Introduction

In the 19th century they called it 'adulteration', in the 20th - 'fortification'. At first the additions were intended to add bulk up bread using raw materials costing less than flour, to mask poor quality ingredients or to enhance whiteness. More recently, the rationale has been to address some of the nutritional deficiencies of wheat flour as produced by the dominant agricultural and milling technology. The common theme in the long and inglorious history of interfering with our daily bread is that, for most people who have had to buy it from a baker, it has often been missing something essential.

How might we recapture the lost vitality of this most basic of foods? The choice is between continued fortification that uses flour as a vehicle for medication, or a reasoned reform of milling and baking whose aim is to recapture the nutritional potential of our daily bread for the common good.

In 2006–07, diet-related ill health cost the National Health Service in the UK £5.8 billion and overweight and obesity cost £5.1 billion. In the words of leading public health researchers, 'poor diet is a behavioural risk factor that has the highest impact on the budget of the NHS'[1].

Governments of all hues have long been persuaded of the link between diet and health and have regularly tried to persuade people to eat better. But whereas regulation is the method of choice to make food *safer* (for example by controlling sources of bacterial contamination), when it comes to dietary quality, individual *choice* is the by-word. Beyond a requirement not to poison people, food manufacturers can process and sell edible substances with no general legal obligation to consider (still less improve) their nutritional quality. Indeed the food industry vigorously defends its right to make and sell products of no evident nutritional worth by claiming that 'there are no healthy or unhealthy foods, only healthy or unhealthy diets'[2] and that, in any case, the problem of diet-related ill-health really lies with a lack of physical activity. Meanwhile, it spends very much more on advertising foods of questionable nutritional quality than on promoting healthier options, especially to children[3].

During both World Wars, the British government intervened to increase the 'extraction rate' of flour used for basic bread, decreeing that more of the bran and germ should be included rather than being removed and fed to animals. Though the main impetus behind this policy was to get more loaves from the severely constrained imported wheat supply, key government advisors – especially in the 1940s – saw improving basic bread as an important way to address the widespread lack of nutrients in the national diet. The subsidised 'National Loaf' was the basic bread eaten by most UK citizens from 1942 to 1953. When white flour milling was once again legalised, iron and two B vitamins were added in synthetic form, joining calcium which had been added to flour since 1941.

There are some similarities between the context of wartime nutrition and the present day. Resource constraints are of a different order, to be sure, and are mediated by international commodity speculation, climate change and a growing world population rather than the supply restrictions imposed by U-boats. Modern malnutrition is as much to do with overconsumption of inappropriate food as any absolute shortages[4]. But a billion people in the world go to bed hungry each day because they have insufficient resources to access nutritious food. The call for government action is the citizens' justifiable response to the failure of 'light touch' regulation and neo-conservative economics to ensure that everyone has the knowledge and resources to consume a balanced and healthy diet. The wartime National Loaf may not have been universally popular, but it is generally considered to have contributed to an improvement in public

health, precisely because it raised the baseline nutrient intake of the poorest in society. Enforcement of better standards in our national flour and bread could once again be a vital component of improved health for all.

> The bread I eat in London is a deleterious paste, mixed up with chalk, alum and bone-ashes; insipid to the taste and destructive to the constitution. The good people are not ignorant of this adulteration; but they prefer it to wholesome bread, because it is whiter than the meal of corn. Thus they sacrifice their taste and their health, and the lives of their tender infants, to a most absurd gratification of a misjudging eye; and the miller or the baker, is obliged to poison them and their families, in order to live by his profession.
>
> – Tobias Smollett, *The Expedition of Humphry Clinker*, 1771

Why do we need a new 'National Loaf'?

Despite a long-term decline in per capita consumption (we now consume about half as much as we did in the 1950s), bread is still an important part of the diet, with almost all households eating it[5]. Wheat is a significant source of iron and zinc. In the UK diet it (along with other cereals) contributes 44% of the average daily intake of iron (15% of this in bread) and 25% of the daily intake of zinc (11% in bread)[6]. This critical position in the national diet is recognised by official policy in various ways. The mandatory fortification of all flour other than wholemeal is an admission that white and other low extraction rate flours are nutritionally inadequate. And the proposal (currently still being considered by minsters) to add nutrients such as folic acid and possibly vitamin B_{12} to the list of four synthetic nutrients is testimony to the attractiveness of bread flour as a vehicle for mass dietary intervention. Views differ, of course, on the democratic legitimacy and nutritional effectiveness of such an approach. What seems indisputable is that, without fortification, white flour and the bread made with it would make a less than optimal contribution to a healthy diet.

This might not matter very much if the nutrients missing (or not available) from the bread that most people eat were routinely supplied from other parts of the diet. But average consumption of whole grains, fruit and vegetables is lower than recommended and though by any historical measure we have a wide range of foods to choose from, some people are not getting sufficient nutrients from their food. UK dietary surveys show that many people consume less iron, calcium, vitamin D and folate than recommended. In the most recent survey, 44% of girls aged 11 to 18 and 22% of women aged 19 to 64 had intakes of iron below the Lower Reference Nutrient Intake[7]. Benefit households are likely to eat more bread than average and more of what they eat is white[8]. Richer households have more nutrient-dense diets than those in the lowest income groups for every nutrient, and the density gap between the rich and poor has widened in recent years.

> 'The difference between those in the highest income group and the lowest is very noticeable for calcium, iron, magnesium, folate and, particularly, vitamin C...nutrient intakes among the poorest fifth of families [have] declined dramatically over the last two decades: vitamin C by 23 per cent and ß-carotene (Vitamin A) by 47 per cent.'[9]

From a public health perspective, it would be difficult to argue that the current situation is satisfactory. But the only policy response to questions of nutrient density and micronutrient intake across the whole population is the partial fortification of flour with calcium, iron and two B vitamins that has been in place since the 1950s. It is a policy that rests on questionable assumptions.

More plants, fewer minerals

One such supposition is that the nutrient density of wheat flour has remained constant since the 1950s. This is both optimistic and scientifically negligent. Major developments in plant breeding and an intensification of agricultural methods have doubled wheat yields in the past sixty years, with an attendant significant increase in protein quantity and functional gluten, making it easier for British bakers to use more home-grown wheat.

One well-documented collateral effect has been a reduction of selenium (Se) status in the UK population, since UK soils are known to be generally deficient in this important

Table 1: Losses in vitamins and minerals in the refining of whole wheat to 70% extraction white flour

Nutrient	Loss
Thiamine (B_1)	77%
Riboflavin (B_2)	80%
Niacin	81%
Pyridoxine (B_6)	72%
Pantothenic acid	50%
Vitamin E	86%
Calcium	60%
Phosphorous	71%
Magnesium	84%
Potassium	77%
Sodium	78%
Chromium	40%
Manganese	86%
Iron	76%
Cobalt	89%
Zinc	78%
Copper	68%
Selenium	16%
Molybdenum	48%

Schroeder H. (1971). Losses of vitamins and trace minerals resulting from processing and preservation of foods. Am J Clin Nutr. 1971 May; 24(5):562-73.

mineral, in contrast to North American soils which supplied the majority of our wheat between the mid-19th century and the 1960s. Dietary Se intakes in the UK have declined from >60 μg per day in the 1970s to 35 μg in the 1990s. The reference

nutrient intakes for adult females and males in the UK are 60 and 75 μg Se per day respectively[10].

But there is evidence that selenium is not the only mineral whose density is lower in modern varieties grown in intensive systems. Research from INRA in France showed that, compared with typical wheats grown forty years ago, modern varieties had 30-40% less mineral content[11].

Research at the International Maize and Wheat Improvement Center (CIMMYT) in Mexico revealed that the best traditional wheat varieties had about twice the iron and zinc of popular modern varieties; and 'iron and zinc density in wild relatives of modern bread wheats [is] even greater, with up to 50 per cent more again'[12].

A US study found a significant reduction of zinc concentration in modern winter wheat cultivars compared to older varieties dating back as far as 1873[13]. Research at Rothamsted in England (where winter wheat has been grown continuously on the same experimental plots for over 160 years) shows a significant decrease in zinc concentration as newer varieties are introduced.[14]

> 'The concentrations of zinc, iron, copper and magnesium remained stable between 1845 and the mid 1960s, but since then have decreased significantly, which coincided with the introduction of semi-dwarf, high-yielding cultivars. In comparison, the concentrations in soil have either increased or remained stable.'[15]

It seems that plant breeding has had more influence on nutrient depletion than the 'dilution' effect of higher yields per hectare brought about by heavy applications of inorganic fertiliser.

Table 2: Differences in vitamin and mineral content of roller-milled and stoneground white flour

	Stoneground white flour	Roller-milled white flour
(per 100 grams)		
Protein	12.5 g	10.1 g
Fat	1.4 g	0.9 g
Total mineral	1.1 g	0.4 g
Calcium	44 mg	20 mg
Phosphorus	180 mg	92 mg
Iron	303 mg	1.0 mg
Carotene (pro-vitamin A)	0.2 mg	nil
Riboflavin (vitamin B_2)	0.02 mg	0.01 mg
Vitamin B_1 (international units)	100	10-15

Drummond, J.C. and Wilbraham, A. (1939). The Englishman's Food: A History of Five Centuries of English Diet. London: Jonathan Cape.

Intensive agricultural methods have had other unintended negative effects on food quality. Spraying nitrogen fertiliser directly onto maturing wheat plants (to boost grain protein levels) increases the expression of omega-gliadins that are implicated in wheat-dependent exercise-induced anaphylaxis[16,17]. This condition was identified only recently and its incidence seems closely linked to developments in plant breeding and selection (for higher total protein and gluten extensibility) and agronomic practice (seeking maximum yield and 'milling quality', i.e. suitability for industrial baking).

Climate change cannot be ignored either. Although there is a common perception that increases in atmospheric carbon dioxide will benefits plants, an experimental study showed that wheat, when grown in an enriched CO_2 atmosphere, has lower concentrations of concentrations of calcium, magnesium, iron and cobalt[18].

Processing, too, contributes to a loss of nutrients and a reduction in the bioavailability of those that remain. Table 1 shows how milling whole wheat into white flour consisting of 70% of the original grain depletes several important micronutrients by between 16 and 86 per cent. An example of the structural nature of nutrient loss – from the citizen's perspective – is the case of vitamin E, located almost entirely in the oily germ of the wheat grain. The roller milling process separates the wheat germ from the rest of the flour. It can then be sold as an 'added-value' bread ingredient or to the pharmaceutical industry which extracts the vitamin E and sells it back to us in capsules from the

Table 3: Average yields of magnesium and zinc in three varieties of wheat grown either conventionally or organically and milled either with stones or rollers (2003 harvest).

Agricultural system & milling method	Mg	Zn
	mg/kg	mg/kg
Non-organic		
Roller-milled	465	13
Stoneground	611	18
Organic		
Roller-milled	538	15
Stoneground	697	19
Difference: stoneground organic v roller-milled non-organic	**+ 49.9%**	**+46.1%**

Chaurand, M., Rémésy, C., Fardet, A., Leenhardt, F., Bar-L'Helgouach, C., Taupier-Lepage, B., Abecassis, J. Influence du type de mouture (cylindre vs meules) sur les teneurs en minéraux des différentes fractions du grain de blé en cultures conventionnelle et biologique. Industries des céréales. 2005, 142, 3-11

N.B. Iron (Fe) was also measured in this study. Base levels were slightly higher in the non-organic grain (for reasons that were not explained) and were less influenced by milling method than Mg or Zn.

chemist at many times the price it would have cost if it had been left in the flour. By contrast, stone grinding disperses the wheat germ oil throughout the milled grain so that even if the flour is subsequently sifted into 'white', it will still contain significant traces

of the vitamins and minerals in which the bran and germ are rich. Table 2 shows the different effect of stone and roller milling on the quantity of certain key nutrients in white flour. Table 3 demonstrates the cumulative benefits of organic agriculture and stone milling on zinc and magnesium levels in flour.

The way in which flour, however milled, is made into dough and then bread influences its nutritional usefulness to the consumer. Yeasts, lactic acid bacteria and naturally-occurring enzymes in the dough, given sufficient time, produce multiple beneficial effects including:

- reduction of 'anti-nutrients', e.g. phytic acid which 'locks up' minerals such as calcium and iron
- increase in bioavailability of micro-nutrients
- lowering of glycaemic index
- improvement in digestibility, e.g. via modification of proteins that trigger intolerance or allergy in certain people.[19]

The case of the B vitamin folate is particularly striking. Studies have shown that dough fermented using a sourdough 'starter' (a mix of yeasts and lactic acid bacteria) contains more than twice the quantity of folates compared with the original raw flour[20]. This makes plans to fortify all UK flour (except wholemeal) with synthetic folate (as folic acid) – in an attempt to reduce the number of children born with spina bifida – appear premature if not negligent. Attention to the way in which food is grown and processed may be a safer, cheaper and scientifically more robust way of ensuring a good diet for everyone in the long run.

Reaching as many people as possible is obviously one of the intentions of mandatory fortification of flour. But as a national strategy this risks ignoring the significant (though officially largely ignored) numbers of people who now avoid bread because of intolerances which may be related to changes in the way bread is manufactured.

Nevertheless, flour and bread products are so significant a component of most people's diet that their nutritional density (and digestibility) is clearly important. But current policy is lethargic and confused. Fortification is based on outdated science and seems to run counter to the current administration's approach to dietary improvement – nudging citizens to make better choices while asking the food industry to be more 'responsible' in deciding what foods are presented for the choosing. If better bread is to find its way into everyone's diet, change is needed – and it must be both rational and national.

A national approach to better bread

The political challenge is to reconcile freedom of choice with improved public health. The staus quo is clearly not achieving the latter, and it can be argued that the former is also compromised by a fundamental lack of transparency (and therefore public awareness) over how our food is produced. If we rule out more of the same, the options for change are to

- remove all fortification and allow the maximum freedom of choice to millers, bakers and consumers
- improve flour fortification to include a better assortment of added synthetic nutrients
- encourage upstream initiatives such as biofortification of soils with essential minerals and the breeding of more nutrient dense cereal varieties

- define and implement a minimum nutritional standard for all breadmaking flour and encourage its uptake via a wide diversity of 'national' loaves

No fortification, no standards

Removing the obligation to add the current four synthetic nutrients would please most millers, especially some of the traditional stone millers who regard their flours as naturally sufficiently nutritious (though this probably needs analytical verification) and who find the cost and complication of adding the government's white powder to their flour difficult. But there would be casualties.

In a response to questions from the Real Bread Campaign[21], the Food Standards Agency stated that '...fortified flour makes an important contribution to the intakes of at least two of the micronutrients for the population, namely iron and calcium. Removing these from flour would exacerbate low intakes of these micronutrients for certain population groups (e.g. older children and young women) where current intakes are already of particular concern'.

Given that most people do not know that their non-wholemeal flour is fortified at present, it is likely that most would also remain unaware of the reduction in nutrients following complete deregulation. Unless, by chance or some triumph of health education, the majority made simultaneous and radical dietary moves to replace the missing nutrients, the effect of deregulation would almost certainly be a significant drop in overall nutritional status, especially among those consuming more than average quantities of flour, i.e mostly lower income groups. It would, in fact, simply confirm an insidious link between highly-refined industrial food and both obesity and 'hidden hunger'. Nutrient poor foods fail to satisfy at a systemic level and may induce overconsumption[22], while in those such as the elderly or the very young with limited appetite or capacity, the density of every mouthful is critical.

Not for the first time, a kind of 'freedom of choice' would have been bought at the price of equity.

More and better fortification

For a society still in thrall to reductivist molecular biology and genomics, there is considerable attraction in trying to 'fix' flour and bread quality by adjustments to the range, quantity and provenance of synthetic micronutrient additions to a universally shared food. We now know (or think we know) much more about the role of minerals and micronutrients in healthy human nutrition than we did when the policy of fortifying flour with calcium (1941) and iron, thiamin and niacin (1953) was mandated. Zinc, magnesium and selenium are examples of minerals with important roles in human health that are significantly depleted (or not naturally plentiful) in the flour from which most British bread is made. Why not add them to flour? Folic acid is already being considered, with vitamin B_{12} on the cards too, perhaps to assuage concerns that mandatory folic acid fortification might mask B_{12} deficiency in older people[23,24]. Where might this process end? Fortification becomes 'nutrification', described by one apologist as 'the most rapidly applied, the most flexible, and the most socially acceptable intervention method of changing the intake of nutrients without a vast educational effort and without changing the current food patterns of a given population'[25].

But making up for deficiencies of diet in this way is fraught with dangers. Inappropriate dosing is almost inevitable in a 'one size fits all' system, where people who already consume adequate dietary minerals and vitamins, cannot avoid the overdose meted out in universally fortified flour. Industry-initiated additions of iron to the food supply (notably in products such as breakfast cereals) may well be contributing to the haemochromatosis caused by excessive iron which affects at least a million adult

Americans[26]. In the brave new world of 'personalised' nutrition that is said to be just around the corner, mass medication of basic foodstuffs would surely be a major confounding factor.

Furthermore, it is by no means certain that synthetic nutrients work as expected and claimed. No less a body than the Scientific Advisory Committee on Nutrition's working group on iron identified the flawed logic of the UK's current stance on flour fortification in its 2009 report:

> 'Evidence suggests that foods fortified with iron make little practical contribution to improving iron status.'[27]

The case of the important anti-oxidant mineral selenium illustrates how complicated it is to ensure that everybody gets the right amount – which means neither too little nor too much, since many essential nutrients become toxic when overconsumed. There are very real genetic differences between individuals which are bound to complicate the achievement of adequate selenium status across the population via the fortification of basic foodstuffs. But even if it were possible to agree a safe 'average' dose, finding the right *form* of selenium to add to food is problematic. Inorganic forms of the mineral are less bioavailable than organic forms[28], and much depends on how the added mineral is incorporated into food. One study seeking a way of increasing the selenium content (and therefore anti-cancer potential) of breads consumed by people living in the shadow of the Chernobyl nuclear disaster found that the bioavailability of added selenium was increased *60-fold* through a combination of sprouting rye grains in a selenium solution and then incorporating them into bread them using typical sourdough methods.[29]

Formulating a rational fortification policy in the face of the multiple interactions of geology, agronomy, genotype, chemical form and processing method is clearly not simple. But it increasingly seems simplistic. More fundamentally, the systematic fortification of food is culturally reductive, suggesting that food should be seen as no more than an aggregate of those nutrients deemed essential to reduce risk and prevent disease, rather than a social construct involving comfort, nurture and celebration. It provides a pathway for fundamentally denatured foods to be shored up selectively in order to meet a limited set of nutritional criteria that cannot encompass the potential vitality of food at its best. Furthermore, fortification runs counter to the whole thrust of health education by implying that individuals need not trouble themselves unduly over their food choices because 'they' will have engineered a default level of nutrients across typical diets. For almost everyone in modern societies dietary choice is not simply a question of crude sufficiency but rather a learned capacity to make decisions about food in which 'health' is but one of a number of interlocking elements.

Better soils, better cereals

That said, to reject systematic fortification in the UK is not to deny everyone's basic right to food that is as good and vital as possible, i.e not needlessly or surreptitiously stripped of important components. Nor is it to overlook the contribution that supplementation can make to addressing acute nutritional deficiencies in developing countries and among people whose food supply is severely limited in both quantity and quality. Given the problems of dosage and bioavailability discussed above, it surely makes sense to enlist the buffering capacities of natural systems to improve the quality of food that everyone eats. Mineral deficiencies such as the lack of selenium in UK wheat could be addressed by 'biofortification', the addition of minerals to soil, as Finland has done with selenium in an attempt to reduce the incidence of cardiovascular disease. The evidence suggests that plants take up the added mineral and turn it into a form that is more assimilable by humans. But this is a long-term approach. According to Howarth Bouis, a leading researcher into micronutrient deficiency worldwide,

> 'When consumed regularly, biofortified foods can contribute to body stores of micronutrients throughout the life cycle. This strategy should contribute to the overall reduction of micronutrient deficiencies in a population, but it is not expected to treat micronutrient deficiencies or eliminate them in all population groups.'[30]

A second strategy for reversing losses in the nutritional density of bread cereals is to broaden breeding criteria away from their sixty-year focus on yield and industrial functionality towards more rounded objectives based on optimum health. Interest is growing in the cereal varieties or sub-species (e.g. spelt, emmer and kamut) that have not been subjected to the distorting effects of hybridisation for intensive high-input agriculture. As new varieties, mixtures and composite crossed populations begin to find a place in the food chain, it will be essential to broaden the quality criteria used to guide farmers in their choice of what to grow to include measures of nutrient density and digestibility informed by public health values rather than the gains sought by shareholders in a seed market dominated by a small number of global corporations.

Minimum nutritional standards for flour and bread

If biofortification and citizen-friendly plant breeding stand to make some contribution to restoring the lost vitality of our daily bread in the longer term, their effects will be minimal unless sensible standards are adopted for the way in which our flour is milled and made into bread.

'Nutrification' has been described as a 'a techno-fix with inherently limited impact, because this method fails to address fundamental causes of inadequate dietary intake, such as poverty or insufficient education'[31]. In other words, access (including monetary resources and market power) and timely information are of the essence. Rights are involved here. If basic foods are, for whatever reason, progressively denuded of their goodness by agriculture and processing in ways that are not visible to the ordinary citizen, there is a clear imbalance of power between those who profit from production and trade and those whose health suffers without them knowing why. This imbalance can only be redressed if the nutritional value of foods is maintained at an acceptable level over time and if everyone knows and trusts that this is the case.

The prevailing narrative of 'consumer choice', invoked by government and food industry alike, assumes that once people know what is healthy they will allocate their food spend in a reasoned way. But this choice may be a mirage if information about the true nature of foodstuffs is either not available or is manipulated by producers and processors. Reasoned action is made more difficult by the dominant culture of brands and advertising, in which price and convenience jostle with healthiness as criteria for picking this rather than that product.

Democratic societies already protect citizens by setting standards for everything from the breaking strength of car seat-belts to the pesticide residues on fruit and vegetables or the presence of additives in baby foods. So there should be nothing inherently controversial in taking a similar approach to our daily bread.

The idea of national bread standards is simple: we should agree minimum levels of the key minerals and vitamins in all flour that is used to make everyday breads, rolls, pizzas and pasta. And we should make this flour available as breads that themselves conform to minimum standards of purity and digestibility. In shorthand, this means no additives and 'processing aids' (the cocktails of undeclared enzymes routinely used to make most British bread) and sufficient fermentation time to ensure reasonable bioavailability of nutrients and comfortable transit through the gut.

What the public health nutritionists of the 1930s and 40s called 'acceptance factors' are still important. So there will certainly be a compromise between nutritional quality and light colour and texture. But the gradual decline of super-white bread's popularity might well accelerate once the benefits of naturally 'golden' alternatives are made explicit. Even in a culture dominated by advertising, reasoned action is possible. A recent study at the University of Kent, designed to examine the influence of health and nutritional information on food choice, revealed that consumers, notably younger ones, were willing to pay more for wholemeal bread when accompanied by a health claim and explanation than for white bread with an added functional ingredient.[32]

French researchers have addressed the tension between health improvement and the traditional preference for refined white bread by proposing a bread made with 'Type 80' flour, containing 0.8 grams of minerals per 100 grams of flour (compared to 0.55 or 0.65 grams for typical white flour). Part of the French National Nutrition and Health Programme of the Ministry of Health, the idea was to adjust milling procedures to preserve vitamin (especially E) and carotenoid content from oxidation, and to use fermentation time to 'ensure the retention of all nutritional components in wheat grains'. Type 80 breads were tested by three professional bakers' organisations and showed 'that the bread-making value and organoleptic qualities of the products corresponded to demands for the production of an everyday bread with improved nutritional qualities'. A national quality assurance system was envisaged:

> A "type 80" logo, applied for by the Confédération Nationale de la Boulangerie (National Baking Federation) and referring to the flour used, would enable bakers to communicate on the nutritional value of these breads, containing high levels of fibre and magnesium.[32]

Could it happen here?

There would be several advantages if the UK could make good the nutritional deficit in its national diet by setting standards for the flour commonly used to make everyday bread. An effective form of regulation would be required to prevent abuse and to ensure a level playing field for all bakers. But it is important to emphasize that highly refined (and unfortified) white flour would not be outlawed *per se*. It could still be used for specialised or luxury items that were clearly not intended as a dietary staple.

The advantages of setting minimum standards for flour as opposed to continuing or even extending partial fortification are set out in Table 4. A key policy gain from this approach would be to reverse the nutritional race to the bottom that bedevils the food supply in a market economy, and that disproportionately damages the poorest and most vulnerable in society. Instead of cutting costs by reducing nutrient density, the bread industry would compete by differentiating and diversifying *upwards* from non-negotiable minimum foundations of nutritional quality: adding values, not 'added value'.

Table 4. Fortification v Minimum Nutritional Standards for all breadmaking flour

Issue or Interest Group	Fortification (as now)	Minimum Nutritional Standards
Scientific basis of approach	Limited number of synthetic additions	Conservation of broad spectrum of nutrients in natural form and balance
Bioavailability	Uncertain, especially for Fe	Potentially optimal, given adequate fermentation time, e.g. to neutralise phytate and maximise folate etc

Dosage/exposure	Problematic given variations in individuals' genotype and diet. Risk of perverse effects, e.g. synthetic folic acid masking deficiency of vitamin B_{12}	Not a micro-nutrient issue, except in rare cases of allergy
Transparency	Basic flour fortification not generally known or publicised. Industry use of 'clean label' device deliberately hides processing aids and methods that may compromise quality	Standards in public domain and explained via quality mark on pack. Golden colour of flour would be sign of positive nutritional intent. Citizen engagement activated
Trust	Undermined by lack of transparency and doubtful bioavailability. Further confused by health claims for proprietary 'nutrification', e.g. addition of omega-3, inulin, etc.	Built by open declaration of standards. Health attributes de-coupled from private brands, backed by publicly-funded science
State	Public health inertia due to long-standing arrangements. Contested scientific advice and limited efficacy of measures. Escalating cost of diet-related ill-health. Inconsistent with 'responsibility deal' and health improvement agenda	Fortification requirement removed after 60 years. New standards are 'better regulation' because evidence-based and stimulate innovation in cause of public health
Citizens	Lack of awareness of fortification and bioavailability issues. Possible assumption that dietary change not necessary if foods fortified. Right to food security compromised by hidden declining nutrient density and link to over-consumption and under-nutrition in e.g. overweight or elderly	Awareness of nutrient density as an issue stimulated. Increased personal responsibility for dietary choices based on sound information. Default nutrient intake of vulnerable groups improved. Obesogenic potential of nutritionally depleted flour moderated
Bakers	Flour refinement 'legitimised' by basic fortification. 'Added value' approach to selective nutrient additions makes cheapest bread least nutritious	Level playing field for all forces honest labelling. Incentive to differentiate basic 'national' loaves by quality not cheapness, e.g. by removing additives and exceeding minimum nutritional standards
Millers	Small added cost. No challenge to prevailing roller milling technology, geared to extreme refinement and removal of most nutritious parts of grain from basic white flour	Technological ingenuity engaged in retaining not removing nutrients. Contracts with farmers expanded to include nutrient density of grain, not just protein quality. Automatic check on declining density of cereals via monitoring of extraction rate required to meet standards
Farmers	No interest in nutrient density or digestibility: yield and 'milling premium' payment are paramount concerns	Seed selection moves beyond yield and agronomy to include nutrients and digestibility. Effect of farming methods on grain nutrient quality drives change towards agro-ecological approaches. Potential positive dialogue with citizens re new and/or heirloom varieties with enhanced nutritional attributes

Plant breeders	No incentive to develop varieties for anything other than farmer-miller-baker benefit. Nutrition only a breeding criterion for animal feed	Pressure from farmers and millers to meet standards with better varieties. Systematic inclusion of nutritional criteria into selection decisions. Feedback loop from farmers, miller and citizens helps arrest historic decline in grain nutrient density

There would be no need for a standard loaf format as there was with the National Loaf of the 1940s. The standards would specify a minimum specification for flour but it would be up to the ingenuity of millers and bakers as to how they milled this flour and made it into bread. Honest disclosure of ingredients and processes would be the basis of reliable health education informed by independent science and citizens would benefit from cycles of innovation and improvement in which capitalist competition was harnessed to humane objectives. Regular independent analysis of baked bread, milled flour and harvested grain, backed by a universally recognisable 'kite mark', would monitor the preservation (or loss) of nutrients through the system, creating virtuous feedback loops based on integrity rather than corner-cutting. Price and efficiency would still be important disciplines, but they would no longer automatically trump the quest for nutritional quality.

Limiting choice

Some will argue that minimum nutritional standards for everyday bread will limit choice. But what more egregious limitation of choice could there be than a bread supply like the UK's where over 80% of all bread is made by the same (Chorleywood) process with its heavy dose of additives and enzymes and minimal fermentation? The success of the Real Bread Campaign and the emergence of scores of artisan and community bakeries proves that there is a demand for simple and nutritious bread and a growing body of craftspeople able and willing to make it.

Fears of oppressive and unwieldy regulation are natural, if often exaggerated. In the case of a change to the basic standards governing our national bread supply, such fears will be overcome only if all interested groups contribute to the project with imagination and good will. Buy-in by the major bakers and millers will be important. They may reflect that the approach outlined above would offer a brighter future than grimly defending the status quo while slugging it out for a share of a declining market.[33]

Presentation will, as always, be a factor in getting everyone's agreement. Perhaps the 'brand' should not, after all, be a new 'National' loaf, with its overtones of embattled solidarity and central control, but rather a 'Common Loaf', appealing to the values of simplicity, collaboration and shared ownership.

Whatever it is called, better bread is everyone's birthright, the minimum needed to sustain healthy life. The fig leaf of fortification is wearing thin after sixty years, revealing the nakedness of a policy that adds the self-interest of powerful food corporations to limited citizen awareness and expects the result to be a healthy diet.

It is time to recover the lost vitality of our essential food by starting down a different and more fruitful path – of enlightened agriculture, careful processing, rational and democratic regulation, citizen power, self-reliance and mutual help.

A brief history of the National Loaf

1899	40% of recruits to the British Army rejected as physically unfit, despite minimum height requirement having been reduced from 5'6" to 5' over the previous hundred years. Concern over health effects of the diets of ordinary people is an element in the first stirrings of the 'welfare state'.
1912	Discovery of vitamins.
1916-18	Government bans white flour to conserve wheat stocks during World War I. Against advice of nutritionists, the ban is relaxed as soon as the war is over. "The British stomach has no ears and refuses to be filled by fine words," says British Minister of Agriculture.
1930s	Widespread malnutrition during the Depression associated in part with refined white bread. Calls for improvements by leading nutritionists echoed in debates in Parliament.
1936	League of Nations Health Committee report (endorsed the following year by the British Ministry of Health) concludes: 'White flour in the process of milling is deprived of important nutritive elements. Its use should be decreased and partial substitution by lightly milled cereals [i.e. more wholemeal]...is recommended'
1941	Fortification of white flour with calcium carbonate implemented in face of opposition from big millers and bakers.
1942	Supply of North American wheat severely limited by enemy action. Milling of white flour banned. 'National Wheatmeal' flour and bread replace white. National loaf receives government subsidy to keep price down.
1953	Health of the nation agreed to have improved despite wartime and post-war food shortages. Rationing and National Loaf played a part.
1953	Medical Research Council report on the nutritive value of flour used evidence from a short-term feeding study of orphans in post-war Germany to argue that any deficiencies in white flour could be made up in a 'mixed diet'. The assumption that such a mixed diet would be consumed equally by all sections of society was ambitious if not unscientific.
1953	White flour ban lifted.on condition that it is fortified with iron and two B vitamins (as well as calcium). Subsidised National Loaf still on sale, costing one shilling. White bread costs one shilling and seven pence. Sales of white bread very low.
1956	Subsidised National flour abolished. White bread made with fortified flour takes approximately 85% of the market.

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