How safe is our food?

A report of the British Nutrition Foundation's eleventh annual conference

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The aim of the British Nutrition Foundation's annual conference on 30 October 1989 was to put acknowledged food hazards into their true perspective in relation to the risks to health. Experts from six different scientific disciplines covered the possible risks due to microbiological contamination, nutritional imbalance, environmental pollution, natural toxins, pesticides and food additives, radionuclides and radioactivity. Their combined response to the question posed in the title of the conference was that our food is in many respects a lot safer than the public has recently been led to believe but there is room for improvement.

The experts pointed out that, apart from the recent justified concern about microbiological hazards, public perceptions of food-related hazards usually do not coincide with the acknowledged health risks established on the basis of accepted scientific criteria. The six principal categories of hazard are listed, in rank order, in Table 1. This ranking, based upon objective scientific criteria (including the severity, incidence and onset of biological symptoms) was determined by Wodicka in 1971 [1]. The ranking is not linear. For example, the risk from residues of artificial pesticides in foods is minimal — more than a hundred times less than that from the natural toxicants in plants and vegetables which act as the plant's own pest-control system.

Table 1. Relative importance of actual food hazards

1. Microbiological contamination	100,000
2. Nutritional imbalance	100,000
3. Environmental contaminants, pollutants	100
4. Natural toxicants	100
5. Pesticide residues	1
6. Food additives	1

Microbiological contamination

Dr Richard Gilbert (director of the PHLS Food Hygiene Laboratory) admitted that a year earlier he would have said that food poisoning is a preventable disease which is not being prevented. However, he now felt that it was more appropriate to say that never has so much been done so quickly on a number of fronts. Numerous measures have been introduced to monitor and control salmonella infection in UK poultry. Specific advice has been issued with regard to eating eggs, and more general food hygiene advice has been given in the MAFF booklet *Food sense* [2]; more than 12 million copies of this booklet were distributed in 1989. In July 1989, the White Paper *Food safety — protecting the consumer* [3] outlined proposals for new food safety legislation. Dr Gilbert expressed the hope that, in the long term, these efforts by government will improve microbiological food safety in the UK, but the success of the efforts in the short term is more difficult to judge.

Ironically, there were more reported cases of food poisoning in 1989 than ever before (see Table 2). Was this due to greater diligence in reporting or to more cases as a result of the long hot summer? Whatever the answer, Dr Gilbert stressed that the future strategy for the prevention of food poisoning must encompass better temperature control for food storage in retail and catering outlets and in the home. New food hygiene regulations being finalised by the Department of Health will bring chilled foods in the retail and distribution system under temperature control for the first time.

Studies conducted in Dr Gilbert's laboratory have shown that poor temperature control was involved in some way in approximately half the food poisoning outbreaks between 1970 and 1982. There is no reason to believe that the situation has greatly improved since

Table 2. Reported cases of *Salmonella enteritidis* phage type 4 in England and Wales during corresponding 9-month periods

January to September	1986:	2,070
January to September	1987:	3,430
January to September	1988:	8,700
January to September	1989:	9,560

PHLS statistics, October 1989.

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then. In 1988 an outbreak in which 72 businessmen became ill after eating pre-prepared Japanese food could be attributed to storage of the food at room temperature for several hours before serving. In the PHLS paté survey conducted in July 1989, 18% of samples purchased had been stored in the supermarket or shop at 10–18°C and 3% at room temperature.

Dr Gilbert stressed that, whatever the government regulations on temperature control, they will only be of benefit if the customer is careful after purchase. He thought it important that everyone should know the temperature in their refrigerator; it should be 4–5°C, and this can easily be checked with a suitable thermometer.

Nutritional imbalance

Dr Roger Whitehead (director of the MRC Dunn Nutrition Unit, Cambridge) made the point that much of the improvement in our nutritional status in the past 100 years has been due to better overall food hygiene practices rather than to improved nutrition *per se*. He illustrated this by comparing the infant mortality figures in England and Wales from 1900 to 1980: prior to 1920 the rate was well over 100 per thousand live births and only dropped in the 1960s to less than 20 deaths per thousand.

Anthropometric data demonstrate that the growth of children in Third World countries can show seasonal faltering which is closely associated with times when there is a particularly high incidence of infection, much of which is due to food contamination causing gastroenteritis.

Dr Whitehead concluded that, in terms of *basic* health, both the anthropometry and the mortality data can be interpreted as showing that UK food is far better than it has ever been before.

Insofar as enhancing our health status still further, Dr Whitehead thought that we are very much at the upper shoulder of the diet/health response curve. He stressed that, although virtually all the dietary guidelines in Western countries feature advice to keep the amount of fat in the diet at 30–35% of total energy, there are also dangers to health if the fat content falls too far. This situation can occur in the UK as well as in Third World countries if, for instance, young children are fed on skimmed milk or on totally macrobiotic diets.

For adults, the data from the National Food Survey have shown that the total amount of fat in our diet has been falling steadily over the past few years. However, total levels of energy intake have also fallen, so the intake of fat as a percentage of total energy intake has remained constant at the 42% level. Dr Whitehead praised the food industry for producing a greater variety of less fatty products which should, theoretically, enable the consumer to decrease fat intake. At the same time, his main concern was that the hearts of the food industry 'barons' are not always in the manufacture or promotion of such products because low fat and high quality are not compatible with low price. Perhaps there has been too much pressure upon the industry to keep prices low rather than to increase the quality. Comprehensive food safety, from the microbiological, pharmacological and nutritional aspects, cannot be achieved without monetary costs.

Environmental contaminants

Dr John Wren (general secretary of the Society of Chemical Industry) pointed out that individuals, communities, commercial enterprises, public bodies, armed forces, and even nature itself, can pollute the environment with chemicals which can enter the food chain. Government surveillance reports show that, on the whole, the levels of these pollutants do not give cause for concern. He presented data for arsenic, cadmium and mercury which showed the levels in most foods to be within the acceptable limits. The highest levels are usually seen in seafoods, particularly brown crab meat, because marine organisms have the ability to concentrate all three metals.

There are, however, some 'hot spots' of pollution such as chlorinated pesticides in certain imported foods, eg processed pork and poultry from China.

Problems can arise in connection with 'extreme consumers of single items'. One example is breast-fed babies; here current attention to dioxins was mentioned. Another example of an extreme consumer is the heavy beer or wine drinker who can run the risk of taking in dangerous amounts of lead picked up from contact materials.

Natural poisons in foods

Dr Roger Fenwick (AFRC Institute of Food Research, Norwich) gave several examples to show that 'natural' is not necessarily synonymous with wholesomeness and safety.

In Britain there are three clear examples of natural poisons in food crops:

- Glycoalkaloids, present in green or damaged potatoes, can inhibit central nervous system function, causing acute illness and, in extreme cases, death. The most recent outbreak of potato poisoning was in Lewisham in 1979 when 78 schoolboys fell ill, three of them seriously.

- Glucosinolates, present in vegetables such as sprouts and cabbages, inhibit human thyroid function and can restrict growth.

- Saponins, which are found in a wide variety of beans, can influence the intestinal absorption of other toxicants; they are being investigated to find out whether they have harmful biological effects on humans.

Dr Fenwick warned that there are risks attached to the growing dietary trend towards vegetarianism and so-called health foods. There are also problems of quality control of 'health' products, tonics and dietary

supplements which legislators and scientists are only just beginning to address.

Recommendations to increase intakes of fibre, vegetable protein and green vegetables cannot be separated from an increased intake of a variety of natural compounds whose long-term effects are unknown. Scientists have already discovered that thousands of under-researched substances in plants, many of them natural poisons which act as the plants' own pest-control mechanisms, are posing dangers for new crop varieties which have been crossbred or genetically engineered to boost yields and increase pest resistance in the field.

The risk posed by natural poisons compared with residues of man-made pesticides is well illustrated by the case of the glycoalkaloid solanine in potatoes which caused several mild cases of nausea and vomiting in Sweden in 1988. Table 3 shows that, in this particular incident, solanine was present at the maximum permitted limit. The residues chlorpropham, diquat, thiabendazole and acephate, and the post-harvest storage chemical tecnazine, were present at well below the permitted maximum levels.

Table 3. Pesticide residues and solanine levels in Swedish potatoes correlated with toxicity

	Acceptable daily intake (mg/kg/day)	Maximum residue limit (mg/kg food)	% ADI/ 300g serving
Chlorpropham	0.5[a]	2.0	2
Diquat	0.008	0.1	6
Thiabendazole	0.3	1.0	2
Acephate	0.003	0.05	8
Tecnazine	0.010	0.5	25
Solanine	1.0[a]	200	100

[a] Swedish Food Administration evaluation.

Pesticide residues and food additives

Dr David Conning (director-general of the British Nutrition Foundation) explained that additives are compounds used in food processing or packaging whereas pesticide residues are derived from compounds used in agricultural production. He insisted that, by any reasonable toxicological criteria, these do not represent a threat to health. To the consumer, however, they probably do constitute something undesirable, akin to adulteration, and fears on safety are easily generated.

Dr Conning queried whether the arithmetical manipulations to estimate the levels of these compounds in the diet are really a satisfactory alternative to extensive definitive chemical analysis of the diet.

The usual method is to determine the 'no effect level' of a compound by toxicological tests in animals. From this, an acceptable daily intake (ADI) is calculated, commonly at 1/100 of the no-effect level. The hundred-fold safety factor is assumed to take account of the differences in size and sensitivity between humans and experimental animals. The manufacturer is then expected to ensure, through good manufacturing practice, that the concentrations of the chemicals used do not exceed the ADI in the products.

Similarly, by defining maximum residue levels, the concentration of agrochemical residues is expected to be maintained within the acceptable safety margins. The efficacy of this procedure depends on the number of food products in the diet that contain the particular additive. This can be estimated from National Food Survey data and manufacturer usage data. Alternatively, the Danish Budget method can be used; this assumes that half of all food eaten will have been processed and that half of it will contain any particular additive.

In the few comparisons that have been possible between the levels calculated from arithmetical manipulations and from direct chemical analysis, reasonably good agreements have been reached. All the same, Dr Conning emphasised that more direct estimation of additives and pesticide residues in human diets is needed, and it is essential that the work on food surveillance by analysis be continued, and expanded.

Radioactivity in food

When Wodicka drew up his original table of hazards in 1971, he did not include the possible hazard of radioactivity in food. Dr Barbara MacGibbon and Miss Frances Fry (from the National Radiological Protection Board, Chilton, Oxfordshire) discussed this subject which is another area in which the hazard is much less than the public fears.

The presence in foods of radionuclides from natural and artificial sources gives rise to annual death risks (1 in 10,000) less than some of those encountered in the course of normal everyday life, eg the risk of 1 in 200 that any smoker faces.

The total risk due to the Chernobyl reactor accident in 1986 was only about a tenth of the annual risk from natural radionuclides in foods. Table 4 shows that radiation exposure from foods is much less than that from other sources. About half of our total exposure is derived solely from natural radon gas, mainly to the lung.

Table 4. Radiation exposure levels (sieverts)

300 μSv	Annual dose from radionuclides in food
1 mSv	Annual dose limit for members of the public
2 mSv	Annual average effective dose equivalent in the UK from natural radiation
50 mSv	Annual dose limit for workers
0.5–1 Sv	Lowest acute whole-body dose to give noticeable effects
4 Sv	Mean lethal dose for acute whole-body exposure

Levels of radionuclides in foods do not pose a problem for the health of the UK public. The long-term health consequences of radiation would be seen as cancer and hereditary effects. The estimates of risk of hereditary effects are based on experiments on mice and are difficult to extrapolate to man. The risks of fatal cancer are more reliable and show that the level of natural radionuclides in food (mainly potassium-40, lead-210 and uranium-238) could only be responsible for a 1 in 83,000 lifetime risk of fatal cancer. The much lower levels of artificial nuclides in food (mainly caesium-137 from weapon testing and the Chernobyl accident) could only be responsible for a lifetime risk of fatal cancer of 1 in 2.5 million.

There is much public concern about the effects of food preservation by irradiation, but the levels of radioactivity induced in foods would be very low and pose an insignificant risk to the consumer. The ACINF report [4] on the wholesomeness and safety of irradiated foods calculated that the maximum annual dose from eating 100 g of freshly irradiated foods each day would be 25 μSv. Even this maximum dose is less than a tenth of the annual dose ingested from radionuclides which occur naturally in foods (see Table 4).

Risk assessment

Many of the speakers referred in general terms to the problems of risk assessment and the perception of risk. Risk is the likelihood that, in certain circumstances, a hazard could cause actual harm. In today's society we have to recognise the growing importance of how the public perceives risk. In decision theory, the acceptability of risk is seen as a two-dimensional function of the importance of an activity and the hazard associated with it. William Waldegrave, when he was Minister for the Environment, recognised that this was inadequate to explain our attitudes as individuals, and proposed two extra dimensions. To the individual consumer it is very important whether he has (i) the freedom of choice to accept a risk and (ii) faith in how any possible hazard has been assessed by the authorities.

Table 5 shows how Waldegrave, by way of example, scored the risks associated with motorcycling and nuclear fuel reprocessing. The activity of motorcycling is not very important to the consumer since there are many other means of transport, whereas nuclear fuel reprocessing is an important alternative to dumping.

A simple 'hospital beds' analysis scores 'absence of hazard' high for nuclear fuel reprocessing and (of course) low for motorcycling. Thus, on the original two-dimensional risk assessment, nuclear fuel reprocessing emerges as much more acceptable for its concurrent risks than motorcycling.

Adding the two new dimensions of consumer perception changes the picture completely. The individual has total freedom as to whether or not he or she will accept the risks of riding a motorbike, but has no choice at all over nuclear fuel reprocessing (which 'experts' control). Furthermore, there is complete faith in how the hazards associated with falling off the motorbike are assessed, but very little faith in the way the experts assess nuclear hazards. On the four-dimensional analysis, therefore, the consumer perceives motorcycling to be more acceptable, with regard to the risks involved, than nuclear fuel reprocessing.

This type of analysis can be used to understand how the 'concerned' consumer views chemical contaminants in the diet. Eating either a standard or an organic diet is perceived as very important and relatively free from hazard on the 'hospital beds' score. Eating a standard diet, however, offers low freedom of choice because 'they' have total control over food production and, as we know, the consumer has little knowledge of, and therefore faith in, hazard assessment by industry

Table 5. Acceptability of risk (hypothetical)

	Motor-cycling	Nuclear fuel reprocessing	Standard diet	Organic diet
Perceived importance of activity (1 = not at all important; 10 = vitally important)	1	7	10	10
Absence of hazard (1 = extremely hazardous; 10 = not at all hazardous)	1	8	9	9
Total (two-dimensional risk)	*2*	*15*	*19*	*19*
Freedom of choice whether or not to accept the risk (1 = no freedom; 10 = maximum freedom)	10	1	1	6
Consumer faith in hazard assessment (1 = no faith; 10 = maximum faith)	9	2	1	8
Total (the higher the score, the more acceptable for its risks)	*21*	*18*	*21*	*33*

and government. Eating an organic diet is scored highly, not because consumers believe that they have more influence on the production methods but because they have great (if somewhat misguided) faith in the assessment of 'natural' hazards. Put simply, it is not acceptable to 'concerned' consumers to have both low freedom of choice and low faith in the hazard assessment. This presents a major challenge to the scientists and the regulatory bodies — How can they bring about the situation in which every consumer, even the most timid and gullible, believes that eating food is safer than riding a motorbike?

Conclusions

Although the conference speakers scored 'absence of hazard' highly, and although their faith in hazard assessment is much greater than that of the average consumer, they were all strongly of the opinion that control of the food chain necessitates perpetual vigilance. In countering the threat to food safety that all the hazards pose, adequate research, surveillance, legislation, enforcement and education have vital contributions to make.

How safe is our food?, *the proceedings of the eleventh BNF annual conference (ed. Margaret Ashwell), is available at £10.00 (including post and packing) from the British Nutrition Foundation, 15 Belgrave Square, London SW1X 8PG.*

References

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