BRAUWELT
INTERNATIONAL

E-PAPER: BREWING 101

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BrauKon
for Beer with Character

For Beer with Character!

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Beer – a Journey – a small brewing school

"Unlike almost no other beverage, beer has exercised not only substantial influence on human cultural endeavors on a grand scale but also on the daily lives of many populations around the world. Along with wine, beer is certainly one of the oldest beverages known to mankind. This deep cultural history makes the production of beer all the more interesting." Some time ago, with these words from our author *Dr. Gerrit Blümelhuber* of Doemens Academy in Gräfelfing, Germany, BRAUWELT International introduced a new series reprising the fundamentals of beer brewing entitled "Brewing 101".

Craft beer is currently "in" and waves of craft brewing are now breaking on the shores of every continent. For this reason, the production of high-quality beers is a fascinating topic for many "beerophiles". In eleven installments, we follow beer on its journey from raw materials, into the brewhouse and onwards through fermentation, maturation, lagering, filtration and finally to the packaging of the finished product. We also explore topics such as quality control, energy, water and wastewater as well as beverage dispensing technology on the journey.

This series is intended to provide a knowledge base for all those who are already acquainted with the brewing process but wish to deepen their understanding of it, or to serve as a kind of "refresher course" for those who studied brewing in the past. The series, of course, cannot replace long-term training or an intensive course of study in brewing; however, we are very pleased to be able to offer you a concise overview of the processes involved in brewing beer in easily understandable language.

Nonetheless, one cannot discuss brewing without understanding a few technical terms. So, we have compiled glossaries of brewing terms. A bit of mathematical knowledge is also necessary, but not to worry because we have compiled a few math problems to help you hone your math skills and even included the solutions in our online forum at **www.brauweltinternational.com** – "Service/Forum". In the forum, you can also pose questions if something is unclear to you or you would like more detailed information.
We hope you enjoy our new Brewing 101 e-Paper!

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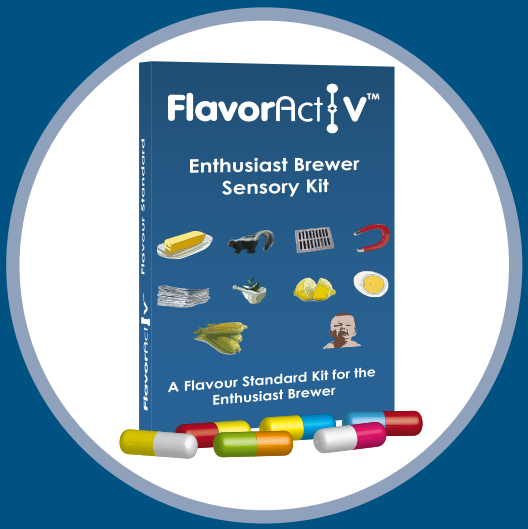

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The **Beginner's Sensory Kit** has 5 flavours. The **Enthusiast Brewer Kit** has 10 flavours. And the **Professional Craft Brewer Sensory Kit** has the following 20 flavours:

Diacetyl	Butyric	Acetaldehyde
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Mercaptan	Catty	Ethyl Butyrate
Metallic	Grainy	Freshly Cut Grass
Papery	Hop Oil	Isoamyl Acetate
Phenolic	Caprylic	Dimethyl Sulphide
Sour	Geraniol	

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Cereals, malts and hops

BASICS | Practically no other beverage has had an influence comparable to that of beer on the culture and daily lives of people the world over. Together with wine, beer counts as being definitely among the oldest beverages that are known to man. Production of beer is thus all the more interesting. In Brewing 101 we will be revisiting some fundamental principles of beer brewing, starting with the topic "cereals, malts and hops".

ESPECIALLY DURING THE LAST 20 YEARS, the beer production process has been demystified. Brewmasters would have counted themselves lucky in former times if consumers had at least heard the names of the main ingredients in beer production. Nowadays, it happens sometimes that interested beer drinkers inquire whether a Cascade or perhaps a Citra has been used for the last hopping of the wort. What brought about this change in some consumers? The reasons lie with the producers, the brewers. An increasing number of brewmasters have begun to experiment, moving away from classical beer types, going back to revived or even on to totally new beer lines. Enthusiasm for beer as something that can be enjoyed is only just emerging as a factor in many countries throughout the world. This has resulted in the fact that many erstwhile consumers are now interested in brewing their own beer. This has led to a situation, particularly in the USA, where there has been a surge in the number of breweries being established. And the founders were not always trained or even studied to be brewmasters. Very often, they were just enthusiastic consumers who wanted to have THEIR product express a very distinctive character all of its own. The fact that these brewers had not learned their handiwork all the way from an apprenticeship onwards or were not recipients of academic honours from acknowledged brewing schools did not affect product quality in any way.

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Our motivation

Nevertheless, it is unfortunately not possible to get along without some degree of in-depth knowledge of beer brewing. And thus, we come to this brewers' primer: it cannot and should not, in any way, be a substitute for a comprehensive study of brewing. Naturally, neither can it substitute for the practical experience that a brewer acquires over long periods in a brewery. It is rather meant to provide a knowledge basis for those starting an operation, give those who are in the business a grounding, and for those who have a lot of experience, open the possibility of reviewing material in a refresher course. We aim to provide an overview of all aspects of the production process in generally understandable terms. But even Brewing 101 cannot get by without some technical terms. They are compiled in glossaries. In addition, most chapters have a section with calculations. It has been found that it is indeed the simplest calculations that cause the most problems and that, instead of calculations, operatives simply guess. OK, sometimes this works out well, but sometimes it does not. The results have been published in the online forum at **www.brauweltinternational.com** – "Service/forum". Now enough of chat, let us begin!

What raw materials are needed for brewing?

Practically every beer drinker is familiar with the raw materials: hops, malt and water. When asking a beer drinker living in a country where the German Purity Law does not apply, one might also possibly refer to rice or corn as ingredients. Yeast is usually not mentioned, nor are the other cereal grains. And one should not ask specific questions about malt, many people know little or nothing about it. In brewing, we principally distinguish between four raw materials:

- **Malt and/or unmalted cereals:** this raw material supplies the extract, i.e. the fermentable and non-fermentable components that, later on in the wort, contribute to original gravity.
- **Hops:** they supply the bitterness in beer and the hop aroma.
- **Water:** it serves as a solvent for extract and hop components.
- **Yeast:** it is debatable whether or not one wants to include yeast as a separate raw material. But we class it with raw materials here. Yeast is responsible for conversion of fermentable sugars to alcohol and carbon dioxide on the one hand and, on the other hand, yeast also supplies fermentation by-products that make a major contribution to subsequent beer aroma.

In the first act, we will focus on the first two raw materials, malt or unmalted cereals and hops. Water and also yeast will come on stage later.

Barley and malting

All about barley

As always, barley is the most important and, in terms of quantity, the most frequently used cereal grain for beer production worldwide. This is because barley has good maltability, producing a good enzyme spectrum

for the cereal grain. In terms of the extract provided by barley, this cereal is also among the frontrunners. In addition, protein fractions in barley contribute important components for the subsequent process.

Barley is an annual grass with the Latin name *Hordeum vulgare*. The plant can grow to a height of between 0.4 and 1.2 m. At its tip, it carries a spike that contains the barley grains. The long awns that develop on the individual barley grains are characteristic for barley spikes. A closer look at barley grains reveals that grains as such are protected by husks, a straw-like envelope.

One of the main distinguishing features between barleys is whether the spikes are two-rowed or multi-rowed. Multi-rowed barleys can be four-rowed or six-rowed.

In brewing, two-rowed barley is preferred. Six-rowed barley is also used. Though this has a lower extract yield, it is richer in proteins and thus also in enzymes. The time of sowing is a further distinguishing factor between barleys. One differentiates between spring and winter barley. In the case of winter barley, the cereal is sowed in autumn and stays in the ground over winter. Spring barley is sowed in early spring. Due to the longer vegetation period of winter barley, yields are higher. But spring barleys usually have superior characteristics for subsequent malting or brewing.

What are the characteristics of good malting barley?

Important characteristics that good malting barley should have [1] are listed below:

- Appearance: shiny, bright yellow, free from foreign grains or substances;
- smell: clean and straw-like;
- condition of husk: as thin as possible;
- size and uniformity of grains: plump, more than 85 % should be larger than 2.5 mm;
- germinative capacity: more than 96 % of grains should be in a position to germinate;
- germinative energy: Germinative energy refers to the number of grains that really germinate after a certain period (3 or 5 days). Germinative energy should roughly be identical to germinative capacity;
- water content: water content is usually between 15 and 16 % but, depending on weather, it can fluctuate between 13 and 20 %;
- protein content: based on dry matter, protein content ranges from 9 to 11.5 % but can also fluctuate between 8 and 13.5 %;
- starch content: based on dry matter, starch content fluctuates between 58 and 66 %;
- extract content: extract content encompasses all water-soluble components after enzyme digestion. Extract content should range from 72 to 80 %.

How is malt prepared?

Apart from the characteristics of barley proper, process control during malting plays a major role in the quality of the resulting malt. Barley is not the only cereal that can be malted but it is the most important one. For that reason, malting is described using barley as an example. When processing other cereals, malting proceeds along similar lines, with slightly different process parameters.

During malting, endogenous grain enzymes are activated, these are needed during subsequent brewing, first and foremost for converting starch into fermentable sugars. Other cell components of the grain are also broken down, for example high molecular weight proteins are broken down to smaller molecules, or gums or high molecular weight carbohydrates are also broken down to smaller molecules. This is important in particular in connection with subsequent wort preparation during lautering and also during final clarifying filtration of the finished beer as gums would make filtration more difficult.

Before barley can be malted, it has to first wake up out of dormancy. Dormancy is nature's protective mechanism preventing the barley grain germinating directly on the stalk or, when falling to the ground, germinating at once. In the case of frost-sensitive spring barley, this would mean that, upon germinating, it would die from cold at the onset of winter. Thus dormancy prevents germination immediately after harvest. It takes weeks or months until barley gets out of dormancy and possesses the required germinative capacity. In the interim, it has to be stored properly.

Once the barley has overcome dormancy, it has to be cleaned prior to being malted. On the one hand, awns that may have remained are removed from the grains and, on the other hand, foreign bodies such as stones, foreign seeds, damaged barley grains or metal fragments are removed from the barley. The barley is then sorted by grading it according to size. Smaller grains would take up water much more rapidly than large grains. Grad-

SELECTION OF DIFFERENT MALT TYPES AND THEIR USES [2]

Brewing malt	Colour / EBC	Use	Addition
Weyermann® Pilsner Malt	3 - 5	Pilsner beers, any other beer type	100 %
Weyermann® Pale Ale Malt	5.5 - 7.5	suitable for all beers, ale, stout, porter	100 %
Weyermann® Vienna malt	7 - 9	Export beers, Maerzen beers, Festival beers, home-brewed beers	100 %
Weyermann® Munich malt	I 12 - 17	dark beers, Festival beers	100 %
Weyermann® Munich malt	II 20 - 25	strong beers, malt beers, black beers	up to 100 %
Weyermann® chitmalt	2.5 - 4.5	for compensating for highly modified brewing malts	max. 15-20 %
Weyermann® smoke-dried malt	3 - 6	smoky beers, lager, Kellerbier, special beers, wheat beers	up to 100 %
Weyermann® acid malt, pH .3.4 – 3.6	3 - 7	Pilsner beers, light beers, low-gravity beers	up to 5 %
Weyermann® wheat brewing malt	3 - 5	wheat beers, Kölsch beers, Alt beers, top-fermented low-gravity beers, light beers, alcohol-reduced beers, non-alcoholic beers	up to 80 %
Weyermann® wheat roasted malt	800 - 1200	only for top-fermented beers such as Alt beers or dark wheat beers	1 - 5 %

Table 1