2. DIFFERENT BEERS WITH DIFFERENT MALTS

Brewing is a creative process. By varying recipes, mashing programmes, types of yeast and fermentation conditions, a brewer can create a variety of different beers. Further variations can be achieved by using different malts. The world of malts is rich, not only because of the wide variety of production methods used in manufacturing different types of malts, but also due to the possibility of using a variety of cereals for malting and brewing. Sometimes, these malts are called special malts, but due to the increased usage of these products in the production of so called standard lager beers, we would rather refer to them as different malts. This article describes the wide variety of malts from which today's brewers can choose when brewing high quality beers, not only for beer enthusiasts but also for brewing volume products.

Raw Materials

The most common cereals used for malting and brewing are barley, wheat and rye. Wheat and rye mainly differ from barley with respect to the absence of the husk and their smaller kernel size.

The main requirements of malting are common across the range of different cereals: the use of pure varieties suitable for malting and brewing purposes, even kernel size, good germination, even modification and protein levels below 12%. Based on the variation in incoming raw materials, the maltster can control the usage of raw materials with different quality characteristics. Normally, barleys with a higher protein content are used in the production of dark brewing malts (because of their better colour formation), while barleys which are low in protein are used in the roasting plant (since they have faster saccharification).

Products

The production of different malts is presented in Figure 1.

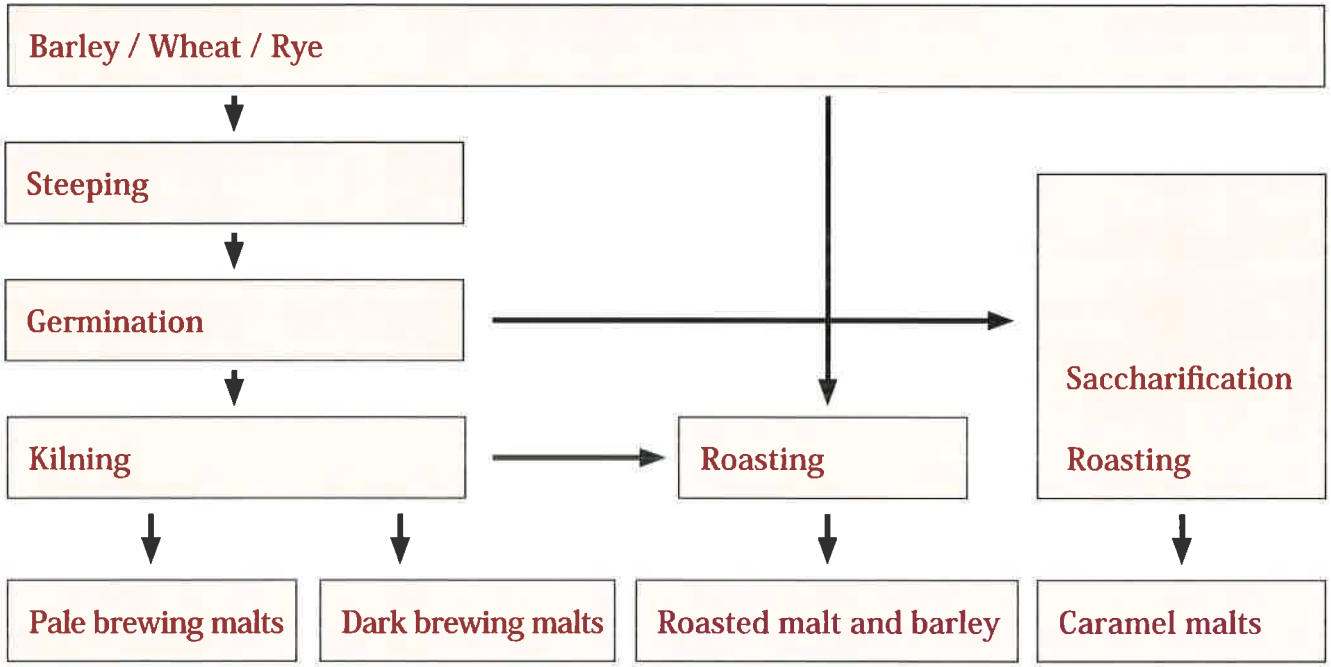


Figure 1. Manufacture of different malts.

Dark Brewing Malts

Dark brewing malts are produced in a similar way to their pale equivalents, the kilning phase representing the only difference in most cases. Some maltsters also select the variety to be used and adjust the germination conditions in order to promote colour formation. When compared to the production of pale brewing malt, the main differences are:

1. The circulation of air with a high moisture content during the early kilning phase (stewing),
2. Higher final kilning temperatures.

The higher the temperatures to which the malts are subjected during kilning, the more flavour and colour compounds are formed. There are two main routes to colour and flavour formation: the so-called Maillard and Strecker degradation reactions. Both reactions involve reducing sugar and amino acids reacting at elevated temperatures. The more the malt is stewed at the beginning of the kilning phase, the more sugars and amino acids are formed. The higher final temperature, the more colour and flavour active compounds are formed. On the other hand, the higher the colour is, lower is the residual enzyme activity. Dark brewing malts usually contain medium levels of enzyme activity, i.e. they can be used in relatively high portions for pale malts, or in some cases even alone.

Typical dark brewing malts include **Vienna**, **Bayer** and **Munich malts**. Naturally, product names differ from producer to producer but, in general, the colour of dark brewing malts varies from 5 to 50°EBC. Some maltsters have designed special kilning programmes to meet the specific requirements of their customers. Our **Dark Ale 30 malt** is an example of this.

Caramel Malts

Caramel malts are produced in a roasting drum, from well-modified green malt. The moisture content should be quite high, preferably at a value higher than 45%. Due to the possibility of achieving higher temperatures in a roasting drum in comparison to conventional kilns, caramel malts have a broader colour variation than kilned dark brewing malts. There are three main steps to producing caramel malts:

1. Heating to approx. 65 °C and saccharification,
2. Removal of excess moisture,
3. Drying and cooling.

Steps one and two are usually identical for all caramel malts, step three varying depending on the colour of the product. During saccharification, the interior part of the kernel reaches the temperatures required for gelatinisation to take place, which are also optimal for the activation of amylotical enzymes. In other words, mashing takes place inside the kernel, with starch and proteins being broken down into sugars and amino acids.

Once modification of the endosperm has been achieved, the roasting drum is opened and the excess moisture removed. Following this, the malts are dried to reach a moisture content which is usually less than 8%. Since the sugar content is high, the colour and flavour develop rapidly, and relatively high colour values can be achieved. While the drying temperature normally varies between 80–140 °C, the colour values of different caramel malts vary from 5 to 500 °EBC. Finally, the malts are cooled using cool fresh air, to temperatures of around 25°C.

Caramel malts have a glassy and hard structure, due to the crystallised sugars of the endosperm, and their level of amylolytic activity is negligible. This is also true for low colour caramel malts.

When compared to dark malts of the same colour, caramel malts are richer in flavour, mainly due to more intensive Maillard reactions during the drying stage. Caramel malts typically have a nutty, caramel or toffee flavour. Many investigations have shown that caramel malts improve foam retention, which could be due to the modification of the proteins during processing. Caramel malts can also contribute to the fullness and mouthfeel of the beer.

Roasted Products

There are two raw materials for the roasting process:

- Dry pale brewing malt and
- Barley or other native cereals

These products are exposed to very high temperatures in the roasting drum, the highest reaching 200°C. This results in very dark products with an array of harsh, bitter and even burnt flavours.

Wheat Malts

The total malting time for wheat is normally shorter than that of barley. Wheat has no husk, allowing a rapid uptake of water in steeping. Great care is needed not to produce oversteeped wheat, which forms a sticky mess when it is turned and transferred. For pale wheat malts, kilning temperatures are usually around 75–80°C. In order to avoid kernel breakage and dust problems, a higher final moisture /5–6%) is allowed. Dark versions and caramel malts can also be produced from wheat in a similar way to the corresponding barley malts.

Rye Malts

Rye is usually considered a bakery cereal, but brewery applications are not unknown. Due to their high concentration of gel forming pentosans, the use of rye malts in breweries is limited. Rye malts can more or less be considered a spice in beer production. However, in some home brews and low alcohol drinks, such as kvas, rye malt forms the main raw material. Rye has a malting characteristic quite similar to that of wheat. Light rye malts are probably most common, but also dark and caramel versions are produced.

Malt Characteristics

Different raw materials and processing conditions produce remarkable differences in the brewing characteristics of malts and the nature of the final product. Typical malt and congress wort analyses of different malts are presented in Table 1. Due to the low enzyme activity of some malts, they cannot be mashed alone, even for analytical processes. Results in *italics* relate to mashes performed with pilsner malt on a 50/50 basis.

Malt	Extract [% d.m.]	Moisture [%]	Colour [EBC]	Protein [% d.m.]	FAN [mg/l]	pH	Viscosity [mPas]	Diastatic power
Pilsner	81	4,5	3,5	11	160	6	1,45	350
Vienna	80	3,5	7	11,5	140	5,95	1,5	330
Munich	80	2,5	16	11,5	110	5,8	1,6	100
Cara Pale (pale caramel malt)	79	7,5	8	*12*	*150*	*5,9*	*1,5*	*0*
Crystal Malt 100 (dark caramel malt)	77	4,5	100	*12*	*110*	*5,5*	*1,55*	*0*
Black malt	65	1	1500	*12,5*	*100*	*5,3*	*1,5*	*0*
Wheat malt	83	6	4	12	120	6,1	1,9	200

Table 1. Typical malt and congress malt analyses.

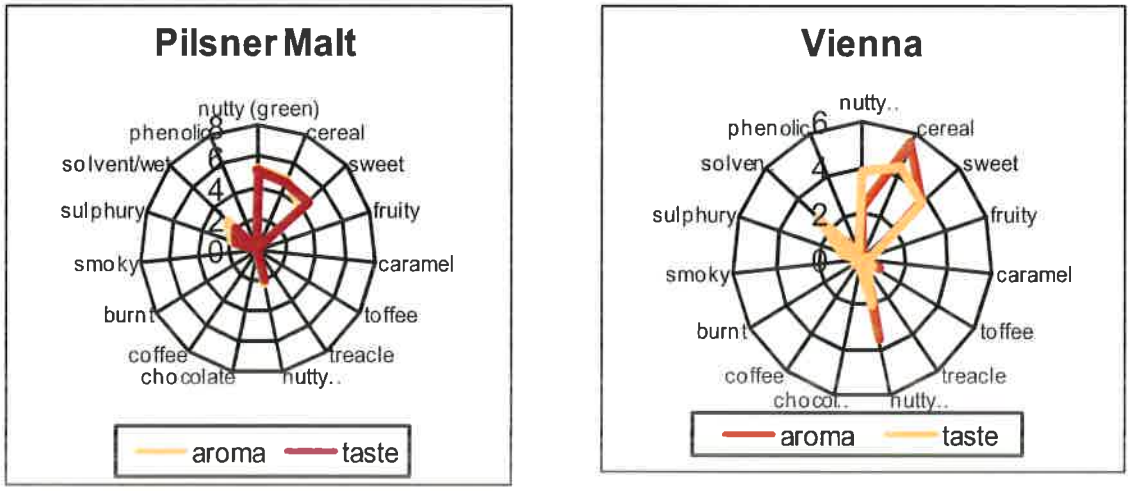
Note: Values in *italics* refer to mashing with pilsner malt on a 50/50 basis.

According to the results, the main conclusions are:

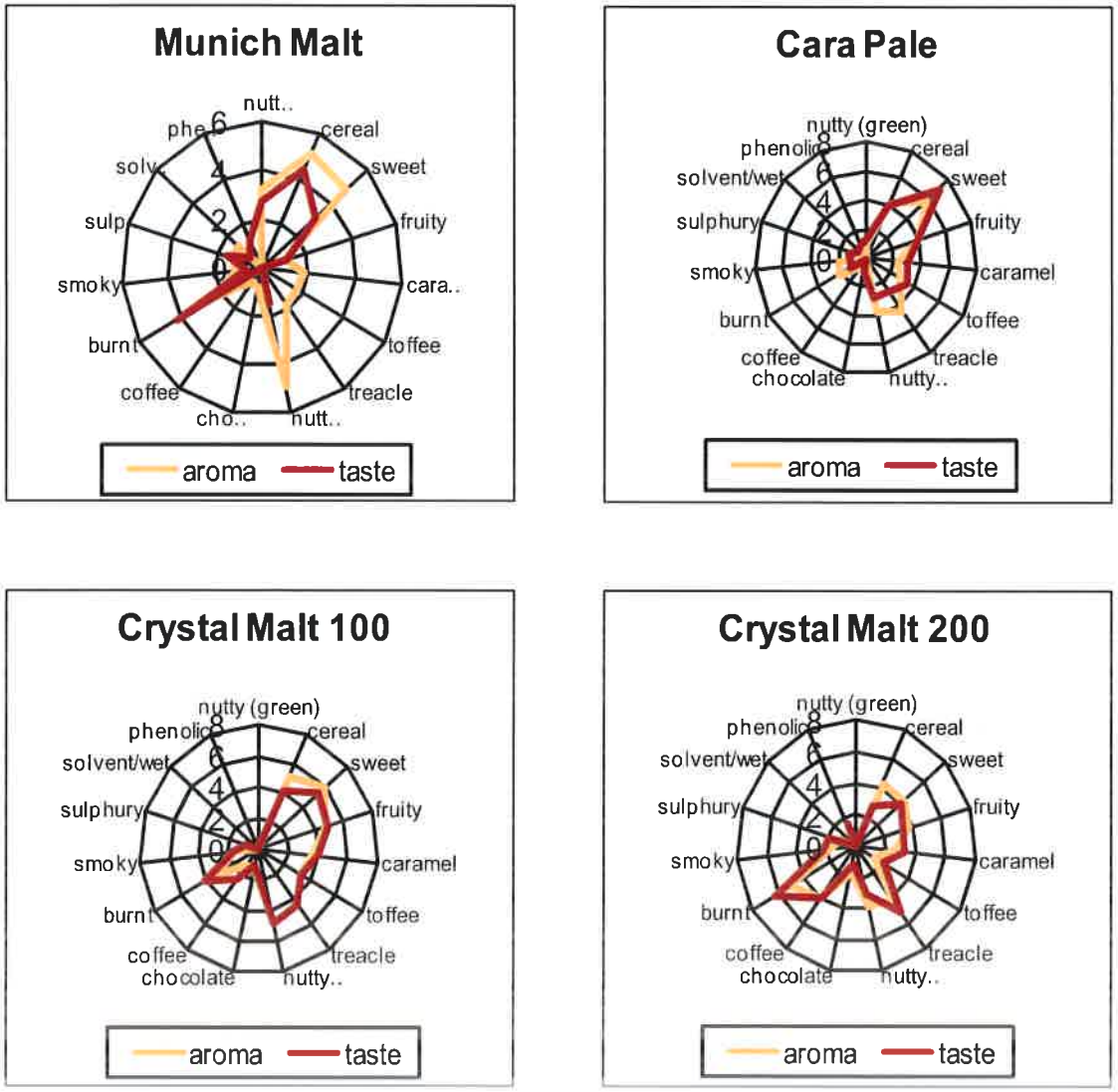
- Dark malts have a lower pH.
- Enzyme activity decreases at higher kilning temperatures.
- Extract content is lower in saccharified products.
- Free amino nitrogen levels decrease as the temperature increases.
- Wheat malt has high extract and viscosity.

Flavour

In the past, dark, caramel and roasted malts were mainly sold and used on the basis of their colour value. On the other hand, as stated above, it is not only the colour that is different, different malts also varying in terms of flavour. The most common way of evaluating the flavour of a malt is probably to taste and score the congress wort. However, due to the high sugar content of the wort, it is difficult to detect differences in flavour components. Therefore we have adopted the "porridge method" developed by BRI. The malt is ground and mixed with distilled water, the porridge is tasted as such, and scores are given separately for aroma and taste. Typical flavour profiles for different malts are shown in Figures 2–7.



Figures 2–7. The typical flavour profiles of different malts.



Figures 2–7. The typical flavour profiles of different malts.

As described earlier, the formation of different flavour active compounds is dependent on temperature, moisture and time. The following figures demonstrate the differences between different malts when evaluated organoleptically.

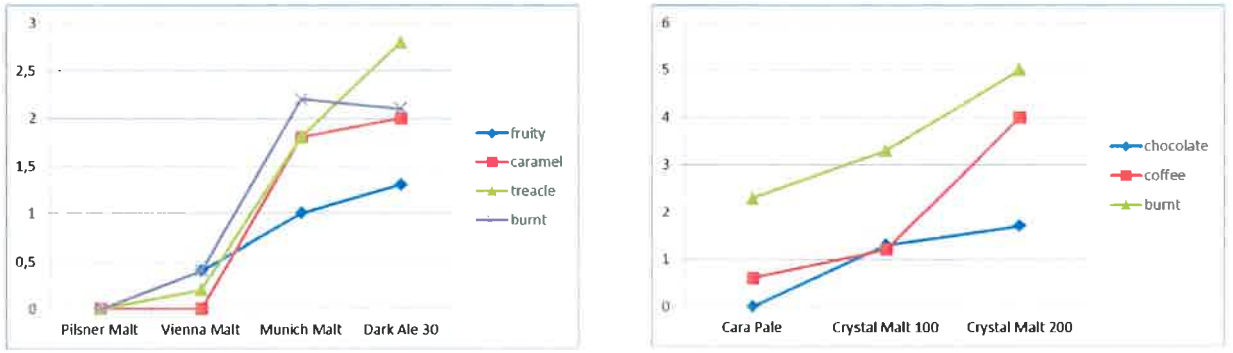


Figure 8. Malt aroma scores, by malt colour, in dark brewing and caramel malts.

The same evaluation method can be used to demonstrate the difference between different types of caramel malts. For example our **Cara Plus** products are produced in a specially designed kiln, while **Crystal Malts** are produced in a roasting drum. The colour and colour shade of the two types of caramel malts are the same, but the flavour is slightly different (Figure 9).

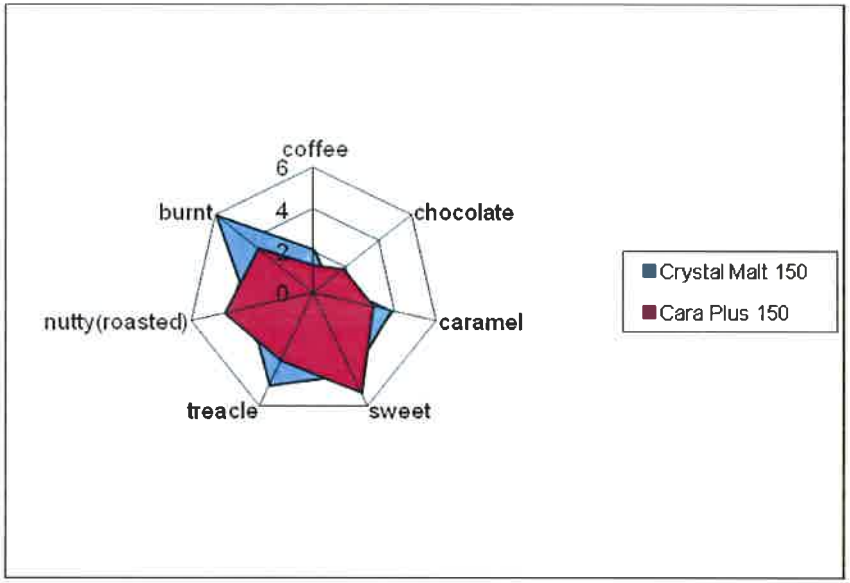


Figure 9. Malt flavour differences of Crystal Malt 150 and Cara Plus 150.

Different Beers with Different Malts

Wheat malt is the natural basis for wheat beers, and use in portions forming more than 50% of the grist is common. Sometimes, due to its higher soluble nitrogen content, wheat malt is used as a foam enhancer (2–5%), together with pale brewing malts.

Rye malt has some applications in commercial breweries, but its use is more common among home brewers and producers of other, beer-like, beverages like *sahti* in Finland or *kvas* in Russia.

Dark brewing malts are widely used when seeking a dark colour in the final beer, and different malts are selected in accordance with the favoured characteristics of the end product. Dark brewing malts are preferred for festival beer, while strong stouts and porters require substantial amounts of roasted malt or barley. Blends of different malts are usually chosen, in order to obtain a versatile and balanced beer flavour.

Caramel malts are used when a sweet taste, full mouth feel and fruity flavour are desired. These malts are widely used, for example in *bocks*, seasonal beers like *märzens* and even in some *ales*.

When used in reasonable portions in a grist, the flavour and appearance of ordinary lager type beers can be improved significantly through the use of different malts, without significant deleterious effects on a brewery's finances. Such improvements include the colour, foam, flavour and mouth feel of any beer.