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Has the food industry benefited from the science of nutrition?

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Presenting the title of a paper as a question always poses a hazard for the speaker. There is always the feeling that the question must be answered in a crisp, clear-cut 'yes' or 'no' manner, an expectation common to many current topics on which science impinges. In view of the broad range of views about what constitutes the science of nutrition and what are its priorities; the diversity of the food industry and its different, often conflicting objectives, it would be difficult to see how the question could be answered simply. I have chosen, therefore, not to present a thoroughly researched, critical assessment of the subject, as would normally be expected at symposia of this Society, but to give a personal and idiosyncratic view based on my experience during a career that has spanned nutritional, biochemical and chemical research in academic, industrial and government-supported institutions as well as my current advisory role within the food industry and as a teacher in the University of Reading.

It is important to be aware of what we mean by 'the food industry'. In its broadest sense it covers all those commercial enterprises contributing to each stage of the food chain from primary agriculture, through food processors, wholesalers and retailers, either directly to the consumer or via the agency of various catering institutions.

Nutrition will impinge on these enterprises in different ways, and the reaction will differ according to the nature of the business and the demands of the customers. Even within the processing industry there are huge variations in size of enterprises and in the extent to which science of any kind impinges on their activities. The food-processing industry is not, in my view, highly science-based. Nevertheless, the giants in the industry spend a certain amount on scientific research of their own, geared mainly to new-product development, and in a few cases support fundamental work which may sow the seeds of innovation in the longer term but is not geared to immediate return. I am talking of a fairly small expenditure on scientific research generally; of this, nutrition research plays a rather minor part.

This all begs the question of what we mean by the 'science of nutrition'. Nutrition hardly exists as an individual discipline. It depends for its existence on the basic contributing disciplines of chemistry, biochemistry and physiology, with some lubrication from psychology, the social sciences and economics. Thus to many, nutrition is seen mainly as involving metabolic research; to others, this is hardly nutrition: they are concerned with food composition, toxicology, dietetics or social nutrition.

We can argue that parts of the food industry have benefited from some of these disciplines but have hardly been touched by others. But what do we mean by 'benefited'?

The food industry is a collection of businesses, and while its main function, like all businesses, is to provide a service, it has to provide a return on capital to survive. Benefits may be measured by some in terms of profits, by others in the development of new products or, less commercially but importantly, in enhancement of its reputation or image. Can we, therefore, discern ways in which one or more components of 'the food industry' have 'benefited' (using one or more of the previously stated criteria) from any of these aspects of the diverse and ill-defined science of nutrition?

Beginning with primary agricultural production it is clear that striking improvements in efficiency that have, in part, contributed to current overproduction, have depended

heavily on advances in the understanding of fundamental nutrition as applied to farm animals. It is now possible to predict very precisely the amount and composition of rations required to produce beasts of the desired weight, conformation and body composition, for the least cost and in a specified period of time. This is now taken so much for granted by farmers that they express incomprehension as to why human nutrition has not reached this degree of sophistication. Of course, these precise production objectives do not apply to human beings, when longevity is the goal and the diseases of old age and affluence are the problems that nutrition in this country is mainly asked to help to solve. Investigations in human nutrition will not, as in farm animal nutrition, lead us to define a 'normal' or 'ideal' food or diet, but should teach us how we may, to our greater advantage, adapt our eating habits to the ever-changing variety of foodstuffs at our disposal (Shaw, 1978).

An example of how nutrition research has influenced the agricultural production of an oil-seed crop which might otherwise have been abandoned as a human food is the story of low-erucic acid rape (*Brassica napus*). Nutrition research with laboratory animals established the potential cardio-toxicity of erucic acid, which a few decades ago constituted the major fatty acid of rapeseed oil. Plant breeders rapidly developed new low-erucic acid varieties, production has boomed and the fats and oils industry is richer from having a wider range of raw materials. This example also illustrates the fine line between 'nutrition' and 'toxicology', and indicates too that it matters not that the only proof of toxicity was in various species of animals, not in man.

In the realm of food processing, it is easy to see how a simple understanding of the nutrient composition of foods and the role of those nutrients in the diet and in the body has enabled food manufacturers to point out the benefits of their foods for the nutrition of man. The manufacturers of breakfast cereals recognized very early the merit of indicating the proportion of the recommended daily intakes of certain vitamins that a portion of their product would provide. Some years ago, protein was regarded as being of particular importance and manufacturers were quick to point out the contribution their products made to our intake of protein either in terms of its quantity, or later with more sophistication, its quality.

It is, of course, a legitimate promotional measure to proclaim the merits of a particular food product or the method of its manufacture, provided that the information is accurate and the claims can be justified. Such claims can, moreover, be a useful means of conveying nutritional information in a way that is directly relevant to food purchasers and easily assimilated by them. Thus, claims can be 'positive' ('contains x g protein/100 g'); 'negative' ('contains no added salt') or comparative ('low sodium', 'reduced fat'). Recently, as nutrition science has probed relationships between man's diet and his susceptibility to certain diseases, manufacturers' claims have become more overtly related to health. This trend began some time ago in the USA and is gaining ground here in the UK now; for example, in relation to claims for beneficial links between dietary fibre and cancer, calcium and osteoporosis, polyunsaturated fatty acids and heart disease, despite the fact that rarely have the links been established beyond doubt, and certainly not to the extent that justifies a simplistic claim.

This is a subject on which scientists should not be afraid to indicate the limits of knowledge, even though ultimately they may have little influence on what the marketing people say.

The food label is undoubtedly becoming one of the most widely read sources of nutrition information, and is a potentially valuable educational tool, provided that it is regulated so as not to furnish misleading or harmful information. Much of the stimulus to use the results of nutrition research as a marketing tool is now coming, not from the

manufacturers but the retailers who have more direct contact with consumers (Freckleton, 1986).

A far-reaching effect of the current consumer interest in nutrition is to make it necessary for manufacturers to pay more attention to quality control. It is not always easy to know to what extent this was originally consumer- or producer-led. In the early 1970s, when the current wave of consumer interest in nutrition had hardly begun in the UK, I was a member of a working group established by Unilever Research to examine the needs of this organization for nutrition research in its broadest sense. The working group clearly identified a need for the operating companies to be aware of the nutritive value and nutrient composition of their products, not only as sold, but also, more importantly, as eaten on the plate after traditional household cooking. Such information, collected by manufacturers, need not, of course, ever find its way onto food labels. The possession of a nutrient database does, however, enable a company to respond to demands for information about the nutritional quality of its products, whether from individual consumers or from regulatory bodies acting as consumer watchdogs. It can, in this way, satisfy the 'consumer's right to know'. The working group's report led, in turn, to the development of better techniques for measuring nutrient composition and to greater thoughtfulness about what was appropriate in terms of nutrient profiles of processed foods. It led to work that demonstrated that the nutritional quality of many processed foods, as eaten, could equal or be superior to the traditional equivalents. It also resulted in the sort of feedback to the processor that led to modification of processing techniques to improve nutritional quality. It seems to me that this sort of exercise has benefited manufacturers, consumers and nutrition science into the bargain.

Of course, companies of the size of Unilever have the resources to commit to such research and development and it would be misleading to suggest that nutrition research has impinged on small companies to the same extent. Nevertheless, smaller companies can eventually acquire the benefits of increased research activity through organizations like the British Nutrition Foundation and Food Research Associations.

The examples I have just discussed have been concerned with a very narrow view of what nutrition science is; little more than food chemistry. It is more difficult to produce examples of where metabolic nutrition research has benefited that part of the industry concerned with the provision of general foods for the average healthy consumer. To find analogies in human nutrition to the contribution made by farm animal nutrition to agriculture, we have to look at groups with special needs, not at the mass markets for which the food manufacturing giants are largely catering.

As an example, the infant-food manufacturing business has already benefited from advances in nutrition research, and the range of infant feeds has grown wider and more sophisticated. General formulas have been tailored better to approximate to human milk as a result of increased knowledge of the role of milk constituents in infant development, although there is certainly a long way to go before human milk can be truly mimicked. In Japan, where human milk contains a range of higher polyunsaturated fatty acids characteristic of the fish that contribute substantially to the mother's diet, the newer baby milks are enriched in these fatty acids. The success of these products has depended as much on sophisticated food science in order to avoid oxidation and flavour problems, as on nutrition science. Current studies in many nutrition research laboratories on the role of the minor whey proteins, like lactoferrin, will certainly result in further developments in infant feeds.

Great strides in the development of special formulas for preterm infants have resulted from research into the development of the fetus and the need to sustain and nourish the preterm baby in its first few weeks postnatally. It can be argued that this is an example of

the situation where 'nature does not know best', and the welfare of such children can only be assured by a successful liaison between nutrition research and the food manufacturer. Development of products for other specialist groups, for example, patients requiring total parenteral nutrition, babies with phenylketonuria, diabetics and many others, have depended on nutrition research at the metabolic level. The extent to which this can be said to have benefited the food industry is a moot point, since this is an area where products are often less in the demesne of the food industry than of the pharmaceutical industry, traditionally more research based and research minded than the food industry.

A good example of an area of nutrition research that began in close association with the food industry and that has developed towards the pharmaceutical industry is the field of the essential fatty acids. After their original discovery in 1929 (Burr & Burr, 1930), important contributions to our understanding of their chemistry, biochemistry and role in diet was made by scientists of Unilever Research in the Netherlands. Commercially, this led to the development of margarines rich in polyunsaturated fatty acids. Basic nutritional studies, first on requirements for essential fatty acids, their blood cholesterol-lowering properties, and later on their conversion into prostaglandins, with their powerful effects on haemostasis, have been used skilfully to promote the company's products. Surely this is a classic example of how nutrition research has been put to work, not only to sell products in powerful competition with more traditional ones, but to persuade vast numbers of people to a particular view of diet and health. The benefits to the company have been in all the areas I cited earlier; new product development, increased profits and company image.

Interest in polyunsaturated fatty acid metabolism by the research fraternity has moved steadily from the basic essential fatty acid, linoleic acid, to the higher unsaturated acids, first linolenic, then dihomo-γ-linolenic, then the penta- and hexaenoic acids characteristic of fish oils. It took many years from the discovery of the essentiality of linoleic acid to the sort of commercialization we now witness, and so commercial activity and consumer interest were able to keep well in step. The recent developments in the biochemistry of the higher polyunsaturated acids and their related eicosanoids have been explosive and, in my view, commercial and consumer interests have run ahead of the scientists' ability to put research findings on a truly firm footing. Thus, I seriously question whether our understanding of the role of the higher polyunsaturated fatty acids in the diet, and the function and physiological effects of the complex interactions of the myriad eicosanoids formed from them, allow many, if any, of the claims that are now being made for products rich in γ-linolenic acid, dihomo-γ-linolenic acid and eicosapentaenoic acid. Moreover, the quantities needed to achieve physiological effects, the types of medical conditions for which benefits have been proposed, and the cost of the materials, bring this field away from nutrition into pharmacology; away from the food industry into the pharmaceuticals industry. Whether this will benefit the food industry or harm it is not within my expertise to say.

I have recently returned from a visit to Japan where I was shown a brand new multi-million-pound fundamental research institute set up by the country's second largest dairy company. The research was in part nutritional, but pharmaceutical interests seemed to me to predominate. Is this the way the food industry is going? The UK dairy industry is certainly a long way from this mode of thinking.

If a food company is to be influenced by nutrition science it must have good advice from professional nutrition scientists. In the case of the giants with the resources to fund their own nutrition research, whether at fundamental or applied levels, this advice comes largely, but not wholly, from within; from their own research scientists. This gives them

tremendous advantages to capitalize directly and rapidly on advances made in their own laboratories. It also has the disadvantage that their ways of thinking become very inbred and channelled. Others may rely on advice acquired through membership of organizations like the British Nutrition Foundation, the Research Associations or contacts with the Research Institutes. Alternatively, they may utilize the services of eminent academics as consultants, and there has been a long tradition of such associations. Whatever the nature of the relationship, the scientist advising the food industry faces an important and interesting challenge. The quality of advice received by the food industry is only as good as the quality of the scientists it employs. It should not be a consideration who pays their wages. There should, therefore, be no distinction between 'academic' and 'industrial' scientists. It is for this reason that I disapprove strongly of the British Nutrition Foundation's classification of its various advisers on this basis. The criterion should be: is he a good scientist or not? By a good scientist I mean one who is capable of thinking originally, can set up hypotheses that advance his subject, can meticulously design experiments with appropriate controls to test those hypotheses, who can painstakingly collect data and appraise those data critically and with integrity.

My experience has been 11 years with Unilever Research, in which I frequently served as adviser to the Flora programme and many other of the company's nutrition initiatives. From 1979, my association has been with various aspects of research for the dairy industry. In all those years and in both 'lives' I have always tried to proclaim a strictly scientific viewpoint, or at least to make it very clear when I was speaking with my 'scientific hat' on or my 'industry hat'. This has often resulted in situations where my 'message' was one that the industry to which I was speaking would really rather not have heard. In my current capacity as nutrition consultant to the Milk Marketing Board, I strive to interpret the results of scientific research to the best of my ability in my capacity as a critical scientist, and hope that scientists in other spheres of life will accept me on a similar footing. This is the only way that the food industry will benefit from nutrition science, and I find it regretable that there is a school of thought that holds that there is something reprehensible about the idea that any scientist worth his salt should be associated with industry and is somehow soiled by that association.

In my career as a research scientist and as a representative of various industries I have been truly fortunate to travel all over the globe. When I have discussed these problems with overseas colleagues, I have usually discovered that these problems are largely characteristic of the UK and that in most, but not all, other countries there is a happier interrelation between industry, research scientists, the medical profession and the media. It is difficult to break out of old traditions and prejudices, but in mounting a colloquium of this nature, our Society is at least attempting to broaden the dialogue so that the science of nutrition may truly be able to benefit not only the industry but all consumers of food.

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