How to brew a wheat beer with intensive banana aroma – A European perspective
By Michael Eder

Producing a German-style wheat beer may not be as difficult as some people think. The most important factors are the ingredients and the technical knowledge; a little bit of historical background might help too…

The first signs of beer brewing date back from 6000 BC. In those days luck played a big part in obtaining a successful brew. Technicalities were not well known until the medieval times when the first steps into brewing science were made. Nevertheless beer brewing was known as an art – and most of the time this art was performed with top fermenting (ale) yeast.

Around 400 years ago during the regency of Lord Maximilian 1st in Bavaria, Germany, wheat beer or "Weissbier", was only allowed to be brewed by aristocrats. This type of beer was therefore very desirable for common people. Until then, production and commerce of wheat beer was only done by the aristocratic family Degenberger who originated from a small town called Bogen, still located in lower Bavaria. By heritage the right to produce wheat beer, the so-called "Weissbierregal" was passed on to Maximilian 1st. He foresaw a great financial success in producing wheat beer and founded ducal wheat beer brew houses across the country – the first one was built in the year 1607 in Kehlheim, a small town located on the Danube River in Bavaria. From that time on until the 18th century, wheat beer dominated the Bavarian beer market. At the turn of the 18th Century, people habits started to change and they started consuming dark or amber beers over wheat beers. The production of this particular beer was not as lucrative anymore and thus quickly declined. Nevertheless the brewing monopole was still effective and common people were not allowed to produce wheat beers.

During the same time period, Mr. Georg Schneider, an ordinary citizen of Munich, was the leaseholder of the "royal wheat beer brew house" (1855 – 1873) in Munich. As bottom fermenting beers became more and more popular, the royal office wanted him to stop the production of wheat beers in the "Weisses Brauhaus" in Munich and produce bottom fermenting beers instead. However, Mr. Schneider still believed in the potential of wheat beer production and negotiated successfully with the royal office (Regency of King Ludwig 2nd) to be allowed to brew wheat beer. Simultaneously, he took an opportunity and bought the brewery "Maderbreu" in Munich. He then went on to found, together with his son Georg the 2nd, the very famous brewery "G. Schneider & Sohn" in the year 1872. Later on in 1928 the production moved to Kehlheim where it is still located these days.

Since the sale of the "Weissbierregal" to Mr. Schneider the consumption of wheat beer became popular again – not as popular as in the medieval time but nevertheless it still represents a stable market share nowadays.

The wheat beers brewed in medieval time were different than those brewed today. The main reason was the low carbonation due to the lack of pressure-resistant vessels (> 1 bar); additionally the raw materials were very different. However, the general character would have been similar to the wheat beers we drink today – a fruity beer, refreshing, easy to drink, very tasteful!

What makes a wheat beer so unique?

The choice of raw materials is essential to a good wheat beer. A mix of barley malt, wheat malt (German brewers are forced by law to use at least 50% of wheat malt for the beer to be labelled wheat beer and also achieve at least 11% original gravity) and caramel malt to deliver the great malty body typical of this style of beer. The hops should be carefully selected to

avoid the presence of too much aromas or bitterness to the beer. Finally the yeast strain used must produce typical wheat beer flavors like clove (4-vinyl guaiacol) and banana (isoamyl acetate). In order to produce sufficient amount of isoamyl acetate ester and therefore increase the banana aroma in the beer, the following recipe is suggested.
The ideal malt ratio for a typical German/Bavarian wheat beer would be 70 % of wheat malt, 27 % pilsner malt and 3 % dark caramel malt to obtain the typical amber colour. Any hops can be used as long as they are dosed carefully to keep the bitterness units below 14; this will allow the estery character of the beer to come through. Finally, a real German / Bavarian wheat beer yeast strain such as "Munich" yeast available in dry form from Lallemand Brewing in the USA (this strain was actually selected at the Doemens institute in Munich / Germany!) should be used to maximise flavors. However, this is only realistic if the yeast has access to the right wort composition which is dependent on the mashing regime.

How to increase the banana flavor of wheat beer?

At the beginning of the mashing process the temperature should be kept low at 30°C to increase the activity of the maltase enzyme in a decoction mash system and increase the glucose concentration (Figure 1). The greater the difference between the glucose vs. maltose in the wort, the more ethyl- and isoamyl acetate will be produced by the yeast. One part of the mash (25-30%) is then separated (thick mash) and heated up to a temperature where the ß – amylase is active (62°C), whereas the second part (thin mash) remains at 30ºC, both for a 30 min time period. After that time they should be mixed back together to achieve a wort temperature of 40 °C. This is the most critical step of the mashing process with the maltase being active and producing glucose for the next 30 minutes. Skipping the ß-amylase rest, the wort should be heated directly to a temperature of 72°C to activate the α-amylase. After checking for a negative iodine reaction, the mash is heated again to the transfer temperature of 78°C.
Such mashing recipe is based on the knowledge of enzymatic activity (Table 1) and yeast metabolism. By using a mash water – grist load ratio of 5:1 a higher pH in the mash is achieved do optimise working conditions of the maltase. The lower mashing temperature of 40°C allows for an increased glucose production. Glucose level is around 8 g/l in a standard mash compared to 17 g/l with such decoction mash system. As a result yeast will demonstrate a so-called "diauxia phenomenon": reduced maltose metabolism, reduced cell growth, acetyl CoA will be transferred to higher alcohols coming from amino acid metabolism, resulting in an increased ester production compared to a standard fermentation, similarly to the process of high gravity brewing.

Conclusions

A specific mashing procedure was designed and developed by Dr. Bertram Sacher of the Doemens Institute (Munich, Germany) to increase ethyl- and isoamyl acetate from 1 mg/l to 3 mg/l and produce wheat beers with intensive banana notes. This method has been successfully tested many times in commercial breweries in Germany.

Enzyme	pH (optima)	Temperature (optima)	Product
Beta-amylase	5.4-5.6	60-65	Maltose
Alpha-amylase	5.6-5.8	70-75	Dextrin
Maltase	6.0	35-40	Glucose
Invertase	5.5	50	Glucose/fructose
Limit dextrinase	5.1	55-60	Dextrin

Table 1: Enzymes involved in the mashing process and their characteristics

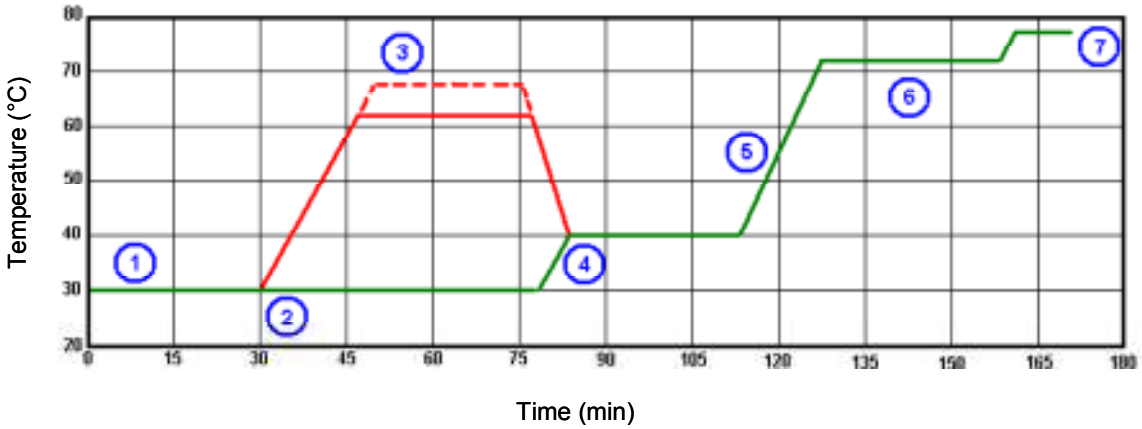

Figure 1: 1-mashing with water/grist ratio of 1:5 **2**-Mash separation (25-30% of thick mash and 70-75% of thin mash) **3**-Heating of the thick mash to 63°C and 30 min rest to activate β-amylase **4**-Mixing of both thin and thick mashes to achieve a temperature of 40°C and activate maltase **5**-Heating to 72°C to perform iodine reaction **6**-Heating to 78°C before transfer to lauter tun.