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Seminararbeit

Malting Technology

Theme no. 47. : Production and properties of special malts

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1 Introduction

Over the years of malting technology many different kinds of malt have been developed. Special malts are primary used to produce special beers. They have the purpose to bring in some special beer characteristics, like palatefullness, colour, flavour or taste to our beverage. Most of them have their origin in the “ old art of brewing “ and are replaceable by modern products. Nowadays the brewing industry normally does not use a lot of special malt because of the higher costs and the worse processability. But for smaller breweries and microbreweries special malts still are significant. They enable them to produce unique special beers.

2 Wheat malt

Wheat malt is a specific german malt speciality. It is mainly used in southern Germany to produce pale or dark wheat beer, but it can also be a component of “Altbier” and “Kölsch” in the rhine-area or of “Berliner Weisse” in Berlin.

Usually the share on the grist load is 50 % at the most, because with a higher wheat malt share different problems like lauter- and filtration-problems can occur. On the other side the german “ Reinheitsgebot “ dictates a wheat malt share of 50 % to name a beer wheat beer. It also demands a first fermentation by top-fermenting yeast for wheat malt containing beers.

The main differences to barley malt are the wheat malt kernels have no husks and a higher protein content. This results in a worse non biological stability and a higher extract yield. A further difference is the use of winter-wheat instead of summer-wheat. The Kolbach index should be not over 42 %, otherwise foam problems can occur. The FAN content is a bit lower as in barley malt but the top-fermenting yeast can deal with this.

Tab. 1 : analysis of wheat malt (1)

water %	4,00 – 5,00
extract % (anhyd.)	81,00 – 85,00
protein % (anhyd.)	11,00 – 14,00
colour EBC	4,00 – 5,00

Because the wheat kernels have no husks the water-uptake is faster than the water – uptake of barley. The germination time amounts to 3,5 to 4 days, the germination temperatures are similar to those of barley malt. The pile has to be turned more often, because of the risk of lump-formation. The withering starts at 40 °C and ends at 60 °C, then the malt is cured with 80 °C or 100°C – 110°C when dark malt is wanted. Because of the shorter germination time the malting loss is lower.

For dark wheat beer also dark wheat malts are produced. The procedure is identical to barley malt. The colour is about 15 – 17 EBC. (1,2,3)

3 Dark malt

For the production of several beer types dark malt is needed. The dark malt production requires different parameters. Barley with a higher protein content is malted, because many degradation products of the proteins (amino acids) and carbohydrates (glucose) are needed to force the melanoidin reaction and the formation of colour combined with it.

To reach this higher modification , barley is steeped up to a steeping degree of about 50% .The common used germination temperature is about 18°C.

Sometimes CO_2 enriched circulating air is used during germination to slow down the life activity of the germ and to force the formation and work of the enzymes.
During kilning the modification process is sped up with a longer withering phase at temperatures around 40 – 55°C. The curing temperature is around 100 °C to 115 °C. As a result of the higher modification during germination and withering, combined with the higher curing temperatures the melanoidin reaction is much stronger, so the wort colour is about 10 – 30 EBC. Because of the higher drying temperatures the moisture content is around 2 – 3 % (1,2)
There are three main kinds of dark malts :

3.1 Munich malt

Munich malt is the main special malt used for the german beer production. In former days it was characteristic for the munich beers. We distinguish between two kinds of munich malt :

1. The brighter one with a colour between 13 and 15 EBC. Its share of the grist load can be up to 85%.

Tab.2 : analysis of dark malt (2)

moisture %	3,20
extract (anhyd.) %	81,40
fine – coarse difference %	0,80
viscosity mPas	1,55
protein (anhyd.) %	9,60
VZ 45°C %	45,00
colour, EBC	14,00
saccharification time (min)	10 - 15

2. The darker one with a colour between 20 and 25 EBC, with a share of the total grist load of 20 to 40%. It is used to emphasise the beer flavour.

Also other types of dark malt for individual beers can be ordered. (3)

3.2 Vienna malt

The origin of vienna malt is a special vienna beer type in earlier days. Nowadays it is often used to correct brighter malt colours or to produce " gold-coloured " beers. The production of vienna malt is similar to pale malt, but the curing temperature is a little bit higher (90°C). A colour of about 5 – 6 EBC is wanted. It should have a pale malt flavour, not in the least a dark malt flavour ! (2)

3.3 Brumalt

Brumalt is a kind of dark malt. It is over-modified, and has a colour of about 30 – 40 EBC. It is used to improve the flavour of dark beers, or in exchange of colour malt or caramel. Sometimes it finds use in the production of nonalcoholic or light beers, because of its strong flavour.

One big advantage is that this malt does not bring a burned taste into beer, like some roasted malts do, even though the colour is very dark. (4,2)

Tab. 3 : analysis of brumalt (2)

moisture content %	4,90
extract (anhyd.) %	80,30
fine – coarse difference %	1,50
Viscosity mPas	1,56
Protein (anhyd.) %	10,10
VZ 45°C %	51,00
saccharification time, min	20 – 30
colour, EBC	30 - 40

A normal batch of germinating dark greenmalt, with a higher water content (48 - 50%) and a protein content over 11,5% in barley, is left to its own devices by switching of the fan.

In earlier days working with malting floors the pile was covered with a plastic-awning for the last 36 hours of germination (7 day-germination) .

Due to the lack of air circulation the developing CO_2 and the heat are not removed, and the temperature rises up to about 45 – 55 °C. Over a temperature of 40°C the embryo stops to grow, but the modification of proteins and carbohydrates is accelerated. So it comes to a accumulation of low-molecular breakdown products like

glucose, fructose, amino acids and peptides. Also some esters and organic acids are formed. The batch is left in this condition for 18 – 20 hours (modern way).
There are two different possibilities of withering :

1. Drying the green malt over 9 hours with a rising temperature of 50 °C to 55 °C and finally 60°C. After 2 – 3 hours of holding a temperature of 65°C, the breakthrough is expected.

2. Temperatures of 50 and 55°C are each held for 4 hours. 75 – 80% circulating air is used. After that the drying process is initiated with heating up the whole batch to 60 – 65°C and by holding this temperature for 2,5 hours.

A one hour rest at 70°C follows. In the end the malt is cured with a temperature between 80 and 90°C with a share of fresh air of 0 – 10% for 3 – 4 hours. The curing temperature depends on the wanted colour. The whole kilning takes about 19 hours.
Because of the high moisture at temperatures over 80°C some enzymes are inactivated, this is linked to the development and origin of glassy kernels and explains why brumalt is not as rich in enzymes as normal pale malt (see Tab. 1).
As a consequence of the forced germination and kilning, the malting loss is about 4 – 5% higher than normal, also the extract yield is 1 – 1,5% lower.
Brumalt can be used with a share up to 50% of the total grist load. (4,2)

4 Caramel malt

Caramel malt is used to emphasise the palatefullness of beer or to give the beer a more malty character and deeper colour.

In earlier days finished produced malt was used to make caramel malt. It was steeped again to a water content of about 45 % within 6 – 10 hours. Because of the resteeping process the anhydrous loss rose about 3 %. The usual way to produce caramel malt nowadays is the use of a well modified greenmalt with a moisture content around 45 – 50 %. This greenmalt is saccharified within 3 – 4 hours at a temperature about 65 °C – 70°C. For this process a special kilning - floor or - drum is needed. When the endosperm is liquefied the saccharification is complete. To dry the malt temperatures about 150 – 180°C are used. We distinguish between two different caramel malts :

- a brighter one, the so called “cara-pils” with a colour around 4,0 – 7,0 EBC and
- a darker one with a colour up to 130 EBC (“cara hell” and “cara-münch”).

To produce the brighter one the temperature is kept for 1 – 2 hours , to produce the dark one up to 3 hours. The high temperatures and the high moisture content results in a very strong caramelisation and maillard – reaction. The typical caramel flavour is formed.

After that a normal kilning process follows with temperatures around 80 °C – 90°C. Caramel malt has a higher moisture content than normal malt. Because of the high kilning temperatures some water is enclosed in the endosperm. (1, 5)

Tab. 4 : analysis of bright and dark caramel malt (1)

	Bright type	Dark type
Water	4,00 – 8,00	4,00 – 8,00
Extract (anhyd.) %	76,00 – 79,00	75,00 – 78,00
Fine/coarse difference %	3,00 – 9,00	5,00 – 9,00
Protein (anhyd.) %	10,00 – 11,00	11,00 – 12,50
Kolbach index	30,00 – 35,00	25,00
Colour EBC	4,00 – 7,00	50,00 – 130,00

5 Colour malt / black malt

The darkest malt type is the colour malt. It is used to create a dark or even black colour in beer. Roasted malt has a wort colour of about 800 – 2500 EBC. It is only used to colour the wort or to strengthen the beer character. It is not used to supply the wort with extract. Only little amounts of roasted malt are needed, so the share of the total grist load is around 1 – 5 %.

The most common beers containing colour malt are strong beers, “Altbier”, dark beers or dark wheat beers.

For the production normal pale malt is taken. This malt is brought by spraying in the roast drum to a moisture content around 10 - 15%. This has to be done with a constant rotation of the drum. This happens with temperatures of 70 – 80 °C. A saccharification occurs. The low molecular breakdown products of proteins and starch are needed to form the melanoidines, which are the main component of the malt colour. This temperature is kept for 1,5 – 2 hours. Then the temperature is increased to 180 °C – 220°C, this is the roasting process, which takes about 1 – 1,5 hours. It is important that the temperature does not rise above 220 °C, otherwise an unpleasant, burned taste will form. The change of colour has to be controlled continuously. After reaching the

desired malt colour the drum has to be emptied very fast and the batch is chilled on a special cooling floor.

Roasted malt has a water content of 2 – 3% and around 60 - 70% extract (anhydrous). A modern product made out of colour malt is colouring beer. It is produced by mashing in with a high proportion of colour malt, followed by a special mashing and fermentation method. After that it gets conzentrated by draining off water. It also gets debittered by a certain process. It has a colour up to 8000 EBC and is easier to process. (1,2,3)

6 Chit malt

Chit malts are used to improve the foam stability or to reduce the palatefullness of beer. They are malts with a very short germination time, and are moved to the kiln or brewhouse when the germination is not completely finished (2 - 4 days after chitting). The purity law dictates that malt has to germinate at least two days, which means that two days after chitting the barley is not raw grain any more.

The modification of such malts is very bad, so that lauter and filtration problems can occur, because of the high viscosity. Due to the short germination time the loss is low. (1)

6.1 short-grown- or chit malt

The most common way to produce chit malt is to steep as usual and to stop the germination after 2 – 4 days. The following kilning process is the same as it is for pale malts. (1)

6.2 greenmalt

When the brewery has it’s own malting plant they can mash in greenmalt. In this way a high amount of energy and costs are saved (no kilning). The effects of greenmalt on beer are nearly the same as those of chitmalt. But because of the adstringend bitterness of the rootlets and the germs the taste is much worse. It is not used very often. (3)

7 Smoke-dried malt / whisky malt

Smoke-dried malt has a very special flavour, it tastes and smells slightly like smoke-dried ham. It is used to produce “Rauchbier”, a german beer speciality of the Bamberg region. The difference in production to normal malt is that the greenmalt is kilned over an open fire of beech wood. The very aromatic smoke draws through the pile, so that the flavour passes into the malt.

The production of whisky is nearly the same, but instead of beech wood peat is burned here. Normally whisky malt is used to produce whisky, but if you want to bring a special whisky flavour into beer also whisky malt can be used for the beer production. (6,7)

8 Acid malt

Acid malt is used to acidify the wort. The reason for an acidification of wort is to force the enzyme activity. Originally it was developed to compensate the negative effect of hard brew liquors. By the usage of acid malt, the pH in wort can go down to 5,0. A disadvantage of the usage of acid malt is the increasing puffer capacity, resulting from the forced activity of phosphatases. This is the reason for a lower pH decrease during fermentation.
It's normal share on the total grist load is 7 – 10%. (2)

Ready malted pale malt is resteeped in warm water of 45°C – 47°C. This is the optimum temperature of lactobacilli, which are still present on the husks. The start a lacto-acid fermentation. When the acid concentration is around 0,7 – 1,0%, which takes 24 – 30 hours, the water is let off. It can be used for the next batch of acid malt, this procedure will speed up the process for 12 hours. The wet malt now is dried carefully with a temperature of 50°C, 60°C at the most. The lactic acid is concentrated by the drying process. The finished produced acid malt has a lactic acid concentration of about 2 – 4%. (2)

It can also be produced by fermenting unhopped wort with lactobacilli. After fermentation it is sprayed onto green malt. The lactobacilli remain on the husks of finished produced malt. (1)

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