



**Issue 14: April, 2022: This e-bulletin is aimed at health professionals, consumers, growers, farmers, packers, processors, distributors, retailers, and others in the plant foods area.**

## **Wheat, flour & bread**

Today's consumers in developed countries take bread for granted as it is available in a wide range of choices in numerous stores at a reasonable price. Many consumers also make bread at home. Bread is highly nutritious and is often referred to as 'the staff of life'. It dates to the origins of time and is mentioned extensively in early folklore and literature both pre- and post-Christian and still extensively today in the media. The war in Ukraine and the possibility of wheat shortages may have awakened Irish consumers to appreciate the precious nature of bread. It has also prompted the Irish Department of Agriculture and Food (DAFF) to encourage Irish farmers to immediately sow spring wheat in case of shortage.

This article deals almost exclusively with white pan breads. Taking good field performance as a given, the term good baking quality wheat is based on a number of factors: **(i)** satisfactory pre-milling tests i.e. protein content, Hagberg falling number, 1000 grain weight, hectolitre weight, hardness index; **(ii)** ease of milling and dough handling, high flour water absorption properties; **(iii)** post-baking quality – this is largely sensory in nature i.e. attractive loaf volume/shape (not stunted or 'blown'), bright white crumb (not grey or dark), uniform crumb structure with many similar sized small cells, soft crumb with a degree of springiness, good flavour (taste and aroma). These post-baking quality factors can now also be measured instrumentally which helps remove human bias (Ktenioudaki *et al.*, 2010).

### **Self-sufficiency**

Irish consumers are exposed on a number of food availability fronts due to failings in self-sufficiency. Government policy has been to promote the dairy and beef sectors to the almost exclusion of the tillage and horticultural foods areas. The outcome is that Ireland imports huge amounts of cereal grains, flour, sugar, potatoes, fruit and vegetables many of which can be grown successfully here. An important compromise is that Ireland needs a degree of self-sufficiency in all foods and the ability to increase production if necessary when an international shortage arises. Consumers are increasingly shopping locally for foods grown 'just down the road'. Air and road mile issues are also a factor as is Brexit. Collectively, these factors point strongly to the need for increased self-sufficiency for many food types and especially those of plant origin, and for a government Minister to have responsibility for the area.

### **Wheat**

The climate, soils and other agronomic factors in Canada and Ukraine are especially suited to the production of high quality hard wheats. The so-called hard wheats have a high protein and gluten content and the quality of the gluten is very good. Such wheats are a desirable component of wheat blends that are milled to produce flours suitable

for bread-making. The question is, therefore, are Irish grown wheats suitable for producing good quality bread? The answer is probably no – suffice to say that some Irish grown spring wheat varieties produce bread of moderate sensory quality. However, if combined with high quality imported hard wheats in a milling blend, then some Irish grown spring wheat varieties will produce bread of high sensory quality.

Extensive trials were conducted in An Foras Taluntais/Teagasc on spring and winter wheats grown by the Department of Agriculture (DA)/DAFF in the period 1975-1996. Summarised results are in the Cereal Technology sections of Teagasc *Food Science & Technology Research Reports* for that period and also in a paper by Dwyer *et al.*, 1982. The outcome was that almost two thirds of spring wheat varieties tested were suitable for producing bread of moderate sensory quality and that most winter wheat varieties were not. Trials on sowing spring wheat varieties in both winter and spring had a negative outcome in that the higher yielding winter sown wheat gave bread of inferior sensory quality to the spring sown. A trial on different levels of late nitrogen application to the winter wheat Copain increased grain protein content but had no effect on improving milling or baking quality (Dwyer & Thomas, 1980). A trial in 2010 on varieties grown in different locations showed that a Canadian blend, Malacca (UK) and Hereward (UK) wheats were classified as of good baking quality; Caphorn (France), Tzemele (Greece) and Tzeneroso (Greece) wheats as moderate; and Irish grown Cordiale and Raffles as of poor baking quality (Ktenioudaki *et al.*, 2010). Current wheat growing trials in Teagasc (Oakpark) are being conducted in cooperation with cereal technologists in Teagasc (Ashtown) thereby ensuring a complete evaluation from 'field to bread'. The DAFF spring wheat recommended list for 2022 gives the varieties Hexham and KWS Talisker, and also provisionally recommends KWS Helium and WPS Duncan. Quality characteristics for these range 11.2-12.5% (protein), 236-315 sec (Hagberg F. No.), 44.3-49.3g (1000 grain weight), 77.3-79.9kg/hl (hectolitre wt). All four are classified as hard wheats and collectively the data suggest they would be suitable for bread-making. However, test milling and baking trials have not been conducted.

## **Flour**

Flour characteristics of wheats from the DA and DAFF trials (1975-1996) were determined as indicators of potentially good bread-making wheats. While many of the flour characteristics suggested good baking quality, this was not the case when test baking was conducted with most bread classified as of moderate sensory quality and some as poor. This highlights the importance of conducting milling and baking tests. Good quality hard wheat is essential for efficient milling as softer wheats are sticky which slows mill output and gives a lower flour yield. High output bakers require good quality white flours with high water absorption capacity. This is advantageous in that it results in a raised water content in the finished loaves which is an economic advantage for bakers (KPM Analytics, 2022). Both gluten content and quality of the flours must also be good. The absence of large flour mills in Ireland will be a problem in the event of Ireland growing a significant amount of its own bread-making wheat. Perhaps the wheat could be sent to millers in the UK but this might raise export/import issues linked to Brexit. It would also add extra cost to the flour. Hopefully this requirement will not arise. However, it is important to stress that there are a number of small/medium sized flour mills in Ireland who produce a wide range of specialty lower quality flours which are highly suitable for the production of a wide range of baked goods (e.g. biscuits, buns, pies, cakes, flavoured breads, brown soda breads) by artisan, small and in-store bakers, and also for home baking.

## Bread

Virtually all large scale bakeries use the Chorleywood bread making process (CBP). This is a high energy input no-time dough system combined with an enclosed high-speed mixer that is used in large-scale production of yeast-leavened bakery products such as white pan bread and buns. The total fermentation and baking takes 3-3.5h compared to almost 6h if using low energy inputs in the dough mixing. The CBP requires flours from milling blends with significant hard wheat content. Such flours have high protein and gluten contents. Gluten can be likened to the 'bubble gum' of bread. Gluten should be elastic and extendable and not brittle as it is required to hold the gas bubbles released during fermentation thus ensuring good crumb structure in the bread. High quality white pan loaves have good volume, an attractive crust colour and a crumb with a large number of small sized thin-walled cells and a soft texture. Loaves from lower quality flours have a smaller loaf volume and a crumb with a mixture of cell sizes and perhaps holes in the crumb due to poor quality gluten. The crumb will also be harder. However, it is important to stress that bread from lower quality flour is almost as nutritious as that made from high quality flour i.e. the differences are of a sensory rather than a nutritional nature. Protein content in the former may be 1-2% lower as may also be some of the other constituents but the loaves are still highly nutritious.

## Bread improvers

Bread improvers are ingredients/compounds that have a positive effect on bread quality such as improving nutritive value, ensuring a uniform crumb structure (small cells), maintaining soft texture, and prolonging shelf life (Sonneveld, 2022). They include enzymes, emulsifiers, hydrocolloids, preservatives and dairy powders. For example, sodium caseinate and hydrolysed casein increased bread protein content and loaf volume, and helped maintain crumb softness. Bread containing 2% or 4% sodium caseinate was rated highly in sensory evaluation (Kenny *et al.*, 2000).

**Conclusions:** Past history suggests that selected Irish grown spring wheat varieties produce white bread of moderate sensory quality. However if combined with high quality imported hard wheats in a milling blend, then some Irish grown spring wheat varieties will produce high quality bread. Virtually all Irish grown winter wheats give bread of low sensory quality. However, these breads are almost equally nutritious as high quality breads. The baking quality of the spring wheats recommended by DAFF (2022 list) has not been evaluated due to the absence of test milling and baking.

## References

- \*Dwyer, E. & Thomas, T. 1980. *Food Science & Technology Research Report*, An Foras Taluntais, 35.
- \*Dwyer, E., Gormley, R. & Walshe, T. 1982. Some aspects of the quality of spring wheat grown in Ireland, 1975-79. *Irish Journal of Food Science & Technology*, 6, 79-89.
- \*Kenny, S., Wehrle, K., Stanton, C. & Arendt, E. 2000. Incorporation of dairy ingredients into wheat bread: effects on dough rheology & bread quality. *European Food Research & Technology*, 210, 391-396.
- \* KPM Analytics. 2022. Water absorption capacity of flour. Accessed on 22 April, 2022. <https://www.kpmanalytics.com/news-events-stories/water-absorption-capacity-of-flour>
- \*Ktenioudaki, A., Butler, F. & Gallagher, E. 2010. Rheological properties & baking quality of wheat varieties from various geographical regions. *Journal of Food Engineering*, 51 (3), 402-408.
- \*Sonneveld. 2022. Why do we use bread improvers? Accessed 22 April, 2022. [https://www.sonneveld.com/en/sonneveld/news/why\\_do\\_we\\_use\\_bread\\_improvers](https://www.sonneveld.com/en/sonneveld/news/why_do_we_use_bread_improvers)

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