool  0.5 – 0.8 % x  
beta-caryophyllene  8 – 13 % x  
aromadendrene < 0.2 % x  
humulene  20 – 30 % x  
farnesene  12 – 18 % x  
beta-selinene  0.5 – 1.0 % x  
alpha-selinene  0.5 – 1.0 % x  

Resistance to disease:
• wilt  good to very good
• downy mildew  average to low
• powdery mildew  average to good

Ripening time  early
Storage stability  average
Average yield  1,200 kg/ha

Very fine aroma variety
• average bitter value
• very good aroma
• average storage stability

Headspace Gaschromatogramme

1 = myrcene  ·  ISN = internal standard  ·  2 = linalool  ·  3 = beta-caryophyllene  ·  4 = aromadendrene  ·  5 = humulene  ·  6 = farnesene  
7 = beta-selinene  ·  8 = alpha-selinene

*weight-%  –  x% relative  –  • ml/100g hops
Spalter
**Bitter substances**
- alpha-acids: 2.5 – 5.5 %
- beta-acids: 3.0 – 5.0 %
- cohumulone: 22 – 29 %
- colupulone: 40 – 45 %

**Polyphenols**
- total content: 5.0 – 6.0 %
- xanthohumol: ca.0.3 %

**Aroma substances**
- total oil: 0.5 – 0.9 %
- myrcene: 20 – 35 %
- linalool: 0.5 – 0.8 %
- beta-caryophyllene: 8 – 13 %
- aromadendrene: < 0.2 %
- humulene: 20 – 30 %
- farnesene: 12 – 18 %
- beta-selinene: 0.5 – 1.0 %
- alpha-selinene: 0.5 – 1.0 %

**Resistance to disease:**
- wilt: good to very good
- downy mildew: average to low
- powdery mildew: average to good

**Ripening time:** early

**Storage stability:** average

**Average yield:** 1,200 kg/ha

**Very fine aroma variety**
- average bitter value
- very good aroma
- average storage stability

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**Headspace Gaschromatogramme**

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene
The local variety Spalter belongs to the Saazer range and is solely grown in Spalt. It is relatively resistant to wilt and other diseases. The yields are not always satisfactory.
## Brewing trial: Spalter

### 1. Beer Analysis

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>7.2 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>12.8 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.3 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>23.3 mg/l</td>
</tr>
<tr>
<td>Bitterness</td>
<td>27 EBC-BU</td>
</tr>
<tr>
<td>iso-xanthohumol</td>
<td>0.75 mg/l</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>0.01 mg/l</td>
</tr>
<tr>
<td>linalool</td>
<td>49 µg/l</td>
</tr>
<tr>
<td>Total polyphenols</td>
<td>253 mg/l</td>
</tr>
</tbody>
</table>

### 2. Sensory Evaluation “Hop Aroma” (Smell)

[Spider diagram showing sensory evaluation scores for fruity, hoppy, flowery, herbal, and citrussy attributes for Base Beer and Beer produced with the variety SPALTER.]
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Spalter imparts the beer a strong but harmonic bitterness. In smell all the aroma impressions except citrussy are evident, in taste the hoppy character distinctly stands out.

4. Sensory Evaluation of the Bitterness

The variety Spalter imparts the beer a strong but harmonic bitterness. In smell all the aroma impressions except citrussy are evident, in taste the hoppy character distinctly stands out.
Tettnanger
# Tettnanger

## Characteristics

### Bitter substances

<table>
<thead>
<tr>
<th>Substance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>alpha-acids</td>
<td>2.5 – 5.5 %</td>
</tr>
<tr>
<td>beta-acids</td>
<td>3.0 – 5.0 %</td>
</tr>
<tr>
<td>cohumulone</td>
<td>22 – 28 %</td>
</tr>
<tr>
<td>colupulone</td>
<td>40 – 45 %</td>
</tr>
</tbody>
</table>

### Polyphenols

<table>
<thead>
<tr>
<th>Substance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>total content</td>
<td>5.0 – 6.0 %</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>0.3 – 0.4 %</td>
</tr>
</tbody>
</table>

### Aroma substances

<table>
<thead>
<tr>
<th>Substance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>total oil</td>
<td>0.5 – 0.9 %</td>
</tr>
<tr>
<td>myrcene</td>
<td>20 – 35 %</td>
</tr>
<tr>
<td>linalool</td>
<td>0.4 – 0.9 %</td>
</tr>
<tr>
<td>beta-caryophyllene</td>
<td>6 – 11 %</td>
</tr>
<tr>
<td>aromadendrene</td>
<td>&lt; 0.2 %</td>
</tr>
<tr>
<td>humulene</td>
<td>22 – 32 %</td>
</tr>
<tr>
<td>farnesene</td>
<td>16 – 24 %</td>
</tr>
<tr>
<td>beta-selinene</td>
<td>0.5 – 1.0 %</td>
</tr>
<tr>
<td>alpha-selinene</td>
<td>0.5 – 1.0 %</td>
</tr>
</tbody>
</table>

### Resistance to disease:

- Wilt: good
- Downy mildew: average to low
- Powdery mildew: average

### Ripening time: early

### Storage stability: average

### Average yield: 1,300 kg/ha

**Very fine aroma variety**

- Average bitter value
- Very good aroma
- Average storage stability

---

**Headspace Gaschromatogramme**

[Graph showing gas chromatogram with peaks labeled 1 to 8, and text explaining the peaks correspond to specific compounds.]
The local variety Tettnanger belongs to the Saazer range. It is solely grown in Tettnang and produces average yields.
1. Beer Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Concentration</th>
<th>Component</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>7.4 mg/l</td>
<td>iso-xanthohumol</td>
<td>0.73 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>11.3 mg/l</td>
<td>xanthohumol</td>
<td>nd*</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.2 mg/l</td>
<td>linalool</td>
<td>54 µg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>21.9 mg/l</td>
<td>total polyphenols</td>
<td>251 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>25 EBC-BU</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)

![Sensory Evaluation Diagram]

- fruity
- hoppy
- flowery
- herbal
- citrussy

Base Beer
Beer produced with the variety TETTNANGER
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Tettnanger imparts the beer a harmonic bitterness of medium intensity. In smell all aroma impressions are evident. In taste particularly citrussy and herbal flavours are evident as well as a hoppy flavour.

4. Sensory Evaluation of the Bitterness

The variety Tettnanger imparts the beer a harmonic bitterness of medium intensity. In smell all aroma impressions are evident. In taste particularly citrussy and herbal flavours are evident as well as a hoppy flavour.
Hersbrucker Spät
**Hersbrucker Spät**  
*Characteristics*

<table>
<thead>
<tr>
<th>Bitter substances</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>alpha-acids</td>
<td>1.5 – 4.0 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>beta-acids</td>
<td>2.5 – 6.0 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cohumulone</td>
<td>17 – 25 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>colupulone</td>
<td>34 – 39 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Polyphenols       |             |     |     |     |     |     |
| total content     | 5.0 – 6.0 % |     |     |     |     |     |
| xanthohumol       | ca. 0.2 %   |     |     |     |     |     |

| Aroma substances  |             |     |     |     |     |     |
| total oil         | 0.5 – 1.0 % |     |     |     |     |     |
| myrcene           | 15 – 30 %   |     |     |     |     |     |
| linalool          | 0.5 – 1.0 % |     |     |     |     |     |
| beta-caryophyllene| 8 – 13 %    |     |     |     |     |     |
| aromadendrene     | 2.0 – 4.0 % |     |     |     |     |     |
| humulene          | 20 – 30 %   |     |     |     |     |     |
| farnesene         | < 1 %       |     |     |     |     |     |
| beta-selinene     | 4.0 – 6.0 % |     |     |     |     |     |
| alpha-selinene    | 4.0 – 6.0 % |     |     |     |     |     |

| Fine aroma variety|             |     |     |     |     |     |
| low bitter value  | •           |     |     |     |     |     |
| good aroma        | •           |     |     |     |     |     |
| low storage stability| •       |     |     |     |     |     |

| Resistance to disease: |             |     |     |     |     |     |
| wilt                   | average     |     |     |     |     |     |
| downy mildew           | low to very low |   |     |     |     |     |
| powdery mildew         | average to low |   |     |     |     |     |

| Ripening time          | medium late to late |     |     |     |     |     |
| Storage stability      | low             |     |     |     |     |     |
| Average yield          | 1,700 kg/ha     |     |     |     |     |     |

<table>
<thead>
<tr>
<th>Headspace Gaschromatogramme</th>
</tr>
</thead>
</table>

*weight-% – (%) relative – (ml/100g hops*)

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene
The local variety Hersbrucker Spät is vigorous and robust, but somewhat susceptible to downy mildew.
Brewing trial: Hersbrucker Spät

1. Beer Analysis

<table>
<thead>
<tr>
<th></th>
<th>Base Beer</th>
<th>Hersbrucker Spät</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>5.6 mg/l</td>
<td>5.6 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>13.0 mg/l</td>
<td>13.0 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.2 mg/l</td>
<td>3.2 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>21.8 mg/l</td>
<td>21.8 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>26 EBC-BU</td>
<td>26 EBC-BU</td>
</tr>
</tbody>
</table>

iso-xanthohumol 0.49 mg/l
xanthohumol nd*
linalool 104 µg/l
total polyphenols 272 mg/l

* nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Hersbrucker Spät imparts the beer a very harmonic bitterness of medium intensity. The smell is characterized by all the aroma impressions, whereby the flowery, hoppy and fruity impressions are a little stronger. In taste the hoppy aroma is prevalent.

4. Sensory Evaluation of the Bitterness

The variety Hersbrucker Spät imparts the beer a very harmonic bitterness of medium intensity. The smell is characterized by all the aroma impressions, whereby the flowery, hoppy and fruity impressions are a little stronger. In taste the hoppy aroma is prevalent.
Hallertauer Tradition
### Hallertauer Tradition

#### Characteristics

**Bitter substances**
- alpha-acids: 4.0 – 7.0 % *
- beta-acids: 3.0 – 6.0 % *
- cohumulone: 24 – 30 % x
- colupulone: 41 – 49 % x

**Polyphenols**
- total content: 4.0 – 5.0 % *
- xanthohumol: ca. 0.4 % *

**Aroma substances**
- total oil: 0.5 – 1.0 % *
- myrcene: 17 – 32 % x
- linalool: 0.7 – 1.2 % x
- beta-caryophyllene: 10 – 15 % x
- aromadendrene: < 0.2 % x
- humulene: 35 – 50 % x
- farnesene: < 1 % x
- beta-selinene: 0.5 – 1.0 % x
- alpha-selinene: 0.5 – 1.0 % x

**Very fine aroma variety**
- average to higher bitter value
- very good aroma
- good storage stability

**Resistance to disease:**
- wilt: good
- downy mildew: good to very good
- powdery mildew: average

**Ripening time**: medium early
**Storage stability**: good
**Average yield**: 1,850 kg/ha

---

**Headspace Gaschromatogramme**

![Gaschromatogramme](graph.png)

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene
7 = beta-selinene · 8 = alpha-selinene

---

* = weight-%  
% = relative  
• = ml/100g hops

---

**Notes:**
- 1 = myrcene
- ISN = internal standard
- 2 = linalool
- 3 = beta-caryophyllene
- 4 = aromadendrene
- 5 = humulene
- 6 = farnesene
- 7 = beta-selinene
- 8 = alpha-selinene
Hallertauer Tradition

Evaluation

- **Aroma Specification**
  - Flowery
  - Citrous
  - Fruity
  - Current-like
  - Sweet
  - Spicy

- **Overall Impression**
  - Pungent
  - Rapidly disappearing
  - Intensive
  - Harmonious
  - Lasting
  - Full
  - Mild

Hallertauer Tradition is a product of the Hop Research Centre in Hüll with good resistance characteristics, high yields and very good production characteristics. This aroma variety was registered as a variety in 1993.
Brewing trial: Hallertauer Tradition

1. Beer Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>7.3 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>11.8 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.4 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>22.5 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>24 EBC-BU</td>
</tr>
<tr>
<td>iso-xanthohumol</td>
<td>0.51 mg/l</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>nd*</td>
</tr>
<tr>
<td>linalool</td>
<td>47 µg/l</td>
</tr>
<tr>
<td>total polyphenols</td>
<td>208 mg/l</td>
</tr>
</tbody>
</table>

*nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Hallertauer Tradition imparts the beer an intensive, harmonic bitterness. In smell the aroma is characterized by flowery and herbal impressions. In taste besides the herbal flavours there is also a hoppy tang.

4. Sensory Evaluation of the Bitterness

The spirit of beer – Hops from Germany
**Bitter substances**
- **alpha-acids** 3.0 – 6.5 %
- **beta-acids** 2.5 – 5.0 %
- **cohumulone** 21 – 27 %
- **colupulone** 37 – 46 %

**Polyphenols**
- **total content** 4.0 – 5.0 %
- **xanthohumol** 0.3 – 0.5 %

**Aroma substances**
- **total oil** 0.6 – 0.9 %
- **myrcene** 20 – 40 %
- **linalool** 1.0 – 1.5 %
- **beta-caryophyllene** 4 – 10 %
- **aromadendrene** 0.5 – 1.5 %
- **humulene** 10 – 22 %
- **farnesene** 15 – 22 %
- **beta-selinene** 2.0 – 4.0 %
- **alpha-selinene** 2.0 – 4.0 %

**Resistance to disease:**
- **wilt** good to very good
- **downy mildew** good
- **powdery mildew** average

**Ripening time**
- medium late

**Storage stability**
- low

**Average yield**
- 1,900 kg/ha

**Very fine aroma variety**
- average bitter value
- very good aroma
- low storage stability

---

**Headspace Gaschromatogramme**

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene
Spalter Select

Evaluation

Spalter Select is a product of the Hop Research Centre in Hüll with good resistance characteristics and high yields. This aroma variety was registered as a variety in 1993.
1. Beer Analysis

<table>
<thead>
<tr>
<th>Compound</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>6.7 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>13.2 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.1 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>23.0 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>24 EBC-BU</td>
</tr>
<tr>
<td>iso-xanthohumol</td>
<td>0.72 mg/l</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>nd*</td>
</tr>
<tr>
<td>linalool</td>
<td>73 µg/l</td>
</tr>
<tr>
<td>total polyphenols</td>
<td>264 mg/l</td>
</tr>
<tr>
<td>nd: not detectable</td>
<td></td>
</tr>
</tbody>
</table>

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

Beer of the variety Spalter Select is marked by a pleasant, harmonic bitterness of medium intensity. Its aroma is characterized by a hoppy tang as well as fruity and flowery impressions both in smell and taste.

4. Sensory Evaluation of the Bitterness

Beer of the variety Spalter Select is marked by a pleasant, harmonic bitterness of medium intensity. Its aroma is characterized by a hoppy tang as well as fruity and flowery impressions both in smell and taste.
Perle
## Perle

### Characteristics

<table>
<thead>
<tr>
<th>Bitterstoffe</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>alpha-acids</td>
<td>4.0 – 9.0 % *</td>
</tr>
<tr>
<td>beta-acids</td>
<td>2.5 – 4.5 % *</td>
</tr>
<tr>
<td>coloumone</td>
<td>29 – 35 % x</td>
</tr>
<tr>
<td>colupulone</td>
<td>48 – 60 % x</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Polyphenols</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>total content</td>
<td>3.0 – 5.0 % *</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>0.4 – 0.5 % *</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aroma substances</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>total oil</td>
<td>0.5 – 1.5 % *</td>
</tr>
<tr>
<td>myrcene</td>
<td>20 – 35 % x</td>
</tr>
<tr>
<td>linalool</td>
<td>0.2 – 0.6 % x</td>
</tr>
<tr>
<td>beta-caryophyllene</td>
<td>10 – 20 % x</td>
</tr>
<tr>
<td>aromadendrene</td>
<td>&lt; 0.2 % x</td>
</tr>
<tr>
<td>humulene</td>
<td>35 – 55 % x</td>
</tr>
<tr>
<td>farnesene</td>
<td>&lt; 1 % x</td>
</tr>
<tr>
<td>beta-selinene</td>
<td>0.2 – 0.7 % x</td>
</tr>
<tr>
<td>alpha-selinene</td>
<td>0.2 – 0.7 % x</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fine aroma variety</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• average to higher bitter</td>
<td></td>
</tr>
<tr>
<td>• good aroma</td>
<td></td>
</tr>
<tr>
<td>• good storage stability</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resistance to disease:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• wilt</td>
<td>good to very good</td>
</tr>
<tr>
<td>• downy mildew</td>
<td>good to very good</td>
</tr>
<tr>
<td>• powdery mildew</td>
<td>average to low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ripening time</th>
<th>medium late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage stability</td>
<td>good</td>
</tr>
<tr>
<td>Average yield</td>
<td>1,800 kg/ha</td>
</tr>
</tbody>
</table>

### Headspace Gaschromatogramme

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene

**weight-% – (x) relative – (•) ml/100g hops**
The aroma variety Perle is a product of the Hop Research Centre in Hüll with good resistance characteristics, high yields and very good production characteristics. This aroma variety was registered as a variety in 1978. In the 1990s it became very popular with the hop-growers.
### 1. Beer Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>8.6 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>10.2 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.4 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>22.2 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>24 EBC-BU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>iso-xanthohumol</td>
<td>0.66 mg/l</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>nd*</td>
</tr>
<tr>
<td>linalool</td>
<td>22 µg/l</td>
</tr>
<tr>
<td>total polyphenols</td>
<td>190 mg/l</td>
</tr>
</tbody>
</table>

*nd: not detectable

### 2. Sensory Evaluation “Hop Aroma” (Smell)

![Spider diagram showing sensory evaluation](image)

- **fruity**: 7.0
- **hoppy**: 6.0
- **flowery**: 5.0
- **herbal**: 4.0
- **citrussy**: 3.0
- **total**
  - Base Beer
  - Beer produced with the variety PERLE
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Perle imparts the beer a harmonic, not too intensive bitterness. The aroma is delicate, both in smell and taste it inclines towards a hoppy tang as well as fruity and flowery flavours.

4. Sensory Evaluation of the Bitterness

The variety Perle imparts the beer a harmonic, not too intensive bitterness. The aroma is delicate, both in smell and taste it inclines towards a hoppy tang as well as fruity and flowery flavours.
Saphir
Bitter substances
alpha-acids 2.0 – 4.5 % *
beta-acids 4.0 – 7.0 % *
cohumulone 12 – 17 % x
colupulone 39 – 47 % x

Polyphenols
total content 4.0 – 5.0 % *
xanthohumol 0.3 – 0.4 % *

Aroma substances
total oil 0.8 – 1.4 % *
myrcene 25 – 40 % x
linalool 0.8 – 1.3 % x
beta-caryophyllene 9 – 14 % x
aromadendrene 9 – 14 % x
humulene 20 – 30 % x
farnesene < 1 % x
beta-selinene 2.0 – 4.0 % x
alpha-selinene 2.0 – 4.0 % x

Resistance to disease:
• wilt good to very good
• downy mildew average to good
• powdery mildew good

Ripening time
medium early

Storage stability
average

Average yield
1,750 kg/ha

*weight-% – x% relative – ml/100g hops

Headspace Gaschromatogramme

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene
7 = beta-selinene · 8 = alpha-selinene
Saphir is a product of the Hop Research Centre in Hüll with good resistance characteristics, average yields and very good production characteristics. This aroma variety was registered as a variety in 2002.
Brewing trial: Saphir

1. Beer Analysis

<table>
<thead>
<tr>
<th>Compound</th>
<th>Base Beer</th>
<th>Beer produced with the variety SAPHIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>4.6 mg/l</td>
<td>0.85 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>13.9 mg/l</td>
<td>nd*</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>2.5 mg/l</td>
<td>0.85 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>21.0 mg/l</td>
<td>0.85 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>28 EBC-BU</td>
<td>28 EBC-BU</td>
</tr>
</tbody>
</table>

* nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

Beers of the variety Saphir are marked by a distinct harmonic bitterness of medium intensity. In smell the distinct aroma is defined by flowery and fruity impressions, in taste also by a hoppy tang.

4. Sensory Evaluation of the Bitterness
Smaragd
**Smaragd**

**Characteristics**

**Bitter substances**
- alpha-acids: 4.0 – 6.0 % *
- beta-acids: 3.5 – 5.5 % *
- cohumulone: 13 – 18 % x
- colupulone: 38 – 48 % x

**Polyphenols**
- total content: 4.0 – 6.0 % *
- xanthohumol: 0.2 – 0.3 % *

**Aroma substances**
- total oil: 0.4 – 0.8 % *
- myrcene: 20 – 40 % x
- linalool: 0.9 – 1.4 % x
- beta-caryophyllene: 9 – 14 % x
- aromadendrene: < 0.2 % x
- humulene: 30 – 50 % x
- farnesene: < 1 % x
- beta-selinene: 0.3 – 0.8 % x
- alpha-selinene: 0.3 – 0.8 % x

**Resistance to disease:**
- wilt: good
- downy mildew: good
- powdery mildew: average to low

**Ripening time:** medium late

**Storage stability:** average

**Average yield:** 1,850 kg/ha

**Very fine aroma variety**
- average to high bitter value
- very good aroma
- average storage stability

---

**Headspace Gaschromatogramme**

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene

*weight-% – % relative – ml/100g hops
Smaragd is an aroma variety from the Hop Research Centre in Hüll with good resistance characteristics, high yields and good production characteristics. The registration of this new aroma variety is expected in 2005.
1. Beer Analysis

co-isohumulone 5.2 mg/l  
n-isohumulone 13.1 mg/l  
ad-isohumulone 2.7 mg/l  
Σ isohumulones 21.0 mg/l  
bitterness 23 EBC-BU  

iso-xanthohumol 0.51 mg/l  
xanthohumol nd*  
linalool 102 µg/l  
total polyphenols 205 mg/l  

* nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The bitterness in the beer imparted by the variety Smaragd is harmonic with medium intensity. Both in smell and taste the aroma is predominantly fruity, hoppy and flowery.

4. Sensory Evaluation of the Bitterness

The bitterness in the beer imparted by the variety Smaragd is harmonic with medium intensity. Both in smell and taste the aroma is predominantly fruity, hoppy and flowery.
Opal
Opal

Characteristics

Bitter substances
alpha-acids 5.0 – 8.0 % *
beta-Säuren 3.5 – 5.5 % *
cohumulone 13 – 17 %
colupulone 33 – 48 %

Polyphenols
total content 3.0 – 5.0 % *
xanthohumol ca. 0.4 %

Aroma substances
total oil 0.8 – 1.3 % *
myrcene 20 – 45 %
linalool 1.0 – 1.5 %
beta-caryophyllene 8 – 15 %
aromadendrene < 0.2 %
humulene 30 – 50 %
farnesene < 1 %
beta-selinene 0.3 – 0.8 %
alpha-selinene 0.3 – 0.8 %

Fine aroma variety
• average to high bitter value
• good aroma
• average storage stability

Resistance to disease:
• wilt good
• downy mildew good
• powdery mildew good

Ripening time medium early
Storage stability average
Average yield 1,850 kg/ha

Headspace Gaschromatogramme

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene

*weight-% – % relative – ml/100g hops
Opal is an aroma variety from the Hop Research Centre in Hüll with good resistance characteristics, high yields and very good production characteristics. This aroma variety was registered as a variety in 2001 and has been marketed since 2004.
Brewing trial: Opal

1. Beer Analysis

<table>
<thead>
<tr>
<th>Compound</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>4.3 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>13.7 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>2.5 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>20.5 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>23 EBC-BU</td>
</tr>
<tr>
<td>iso-xanthohumol</td>
<td>0.47 mg/l</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>nd*</td>
</tr>
<tr>
<td>linalool</td>
<td>67 µg/l</td>
</tr>
<tr>
<td>total polyphenols</td>
<td>172 mg/l</td>
</tr>
</tbody>
</table>

* nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The bitterness in the beer of the variety Opal is not too strong with a distinctive harmony. In smell there is an almost even dispersal of all aroma impressions, in the taste the citrussy flavour is a little weaker.

4. Sensory Evaluation of the Bitterness

The bitterness in the beer of the variety Opal is not too strong with a distinctive harmony. In smell there is an almost even dispersal of all aroma impressions, in the taste the citrussy flavour is a little weaker.
Hallertauer Magnum
**Bitter substances**
- alpha-acids: 11.0 – 16.0 % *
- beta-acids: 5.0 – 7.0 % *
- cohumulone: 21 – 29 % x
- colupulone: 38 – 48 % x

**Polyphenols**
- total content: 2.0 – 3.0 % *
- xanthohumol: 0.4 – 0.5 % *

**Aroma substances**
- total oil: 1.6 – 2.6 % *
- myrcene: 30 – 45 % x
- linalool: 0.2 – 0.7 % x
- beta-caryophyllene: 8 – 13 % x
- aromadendrene: < 0.2 % x
- humulene: 30 – 45 % x
- farnesene: < 1 % x
- beta-selinene: 0.3 – 0.8 % x
- alpha-selinene: 0.3 – 0.8 % x

**High-alpha variety**
- very high bitter value
- average aroma
- good storage stability

**Resistance to disease:**
- wilt: good to very good
- downy mildew: good
- powdery mildew: very low

**Ripening time:** medium late to late
**Storage stability:** good
**Average yield:** 2,000 kg/ha

**Headspace Gaschromatogramme**

**Notes:**
- % weight - % relative - ml/100g hops
Hallertauer Magnum is a product of the Hop Research Centre in Hüll with high yields and strong growth. This high-alpha variety was registered in 1993 and quickly became important.

### Aroma Specification

<table>
<thead>
<tr>
<th>Aroma</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flowery</td>
<td>5</td>
</tr>
<tr>
<td>Citrous</td>
<td>4</td>
</tr>
<tr>
<td>Fruity</td>
<td>3</td>
</tr>
<tr>
<td>Current-like</td>
<td>2</td>
</tr>
<tr>
<td>Sweet</td>
<td>1</td>
</tr>
<tr>
<td>Spicy</td>
<td>5</td>
</tr>
</tbody>
</table>

### Overall Impression

<table>
<thead>
<tr>
<th>Character</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pungent</td>
<td>5</td>
</tr>
<tr>
<td>Rapidly Disappearing</td>
<td>4</td>
</tr>
<tr>
<td>Intensive</td>
<td>3</td>
</tr>
<tr>
<td>Harmonious</td>
<td>5</td>
</tr>
<tr>
<td>Lasting</td>
<td>4</td>
</tr>
<tr>
<td>Full</td>
<td>3</td>
</tr>
<tr>
<td>Mild</td>
<td>2</td>
</tr>
</tbody>
</table>
Brewing trial: Hallertauer Magnum

1. Beer Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Beer</th>
<th>HALLERTAUER MAGNUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>7.6 mg/l</td>
<td>7.6 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>12.3 mg/l</td>
<td>12.3 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.2 mg/l</td>
<td>3.2 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>23.1 mg/l</td>
<td>23.1 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>24 EBC-BU</td>
<td>24 EBC-BU</td>
</tr>
<tr>
<td>iso-xanthohumol</td>
<td>0.40 mg/l</td>
<td>0.40 mg/l</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>0.02 mg/l</td>
<td>0.02 mg/l</td>
</tr>
<tr>
<td>linalool</td>
<td>21 µg/l</td>
<td>21 µg/l</td>
</tr>
<tr>
<td>total polyphenols</td>
<td>164 mg/l</td>
<td>164 mg/l</td>
</tr>
</tbody>
</table>

2. Sensory Evaluation “Hop Aroma” (Smell)

- fruity
- hoppy
- flowery
- herbal
- citruussy

Base Beer vs Beer produced with the variety HALLERTAUER MAGNUM
3. Sensory Evaluation “Hop Flavour” (Taste)

The beer of the variety Hallertauer Magnum has a harmonic bitterness of medium intensity. In smell its delicate aroma inclines towards a flowery and fruity flavour, in taste it also has a hoppy tang.

4. Sensory Evaluation of the Bitterness

The beer of the variety Hallertauer Magnum has a harmonic bitterness of medium intensity. In smell its delicate aroma inclines towards a flowery and fruity flavour, in taste it also has a hoppy tang.
Hallertauer Taurus
Hallertauer Taurus
Characteristics

Bitter substances
alpha-acids 12.0 – 17.0 % *
beta-acids 4.0 – 6.0 % *
cohumulone 20 – 25 % x
colupulone 38 – 48 % x

Polyphenols
total content 3.0 – 4.0 % *
xanthohumol 0.9 – 1.0 % *

Aroma substances
total oil 0.9 – 1.4 % *
myrcene 30 – 50 % x
linalool 1.0 – 1.5 % x
beta-caryophyllene 6 – 11 % x
aromadendrene < 0.2 % x
humulene 23 – 33 % x
farnesene < 1 % x
beta-selinene 4.0 – 8.0 % x
alpha-selinene 4.0 – 8.0 % x

High-alpha variety
• very high bitter value
• average aroma
• very good storage stability

Resistance to disease:
• wilt good
• downy mildew good
• powdery mildew low

Ripening time late
Storage stability good
Average yield 1,850 kg/ha

Headspace Gaschromatogramme

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene
7 = beta-selinene · 8 = alpha-selinene

*weight-% – x % relative – ml/100g hops
Hallertauer Taurus

Evaluation

Hallertauer Taurus is a product of the Hop Research Centre in Hüll with very high alpha-acid content. This high-alpha variety was registered as a variety in 1995.
1. Beer Analysis

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>5.7</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>10.1</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>2.7</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>18.5</td>
</tr>
<tr>
<td>bitterness</td>
<td>20 EBC-BU</td>
</tr>
<tr>
<td>iso-xanthohumol</td>
<td>0.62</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>nd*</td>
</tr>
<tr>
<td>linalool</td>
<td>63 µg/l</td>
</tr>
<tr>
<td>total polyphenols</td>
<td>179 mg/l</td>
</tr>
</tbody>
</table>

* nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Hallertauer Taurus gives the beer a harmonic, not quite so strong bitterness. In smell its delicate aroma is evenly distributed, in taste the aroma has more distinctive hoppy tang.

4. Sensory Evaluation of the Bitterness

The spirit of beer – Hops from Germany
Hallertauer Merkur
Hallertauer Merkur

**Characteristics**

### Bitter substances

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-acids</td>
<td>10.0 – 14.0 % *</td>
</tr>
<tr>
<td>Beta-acids</td>
<td>3.5 – 7.0 % *</td>
</tr>
<tr>
<td>Cohumulone</td>
<td>17 – 22 % x</td>
</tr>
<tr>
<td>Colupulone</td>
<td>37 – 45 % x</td>
</tr>
</tbody>
</table>

### Polyphenols

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total content</td>
<td>4.0 – 5.0 % *</td>
</tr>
<tr>
<td>Xanthohumol</td>
<td>ca. 0.3 % *</td>
</tr>
</tbody>
</table>

### Aroma substances

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total oil</td>
<td>1.4 – 1.9 % *</td>
</tr>
<tr>
<td>Myrcene</td>
<td>25 – 35 % x</td>
</tr>
<tr>
<td>Linalool</td>
<td>0.6 – 1.1 % x</td>
</tr>
<tr>
<td>Beta-caryophyllene</td>
<td>9 – 15 % x</td>
</tr>
<tr>
<td>Aromadendrene</td>
<td>&lt; 0.2 % x</td>
</tr>
<tr>
<td>Humulene</td>
<td>35 – 50 % x</td>
</tr>
<tr>
<td>Farnesene</td>
<td>&lt; 1 % x</td>
</tr>
<tr>
<td>Beta-selinene</td>
<td>0.4 – 0.9 % x</td>
</tr>
<tr>
<td>Alpha-selinene</td>
<td>0.4 – 0.9 % x</td>
</tr>
</tbody>
</table>

### High-alpha variety

- Very high bitter value
- Average aroma
- Good storage stability

### Resistance to disease:

- Wilt: Good
- Downy mildew: Good
- Powdery mildew: Good

### Ripening time: Very late

### Storage stability: Good

### Average yield: 2,000 kg/ha

---

*weight-% – % relative – ml/100g hops

**Headspace Gaschromatogramme**

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene

---

mV (Span=200)

0 5 10 15 20 25 30 35 40 45 50 55 60

0 20 40 60 80 100 120 140 160 180 200

minutes (Span=60)
Hallertauer Merkur

Evaluation

Hallertauer Merkur is the first mildew-resistant variety from the Hop Research Centre in Hüll. A disadvantage is its low winding property and its high susceptibility to botrytis. This high-alpha variety was registered as a variety in 2001.
Brewing trial: Hallertauer Merkur

1. Beer Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Beer</th>
<th>Beer produced with the variety HALLERTAUER MERKUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-iso-humulone</td>
<td>5.2 mg/l</td>
<td>iso-xanthohumol 0.37 mg/l</td>
</tr>
<tr>
<td>n-iso-humulone</td>
<td>13.3 mg/l</td>
<td>xanthohumol nd*</td>
</tr>
<tr>
<td>ad-iso-humulone</td>
<td>2.7 mg/l</td>
<td>linalool 65 µg/l</td>
</tr>
<tr>
<td>Σ iso-humulones</td>
<td>21.2 mg/l</td>
<td>total polyphenols 172 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>23 EBC-BU</td>
<td></td>
</tr>
</tbody>
</table>

* nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Hallertauer Merkur gives the beer a harmonic bitterness with medium intensity. In smell the flowery and hoppy impressions stand out as well as the fruity ones. In taste the hoppy tang prevails to some extent.

4. Sensory Evaluation of the Bitterness

The variety Hallertauer Merkur gives the beer a harmonic bitterness with medium intensity. In smell the flowery and hoppy impressions stand out as well as the fruity ones. In taste the hoppy tang prevails to some extent.
Herkules
### Herkules

#### Characteristics

**Bitter substances**
- alpha-acids: 12.0 – 17.0 % *
- beta-acids: 4.0 – 5.5 % *
- cohumulone: 32 – 38 % x
- colupulone: 52 – 58 % x

**Polyphenols**
- total content: 3.0 – 4.0 % *
- xanthohumol: ca. 0.7 % *

**Aroma substances**
- total oil: 1.6 – 2.4 % *
- myrcene: 30 – 50 % x
- linalool: 0.3 – 0.8 % x
- beta-caryophyllene: 7 – 12 % x
- aromadendrene: < 0.2 % x
- humulene: 30 – 45 % x
- farnesene: < 1 % x
- beta-selinene: 0.3 – 0.8 % x
- alpha-selinene: 0.3 – 0.8 % x

**High-alpha variety**
- very high bitter value
- average aroma
- good storage stability

**Resistance to disease:**
- wilt: good
- downy mildew: good
- powdery mildew: good

**Ripening time**: very late

**Storage stability**: good

**Average yield**: 2,300 kg/ha

*weight-% – % relative – ml/100g hops

---

**Headspace Gaschromatogramme**

![Gaschromatogramme](image)

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene
Herkules is a very high-yielding breeding line from the Hop Research Centre in Hüll with very high alpha-acid content.

**Evaluation**

### Aroma Specification

- **Intensity**
  - 1: weak
  - 2: low
  - 3: moderate
  - 4: high
  - 5: very high

- **Aroma**
  - Flowery
  - Citrous
  - Fruity
  - Current-like
  - Sweet
  - Spicy

### Overall Impression

- **Intensity**
  - 5: intense
  - 4: very intense
  - 3: intensive
  - 2: strong
  - 1: weak

- **Character**
  - Pungent
  - Rapidly disappearing
  - Intensive

- **Harmoniousness**
  - Lasting
  - Full
  - Mild
1. Beer Analysis

<table>
<thead>
<tr>
<th>Compound</th>
<th>Base Beer</th>
<th>Beer produced with the variety HERKULES</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>9.0 mg/l</td>
<td>iso-xanthohumol 0.49 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>9.8 mg/l</td>
<td>xanthohumol 0.03 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>2.6 mg/l</td>
<td>linalool 23 µg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>21.4 mg/l</td>
<td>total polyphenols 165 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>22 EBC-BU</td>
<td></td>
</tr>
</tbody>
</table>

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The variety Herkules gives the beer a harmonic, not too strong bitterness. It imparts the various aroma impressions evenly and not too distinctly. Only in the taste the hoppy tang slightly prevails compared with the other impressions.

4. Sensory Evaluation of the Bitterness

The variety Herkules gives the beer a harmonic, not too strong bitterness. It imparts the various aroma impressions evenly and not too distinctly. Only in the taste the hoppy tang slightly prevails compared with the other impressions.
Nugget
<table>
<thead>
<tr>
<th>Bitter substances</th>
<th>Bitter variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>alpha-acids</td>
<td>• high bitter value</td>
</tr>
<tr>
<td>9.0 – 13.0 % *</td>
<td>• low aroma</td>
</tr>
<tr>
<td>beta-acids</td>
<td>• good storage stability</td>
</tr>
<tr>
<td>3.0 – 5.0 % *</td>
<td></td>
</tr>
<tr>
<td>cohumulone</td>
<td></td>
</tr>
<tr>
<td>24 – 30 % x</td>
<td></td>
</tr>
<tr>
<td>colupulone</td>
<td></td>
</tr>
<tr>
<td>47 – 57 % x</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Polyphenols</th>
<th>Resistance to disease:</th>
</tr>
</thead>
<tbody>
<tr>
<td>total content</td>
<td>• wilt</td>
</tr>
<tr>
<td>3.0 – 4.0 % *</td>
<td>average to low</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>• downy mildew</td>
</tr>
<tr>
<td>0.5 – 0.7 % *</td>
<td>low to very low</td>
</tr>
<tr>
<td></td>
<td>• powdery mildew</td>
</tr>
<tr>
<td></td>
<td>low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aroma substances</th>
<th>Ripening time</th>
</tr>
</thead>
<tbody>
<tr>
<td>total oil</td>
<td>very late</td>
</tr>
<tr>
<td>0.9 – 1.3 % *</td>
<td></td>
</tr>
<tr>
<td>myrcene</td>
<td>Storage stability</td>
</tr>
<tr>
<td>27 – 42 % x</td>
<td>good</td>
</tr>
<tr>
<td>linalool</td>
<td>Average yield</td>
</tr>
<tr>
<td>0.5 – 1.0 % x</td>
<td>2,200 kg/ha</td>
</tr>
<tr>
<td>beta-caryophyllene</td>
<td></td>
</tr>
<tr>
<td>10 – 20 % x</td>
<td></td>
</tr>
<tr>
<td>aromadendrene</td>
<td></td>
</tr>
<tr>
<td>&lt; 0.2 % x</td>
<td></td>
</tr>
<tr>
<td>humulene</td>
<td></td>
</tr>
<tr>
<td>25 – 40 % x</td>
<td></td>
</tr>
<tr>
<td>farnesene</td>
<td></td>
</tr>
<tr>
<td>&lt; 1 % x</td>
<td></td>
</tr>
<tr>
<td>beta-selinene</td>
<td></td>
</tr>
<tr>
<td>1.0 – 2.0 % x</td>
<td></td>
</tr>
<tr>
<td>alpha-selinene</td>
<td></td>
</tr>
<tr>
<td>1.0 – 2.0 % x</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resistance to disease:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• wilt</td>
</tr>
<tr>
<td>average to low</td>
</tr>
<tr>
<td>• downy mildew</td>
</tr>
<tr>
<td>low to very low</td>
</tr>
<tr>
<td>• powdery mildew</td>
</tr>
<tr>
<td>low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Headspace Gaschromatogramme</th>
</tr>
</thead>
</table>

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene · 7 = beta-selinene · 8 = alpha-selinene
Nugget is a very vigorous, high-yielding variety with high susceptibility to disease. Due to the too low alpha-acid contents this variety is increasingly diminishing in importance. This bitter variety was registered as a variety in 1982 in the USA.
Brewing trial: Nugget

1. Beer Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Base Beer</th>
<th>Beer produced with the variety Nugget</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>8.0 mg/l</td>
<td>iso-xanthohumol 0.67 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>11.4 mg/l</td>
<td>xanthohumol 0.02 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>3.7 mg/l</td>
<td>linalool 40 µg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>23.1 mg/l</td>
<td>total polyphenols 180 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>26 EBC-BU</td>
<td></td>
</tr>
</tbody>
</table>

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

With the variety Nugget it is possible to obtain a strong but harmonic bitterness in the beer. The aroma inclines a little more towards a hoppy tang as well as towards flowery and fruity flavours.

4. Sensory Evaluation of the Bitterness

With the variety Nugget it is possible to obtain a strong but harmonic bitterness in the beer. The aroma inclines a little more towards a hoppy tang as well as towards flowery and fruity flavours.
Northern Brewer
Bitter substances
alpha-acids 6.0 – 10.0 % *
beta-acids 3.0 – 5.0 % *
cohumulone 27 – 32 % x
colupulone 48 – 53 % x

Polyphenols
total content 3.0 – 4.0 % *
xanthohumol ca. 0.6 % *

Aroma substances
total oil 1.0 – 1.6 % *
myrcene 25 – 45 % x
linalool 0.3 – 0.8 % x
beta-caryophyllene 10 – 20 % x
aromadendrene < 0.2 % x
humulene 35 – 50 % x
farnesene < 1 % x
beta-selinene 0.3 – 0.8 % x
alpha-selinene 0.3 – 0.8 % x

Resistance to disease:
• wilt very good
• downy mildew average to low
• powdery mildew low

Ripening time early
Storage stability good
Average yield 1,600 kg/ha

*weight-% – x relative – ml/100g hops

Northern Brewer
Characteristics

Headspace Gaschromatogramme

1 = myrcene · ISN = internal standard · 2 = linalool · 3 = beta-caryophyllene · 4 = aromadendrene · 5 = humulene · 6 = farnesene
7 = beta-selinene · 8 = alpha-selinene
The bitter variety Northern Brewer is resistant to wilt and ripens early. It has clearly diminished in its importance for production in recent years. Northern Brewer was bred in England in 1934.
Brewing trial: Northern Brewer

1. Beer Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>co-isohumulone</td>
<td>6.8 mg/l</td>
</tr>
<tr>
<td>n-isohumulone</td>
<td>9.7 mg/l</td>
</tr>
<tr>
<td>ad-isohumulone</td>
<td>2.9 mg/l</td>
</tr>
<tr>
<td>Σ isohumulones</td>
<td>19.4 mg/l</td>
</tr>
<tr>
<td>bitterness</td>
<td>21 EBC-BU</td>
</tr>
<tr>
<td>iso-xanthohumol</td>
<td>0.72 mg/l</td>
</tr>
<tr>
<td>xanthohumol</td>
<td>nd*</td>
</tr>
<tr>
<td>linalool</td>
<td>34 µg/l</td>
</tr>
<tr>
<td>total polyphenols</td>
<td>201 mg/l</td>
</tr>
</tbody>
</table>

* nd: not detectable

2. Sensory Evaluation “Hop Aroma” (Smell)
3. Sensory Evaluation “Hop Flavour” (Taste)

The bitterness of the beer brewed with Northern Brewer is harmonic with medium intensity. Both in smell and taste the delicate aroma inclines predominantly towards a hoppy tang.

4. Sensory Evaluation of the Bitterness

The bitterness of the beer brewed with Northern Brewer is harmonic with medium intensity. Both in smell and taste the delicate aroma inclines predominantly towards a hoppy tang.
Certification of hops
Certification of hops

Quality is everything

The German hop-growers have always placed great importance on excellent quality and transparency in the production of their hops. Not only since the corresponding EU regulations came into force have they guaranteed traceability through certification for each hop lot with regard to production region, variety, crop year, hop farm and hop yard.

As early as 1538 the Eichstätt Prince-Bishop awarded the first German hop seal to the town of Spalt in order to document the authenticity of the aromatic Spalt hops. For the first time in 1929 one single law for Germany was passed – the Hop Provenance Law, which was replaced by the 1996 Hop Law. Today three EU regulations control the hop certification: the Hop Law at national level as well as the regulations for implementing the Hop Law at the state level.

According to the state regulations seven hop producing regions in Germany have been laid down by law (refer to box on next but one page). Only hops which are produced in one of these regions can be certified and consequently marketed. The hop producers and the trading firms undertake the costs.

Certification System

Producer

Hop Specialist/Hop-Growers’ Association

First Certification LKP/Hopfenring

Accompanying certificate “German Seal Hops” - untreated

Second Certification Seal District

Accompanying certificate “German Seal Hops” – treated - “German Hop Product”

Brewer
First certification of the leaf hops
In May the hop-grower gives a hop-producer declaration to the producer group in which he provides information about his hop acreage and the varieties grown. He receives a producer identification card and the hop seal from the Hop-Growers’ Association. Once the hops have been harvested the hop-grower seals and marks the packages and declares the origin of the hops; this is then confirmed by the Hop-Growers’ Association. Each package is given a seal with the designation “German Seal Hops” and in addition the following is indicated on it:
• the country of origin
• the production region
• the crop year
• the variety
• and whether the hops have been treated or not.

D.S.H.N.A. = Deutscher Siegel Hopfen Nicht Aufbereitet (German seal hops untreated)
1075490 = consecutive packet number

The hops are weighed in the seal hall, in the certification depot or directly on the farm and the weight is entered on the weighing certificate. The Hopfenring takes samples from the individual hop lots, which are then sent on to an independent laboratory for quality control (refer to Chapter “Independent Quality Control”). If the minimum legal requirements are not fulfilled then the Hopfenring is informed respectively. Then it is not possible to certify the hops.

Afterwards the hops are certified by the district authority or by the Hopfenring appointed by the Landeskuratorium für pflanzliche Erzeugung (LKP). At the same time the seal on the packages is supplemented by a sticker with the final designation.

2003 = crop year
H.H.T = Hallertau production region, variety: Hallertauer Tradition
10 D = code number of the certification depot LKP
In addition the Hopfenring issues an accompanying certificate which states the hop seal data.

During all these steps there is no lack of control: The information on the hop producer declaration is checked by the staff at the Federal Institute for Food & Agriculture. The declaration made by the hop-grower on the origin of the hops is confirmed by the hop official from the Hop-Growers’ Association. The results of the weigh-in as well as the certification are controlled by the government.

All data converges at the offices of the Hopfenring: There they undertake the centralized data collection and inspection, there the records are kept on the certificates issued and the documents filed in their archives.

**accompanying certificate:**
- seal district of origin
- reference number
- variety
- crop year
- number of packets
- packet numbers
- weights
- official seal

**German hop production regions**

*Bavaria:*
Hallertau, Spalt

*Baden-Wurttemberg:*
Tettnang, Baden

*Rhineland-Palatinate:*
Rhine-Palatinate, Bitburg

*Thuringia/Saxony:*
Elbe-Saale
Second certification

After the first certification the natural hops are delivered in rectangular bales to the processing works. When opening and further processing the packages the staff break the seals of the first certification.

Pellets, extract or hop powder or treated hop cones are for example made from leaf hops. A complete process is prerequisite for the certification of these refined hops.

An official inspector is always present and records all in- and outputs in a log book.

Staff fill the refined hops – i.e. pellets, extract, hop powder or hop cones – into individual packages and pack them in boxes.

The description of the contents, the variety and certification reference number is stated on every package.

The route to the Second Certification

1. The hop bales are opened and put into the processing. In doing so the seal labels are broken.

2. The leaf hops are processed to hop pellets or extract. The certification of the hop products can only be carried out if the processing took place in a complete operation.

3. The products are filled into single packets and packed in cardboard boxes. The following information at least is on each packet: • description of goods / • variety / • certification reference number.

4. Each lot is given a certificate. This contains at least the following information: • description of goods / • certification reference number / • the final weight and/or gross weight / • the place where the hops were grown / • the crop year / • the variety. In addition the date of processing must be stated.
Every hop lot is given a certificate which contains the following information:
- description of contents
- the certification reference number
- dead weight and/or gross weight
- the production region
- district of origin and seal district
- the crop year
- the variety
- date and place where the hops were processed

From these accompanying certificates it can also be seen e.g. whether the hop product was made from hops which originated in the EU or the USA.
Developments
In recent years other quality assurance systems have developed beyond the requirements of the hop certification. Among these are for example the controlled, contracted production (KVA) or the certification for individual farms according to DIN EN ISO 9001, in which the hop-grower records all measures etc. which are undertaken in his hop yard.

<table>
<thead>
<tr>
<th>Statutory bases</th>
<th>Legal standards in Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Following EU regulations are relevant:</strong></td>
<td>Hop Law of 21st October 1996:</td>
</tr>
<tr>
<td>- EU Council regulation on the Common Market organisation for hops (Decree [EEC] Nr. 1697/71)</td>
<td>The Hop Law essentially contains authorizations for the states to agree individual rulings linked with the certification.</td>
</tr>
<tr>
<td>- EU Commission Regulation on the certification of hops (Decree [EEC] Nr. 174/77)</td>
<td>The states agree these rulings in their regulations to implement the Hop Law.</td>
</tr>
<tr>
<td>- EU Commission Regulation on the procedure for the certification of hops (Decree [EEC] Nr. 890/78)</td>
<td></td>
</tr>
</tbody>
</table>

Certification of hops
Independent Quality Control
Independent appraisal is elementary

The Independent Quality Appraisal enables the leaf hops to be assessed accurately.

The hop industry has agreed on joint criteria for the organisation and execution of the quality control, which have been laid down in the guidelines of the “Work Group Independent Quality Appraisal”. All market partners recognize the results. In this way a uniform, independent quality appraisal can be obtained.

Course of examination for the “Independent Quality Appraisal for Hops”

- Samples delivered by Hopfenring courier service
- Incoming inspection depository
- Alpha sample
- Return sample for firm
- Four-fold sample divider
- Sieve tower for 3 sieve fractions 8.0 + 2.8 + 0.6 mm
- Selection, defining leaf/stem proportion, hop waste, proportion of loose bracteoles
- Compiling and despatching result
- Examined hops are disposed via the composting plant
- Hop-grower
- Purchaser
- Reserve sample for laboratory
- Reserves stored in laboratory
- Assessing cones for pests and diseases, damaged cones and variety purity
- Dry matter definition EBC 7.2 and/or microwave
- Purchaser
- Hop-grower
- Assesing cones for pests and diseases, damaged cones and variety purity
- Dry matter definition EBC 7.2 and/or microwave
- Compiling and despatching result
- Examined hops are disposed via the composting plant
At the certification place (at the hop-grower’s farm, in the certification depot or in the seal hall) the Hopfenring, appointed by the Landeskuratorium für pflanzliche Erzeugung (LKP), takes hop samples according to a set procedure.

A courier service collects these samples in lead-sealed sacks and brings them to an independent laboratory where they are analysed within 24 hours. First of all the staff ensures that all seals and lead-seals are intact before they open the specimen samples. Every single sample is given a bar-code label with an unmistakeable laboratory and analysis number. First of all the homogeneity of the sample and the data on the weighing certificate are checked.

Incoming inspection, checking for homogeneity
Afterwards the sample is divided up into 4 specimens:
• Laboratory sample
• Laboratory reserve sample
• Alpha sample
• Company reserve sample

Two qualified people assess the cones of the laboratory sample by hand. They examine them for:
• Attacks of pests and diseases (peronospora, mildew, botrytis, aphis, red spider)
• Damaged and set cones (overdried, funny smell, damaged and set cones)
• Varietal purity, foreign bodies, seed parts

In addition the following quality parameters are analysed:
• Moisture-content (according to EBC ruling 7.2 and microwave)
• Proportion of leaves and stems, loose bracteoles and hop waste

Independent Quality Definition

Besides the quality requirements in compliance with the hop supply contract, the minimum quality requirements must be fulfilled in compliance with (EEC) Regulation No. 890/78. In this way a uniform, objective quality appraisal can be obtained.
Independent Quality Control

The spirit of beer – Hops from Germany

Based on these findings the laboratory compiles a quality appraisal, which accompanies the hop lot in the form of a certificate and facilitates optimum utilization and processing. Buyer and seller are presented with the findings individually.

If the hops do not fulfil the minimum requirements, the certification office is informed and then the hops cannot be marketed and are not certified.

The laboratory reserve sample is kept at the laboratory in case of complaints later on in order to make further examinations possible. Not only the purchasing firm but also the hop-grower has the right to demand a further examination. The application must be made at the latest 14 days following payment of the purchase price.

The company reserve sample is sent with the alpha sample to the purchasing firm. With the alpha sample the hop-trading firm determines the alpha-acid contents at their in-house laboratory.

Quality findings:
- Producer and purchaser
- Reference No.
- No. of bales
- Weight
- Variety
- Results of examination and final result

Storing reserve samples
Hop Research Centre Hüll
Committed to the “Green Gold“

Ever since 1926 application-oriented research around hops has been conducted at the Hop Research Centre in Hüll near Wolnzach in the Hallertau. In 1926 the German brewing industry set up the Gesellschaft für Hopfenforschung e. V. (GfH). Since 1972 all research activities have been carried out in a cooperation between the Free State of Bavaria, represented by the Bayerische Landesanstalt für Bodenkultur Landwirtschaft (LfL), and the GfH.
The geographic location of the Centre is a special advantage: Right in the middle of the Hallertau – the largest single hop production region in the world – there is direct contact not only to the hop-growers but also to the most important hop-trading firms in the world with their hop-processing facilities and research laboratories in Au, Mainburg, St. Johann and Wolnzach. But also the leading brewing and scientific agrarian establishments of the TU Munich-Weihenstephan are not far away in Freising.

**The main areas of research at the Hop Research Centre in Hüll are:**
- Breeding new hop varieties
- Bio-technology with genome analytics as support for the hop-breeding
- Production of environmentally compatible hops
- Developing strategies to control pests and diseases
- Analytic examination of the relevant valuable hop components and developing new methods of analysis
- Providing the hop-growers with comprehensive, competent advice

*The “genetic finger print” for analysing genetic material*
Numerous wide-spread hop varieties originated from the hop research at Hüll (refer to box on next page). Varieties bred in Hüll are already being grown on 70% of the German hop acreage. The Hüll breeders are aiming at breeding varieties which on the one hand show the required first-class brewing quality which the brewing industry needs and on the other hand which meet the hop-farmers’ demands for resistance to pests and diseases, good production properties and high yields.
Breeding is carried out by traditional cross-breeding which is backed up by state-of-the-art bio-technological methods and genome analysis. Molecular markers are already being used especially in the selection. In the future bio-technological methods will speed up the whole breeding process. The varieties will only be registered and introduced into practice after extensive tests and practice brews have been conducted. Therefore up to 20 years can pass from the cross-breeding until the new variety is introduced on the market.

At the moment 32 varieties are being grown in the breeding yard of the Hop Research Centre for the variety registration test. This range embraces the most important commercially grown varieties in Germany as well as breeding lines for which the European Variety Protection has been applied for. 150 varieties which almost completely reflect the whole spectrum of the internationally used gene pool, are being grown and to some extent integrated in new crossings.

The genetic variability of the hop gene pool is constantly being enlarged by about 100 artificial crossings per year. In addition to this the Hop Research Centre has a collection of wild hops at its disposal from 120 different locations in Europe, USA and Asia.

**Breeding successes of the Hop Research Centre:**

Aroma variety:
- Perle (PE)
- Hallertauer Tradition (HT)
- Spalter Select (SE)
- Saphir (SR)
- Opal (OL)
- Smaragd (SD)

Bitter variety:
- Hallertauer Magnum (HM)
- Hallertauer Taurus (TU)
- Hallertauer Merkur (MR)
- Line 95/94/816 (Herkules-HS)

Scientific evaluation of hop components – here for example the variety “Magnum”

**HPLC Chromatogramme total separation (variety “Magnum“)**

<table>
<thead>
<tr>
<th>Peak</th>
<th>Retention Time (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>cohumulone</td>
</tr>
<tr>
<td>2</td>
<td>adhumulone</td>
</tr>
<tr>
<td>3</td>
<td>n-humulone</td>
</tr>
<tr>
<td>4</td>
<td>colupulone</td>
</tr>
<tr>
<td>5</td>
<td>n-lupulone</td>
</tr>
<tr>
<td>6</td>
<td>adlupulone</td>
</tr>
<tr>
<td>7</td>
<td>xanthohumol</td>
</tr>
</tbody>
</table>

HPLC Chromatogramme total separation (variety “Magnum“)
Environmentally compatible hop production
It is very important to work out environmentally compatible production techniques in growing hops. This includes for example optimized fertilization in order to avoid pollution in ground water and to minimize the nitrate content in hops. Soil erosion can be avoided by sowing green fertilization plants. By determining the best possible harvest-time for each variety it is possible to optimize both yield and quality. In addition to this, the Hüll researchers are working on the development of optimum drying and conditioning processes to ensure the brewing quality of the hops.

Development of strategies to control pests and diseases
Also among the tasks of the Hop Research Centre is testing suitable plant protectives as well as optimizing the spraying technique. The aim is an application with the least possible residues and therefore the maximum environmental compatibility and the lowest possible residues. At the same time trials are carried out in the field. In addition the Hüll researchers are developing biological methods for controlling pests as well as alternative pest controls.

Counting the spores in the microscope as a basis for the peronospora (downy mildew) warning service
**Analysis of the relevant, valuable hop components and development of new analysis methods**

Analytic examination of the properties which determine the brewing value plays an important part in characterising newly bred lines and varieties. These examinations are conducted by the Hop Research Centre. In addition to this, ring analyses for quality assurance are organised and evaluated when determining the alpha-acid for hop supply contracts. New technologies are constantly improving the analysis methods. Following methods are applied:

- Bitter substances: conductometric titration, HPLC, NIR (being developed)
- Essential oils: headspace gas-chromatography, steam distillation, SPME (= fixed phase micro-extraction)
- Polyphenols: HPLC, spectral photometry (total polyphenols, xanthohumol, quercetine, kaempferol)

**Implementing the research results by giving the hop-grower comprehensive, competent advice**

The Hop Research Centre in Hüll works independently from company interests. All scientific findings are passed on to the hop industry and the hop-growers to ensure they are implemented and applied as quickly as possible. Being the competence centre for hops, the Centre deals with all questions concerning hops in only one organisation which is recognized all over the world.
Service Centre for hop farmers

The “Haus des Hopfens” in Wolnzach, a service centre for the hop farmers, was inaugurated in summer 2003. United under one roof and closely interlinked, amongst others here are the offices of the Deutsche and Hallertauer Hopfenpflanzerverband e. V. (German and Hallertau Hop-Growers’ Assn.), the Hopfenring Hallertau e. V. as well as the Landesanstalt für Landwirtschaft, Produktionstechnik Hopfen (State Institute for Agriculture, Hop Production Techniques).
Verband Deutscher Hopfenpflanzer e. V.  
Verlag Hopfen-Rundschau

For over 125 years the Verband Deutscher Hopfenpflanzer e. V. (Assn. of German Hop-Growers) has been the central umbrella organisation of the hop producers in Germany and their regional associations: Hallertau, Tettnang, Elbe-Saale, Spalt. Here all the regional, national and international strings of the German producer side converge at the Association's headquarters in the “Haus des Hopfens” in Wolnzach. A concept which for centuries has proved its worth for the association work extremely well and for representing the interests of the hop-growers in Germany. 
Once a month the Association's own publishing house, the Verlag Hopfen-Rundschau, issues the Association’s magazine of the same name: the “Hopfen-Rundschau” and their special issue: the “Hopfen-Rundschau International” which appears annually.

Hopfenpflanzerverband Hallertau e. V.

The hop-growers in the largest hop-growing region in the world are organised in the Hopfenpflanzerverband Hallertau e. V. (Hallertau Hop-Growers' Assn.) The “old” Haus des Hopfens was built in 1959/1960 to house the Association by the Hopfenpflanzerverband Hallertau e. V. Their work is very closely linked with the Verband deutscher Hopfenpflanzer e. V. (German Hop-Growers’ Assn.). For example the management of both associations is in one hand.

Main areas of work:
• foreign seasonal workers
• hop supply contracts
• hop market regulations
• representation and cooperation in the IHGC
• sales promotion
• market reporting/crop estimation
• events/publicity work
• plant protection
• advice for members
• tax advice
• legal advice
• expertises, indemnification cases etc.
Lfl, Produktionstechnik Hopfen

Practice-oriented research for the hop and brewing industries is conducted at the Hop Research Centre in Hüll/Wolnzach

- in a target-oriented cooperation between the Gesellschaft für Hopfenforschung e. V. which is organised under private law and the Free State of Bavaria, represented by the Bayerische Landesanstalt für Landwirtschaft (LfL) i.e. Bavarian State Institute for Agriculture

- four work-groups in the Hops Dept. at the Institut für Pflanzenbau und Pflanzenzüchtung (Plant Cultivation & Breeding Research Centre)
  - plant protection in hops
  - hop breeding research
  - hop quality and analytics
  - hop cultivation, production techniques residing in the “Haus des Hopfens”

The function of the work-group Hop Cultivation, Production Techniques, is to develop environmentally compatible production systems for hop cultivation (e.g. optimising the nutrition supply, low-trellis production system) and to pass the research findings on to the hop-growers by means of a comprehensive, competent advisory service. In this respect the close cooperation with the Hopfenring as well as the Hopfenpflanzerverband (Hop-Growers’ Assn.) and the Hopfenverwertungsgenossenschaft (Hop Producer Cooperative) is necessary for effective work.

Hopfenring Hallertau e. V.
Erzeugerring für Qualitätshopfen Jura e. V.

The Hopfenring Hallertau is a self-help organisation for the Hallertau hop-growers and is a member of the LKP (State Institute for Plant Production). The legal and financial basis for its work is the Act to promote Bavarian agriculture.

Main areas of work:
- Informing the members on cultivation and production techniques in cooperation with the LfL.
- accompanying and advising on rational, environmentally compatible production
- conducting quality and performance tests
- evaluating these results to give advice to the member farms
- realizing environmentally compatible production processes on the member farms taking into consideration the ecological and economic requirements
- promoting new developments and their rapid introduction in the field
- carrying out hop certification for leaf hops (official certification process)
- applying a quality management system according to DIN EN ISO 9001, which is open to registered producer farms

Objectives:
To promote production in line with market requirements and to improve hop cultivation as well as the quality of hops in the member farms.
The CMA Centrale Marketing-Gesellschaft der deutschen Agrarwirtschaft mbH (Central Marketing Organization of German Agricultural Industries) supports you in many ways to make contact with German exporters.

We offer you the following services:
• arranging contacts between German exporters and foreign importers
• taking part in trade fairs
• providing information on German products and supplies
• advertising materials

Further information on the CMA service offers can be found on the internet under:
www.cma-exportservice.com
or contact one of our offices abroad or the CMA head office at:

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