

The Quality of Cereal Foods*

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ABSTRACT

Cereal foods have a very important place in the nation's diet. Over 8 million tonnes/year of cereals are consumed by the food and drinks industries. Bread is the main form of cereals consumption, but 70% of people in a recent survey regularly eat breakfast cereals. Cereals provide 30% of energy uptake, 25% of dietary protein, over 40% of dietary fibre, and also provide essential minerals and vitamin B. By contrast, they contribute little fat. Bread is the freshest of manufactured food products on the market, and the quality of its contribution to the diet is very evident.

Successive Government committees have pointed to the nutritional benefits of cereal food consumption. The public is absorbing that advice and the industry is responding to changes in the public taste. Demand for brown and wholemeal bread has risen from 3% to 30% of bread consumption in 35 years as technology has advanced and the industry has provided more satisfying products, such as the soft textured expanded wholemeal loaf. Wholemeal pasta products have shown a three-fold increase in consumption since 1982. It is expected that these trends will develop further as a more discerning public continues to look for improvements in the quality of its diet.

INTRODUCTION

Cereal foods have such an important place in the nation's diet that no discussion at this meeting of the Royal Society of Chemistry's Food Chemistry Group would have been complete without some such paper.

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I shall discuss first just how important that place is, go on to discuss a number of different aspects of the quality of cereal foods—organoleptic quality, nutritional quality, quality in respect of food safety and of course its natural image, and finally discuss some thoughts about future trends in cereal foods.

IMPORTANCE OF CEREAL-BASED FOODS IN DIET

Over 20 million tonnes of cereal grains are used in the UK each year, of which more than 8 million tonnes are consumed by the food and drinks industries. This represents a raw materials bill of over £1 billion. In addition around 12 million tonnes of cereals are used for animal feed and, hence, indirectly mainly for human food production. Table 1 shows also that the

TABLE 1
Utilisation of Cereals in the UK (Mt)

<i>Harvest year</i>	<i>Production</i>	<i>Imports</i>	<i>Total utilisation</i>	<i>Food and drinks industry usage</i>
1976/77	13.3	8.9	22.4	9.1
1981/82	19.6	4.1	19.1	8.6
1986/87	24.5	3.0	20.6	8.3

proportion of home-grown to imported cereals has increased substantially over the past 10 years as we have grown accustomed to living within the European Community.

The food industry uses approximately three times the amount of cereals, predominantly wheat, as does malting and brewing, predominantly barley. The pattern shown in Table 2 has remained fairly constant in recent years, although rice utilisation in the UK has increased by about 50% over the past

TABLE 2
Cereal Utilisation by Food and Drinks Industry in 1986/87 (Mt)

<i>Cereal</i>	<i>Food Production</i>	<i>Malting and brewing</i>
Wheat	4.9	0.33
Barley	—	1.7
Maize	1.0	0.13
Rice	0.19	—
Oats	0.16	—
Total	6.2	2.1

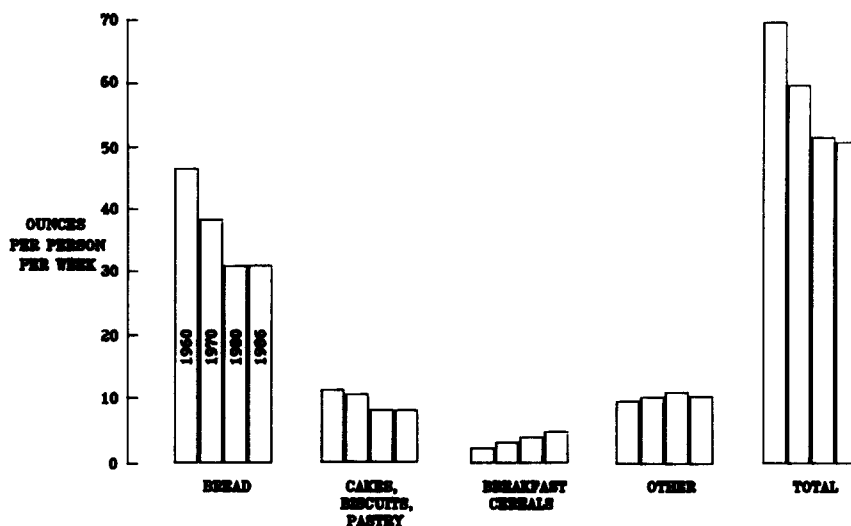


Fig. 1. Consumption of cereal products in the UK (MAFF food surveys 1960-86). (1 oz = 28.35 g).

5 years and consumption of oat products has increased by about 3% a year over the last 15 years.

If we examine the types of food based on cereals (Fig. 1) it is clear that bread is still the main form in which cereals are consumed, currently representing about 56% of total cereal consumption. Although cereal consumption fell steadily from the 1950s until 1980, it has now levelled out. A gradual fall in biscuit, cake and pastry goods has been balanced by an increase in breakfast cereals. A recent *Which?* report (Anon, 1988) states that seven out of ten of their readers eat a breakfast cereal and that total consumption has almost doubled in the past twenty years. In keeping with this increase in consumption there has been a great increase in types and varieties of breakfast cereals in the supermarkets: the *Which?* report lists 40 different packages. Around 10% of cereal consumption is accounted for by 'other' products such as rice and pasta products and flour used in the home.

The important contribution of cereals in general and of bread to energy requirements and essential dietary components is illustrated in Fig. 2. Thirty per cent of energy intake, mainly as carbohydrate, and over a quarter of dietary protein is provided on average by cereal foods which also represent a very important proportion, over 40%, of dietary fibre. Cereal foods also represent major sources of essential minerals and vitamins B. A Government proposal in 1984 to abolish the statutory requirement for mineral and vitamin supplementation of white flour was withdrawn after objections from the medical profession which pointed out that, for some sections of the population, flour-based products were the main sources of these essential

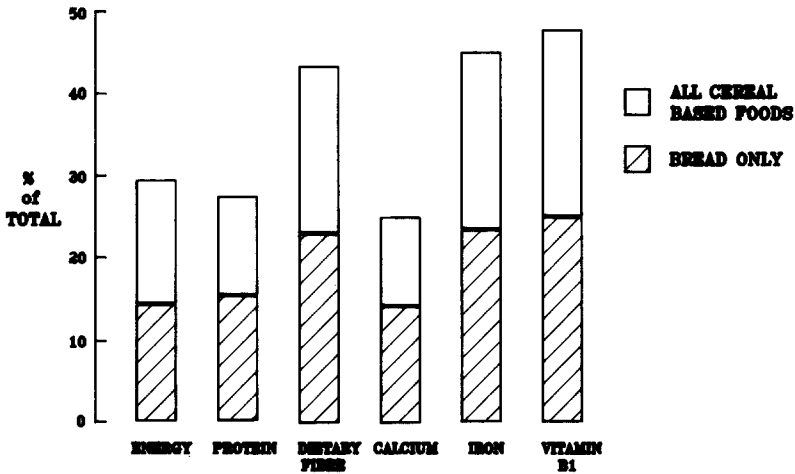


Fig. 2. Percentage of dietary components provided by cereal foods and bread (average values for the UK). (Source: MAFF).

nutrients. On the other hand, cereal grains contain little fat and, thus, make only a minor contribution to fat intake.

QUALITY OF CEREAL FOODS

What is meant by 'quality' in the title of this paper? I have listed here four different (Table 3) aspects of quality in food products: organoleptic quality and nutritional quality are self-evident. In the current environment, two other aspects call for discussion: these are food safety and the increasing interest in so-called 'natural' foods. Let us examine each of these aspects separately.

Organoleptic quality

Organoleptic quality is the most important aspect for the majority of consumers and can be considered under four headings shown here. Indeed, I think organoleptic is one of those jargon words whose meaning is best defined as having to do with the sort of qualities defined (Table 4).

TABLE 3
Aspects of Food Quality

Organoleptic quality
Nutritional quality
Food safety
'Natural' image

TABLE 4
Organoleptic Quality

Appearance
Texture
Taste
Freshness

If the appearance of food presented for sale is not acceptable, it will remain on the shelf. Thereafter, texture and taste are the important features.

Recently the concept of freshness has become an increasingly important element in food quality. The continued growth in frozen foods and the more recent rapid advance of chilled foods has highlighted this concept of freshness. Consumers show a clear decreasing order of preference from fresh material, through chilled, frozen, and canned foods to dried products. So far as cereal products are concerned, of course, nearly all the bread sold today was ordered from the bakery only yesterday afternoon: no other industry gets a manufactured product to the final customer more quickly and in such a fresh condition.

Nutritional quality

The important contribution made by cereals to the diet has been mentioned already. In particular, the polysaccharides of cereals have been shown to have beneficial effects on nutrition and health. Cereal polysaccharides are usually considered in two categories: starch and the non-starch polysaccharides (Table 5).

The non-starch polysaccharides are the major, but not the only, components of dietary fibre in cereal grains. These are present in higher concentrations in the outer bran layers of cereal grains, although they are also present as cell wall constituents throughout grains.

In 1980, the Royal College of Physicians (Anon, 1980) reviewed the role of

TABLE 5
Recent Increases in Consumption of Wholegrain or Bran-enriched Cereal Products

<i>Product</i>	<i>Percentage of total consumption</i>	
	<i>1982/83</i>	<i>1985/86</i>
Bread	17	30
Pasta	3	10
Breakfast cereals	10	14
<i>Percentage of consumers buying brown rice</i>		
	<i>1982/83</i>	<i>1985/86</i>
Rice	8	16

dietary fibre and tentatively recommended an increase in intake, but in 1981 the DHSS Committee on Medical Aspects of Food Policy (COMA, 1981), in its report on Bread and Flour, positively recommended increased consumption of cereal fibre, bread and breakfast cereals. In 1983 the National Advisory Committee on Nutrition Education (NACNE, 1983) made quantitative recommendations that the UK diet should be reduced in its proportion of energy from fat, that sugar and salt consumption should be reduced and that the intake of fibre should be increased. To maintain energy intake and achieve the fibre increase, it was recommended that the consumption of fibre-rich carbohydrates should be increased. The COMA (1984) report on Diet and Coronary Heart Disease made similar recommendations to reduce fat intake and increase the intake of fibre-rich carbohydrates.

The response by consumers to the awareness of nutritional benefits of cereal fibre can be illustrated by two developments. First there is the arrest in the long-term decline in cereal consumption as mentioned earlier. Secondly, there is an increase in the proportions of wholegrain versions of different cereal products. Examples are shown in Table 5. Just in the last 3–4 years, brown and wholemeal bread has increased from 17% to 30% of all bread consumed. Ten years ago it was only about 8%.

Wholemeal pasta products have shown a 3-fold increase since 1982 and now represent 10% of total pasta consumption. A smaller proportional increase in bran-enriched breakfast cereals has also occurred. On another front of altogether different scale, twice as many people were buying brown rice in 1985 as in 1982.

The other category of cereal polysaccharides is starch. Historically this has had a negative nutritional image as many consumers, particularly women, have considered starchy foods, such as bread and potatoes, to be fattening. However, this image is beginning to recede in the light of recent evidence that starch has positive nutritional attributes and, *per se*, is a more desirable form of energy than saturated fats.

Some forms of starch are digested more slowly than sugars, thus resulting in lower blood glucose levels. This is considered to be beneficial, especially of course for the control of diabetes. Other forms of starch are not digested in the small intestine but, like the non-starch polysaccharides, have the properties of dietary fibre in that they are digested by microorganisms in the large intestine, improving bowel function and generating short chain fatty acids that may have an important physiological role in the prevention of bowel cancer.

White and wholemeal bread, as well as other cereal products, contain resistant starch and there is current research about the contribution of such forms of dietary fibre to body functions.

Quality and food safety

If we look at potential hazards in foods in decreasing order of importance, as listed recently by Dr Juliet Gray in her article on 'How Safe is your Diet?' (Gray, 1985), microbiological hazards are the most important for foods in general (Table 6).

TABLE 6
The Order of Importance of Food Hazards^a

Microbiological
Nutritional
Environmental contamination
Natural toxicants
Pesticide residues
Food additives

^a Source: Gray (1985).

These microbiological hazards are caused by the food poisoning group of organisms, particularly *Salmonella* and *Staphylococcus* with somewhat less well known names, e.g. *Campylobacter*, *Listeria* and *Yersinia*, increasingly brought to our attention. For cereal products, fortunately, these bacteria are not a serious hazard, and people eat their bread and cornflakes with confidence.

Nutritional aspects and food additive concerns are dealt with elsewhere in this paper; it is sufficient to say here again that the quality of the nutrition story to be told for cereal products is a good one.

We must ensure that foods are free from the toxic compounds that are produced by fungi that can grow on crops in the field or in stored grain. No one would want to return to the ergotism epidemics of earlier periods. Ergotism was a form of madness diagnosed in the nineteenth century as arising from toxicants in grain produced by fungal action. Modern fungicide treatments have allowed us almost to forget that any such problems existed.

Pesticide residues have recently been a subject of news reporting. The industry gives careful consideration to this potential problem, since we take very seriously our responsibility to provide wholesome food to our customers, free of both harmful levels of residues, and free of insects or their larvae. To prevent such infestation, treatment with pesticides is necessary. Pesticide levels in wheat have been monitored since 1970. Levels are generally very low and well within the appropriate EEC (1986, 1988) or Codex Alimentarius (1987) limits which are themselves set at one hundredth of any level which toxicology believes might be harmful.

Natural image

If we now turn to the fourth aspect of quality, the current interest in 'natural' foods, there has been some demand from consumers to reduce or eliminate the use of preservatives, additives, or in fact anything with an E-number, even where there is no evidence for any harmful effect and even although the preservative is there for good reason. The food industry tries to meet these and indeed any other demands of its customers and to anticipate future requirements.

CHANGES IN CONSUMER DEMAND

The ways in which the products of the food industry change with time can be illustrated by changes in the milling and baking industry since the 1950s.

During (and for some years after) the war, bakers were restricted to the use of National Flour—an 80–90% extraction flour that made a then unpopular dark bread. When restrictions were lifted in 1953, the demand was for very white flour and bread. Millers would bleach flours to meet this demand.

Brown bread was not at all popular, representing only 3% of total bread consumption.

The advent of the Chorleywood Bread Process in the 1960s enabled bakers to produce long-shelf-life white bread from flour containing higher proportions of home-grown wheat.

Major changes in consumption patterns and recipe formulations took place in the late 1970s and early 1980s as a result of several influences. The COMA report of 1981 and NACNE report in 1983 recommended increased consumption of cereals and of dietary fibre, especially from cereals. The Bread and Flour Regulations of 1984 (Anon, 1984) resulted in recipe changes, especially for wholemeal bread. Since 1984, further changes have taken place in response to consumer demand rather than legislation. For example, bread and flour with less white appearance is now more acceptable and thus bleaching of bread flour is not necessary, and some E-number constituents formally used have been removed.

A substantial proportion of salt in the diet is contributed by bread. In response to current medical opinion that a reduction in salt intake would be beneficial, bakers are reducing the amount added to bread. The salt level in bread has been reduced by about 15% over the last 5 years but further reduction leads to consumer resistance because the taste of bread made without salt is unacceptable to most people.

Over this thirty-five year period, since 1953, in response to the influence of nutritional advice and other factors I have listed here, consumption of

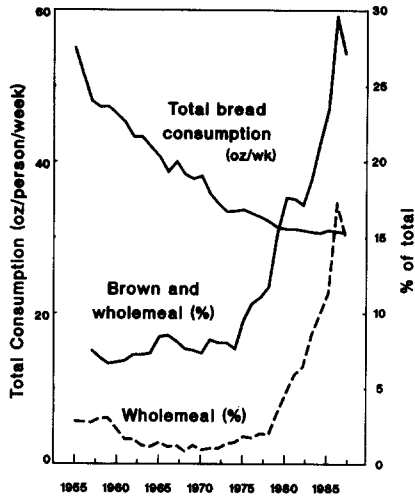


Fig. 3. Trends in domestic consumption of bread in the UK 1955-87.

brown and wholemeal bread has gone up to 30% of all bread consumed (Fig. 3). The change has been most dramatic in the past ten years. This change is all the more dramatic since it took place during a period when bread consumption fell steadily as a whole for many years.

It can be seen that in the recent dramatic increase in brown and wholemeal bread, it is wholemeal that accounts for most of the increase. The type of wholemeal that is responsible for most of this increase is the soft-textured, expanded loaf shown here (Fig. 4), rather than the traditional dense product.

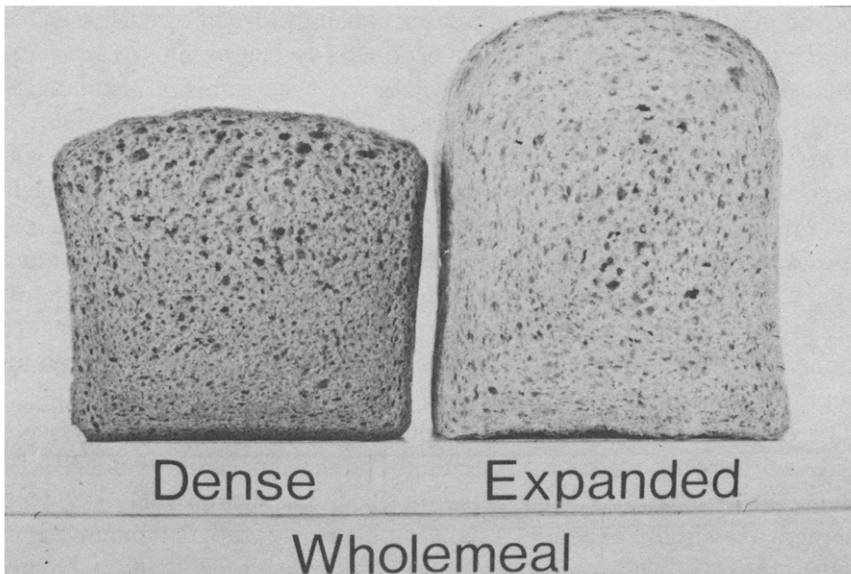


Fig. 4. Loaf texture.

Production of the popular expanded loaf became possible with the use of emulsifiers, permitted under the 1984 Bread and Flour Regulations. These emulsifiers have E-numbers of course and nowadays are the only E-number materials used in most proprietary brands of wholemeal bread. It is unlikely that the increased intake of dietary fibre in the form of wholemeal bread would have occurred to such an extent if the popular expanded type of loaf containing emulsifiers had not been available.

CEREAL FOODS IN THE FUTURE

The first thing to say is that current trends in demand for food that is both wholesome and convenient are likely to continue. Despite the high profile being given to nutrition and health, factors that determine food choice will continue to be sociological and psychological as well as any perceived health benefits.

As far as cereal-based foods are concerned, the long-term gradual fall in consumption has been arrested and the trend towards higher levels of dietary fibre from cereals is forecast to continue for some time. A recent report predicts a 3–5% year-on-year growth in future sales of wholemeal bread. Breakfast cereals are predicted to show a long-term growth in consumption of between 5% and 6% per year. Morning goods, that is bread rolls, muffins, etc., are currently increasing strongly in sales every year.

Thus, it would appear that the message from nutritional authorities, both here and in other countries, for increased consumption of cereal-based foods at the expense of meat and dairy products, is beginning to show up in purchasing patterns. The current growth in vegetarianism, particularly in young women, is reinforcing this trend.

Two factors tend to limit the acceptability of cereal products. One is that the industry has not been fast enough in bringing out widely acceptable high fibre products. The broad success of the soft textured wholemeal bread shows what can be done with a good product. Currently the soft grain and granary baked products are also well-received. We can expect that future trends will be in the development of cereal products—perhaps bran enriched—that combine the benefits of nutritional quality with even more acceptable organoleptic properties.

The other limiting factor in acceptability of cereal-based foods is the negative image of starch as fattening. As the emerging evidence of the beneficial attributes of starch in the diet becomes more widely known and accepted, we might expect a further increase in cereal consumption as hitherto resistant sections of the community change their attitude to starchy foods.

We are already seeing a growth in demand for foods based on other cereals, such as oats, rice and durum wheat and in wholegrain products from these. The increasing popularity of cereally based ethnic foods should continue to reinforce this trend. There is an increasing tendency towards 'grazing': that is, consumption of snacks at the expense of conventional multi-course meals, and we can expect the food industry to cater for this market with products that meet the demand for wholesome, attractive and convenient foods with lots of opportunities particularly for cereal-based products.

Similarly, the position on additives and preservatives will move to a point where organoleptic and food safety factors balance the demand for additive-free products. The balance point is likely to move with time as attitudes change. For example, I have already mentioned the current acceptability of darker, unbleached flour and bread now, compared with the post-war demand for white flour products. In the lead-up to 1992 and harmonisation of food regulations within the EEC, there will be some interesting debates about the position of different additives in foods.

Within the food industry, we welcome consumer interest in the qualities on which the choice of food is based. Although the food industry has a role to play and a responsibility in helping consumers to make sensible decisions in their choice of food, there will also be need for Government, educational and consumer organisations and, in particular, informed and responsible media, to contribute to the debate.

The one thing that is certain about future perceptions of quality is that these will continue to change. Thomas Elyot, a 16th century surgeon, would not have approved of the current recommendations for more cereal fibre in the diet because, in his view: 'Breade havynge moche branne fylleth the beale and nourysheth lytell or nothyng ...'.

Much else has also moved on since his time.

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