Ancient wheats

Some experiences from the project ALTERBAKE: Technological challenges in the processing of ancient wheats

by Melissa Camerlink, University College Ghent, Department of Bio- and Food Sciences, Belgium

During the past two years, the ALTERBAKE-project has investigated the application potential of alternative cereals in the development of innovative bakery products. This project was a collaboration between Ghent University (UGent) and the University College Ghent (HOGENT). The scope of the research project included several ancient grains such as three ancient wheats (einkorn, emmer and khorasan), teff and three pseudo-cereals (quinoa, amaranth and buckwheat). In addition, tritordeum, a relatively new cereal, was studied.

Ancient grains

Ancient grains are defined as the populations of primitive grains, which were not subject to modern selection or breeding programs. They sometimes still have characteristics of their wild ancestors such as individual variability and ear length, a fragile ear and a low yield index. Over the course of time, ancient grains were bred towards species with higher yields. Nowadays, 95 percent of the cultivated wheat is bread wheat (or *Triticum aestivum*), while the other five percent mainly consists of durum wheat (*Triticum durum*).

However, ancient grains are gaining renewed interest because of the increasing demand in organic, traditional or artisanal food products. They are considered an highly adaptable species and there is a strong demand to preserve genetic diversity in the field. Moreover, some ancient grains are being characterised by interesting nutritional properties.

Ancient wheats

Ancient wheats are for example einkorn, emmer, khorasan and spelt. These ancient wheat plants can grow very high (>1 metre), which makes them very susceptible to lodging so yields can be very low compared to modern bread wheat varieties. Ancient wheats are suitable for organic farming since they are considered low input crops.

The oldest ancestor of common bread wheat is einkorn or *Triticum monococcum*. The name of this ancient wheat species reveals that one husk contains just one kernel. Other commonly used names are 'small spelt', 'petit épeautre' and 'farro piccolo'. Einkorn was first cultivated 14,000 years ago and knows its origin in Turkey, Iran and Iraq.

Over time, einkorn spread to Europe and, about 10,000 years ago, emmer wheat emerged. Later on, about 8000 years ago, spelt was derived from emmer. Emmer (*Triticum dicoccum*) contains two kernels in each husk and this crop is still being cultivated in some areas of Europe. Meanwhile spelt (*Triticum spelta*) is a well-known cereal in Europe.

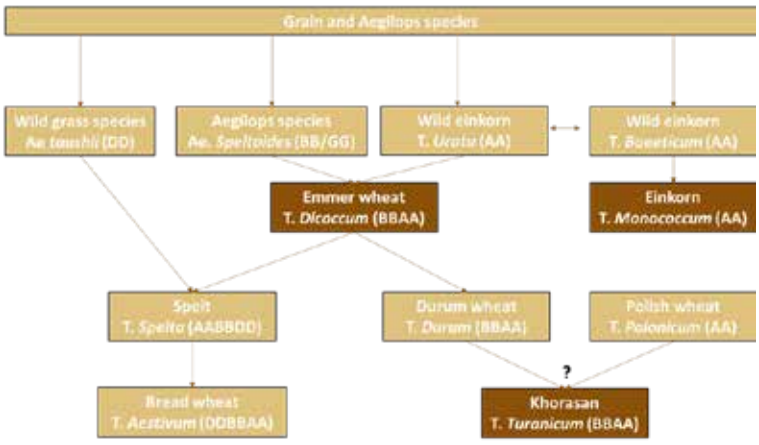
Einkorn, emmer and spelt are all hulled wheat species that first need to be dehulled before they can be processed into flour. Because of the low yields and this extra dehulling step, it became less interesting to grow these ancient wheats and more interesting to grow common bread wheat (a high-yielding, disease resistant wheat species with dwarfing genes). Khorasan (*Triticum turgidum* ssp. *turanicum*) is also an ancient wheat. Khorasan is a free-threshing cereal and most likely originates from Polish wheat and durum wheat. It is better known as the registered trademark KAMUT® (variety QK-77). Khorasan is mainly cultivated in Canada and North America by KAMUT International.

During the research project milling and functional properties of commercially available samples einkorn (2-3), emmer (5-6) and kamut (1-2) were investigated.

Milling properties

Ancient wheats can be milled into flour and whole meal. Einkorn and emmer need to be dehulled before milling which

Figure 3: Phylogeny of ancient wheat species



means extra labor and extra costs. It is not always easy to remove the hull of einkorn mechanically, while dehulling emmer is quite similar to spelt. Dehulling results in a 25-30 percent weight reduction.

Einkorn is also very difficult to process on a roller mill. During milling, sieves easily clog with the sticky, light and inert flour. Flour properties are similar to cookie flour properties. A larger amount of the endosperm sticks to the bran since kernels of einkorn easily disintegrate during milling. Therefore, the fraction of flour that is being extracted by the bran finisher was much higher compared to the milling process of common bread wheat. The amount of damaged starch was also lower (±3 percent) compared to common bread wheat (±5 percent). Milling of einkorn through stone milling can avoid problems such as clogging. It is important to mention that flour properties will be different when a different milling technique is applied.

In contrast to einkorn, emmer and khorasan can be milled on a roller mill without difficulties. The damaged starch content of the khorasan sample was slightly higher compared to bread wheat which can be explained by the kernel characteristics. Khorasan wheat kernels are harder than bread wheat kernels. This is not surprising, since khorasan is related to durum wheat.

Flour extractions for einkorn, emmer and khorasan on a Bühler laboratory mill were respectively 58-70 percent, 59-69 percent and 68 percent, compared to a flour extraction of a common bread wheat of about 68-70 percent. Notice that these results were obtained on a laboratory mill and will most likely be higher when tested on an industrial roller mill.

Functional flour properties

Functional flour properties such as Zeleny sedimentation, Hagberg falling number, wet gluten content and gluten index were also analysed. Zeleny analysis showed that gluten quality of the ancient wheats samples available on the Belgian market was (very) poor. Einkorn shows Zeleny values below 10ml, while emmer and khorasan show values of about 13ml. Results of the gluten index confirm that gluten in ancient wheats are weak (results are much lower than the recommended 80 percent

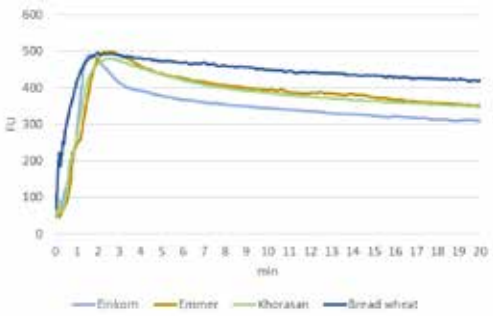


Figure 1: Flour properties (damaged starch, Zeleny sedimentation, Hagberg falling number, Gluten index and wet gluten context) of ancient wheats and bread wheat
*due to the very weak gluten in einkorn flour, it was not possible to measure the wet gluten content and gluten index with the Glutomatic

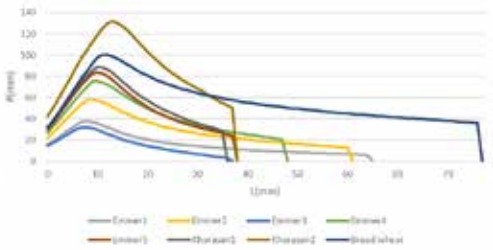


Figure 2: Farinograph results of ancient wheats and bread wheat

Figure 4

Figure 5

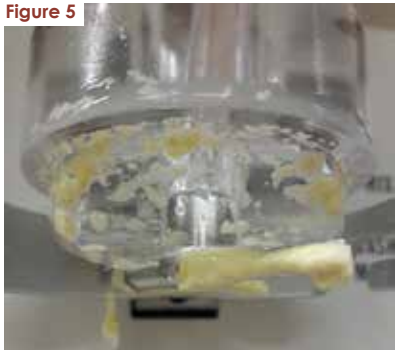


Figure 6

Figure 4: Illustration of difficulties of milling einkorn with roller mills

Figure 5: Glutomatic result after washing out gluten in einkorn flour

Figure 6: Dough made with einkorn flour could not by analysed by the Alveograph

minimum gluten index with common bread wheat).

Samples were also subjected to a standardised Farinograph and Alveograph test to assess the rheological properties of bread dough with ancient wheats. Water absorption of einkorn flour (±52 percent) is low while water absorption of emmer and khorasan flour is similar to bread wheat flour (±60 percent). The dough stability of ancient wheat flours is much lower and the degree of softening is much higher compared to bread wheat flour. Overkneading of the dough will therefore be a problem (See Tables 1, 2 and 3).

Some conclusions

To develop high quality bread with ancient wheats, bakers need background knowledge on the processing properties of these ancient wheats so they can adjust their processing schemes. Our results indicate that breadmaking with ancient wheats available on the Belgian market is a challenge.

Doughs are more difficult to handle and bread volumes are generally lower. There is a need for alternative processing methods such as sourdough, cooled doughs, polish dough methods, etc. Our research shows that applying these techniques increases the processability of ancient wheats and improves the quality of the resulting breads.

Despite the many challenges, there is a great potential for these ancient wheats since consumers show a clear interest in these products. A survey, conducted with 300 consumers, showed that one third of the respondents is willing to pay 50 percent extra for a bread with ancient grains.

If these grains are locally grown, more than half of the respondents are willing to pay the extra money. One of the Belgian bakers who started working with these ancient wheats tells us, "Try and keep trying. Do not give up and look for the right processing technique for each ancient wheat. This way you can create tasty and traditional bread".

For more information please contact:
Filip Van Bockstaele – filip.vanbockstaele@ugent.be
Melissa Camerlinck - melissa.camerlinck@hogent.be
Ingrid De Leyn – ingrid.deleyn@ugent.be

www.alterbake.be