Centre for Agricultural Strategy

Agricultural and food research – who benefits?

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5 The benefits of R&D to food processors, distributors and retailers

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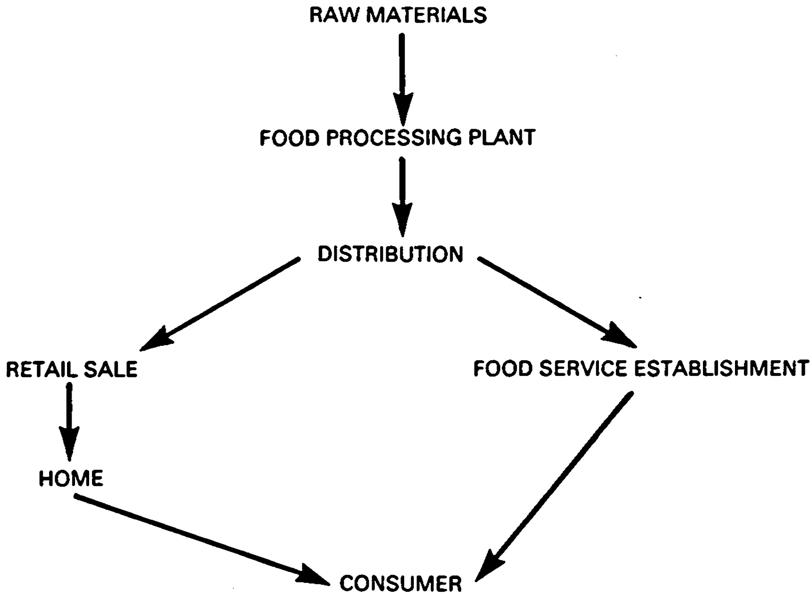
INTRODUCTION

This conference is to debate the subject of research and I shall be looking at the food end of the chain. To me, the answer to the question of who should benefit must be the consumer. Food processors, distributors and retailers should benefit too. As we have seen from the previous paper, there are large numbers of consumers out there in all parts of the world. They are increasing in number all the time and it would be good to feel that our ability to feed them was also increasing but that, unfortunately, is not true in many places. We thus have developed versus developing world, plenty versus shortage, and sometimes it is just a small difference between surplus and shortage (King 1989).

I am sure that most of you do not eat full meals any longer these days – certainly most young people do not; they are on the move all the time (when they are not stopped in traffic jams!). One way or another, people tend to become what we call 'Euro-grazers'. On average, they graze about 5 times a day. For the UK population, that gives 100 billion eating occasions annually, with clearly a much larger number in the rest of the world.

To produce that sheer quantity of food through the food production chain (Figure 1) inevitably means an enormous enterprise so that the food manufacturing and distributing industry is our largest enterprise; 'our' meaning for the world as a whole. Expenditure on defence is of a comparable magnitude. But whilst R&D spending on defence is very large, R&D spending on food is always at the margins of a very competitive industry. Nevertheless, food R&D is still a large activity, the industry being dependent on science and technology. In the UK much research and teaching is undertaken at the largest University Department of Food Science and Technology which is at Reading.

Figure 1
Food production chain



We do not just eat; we live in an environment which has to be protected while at the same time producing the sustenance for everything we do. There is then a close interaction between the two in all parts of the world.

A previous speaker has referred to the distinction between the developed and the developing world. There is a tendency sometimes to think that those in the developing world live in rural areas and produce their own food. But it was brought home to me on a recent visit to China that this was not necessarily so; many workers lived in towns in high-rise buildings, commuted to work and could not physically have produced the food that they and their families ate.

The mass movement into cities dominates developing areas, particularly Africa and Central and South America. Today there are 4 cities in Africa with over 4 million people in each; by only the year 2000, there will be 15 such cities. Their occupants will need to be fed, which will require a distribution service of food to supermarkets or street stalls day in, day out allowing the bulk of the population to go about their other activities.

So wherever we are, as we shall never be able to produce enough food for the populations at the points of consumption, we have to be able to process and preserve food, and to distribute that food, a food that is safe, wholesome, and attractive to consumers. These are the key objectives of food technology (Campbell-Platt, 1988).

THE SCOPE OF FOOD TECHNOLOGY

What is a 'safe' food? There is no such thing as absolute safety. Generally, the food industry has a good safety record but we have seen recently that it is not a perfect record (Richmond, 1990; 1991).

Incidentally, on food safety, the most dangerous aspect is driving to the supermarket with a juggernaut just behind you – 2 out of 3 lorries on Britain's roads are delivering food or taking raw materials into food-processing factories. But at least you assume that the driver has a qualification and can drive. We are still trying to get to that position with the food industry, namely that the people in charge of it should be qualified and able to take proper responsibility for it. Under the new Food Safety Act, there is now registration of food premises so we should have improved control. It is to be hoped that by the end of the century we shall get to the point of having people in charge of food production who are of full professional status.

A 'wholesome' food is one that is nutritious and well-balanced, although more exactly it is the diet as a whole that has to be properly balanced. Food also has to be 'attractive' because in times of plenty people are very selective about what they eat and even in times of shortage it is desirable that the available food is attractive.

THE MAIN AREAS OF FOOD RESEARCH (Figure 2)

Biotechnology is an all-embracing word but so much of food is a bio-system that one could argue that much of what we do is using bio-organisms and the bio-technology of them.

Food composition is a complex subject; those who research it know how little we know about the components of food and the interactions between them. We need to be able to analyse food but, as we get more and more sophisticated instrumentation and as the capital investment per researcher increases, we will detect at ever lower levels things like pesticide residues in the food chain. There are lots of new crises ahead generated by better *methods of analysis!*

Figure 2
Food research

Biotechnology

Food composition

Methods of analysis

Food processing

Food microbial interactions

Food safety

Food quality

Food acceptability

The objective is FOOD CONTROL

Food processing is concerned with how we go from the raw material to the end-product. Some people think that food science and technology was invented only recently just to 'muck about' with food. I would just point out that the main raw material for the world after sugar is wheat and who regularly eats wheat grains? Or do we prefer it processed into bread, breakfast cereals, biscuits, pasta, and so on? Clearly, we must be able to understand the science behind such processes.

Food microbial interactions are important because there is a wonderful bio-technological system operating naturally in foods. Some one third of the European diet is fermented naturally and desirably whether it is the beer, wine, cheese, yogurt, bread, salami or sauerkraut that we consume, a whole range of naturally fermented products (Campbell-Platt, 1987).

Yet, as we all know, microbial contamination of food is a major problem in food safety. So there is here a whole research area, namely improved natural preservation systems in which the desirable organisms are encouraged and the undesirable ones discouraged without having to add to the food so many alternative preservatives.

Those who may not be familiar with food science and technology may then be able to see from this breakdown that all its aspects are science-based, are multi-disciplinary, and involve enterprise and industry. You cannot be involved in food without being involved with people and production.

The distinction between science and technology is worth a brief mention. Science is an analytical understanding of the components of the system; technology is putting the components back together again. As a previous speaker has said, however much time and effort you spend on the science of the system unless you are also prepared to spend on development work you will have wonderful research results which will just not relate to the actual products that we eat.

CONSUMER SOVEREIGNTY

Food technology then depends on putting components of food systems together in terms of what consumers want. A key area is the control of fermentation processes. Thus on safety issues, by using bio-sensors, we might be able to get straight to toxins rather than isolating and identifying micro-organisms, or even, as sometimes now, just counting them. Minimising by-products and wastes is important in environmental and resource terms. Micro-organisms create huge problems of wastage and spoilage and more rapid methods for the prediction of shelf life would provide the industry with large economic benefits. Retailers are always talking about wastage and shrinkage and margins, by which they refer not to shoplifting but to spoilage, damage, bruising, and so on.

In all this, it is important to remember the constraint of acceptability to consumers. For example, conventional plant breeding is familiar and accepted. But as we move towards tissue culture and genetic engineering, we may be making biological improvements but are we making them in ways that consumers will accept? If not, we ought to do something about it now, to explain to people what we are doing and why we are doing it. If we do not, there will be stormy days ahead with lots of conferences about how it all went wrong.

Again, using bio-technology in food, just the enzymes themselves might be needed, not always the complete micro-organisms. But perhaps a natural lactic culture might appear more friendly than an engineered enzyme which did the same job.

FOOD IRRADIATION

I would also like to mention something that is happening right now, which is the introduction of food irradiation which is legal in Britain from January 1991. It has been debated at great length and argumentatively. I myself was asked in a late-night TV discussion programme 'Are you for or against it?' I have never been asked that about any other form of food processing that I have been involved in, which I find a fascinating reflection on how the word 'irradiated' is confusing and alarming.

Irradiation does have some advantages in helping to improve the safety and keeping quality of food. It can be done using machine sources, such as we have at Reading, or using radio-active isotopes such as cobalt-60 as used in the research facility in Northern Ireland. Either way, you finish up with a food that is no more radio-active than it was before you started. The glib TV people wanted to know whether irradiated food was radio-active, yes or no? The answer is that all food is radio-active, in the same way that we are all radio-active and our environment is radio-active, for example due to the presence of the natural carbon-14 or potassium-40, but at the low energy levels used in irradiation food is no more radio-active than it was before.

It is encouraging that Europe is now getting its scientific act together and has listed foods recommended for irradiation. As far as safety is concerned, an expert committee in Britain has recommended that any food at all could be irradiated, up to an absorbed dose of 10 kilograys. This may not be acceptable on taste grounds, for example a fatty food might be rancid (Advisory Committee on Irradiated and Novel Foods, 1986). At any rate, the fact that scientists have reached a European agreement (Scientific Committee for Food, 1986) before the technique is used should be good news for consumers. But this is not what they read in the popular Press.

Irradiation is not a panacea; it is just another processing aid. In some circumstances, it can improve safety. For example, half the raw poultry sold in this country carries *Salmonella* and *Campylobacter*. You will not read about *Campylobacter* because the word is too long for the tabloid Press but it is even nastier in effect than *Salmonella*. Similarly, in the Netherlands a few years ago 15 people in an old peoples' home died because of *Shigella* in prawns. Both poultry and prawns could be made safer by irradiation. It can also extend the shelf-life and mould-free life of fruit and possibly – we are working on this at Reading – preserve the taste of tropical fresh fruit.

THE MEDIA AS THE CONSUMERS' SOURCE OF INFORMATION

Finally, I see as a very important issue that of scientists and the media. Where does the aware public get its information? Often there is a complete mismatch between public beliefs and scientific knowledge. A relevant example in food is the public concern about food additives, while the scientists know that the greater hazard is microbial contamination (Wodicka, 1971, Figure 3). Some of you may know about and contribute to the Media Resources Service which is designed to give journalists the best possible scientific understanding of the articles they are about to write. From

Figure 3
Food hazards

In order of Decreasing Priority	
1	Microbial contaminants
2	Nutritional imbalance
3	Environmental contaminants
4	Natural toxicants
5	Pesticide residues
6	Food additives

Source: Wodicka (1971) Food Chemical News, **12**: 12-17 such requests, you can get an indication of the subjects of interest and how the information will be published.

TV and newspapers account for most of our sources of information, and with lower frequency the radio, magazines and sundry other sources. So it seems to me that it is the first two where a better understanding is required – why we are doing food science and technology. That is why some of us in the front line agree to appear on late-night TV if necessary, although the majority of scientists will not agree to it. But if they do not, someone else will write the articles which will leave them trying to recover the ground later on and complaining about what has been said. It seems to me better to join the debate early on, to explain that there are not always simple issues or simple answers. The need is to work with consumers in R&D terms – to improve their scientific literacy, their education in the new technologies, and to make them aware of the benefits of some of these technologies. Otherwise, the potential benefits of all this research are going to go to waste as when the consumer says, for example, 'If it's irradiated, I don't want it.' Or when customers in supermarkets say 'I won't have it if it contains E numbers' although E numbers can be substances like vitamin C and other natural ingredients. In fact an ordinary fresh tomato contains 11 E numbers! (Figure 4).

Figure 4
'E Numbers' in foods

Naturally Present in Tomatoes

Cellulose	E460	Malic acid	E296
Pectin	E440	Fumaric acid	E297
α-Tocopherol	E306	Succinic acid	363
Citric acid	E330	Bicarbonate	500
		Carbon dioxide	E290
Flavour enhancer:	Monosodium glutamate		621
Colours:	Carotene		E160(a)
	Lycopene		E160(d)
	Riboflavin		E101
Antioxidant:	Ascorbic acid		E330

What areas of science interest the media and, presumably, the public? A recent analysis showed Health and Medicine as way out ahead. Food was not even mentioned and Agriculture, Life Sciences, Social Sciences, Environment had low scores; even Physics, Computers, Industry, Technology, Energy, Space, and Military had low ratings considering the large expenditures on them. Yet Research Councils, if they were asked the question, might put the subjects in reverse order.

We in food nevertheless have a tremendous opportunity. Surely Food is about Health – it is only when it goes wrong that we have Medicine. And if you ask young people what they want, it is to be healthy, have a good life style, and live in a naturally healthy environment. This is the challenge and the opportunity, as I see it, for food scientists to work closely with the public. We have to face all the issues: technical, legal, ethical, moral and social. If we do not, the benefits of much of our research will go to waste.

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GLOSSARY

Kilogray: 1 Gray is the unit of energy absorbed from ionising radiation by the matter through which the radiation passes.

1 Gray involves the absorption of 1 joule per kilogram.

1 Kilogray = 1000 Grays.