1-1-1960

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A R. Egan

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**Some Factors**

**Affecting the Baking Quality in Wheat**

By A. R. Egan, B.Sc. (Agric.), Adviser, Cereal Laboratory

Although between 10 per cent. and 15 per cent. of wheat consumed in Australia is used in feed for domestic animals, the primary usage in home consumption is for bread-making. Exports, which account for roughly 75 per cent. of the normal Australian crop, are also mainly used in bread-making.

For this reason it is on the basis of the nature of the loaf produced that wheat quality is commonly assessed.

Baking quality is controlled by conditions on the farm, including choice of variety, and very little can be done to improve this characteristic except by the farmer, whose attitude must largely be governed by what the market demands and is willing to pay for.

According to general agreement among authorities, an overall improvement of quality in our wheat will improve its saleability.

To appreciate the extent to which the farmer can improve the quality of the wheat which he produces, some knowledge of factors affecting wheat quality is necessary.

Baking quality is, by and large, determined by the protein of the grain. Two aspects of protein are important in the overall consideration. These are the quantity of protein present in the grain (usually represented as protein percentage) and the quality of this protein. These two characteristics are somewhat differently controlled.

The quality of the protein is almost exclusively determined by the variety of wheat grown and it is this aspect which gives different varieties their varying reputations for quality. Because of this we can speak of "good quality," or "semi-hard" or "strong" varieties such as Gabo, Eureka and Wongoody, and "weak" or "soft" varieties, such as Bencubbin Insignia and so on.

Quite early in the history of investigations on baking quality it was found that samples of grain with the highest protein content did not necessarily give the best loaf, but that certain varieties always gave a better loaf than others at the same protein content. Thus the idea of protein quality and its relationship to variety arose. High protein quantity will not make up for poor protein quality, but on the other hand, good quality characteristics of the variety will not cancel out the effect of very low protein percentage. The grain from good quality varieties grown under conditions which result in low protein percentage, are mottled and undesirable because of poor milling and baking behaviour.

Varieties show very little control over protein percentage, the only effect being insofar as maturity characteristics and such factors as drought resistance fit in with the effects of climate.

On the other hand, factors which affect the quantity of protein in the grain have very little influence, if any, over the quality of protein.

The factors concerned in the determination of protein percentage are thus external to the plant, or environmental, and include climate, soil moisture relations, and soil fertility, particularly the aspect of nitrogen in the soil and its availability to the growing and maturing plant. These environmental factors determine how much nitrogen goes into the grain as protein and to what extent this protein is diluted in the grain with starch.

**Climate**

Climate, as such, is not a factor which can be controlled by the farmer, but it is...
possible to alter its effects by changes of rotational practices, and cultural operations, and by choice of varieties whose growth cycle is most likely to fit in with the expected season insofar as length of time to maturity is concerned. A variety which leads the maturing phase of the plant into a period where moisture is deficient results in "pinching" of the grain, with higher protein percentage because of lower starch content. Late planting can have the same effect. With knowledge of these effects, it is possible to partially avoid the more adverse effects of unfavourable climates with respect to both yield and protein content.

A long, slow ripening period favours high yield (provided there is no interference from disease) and, unless nitrogen is readily available during this period there is a lowering of protein percentage. Thus the effects of such a season can be offset by raising the fertility of the soil with respect to nitrogen. This is achieved where legume-pastures figure in the rotation system. More will be said about this later.

Areas with shorter growing seasons, and shorter ripening periods produce grain of higher protein percentage, associated usually with lower yield than is experienced in the wetter and longer seasoned areas. In efforts to increase yield, high protein content will be maintained provided soil fertility is kept at a high level with respect to available nitrogen.

Other aspects of climate cannot be affected by farmers' activities very readily, and consequently a close study of conditions as they exist now has been undertaken in our recent investigations in order to examine the variations from year to year in the distribution of grain of differing protein content over the State. High protein wheat is produced in the drier northern and north-eastern wheat-belt areas. Coming southward and westwards, as a general rule the longer the growing season, the lower the protein percentage. It is possible to produce some high protein wheat over a wide area of Western Australia, but this class of grain represents a decreasing proportion of deliveries to the railway sidings as rainfall increases. At any siding, the same variety produces grain with a wide range of protein percentages. For example in one year, at Coorow, the variety Wongoondy had protein percentage varying from 6.9 to 12.6 per cent.; while for the variety Gabo at Lake Grace the range was 7.8 to 12.1 per cent. This is due to either soil conditions and fertility, or to such factors as dates of planting.

SOIL CONDITIONS

While the farmer can only partially avoid the more adverse effects of climate, he can exercise a measure of direct control over the soil conditions on his farm. Western Australian soils are notoriously poor in fertility, perhaps more so in the wetter areas than in the drier areas. This infertility extends to the available nitrogen status as well as the well known phosphate and trace element deficiencies.

For this reason it is necessary to make use of fertility boosting practices. Wheat yields in Western Australia are so greatly affected by phosphate application, and also by use of trace elements in certain areas that fertilisation of the soil with these plant nutrients is a general practice. The deficiency in nitrogen could also be overcome by the use of nitrogen fertilisers, such as sulphate of ammonia, or urea form, but the economics of such a practice are at present in doubt. Nitrogen applied to the soil early in the growing season boosts plant growth, and, provided moisture is available as required, allows big yield increases. Later applications may boost yield, but can cause the plant to die if applied too late, or too heavily. Lack of soil moisture causes nitrogen fertiliser to produce lower yields.

Unless the season has adverse effects on yield, the protein percentage of the grain is likely to be little affected by early application of nitrogen, until high levels of nitrogen are used.

Late applications of nitrogen should increase protein percentage but often have small effect on the yield. Increase in protein percentage without increase in yield is at the present unrewarding, and as a consequence it is desirable to increase protein percentage more or less as an incidental to increasing yield. Slow release of nitrogen continuing throughout the season appears to be the answer, and organic matter is the best such source. Clover or other leguminous pasture plants which take up nitrogen from the air are a method of adding to the soil fertility.
in this way, and ley-farming systems incorporating these have been shown to increase both yield and protein percentage of wheat. This method is simple and practical, whereas at the present nitrogen fertilisation is rather a complicated question from the economics standpoint of its effect on yield and has different effects on protein percentage depending on the time and method of application, and the chemical nature of the fertiliser used.

**TO SUMMARISE**

(1) Baking quality is dependent upon both the quantity and the quality of protein present in the grain.

(2) The quality of protein depends mainly upon variety. Environmental influence is small.

(3) The quantity of protein and its relationship to yield, or more directly starch dilution in the grain, is mainly an environmentally controlled factor. Such aspects as rainfall, and its distribution throughout the season, and soil fertility from the nitrogen point of view are probably the most important features. Smaller variations are caused by factors such as time of planting, variety used and methods of cultivation.

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