Foresight for Food and Drink

Dairy

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Foresight For The Dairy Sector

The UK's Foresight programme was first announced in the 1993 White Paper *Realising our Potential*. Its aim is to create sustainable competitive advantage and enhance the quality of life, by bringing together business, the science base and Government to identify and respond to emerging opportunities in markets and technologies.

The Foresight programme is spearheaded by 16 panels set up to explore opportunities in different sectors of the economy. In 1995, the panels published their first reports following widespread consultation. These reports aimed to identify:

- the likely social, economic and market trends that will affect the UK in the medium to long term;
- the developments required in science, engineering and technology to best address future needs; and
- the implications for policy and infrastructure and for business investment strategies.

The Food and Drink panel has since looked in further detail at six sub-sectors:

- Alcoholic Drinks
- Cereals
- Dairy
- Fruit and Vegetables
- Meat
- Soft Drinks

The groups involved were asked to perform Foresight analyses for each of their sectors, to challenge the original panel findings and to make recommendations for further action aimed at involving industry and academia in debate about priorities for the future.

This report summarises the work of the Dairy sub-group of the Food and Drink panel.

Executive Summary

The supply of the dairy sector's chief raw material is minutely controlled by the effects of World and EU trade agreements. With moves towards the removal of trade barriers and price support, the UK will increasingly be operating on a world market with prices controlled by free market forces. The adoption, and degree of national enforcement, of international legislation on standards (such as CODEX) and environmental impact will also have important effects on UK competitiveness.

Consumer interest in the health aspects of food is likely to increase in the future and this will offer opportunities for the UK dairy sector to build on its positive image by producing innovative products with beneficial health properties. The success of such products will rely, however, on demonstrating the health benefits to the consumer of new technologies employed (for example, genetic modification) and on the ability of producers to advertise such benefits.

Manufacturers will increasingly be selling to European and global markets and so will have to drive for exports and not rely on domestic markets. There is great potential, legislation allowing, for increasing volume production to serve these markets.

Scientific and technical developments can be foreseen to lead to many improved dairy products in the future. These include:

- fractionation of milk components for high added-value products, including those with health benefits;
- feeding regimes to determine more precisely the composition of milk in terms of its processing characteristics;
- the isolation and characterisation of useful micro-organisms for new and improved cultured products;
- large-scale production of pharmaceuticals in milk;
- better processing aids and preservation techniques and packaging for dairy products.

The dairy sector faces a number of barriers to progress including the quota system, which does not encourage innovation, the difficulty in sourcing dairy processing machinery tailored to UK industry requirements, and finding uses for excess butterfat as consumption of low-fat products increases.

The sub-group recommends that all the component industries and their associations and public sector research sponsors should together agree a strategy for medium to long-term science, engineering and technology to support the dairy sector. Priority topics for support are identified in the report. The industry should support the international information exchange provided by the International Dairy Federation and should be involved in initiatives to involve the public in debate about new technologies. There should be more effort into publicising the health benefits of milk in the human diet.

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Background To The Sector

1. The dairy sector includes all the industries involved in the production of liquid milk (from cows, sheep and goats) through to doorstep or retail sales. The value of the UK market for dairy produce is some £7 billion, most of which (£6.4 billion) is produced in the UK. There is a healthy export trade, particularly to the EU, worth about £700 million but the UK is a net importer, particularly of yoghurt, cheese and butter. Data on dairy sales are given below.

Table 1 . UK Dairy sales 1995/6 (£ million)

	01	02	03	04	05	06
Liquid - doorstep	1682			1682		1682
Liquid - other	1790			1790	30	1820
Chilled products	761			761	56*	817
Cream	103	20	109	232	7	239
Condensed	62	32	46	140	20	160
Cheese	713	118	157	988	533	1521
Butter	121	159	140	420	222	642
Whey milk protein		27	171	198	16	214
Skimmed milk protein		90	101	191	21	212
Total	5232	446	724	6402	906	7308
					Value c.i.f	
					*yoghurt only	

Source : Dairy Industry Federation

Key
01 - Retail Sales
02 - Industrial Sales
03 - Export Sales
04 - Total UK industry
05 - Imports
06 - Total UK

2. The dairy sector works in a market where, perhaps more so than in any other sector, the supply of its chief raw material, liquid milk, is minutely controlled by the effects of World and EU trade agreements - the Common Agricultural Policy (CAP) and the General Agreement on Tariffs and Trade (GATT)/World Trade Organization (WTO). At present, the CAP imposes a quota on milk production for member states which, together with

restrictions on imports, is designed to maintain a higher than world market price at a roughly uniform level from country to country within the EU. However, with increasing moves towards the removal of trade barriers and price support as a result of GATT and the WTO, the UK will be increasingly operating on a world stage with prices controlled by free market forces. It is possible that the support to farmers currently provided by the CAP will be replaced by some other means of rural community support, perhaps justified on the grounds of environmental protection.

3. In addition, until November 1994 the Milk Marketing schemes cushioned farmers from market forces. By law, all their milk had to be sold to the Milk Marketing Board which then negotiated prices with the Dairy Trade Federation, whose members were the processors and manufacturers. Since deregulation, farmers have been free to sell their milk to whom they please and many (currently some 65% in England and Wales) have chosen Milk Marque.

4. Prices for milk are also determined by composition in terms of fat and protein content. Processors pay farmers on the basis of the fat and protein content of their milk as well as on volume; this has resulted in an increase in fat and protein over the years but is now leading to a conflict with market requirements for reduced and low fat products.

5. Milk production in the UK to March 1996 was 13.8 billion litres. The dairy industry employs 55,000 people including about 37,000 dairy farmers (1994 data).

6. Consumption of milk and cream declined from 2600 to 2169 grams per person per week in the decade to 1990 and has since remained at roughly this level - consumption in 1995 was 2170 grams per person per week. Consumption of cheese has remained virtually static over the period 1980-1995 at about 110 grams per person per week (1).

(1) Consumption data from the 1995 National Food Survey, MAFF, published by The Stationery Office, 1996

Key Drivers

Legislation

7. The effect of milk quotas is described above. However, there are several other legislative drivers that will influence the UK dairy sector in the future. Perhaps the most important of these is that in the medium to long term there will be a market driven move to world standards (such as CODEX) and the removal of import barriers as a result of the GATT/WTO. This will mean that it will be illegal for individual countries to use unjustified concerns about a particular product or class of products (whether on scientific or other grounds) to prevent imports. There are, however, also a number of more immediate related drivers which will be important for the UK sector:

8. The variability in the national legislation of Member States. For example, fermented milk products can only, at present, be sold as yoghurt in some Members States if they contain specified cultures. On the other had, the more liberal UK legislation, following deregulation, can allow certain products (e.g. Cheddar cheese) to contain ingredients not permitted by Member States.

9. The degree of national enforcement of EU regulations by different member states will affect the competitiveness of the UK sector. Historically, there has been wide variability in compliance.

10. Finally, the position that the UK government takes on the balance within Europe of federal versus national legislation will act for or against the UK dairy sector as implied above.

11. A second major legislative driver will be the ability of companies within medical and health legislation to make claims about the health benefits of particular dairy product. This will determine whether these products can attract a higher added value than more basic dairy products. MAFF is currently finalising labelling rules on functional foods which should introduce useful clarity in this area. Differences in the scope and stricture of rules in other countries will influence UK exporters ability to use claims about health in marketing their products.

12. Environmental legislation affecting the products from dairy farms and processing plants (including odour, noise, liquid and solid effluent) is likely to tighten and will impose major costs on the sector.

Consumer issues

13. The desire for variety combined with price consciousness will be, as for many sectors, an important issue for consumers in the future. Because of the existing high penetration of imported dairy products, there is unlikely to be significant 'loyalty' to UK made products in the future.

14. The health aspects of dairy products in the diet will be of increasing importance to consumers. Products with accepted healthy properties, such as yoghurts and reduced fat products, are likely to become more popular. This will result in the need to find uses for the increasing amounts of dairy fat produced as a by-product. The availability of non-dairy products with similar eating qualities to traditional dairy products but with 'healthier' properties in terms of fat content and so on is also likely to increase.

15. As in all food production, the physical, chemical and microbiological safety of dairy products will continue to be essential.

16. Concerns about all aspects of food production will extend to the dairy sector where issues of animal welfare, environmental impact, traceability and acceptance of new technologies will increase in importance. The influence of consumer groups to affect public opinion about production methods will grow in the future.

17. Consumer acceptance of biotechnology (e.g. the genetic modification of feedstuffs or of animals themselves) will determine whether the industry is able to take advantage of the opportunities offered for new products or improved production efficiency. Such acceptance will depend on demonstrable benefits to the consumer. It will also rely on allaying the public's fears about harm to the environmental or animal welfare and decisions on the ethical aspects of these technologies.

18. Changes in lifestyle patterns affecting, for example, the frequency of shopping, will place new demands on dairy products such as longer keeping properties.

Retailing

19. The UK retailing system has a very great influence on farmers and manufacturers in terms of specification of production systems, price and control over innovation. There have been, and are likely to be in the future, both positive and negative effects. For example, standards of production have increased greatly benefiting consumers but own-label products have squeezed branded products to the detriment of certain manufacturers.

20. Lower priced milk in the large multiple retail outlets and the changes in lifestyle above have resulted in a steady and significant reduction in the volume of liquid milk being sold at the doorstep. The convenience of home delivery, however, is beginning to be used as a marketing position by the large retailers and may have implications for the dairy industry.

Markets

21. Manufacturers will increasingly be selling to European and global markets. They will have to respond and to drive for innovation and exports and not rely on domestic markets. The quota system will continue, as long as it is in force, to have a very strong effect on the economics of production.

22. There will be increasing demands made by the processor and retailer on the dairy farmer for milk of a particular composition and on the dairy for milk components meeting exact specifications.

23. The current trend for a general reduction in price support and a move towards world prices will force companies in the sector to reduce production costs. This is likely to lead to a conglomeration of smaller firms into fewer, larger ones.

Research

24. Developments in curiosity-driven research can make significant changes to production methods and so can be drivers in their own right.

Scientific And Market Opportunities

Milk production

25. The UK dairy farming industry is regarded as one of the most efficient in the world, although the distortions produced by the CAP make comparisons difficult. There will be a general trend in the future towards decreasing price support for dairy production leading to lower prices for liquid milk. However, with increasing demand for liquid milk and milk products caused by an expanding worldwide population, there is great potential to address export markets by increasing volume production significantly (the quota system allowing).

26. There will also be opportunities in domestic and worldwide markets for increasing the production of milk products (fat, protein etc.) to meet particular specifications for higher added-value products - food as well as non-food. This may involve either modifying the composition of raw milk by feeding or genetics or both, as well as fractionating whole milk into its components.

27. These opportunities can be met by a combination of science and technological research in a systems approach as follows:

28. The results of research in the UK and overseas on ruminant nutrition and on the use of improved feedstuffs can be used to maximise production efficiency, not just volume, i.e. to reduce the amount of feed that is wasted whilst maintaining high standards of welfare.

29. There is potential to develop pasture and diet supplement regimes that would allow the predetermination not only of fat and protein levels but also factors such as the degree of saturation of fat, the casein: whey protein ratio and the flavour and texture potential of fermented dairy products. This should allow milk tailored for a particular product or nutritional value to command a premium although the price of general purpose milk might fall.

30. Genetically superior cattle can be produced from existing lines or selected using molecular markers for quantitative traits such as: improved feed conversion; reduced incidence of mastitis and lameness; easier calving; milk composition for food; and the production of pharmaceuticals in milk.

31. Development of lower cost and more reliable in vitro embryo production, embryo sexing and embryo transfer techniques together would give more reliable reproduction of animals with a particular genetic makeup. Taking intervention in reproduction as far as genetic transformation is unlikely to be acceptable to consumers as far as food products is concerned, however, although producing pharmaceutical products in milk does not seem

to generate significant concerns.

32. There is currently publicly funded research into many of the above areas and this should be maintained for the future competitiveness of the sector.

33. There is also a need and an opportunity to increase the awareness among the public of the nutritional benefits of milk, including calcium and protein, counteracting that of the possible disbenefits of fat content.

Processing

34. The use of dairy products as functional foods that confer or are perceived by consumers to confer health benefits should be a growth area for the future. Examples of such functional foods include dairy products with pro- and pre-biotic properties (pro-biotics such as yoghurts containing a starter culture; pre-biotics also contain agents to facilitate digestion such as inulin). For such products, work within UK companies, e.g. for pro-biotics to isolate and produce useful micro-organisms, needs to be partnered with public sector research in identifying and explaining to the public the apparent health promoting effects. Optimising these benefits in attractive products should give the UK a very competitive position. The UK is well placed to achieve this, building on expertise at the Institute of Food Research and the Dunn Clinical Nutrition Centre.

35. Other components of dairy products with potential health benefits include: oligosaccharides which may have beneficial properties; biologically active peptides; calcium which may reduce the risk of gastric cancer; phospholipids which may lower blood cholesterol; milk proteins in the treatment of diabetes; components of dairy products that are beneficial in preventing dental caries. The potential to use these components in new products will rely on new separation and enhancement technologies.

36. To produce more attractive products in terms of taste, texture and so on, a better understanding of the relationship between consumer preferences, product composition and the processing that a material has received is needed. An example would be the relationship between the chemistry, time/temperature/shear history and the perceived texture of a cheese.

37. There is also likely to be an increase in the use of milk fractions to produce high value feedstock products for the non-food industries such as pharmaceuticals; milk has some components that cannot be derived from other sources such as antimicrobial, pharmacokinetic and analgesic components. New bioseparations technologies, such as 'smart' imprinted polymers, will be critical in isolating these fractions and the UK companies could be well placed to take advantage of the strong UK research base in this area.

38. A wide range of processing aids are used in the dairy industry. Some are already the products of genetically modified organisms (such as non-animal chymosin as a substitute for rennet). There will be strong market benefits in being able, for example, to use a standardised and efficient process for maturing cheese with reduced cost whilst retaining or restoring the sensory appeal of traditionally produced cheese. Biotechnology can play a significant role in future innovation in this area e.g. in enzymes for the accelerated ripening of cheese. Underpinning research is already in train but needs to be coordinated with more fundamental work, for example on flavour generation.

39. Novel processing routes to give safer products will make a big contribution to future competitiveness. One example is high pressure processing for sterilising dairy products without affecting organoleptic qualities. Current equipment is for batch processing but techniques are likely to be available in the medium to long term for high pressure continuous processing - the UK has a strong presence in the development of these techniques.

40. Smart packaging for dairy products, for example to indicate the freshness of the contents, are likely to be available in the medium term. These will help reduce wastage without compromising safety standards and provide the customer with an easily understood indicator of the contents' status.

41. Process control and quality control can be improved by taking advantage of new or forthcoming developments in sensor science - both biosensors and mechanical/physical sensors. Examples include: enzyme-based metabolite sensors to monitor fermentations; antibody-based contaminant sensors; microelectronic stress sensors to monitor texture formation; and smart polymer-based electronic nose devices.

42. Better control of production and processing of milk, a multi-component, variable-constituent raw material, can be aided by new developments in chemometrics - a powerful emerging science based on non-linear statistical methods for data analysis. It can also be used to predict the key variables which influence product quality parameters.

43. A better understanding of the molecular and microscopic determinants of milk material properties would help the introduction of the functionally determined products outlined above. Some sectors of the food and drink industry already use advanced spectroscopic and microscopic techniques to relate the mechanical properties of food to their microstructure, and in turn, to their sensory quality. The dairy industry has not, however, thus far been active in taking up these techniques nor in making its particular needs known to centres of research.

Barriers To Progress

Milk production
44. The complexity of forecasting price changes make it difficult for dairy farmers to justify investment in new management practices and technology. However, the trend identified above towards greater specification of milk components means that continued investment will be essential to maintain margins and productivity.

45. The current EU quota system which maintains milk prices at an artificially high level (although liquid milk is still relatively unprofitable) does not give an incentive for innovation.

Processing
46. Consumer acceptance of food products using new technologies either in production and processing will be as critical for this sector as for others.

47. The comparative weakness of the UK dairy processing machinery industry leads many processors to source their equipment from overseas. Such equipment may not be tailored to the particular requirements of the UK industry which has many speciality British products. Also, it is difficult to get technical developments by UK academic institutions taken up by these overseas companies unless their potential application is much wider than the UK market.

48. Finding uses for excess butterfat may be either an opportunity or a barrier to progress. At present, it is a major problem for processors which may be exacerbated as consumers move further towards reduced fat products.

Conclusions And Recommendations

49. Representatives of dairy farmers, processors and retailers should together with public sector research sponsors and the Milk Development Council agree a strategy for medium to long-term science, engineering and technology needs to support the UK dairy sector, taking into account the industry needs and scientific opportunities identified in this report, and publicise its existence and content to the whole sector.

50. Industry will need to increase its production and processing efficiency if it is to compete in future markets.

51. Priority topics for continued or enhanced strategic research to underpin the sector in the future include:

- the relationships between ruminant nutrition and feed composition relating to milk production and composition;
- the genetics of cattle and the identification and use of molecular markers for quantitative traits conferring production, health or welfare benefits;
- the improvement of the efficiency of techniques to aid successful, targeted reproduction in dairy cattle;
- human nutrition in relation to the dietary properties of milk ingredients with known or potential beneficial properties;
- separation techniques to allow more precise fractionation of a wide range of milk components;
- the development of biotechnological processing aids to improve the efficiency of manufacturing processes and the quality of the final product;
- processing techniques for maintaining the safety of dairy products while retaining organoleptic properties;
- smart packaging to indicate the status of its contents;
- the use of bio- and physical sensors, spectroscopic and microscopic techniques and chemometrics to improve process control in the dairy sector;

52. Industry should support, through the United Kingdom Dairy Association, the International Dairy Federation which acts as an international information exchange.

53. Initiatives such as consensus conferences to inform and involve the public in debates about the use of new technologies should include examples from the dairy sector.

54. More effort should be put into publicising the health benefits of milk in the human diet.

Consultation
55. This report has already benefited from discussions at a workshop of industry and academic representatives and from comments from a range of organizations.

Appendix - Scenarios

The sub-group and a workshop held to consult further industry and academic representatives considered two scenarios to help in prioritizing the many influences on and needs of the sector in the future. These were not designed necessarily to be realistic but were used as an aid to lateral thinking and discussion.

Milk quotas are removed

In this scenario, EU quotas are removed affecting all Member States. Initially production increases throughout the EU and surpluses within individual Members are exported. UK industry remains competitive by having high production and processing efficiency.

To underpin this high efficiency, research needs would include livestock genetics and nutritional physiology and for processing, separation of milk components (including membrane technologies) and by-product utilisation.

Quotas are reduced

In this scenario, all EU quotas are significantly reduced. Both producers and processors would need to increase their margins to maintain profitability with reduced supply of raw materials and the research needs would be similar to those in the previous scenario.

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