Wheat quality and the factors affecting it

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Wheat quality is a conformance to requirements, depending on whose hands it's passing through from field to table. The farmer expects a high yield, the miller expects a good milling quality and the baker expects flour suitable for the end product he wishes to produce. The consumer relies on his senses – what he sees, feels, smells and tastes.

Wheat breeders can manipulate the genetic make-up of a cultivar and they can try to combine all the traits in a cultivar as required by the industry, but the effect of the environment makes it difficult. Wheat quality traits of importance to producers are:

- hectoliter mass (test weight),
- falling number, and
- protein content.

**Hectoliter mass**

Hectoliter mass is an indication of the density of wheat kernels. Denser kernels yield more flour, which is more profitable for millers. The impact of stress-factors during the grain-filling stage of the plant results in lower hectoliter mass. These factors include drought, excessive soil moisture, a shortage of nutrients, too little sunlight, too low or too high temperatures, insect damage and weather damage like frost or hail.

**Falling number**

Wheat flour consists of protein and starch. Starch plays the biggest role in bread structure and if it rains on ripe wheat and favourable weather conditions follow, pre-harvest sprouting occurs. When this happens, the starch is broken down by an enzyme, alpha-amylase, and excessive sugars form (low falling numbers occur). The excessive sugars lead to 'sticky', runny dough and this dough is difficult to handle mechanically. Bread will also have a dark crust, a coarse texture and a poor structure, and this results in bread that cannot be cut mechanically (Figure 1).

Environmental factors such as wet weather and day temperatures have a big effect on pre-harvest sprouting during the kernel-hardening growth-stage.

**Protein content**

The unique proteins of wheat (gluten) make it suitable to be utilised for bread. Gluten can be divided into a glutenin and a gliadin fraction, where glutenin confers stability to dough and gliadin confers elasticity. A balance between these two fractions is important, because it will determine the quality of the end product. Environmental factors including fertilisation and moisture availability as well as the genetic background of a cultivar can influence the balance between the different protein fractions.

Different cultivars will exhibit different loaf volumes at the same protein content levels, due to the genetic background. Nitrogen fertiliser leads to a higher protein content. Therefore, an increase in nitrogen availability leads to an increase in the gliadin fraction, which results in more dough elasticity.

Moisture stress leads to an increase in protein content, because less starch is formed. Usually, a higher protein content (within a normal range of 10 - 13%) will result in higher loaf volumes (Figure 2) and a higher profit for bakers.

It is clear that the three characteristics of importance to wheat producers are influenced by the environment as well as by production practices and that the plant's reaction towards these two factors is also influenced by its genetic make-up. The genetic effect also differs for each quality trait and the proportion that can be manipulated by breeding will therefore also differ.

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