

RURAL ECONOMY

Consumers, Public Perceptions and Biotechnology

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Introduction

This paper views the social landscape of biotechnology from the perspective of emerging perceptions and attitudes of consumers to food biotechnology. The information from which consumers' perceptions and attitudes may be discerned comes in several different forms. These include market responses to food biotechnology. Media attention paid to this issue is a second source of information. The attention that is directed toward policy processes and regulatory institutions for food biotechnology, as this is translated through the political system into policy, is another expression of consumers' attitudes. Information from publicly-reported opinion polls and studies of social scientists of attitudes to biotechnology also provides insight on consumers' perceptions. More emphasis is directed at the last two of these expressions of attitudes to food biotechnology in this paper, since at this point of time they are the most readily assessed of the various manifestations.

Each of the four focal viewpoints of market reactions, media attention, policy processes, and polls and related studies indicates that levels of public and consumer awareness of food biotechnology are increasing. The differences that are seen in the regulation of agricultural biotechnology in different regions of the world suggest that attitudes of different groups of people to biotechnology vary greatly and this is confirmed by opinion polls and related studies. The level of concern about agricultural biotechnology seems to be increasing as public awareness of this new technology increases. Background to this paper is provided through the following overview of divergences in attitudes to food biotechnology. Subsequent discussions move to expressions of increased consumer interest in food biotechnology, differences in approaches to regulation of food biotechnology, the broad features of recent major opinion polls and some studies of consumers' attitudes. The final section of the paper summarises major features of the discussion and suggests some conclusions.

Background

There has been increasing consumer awareness of biotechnology during the last decade, reflecting the considerable growth in the scope and use of biotechnological procedures and products that has occurred during this period. Research and applications of genetic modification (GM) have followed two main paths---agricultural applications, directed primarily at crops to this point, and medical applications, directed mainly at problems of human health¹. A third area of biotechnology involves industrial and environmental

¹ Biotechnology research with agricultural applications has focused on crops (such as corn, soybeans, canola), other plants used for human food (some fruits and vegetables), or for other human uses, such as tobacco (virus-resistant tobacco has been a significant crop in China), animal feed, and fibre (cotton). GM microbial applications have been developed to produce the enzyme chymosin that is used in cheese production. Other microbial GM treatments for food and feed processing uses have included vitamin production (OECD, 2000c). A cross-over area of agricultural and human biotechnology relates to the use of biotechnology in the development of animal health and illness treatments, as with vaccines directed at problems of animal health and feed amendments or supplements. Animal biotechnology includes the biotechnological production and use in some, but not all, countries of otherwise naturally occurring growth hormones, such as rBST (Figure 1). Most agriculture and food GM applications to this point have been with plants and microbes; potential future uses of food/agricultural biotechnology are expected to be directed at fish (salmon) and, at a point even further in the future, may involve animals.

applications that focus, for example, on biological treatment of water and sewage, using genetically modified bacteria.²

Much of the recent public debate about biotechnology has been directed at its use in food through agricultural applications. As pointed out in a recent report on agriculture by the Organisation for Economic Cooperation and Development, modern biotechnology has been associated with agriculture for more than 15 years but has only been a major “talking point” since recent large scale introduction of genetically modified (GM) crops. GM crops were planted on an appreciable scale in 1996 and the level of their planting increased rapidly through the balance of the 1990’s (OECD, 2000a).

The largest area of GM crop plantings, by far, has been in the United States. Planting of GM crop varieties in Argentina, Canada, China and Australia have also been significant (OECD, 2000a,d; Europa, 2000a). In addition to agricultural GM, focus on human medical applications of biotechnology has also greatly increased, as seen in the search for commercial diagnostic and therapeutic products, developed with the aid of molecular biology, that has flourished during much the same time period (Caulfield, 1998).

The potential of benefits to consumers of agricultural biotechnology to this point has been viewed mainly to arise indirectly, through the modification of plant “input” traits that have increased crop yields and lowered inputs of agricultural chemicals, from currently licensed genetically-modified crop varieties which are herbicide or insect resistant (See Figure 1 for the definitions of these and related terms used by the Organisation for Economic Cooperation and Development)³. For a future “second generation” of genetically modified crops, the potential for introduction or intensification of plant “output” traits that are desired by customers is anticipated by crop scientists and others associated with agricultural biotechnology. Examples are “nutritionally dense” crops, vegetable oils with compositional qualities believed to have particular health benefits, coloured cotton that would not need dying, and a variety of “functional foods.” GM plants with “value-enhanced” output traits that had already been licensed for use in the US by May 1999 included rapeseed with high-lauric-acid oil, soybean with high-oleic acid oil, and a carnation variety with altered flower colour (USDA, 2001).

Agricultural biotechnology is largely being developed in the private sector, for commercial crops. Pursuit of potential future benefits from improvements in crop yields and human nutritional components that are targeted to farmers and consumers in low income countries is not the priority of the North American and European “life-science” and “agro-chemical” firms that have developed and marketed GM seeds. Enhanced food security and nutritional quality are, however, priorities for international public plant breeding through the international agricultural research centres that focus on agricultural research directed to the

² German firms are cited to lead in environmental biotechnology, accounting for 26 % of international patent applications (DFAIT, 2001).

³ The complexity of biotechnology is reflected in the fact that although national regulatory agencies apply definitions of “genetic modification” and “genetic engineering” that are embodied in Figure 1, this is not universally preferred. Some groups would prefer a broader definition of genetic modification that would include processes like accelerated mutagenesis that were introduced and applied in plant breeding prior to the development and use of modern molecular biological methods. A broader approach to identify genetically-modified crops is, for example, the approach favoured by the Consumers’ Association of Canada (CAC, 2000). The term “modern biotechnology” distinguishes GM processes based on molecular biology from earlier-developed processes of accelerated mutagenesis.

world's poorest nations.⁴ Two major issues for poor nations are potential benefits in food quality and food security from added nutritional qualities of basic crops such as rice, as through Vitamin A enhancement, and the prospect of drought or pest resistance for local crops, like yams, cassava and sweet potatoes (Serageldin, 1999; Falcon, 2000).

From the perspective of more critical views of agricultural biotechnology, the benefits to this point seem to have accrued largely to the large multinational firms that are major developers, suppliers and promoters of agricultural inputs and to farmers in the adopting regions. The process of very rapid adoption by farmers in applicable regions suggests they have had strong profitability expectations, based mainly on yield increases and /or cost savings, but studies suggest that GM crop outcomes may have been mixed for many farmers. Farmers' profits may have been variable and may have been more consistently evident for GM cotton than for some other crops; there have also been benefits of convenience to farmers in flexibility of field operations for herbicide-resistant crops (Europa, 2000a; OECD, 2000d; USDA, 2001).

Concerns have been expressed that agricultural biotechnology may be associated with health and environmental risks. The most evident expression of potential health risks for biotechnologically-derived foods is the possibility that allergens might be introduced into foods through biotechnological transfer of novel traits to GM plants. The other major focus of concern about agricultural biotechnology relates to possible environmental risks of genetically modified crops or other products, particularly the possibility of increased resistance to insects or other pests associated with insect-resistant crops, and to issues of possible gene escape or out-crossing that might, for example, add to problems of agricultural weediness, especially for herbicide-resistant crops. Broader concerns have also been expressed by some people that GM is unnatural or irreligious. These arguments are summarised by Comstock (2000).

Expressions of Increased Consumer Interest in Biotechnology

Consumer sovereignty and market power

Consumers' attitudes to food biotechnology are not only expressed indirectly, in the media, in polls, and in political reactions and decisions that lead to the formation of public policy and associated regulations. Consumers' attitudes are also expressed directly through the market forces of consumer sovereignty—the decisions that consumers make on whether or not to buy certain food products. Anticipation of these decisions, coupled with the concerns of retailers and processors to avoid the costs and adverse publicity of food scares and food safety problems, has provided a powerful expression of market reaction to agricultural biotechnology in some regions and for some products. Observers of global food markets have noted an increasing concern with issues of food safety (Veeman, 1999). Pursuing, and being seen to be pursuing, a high level of emphasis on food safety has become a necessary marketing strategy for food processors and retailers.

⁴ The Consultative Group on International Agriculture Research [CGIAR] operates a network of agricultural and related research institutes in poor nations, funded largely by international donors. The 16 Centres of the CGIAR maintain gene-banks to protect biodiversity of plant materials. The major purposes of the CGIAR centres are to adapt or develop agricultural research suited to the conditions and problems of farmers in poor nations.

Figure 1: Definitions of Agricultural Biotechnology

- **Biotechnology** is the application of cellular and molecular biology to diverse life processes and biological products.
- **Modern agricultural biotechnology** is the application of cellular and molecular biology to diverse agricultural production processes and products. One important aspect of this new agricultural biotechnology is in the breeding of new plant varieties as well as specialised micro-organisms through genetic modification (GM) or engineering.
- **Genetically modified organism – GMO** - refers to any plant, animal or micro-organism, or virus, which has been genetically engineered or modified.
- **Insect resistant - Bt crops** are engineered so as to contain a gene from the soil bacterium *Bacillus thuringiensis* that is specifically toxic to certain insect pests.
- **Herbicide resistant - HR-crops** are genetically engineered to resist high doses of specific herbicides.
- **Recombinant bovine somatotropin-rBST** is a genetically engineered version of a naturally occurring hormone, which stimulates milk production in cows.

Source: The five cited definitions for agricultural biotechnology are from OECD, 2000a.

Pressure against the introduction and retail sale of GM food, and against its use in livestock feed, has been the subject of organised campaigns led by Friends of the Earth, Greenpeace, RAFI and other non-government organisations (NGOs) since the mid-1990s. This campaign focused initially on supermarkets in the United Kingdom in 1996 and 1997. By 1998 several food retailers, including Iceland, Tesco, and Spar UK had followed the lead of Sainsbury's in initiating policies to restrict or label GM foods and publicised this in their advertising and product labeling. By 1998 numbers of UK-based food manufacturing companies had also announced policies to restrict the use of GM ingredients in their food products. These moves were subsequently adopted by a number of supermarkets in continental Europe, as with Carrefour (France) and Delhaize (Belgium) amongst others. Some European food companies have now developed affiliations directed to building "non-GM" supply chains (Greenpeace, 2000; Europa, 2000a). The campaign against retail sale of GM food has continued to be pursued by Greenpeace and Friends of the Earth, as through the concerted efforts in the UK to highlight food products and food processors that have not adopted non-GM policies (Greenpeace, 2000; FOE, 2000).

The movement to restrict retail sale of GM food and the use of GM animal feeds has not made inroads in North America, although some multinational food processors, including some that are based in North America, have adopted policies of "no GM food ingredients." Firms that now follow this policy include the foods division of Novartis (the parent company is headquartered in Switzerland) which is the manufacturer of Gerber baby food. Other major US major food manufacturers, such as H. J. Heinz Company, have also adopted the policy not to use GM foods in baby food. The Canadian-based company, McCain Foods,

has reversed its earlier policy favouring GM insect resistant potatoes to adopt a non-GM policy for its products. The Canadian-based distillery company, Seagram, is now following a policy of not using GM corn in its liquor.

Although the list of international food marketing companies that are following “no GM” strategies has increased over time, there does not currently seem to be a significant demand for “non-GM” foods in North America. The nature of labelling policies and marketing channels for genetically modified food in both Canada and the United States is evolving. The major form of food derived from agricultural biotechnology currently grown and distributed in Canada is canola oil, from licensed herbicide-resistant varieties of this oilseed crop. Protein in its meal byproduct, consumed mainly by livestock, is the focus of the genetic modification of canola, leading representatives of this industry to propose that the refined vegetable oil from the herbicide-resistant GM varieties of canola oil should not be classified as genetically modified.⁵

In the United States, a wider range of GM crops is grown and processed than in Canada, including GM soybeans, corn and cotton. More GM products are in the pipeline (USDA, 2001). Some of these are nearing application for licensing in both Canada and the United States, including herbicide-resistant wheat, which is currently opposed by the Canadian Wheat Board, and GM salmon, which has received very critical comment on environmental grounds by the Royal Society panel on food biotechnology (2001).

The negative market reactions to agricultural biotechnology that have been observed in Europe are impinging on the development and use of agricultural biotechnology in Canada. For example, a GM flaxseed variety was developed but not licensed in Canada, due to the concerns of adverse market consequences expressed by farmers’ organisations and exporters, since most Canadian flaxseed exports are to the European Union (EU).

Concern voiced in late 2000 and early 2001 by farmers’ groups in Canada, Australia and the United States about the proposed licensing of GM wheat is not an expression of concern by farmers with the food safety of these varieties but reflects the fear of loss of export markets due to potential adverse reactions to GM crops of customers and regulators in major importing markets. For wheat exporters like Canada, the fears of adverse market reactions extend beyond the EU (the EU, where consumer concerns about GM foods were apparently first centred, is not a net importer, but an exporter of wheat). Fears of adverse market reactions by customers for wheat are being extended to Japan, which is a premium wheat import market, where issues of food quality and safety are highly rated, and to a variety of other nations that are involved in world wheat trade (Manitoba Co-operator, 2000a). The CWB anticipates that introduction of GM wheat would necessitate costly systems of product segregation to ensure identity preservation of non-GM wheat, and argues that licensing should not occur until benefits to farmers are clearer (CWB, 2001).

A reasonable hypothesis seems to be that demand for “non-GM” foods in Canada may show a market trend similar to organic foods. Organic foods account for a relatively minor but increasing proportion of Canadians’ food consumption. The consumption of organic foods is also increasing in other countries. Despite the fact that interest in organic foods seems to be higher in Western Europe than in North America, organic foods only

⁵ This argument has been rejected by Canada’s national consumers group (CAC, 2000). However, the GM food labelling policy proposed in Australia and New Zealand will exempt from mandatory labelling, oils, starches and sugars where refining and processing remove any novel DNA or protein (Agra, 2000).

account for a very small proportion of food consumption in Europe. For example, organic food is estimated to be 2.5% of food consumption in Germany (Economist, 2001) and 1% in the United States (USDA, 2000b). Some two thirds of retail sales of organic food in the EU are through supermarkets (AAFC, 2000), which might suggest that this is becoming a more mainstream focus of food consumption. In North America also, organic foods are moving beyond the niche outlets of “health stores” to be sold in supermarkets. Although the organic segment of the market for food is very small in aggregate, this segment is forecast to increase appreciably in future, both in the EU and North America.

Media Attention

One reflection of increasing public interest directed at agricultural biotechnology is the considerable increase in the levels of media coverage directed at this issue during recent years. For example, Einsiedel (2000) noted a steady increase in the number of press articles about biotechnology in the Canadian national newspaper, the *Globe and Mail*, in the years from 1995 (70 stories) to 1999 (170 stories). One aspect of worldwide media coverage is associated with the effective campaigns directed at mobilisation of public opinion that have been directed at agricultural biotechnology by numbers of international NGOs since the mid-1990's. (Europa, 2000a). These have involved media campaigns, lawsuits and direct action. Much use has been made of the internet to set up discussion fora and databases and to organise petitions and lobbying actions. Various interests have been expressed by the groups involved in the movement to lobby against GM food, initially known as “The Pure Food Campaign,” later known as the “Campaign for Food Safety” and now called “The Real Food Campaign”; these included the protection of consumers, sustainable development, and ethical concerns relating to genetic research (Europa, 2000a; Greenpeace, 2000; FOE, 2000).

The process of “global mobilisation” of public opinion, focused largely in Western Europe, has continued since 1996. Activist groups have filed lawsuits, as against the US Environmental Protection Agency in 1997 relative to the licensing and use of GM insect resistant crop varieties, and the 1998 suit challenging the US Food and Drug Administration's review and labelling provisions for food biotechnology. The suit against the EPA was dismissed by the US Federal Court in 2000, as was the lawsuit challenging the FDA (BIO, 2000). Activist groups also proceeded in 1999 to engage in legal action against major biotechnology companies, alleging monopolistic practices; numbers of other actions have involved petitions and demonstrations (Europa, 2000a). Instances of low-level “contamination” of imported seed with traces of GM varieties that had been licensed in North America, but not in the EU, also sparked demonstrations by environmental groups and have added to media attention (Agra, 2000).

In the United States—and in Canada—counter-organisation groups have emerged with the mission of providing information to counteract information on agricultural biotechnology that is viewed to be incomplete or incorrect. These groups, which tend to represent scientists, industry and farmers, have also commissioned occasional reports (see for example the report of KPMG (2000) on potential costs of mandatory food labelling), as well as distributing information through web-sites and newsletters. Other counter-activities have included lobbying for more research funding for biotechnology by scientists (both in Canada and the United States) and a US campaign, initiated in October 1999 as the “Betterfood

Campaign”, supported by the Grocery Manufacturers of America, the American Farm Bureau, and some 30 US food companies (Europa, 2000a)

Despite the influence of the organised campaign against agricultural biotechnology in numbers of European countries, it would be a considerable overstatement to conclude that opposition to particular features of biotechnology comes only from extremist organisations. Intense opposition from a broadly-based range of NGO’s and civil groups, including the Consultative Group for International Agricultural Research and numbers of farmers’ groups and civil groups, drove Monsanto to its 1999 decision not to pursue the “terminator gene technology” that would render seed sterile⁶. The decision not to approve the use of the milk-stimulating hormone, rBST, for dairy cows in Canada, as in numbers of other countries, reflects the fact that issues of animal welfare can be an important social consideration, as can the fear of adverse reactions of consumers (Kuperis et al, 1999). The activist campaign against GM foods seem to have influenced some European food retailers and processors not to use GM ingredients. Concern or opposition to GM food is expressed by numbers of people in Europe, including such opinion leaders in the United Kingdom as Britain’s Prince Charles and the British Medical Association (Europa, 2000a).

The disrupted Seattle meeting of the World Trade Organisation in December 1999, and subsequent high profile international meetings of governments and related world organisations, have also been focal points for demonstrations against globalisation that have successfully sought media attention. These demonstrations have included expressions of opposition to agricultural biotechnology, expressed primarily, but not solely on environmental grounds. Hobbs and Plunkett (1999) note that GM food has become somewhat of a lightning rod for a coalition of different interest groups in Europe. In North America a coalition of disparate interest groups has emerged that reflects various concerns about globalisation, which includes focus on environmental fears attributed to GM food.

Public Polls and Research Studies

Increasing political and press awareness of biotechnology as a focus of public interest is also expressed in the monitoring of people’s perceptions of issues associated with biotechnology. This has occurred in recent years through a series of well-organised surveys of public opinions, mainly in Western Europe and North America. As well, a number of assessments of attitudes and behaviour of people to some issues of biotechnology have been conducted by sociologists, economists, and communication specialists. These various sources of information are helpful in giving insight into consumers’ perceptions of biotechnology. Several of these studies are called on throughout this paper. A more extensive discussion of the information from some major polls is given in a later section.

Public Policy Processes

A major focus of public concern, and the recognition of this by politicians and bureaucrats, relates to the heightened level of interest expressed in public policies and procedures

⁶ The approval of this joint patent, between Delta & Pine Land company and the USDA, for Technology Protection System or TPS, was intended to prevent seed-saving and subsequent unauthorised use by farmers of patented gene technologies (USDA, 2001). As reflected by CGIAR rejection and the legislative ban, in 2000, on TPS in India, the plan for TPS technology antagonised many groups and created fear among others.

relating to biotechnology. One emphasis of public attention toward biotechnology is directed at encouragement of industrial growth associated with powerful new technologies. To this end the Government of Canada announced a “biotechnology strategy” as early as 1983; renewal of this strategy was subsequently highlighted in 1997 (CBAC, 2000). In turn, a variety of interest groups and NGOs have expressed interest and concerns relating to the regulatory processes involved in the testing of biotechnology-derived products, the assessment and approval procedures for these, their commercial development and use, and the existence and nature of any subsequent monitoring for unintended effects. Most of these discussions have been directed at agricultural biotechnology.

A search for an internationally acceptable approach to the assessment of the safety of foods from plants with novel traits, that is, from plants with characteristics that have been introduced through biotechnology, started in the 1980’s. In the early 1990’s the Food and Agricultural Organisation (FAO), the World Health Organisation (WHO) and the OECD developed the concept of “substantial equivalence” for GM food when the “new food” is substantially equivalent to analogous “traditional foods” (OECD, 2000bc). In the regulatory process for approval of foods from biotechnological processes in Canada, as in numbers of other countries, the finding of substantial equivalence has been an important element in the process of risk assessment. Less testing and a higher likelihood of licensing approval applies for GM foods that are considered substantially equivalent to traditional foods. However, numbers of countries are now emphasising “precautionary approaches” to issues of food safety, although the precise interpretation of this, as with the concept of substantial equivalence, may be open to interpretation.

The differing interpretations and approaches that apply for GM foods are seen in the search for international consensus on principles to guide the labelling of GM food. This has been sought through the Codex Alimentarius Commission and its committee on food labelling, which operates within the food standards program of FAO and WHO. While there is consensus in this committee on the principles for labelling declarations when GM foods have compositional changes or allergen potential, consensus on other features of labelling GM/GE food had not been achieved through the Codex process by early 2001. Thus the “step 3” discussion draft text of recommendations for the labelling of GM foods, distributed by the Codex committee in February 2001, continued to highlight alternate forms of wording for foods or food ingredients that are the product of GM/GE techniques⁷ (Codex, 2001).

The governmentally-requested panel established by the Royal Society of Canada (2001) on agricultural biotechnology advises dependence on a “precautionary approach” to assess food biotechnology, an approach related to the “precautionary principle.” This reflects the desire of some consumer and environmental groups to place particular emphasis on avoiding possible injury where there may be a lack of evidence, and thus some uncertainty, of possible long-term effects of biotechnology. A precautionary approach is written into the statements of food safety policy of many countries (OECD, 2000e,f) and this concept is also embodied in some international agreements. The precautionary approach is included, for example, in the agreement of signatories to the World Trade Agreement on sanitary and phytosanitary standards for trade in livestock and crops, which provides for qualified provisional application of this approach, pending the development of more objective

⁷ This draft incorporates alternative wording of “no longer equivalent to/differ substantially from” for “GM/GE” foods (Codex, 2001).

measurements of risks. A precautionary approach to “genetically modified life forms” is also embedded in the Cartagena Protocol on Biosafety; like other international agreements, to be effective this requires ratification by the world’s major nations). However, there is little general agreement or generally accepted definition of the standards that would be involved in applying the precautionary principle in this context.

Some groups have argued for a very broad application of the concept of precautionary principle (OECD, 2000b). Other groups, like the expert panel of the Royal Society of Canada (2001), see a precautionary approach as not necessarily inconsistent with the approach of substantial equivalence. This panel advocated more transparency, research and arms length review of the application of the concept of substantial equivalence in Canada’s regulatory system for food to assure that regulatory screening and assessment is applied in a precautionary manner.

The considerable room for debate in approach, definitional process and regulatory procedures for GM products has led to numbers of international efforts to seek consensus on concepts, standards and criteria relating to genetically modified food and more common ground in the ways these are applied in practice. The recent OECD report on the safety of novel foods and feeds notes the possibility that food safety concerns may increase with the “next generation” of agricultural biotechnology, since changes in output traits are expected to give products that are less likely to be substantially equivalent to traditional foods. Thus continuing reviews are recommended (OECD 2000c).⁸ The Codex intergovernmental task force on foods derived from biotechnology and the recent OECD task force on novel foods and feeds are only two of the bodies that have been the focus of recent international discussions on these issues (OECD, 2000ba,c). Discussions in a variety of intergovernmental working parties and committees that seek consensus on the standards and criteria for GM foods can be expected to continue.

One focus of public discussion about regulatory procedures concerns the role of the public in the process of regulatory review of biotechnology. There has been growing interest in issues of food safety in Canada, and in numbers of other nations, in recent years (Veeman, 1999). Agencies like the Canadian Food Inspection Agency (CFIA) are tending to place more emphasis on public communication, through their web-site, consultation processes and reporting, than was the case in earlier years. Recognition within the federal government of the need for more external assessment and public participation in the regulatory processes for food biotechnology is seen in several recent initiatives. These include the November 2000 invitation from Health Canada, CFIA, and Environment Canada to the Royal Society of Canada to commission an expert panel to provide advice relative to new food products developed through biotechnology. A further federal initiative in 1999 to seek public input was through the establishment of a government-appointed Canadian Biotechnology Advisory Committee. The purpose stated for this committee is to advise legislators on broad issues of public policy, such as the patenting of various life forms, through consultation with experts

⁸Continuing efforts in the search for international consensus on standards and procedures for GM food assessment is also one of several recommendations by the Chair of the recent OECD Conference on the Scientific and Health Aspects of Genetically Modified Foods, hosted by the Government of the United Kingdom, that was held in Edinburgh in 2000. That conference was one component of a program of assessment of biotechnology and other aspects of food safety that is being undertaken by the OECD at the invitation of heads of state and members of government of the “Group of Eight” large nations.

and members of the public. A process of public consultation on food biotechnology is being pursued through this agency in 2001 (CBAC, 2000).

A related focus of public discussion about biotechnology regulation is the public availability of information about the assessment and decision-making for licensing agricultural biotechnology. There are issues of proprietary information where patenting of biotechnology is involved. As well, firms are generally reluctant to have information released that may be informative to their competitors. Even so, there has been wide recognition of a need for more transparency involving public scrutiny, involvement and reporting of regulatory policy for food. This theme has been seen in a variety of arms-length reports to governments, including the recent report of the Royal Society of Canada panel on agricultural biotechnology, which has also argued for more provision of public funding of research to assess and measure possible impacts of agricultural biotechnology (Royal Society, 2001).

Other focal points of public discussion about regulatory policy have included how information policies for consumers relating to agricultural biotechnology may best be provided, whether through food-labelling regulations, or by other means (like point of sale information, toll-free phone lines, or web-information) of providing information on food content, ingredients and process. This ongoing debate includes whether there should be mandatory labelling of GM foods and ingredients, as versus providing for voluntary labelling. Related issues of labelling include the appropriate tolerance levels of genetically modified ingredients, in processed or prepared foods, that would be associated with labelling or other information statements about the content—or absence--of GM ingredients⁹. Associated with this is the need to avoid misleading or fraudulent labelling statements. Consequently it is necessary to develop procedures by which informational statements on labels may be verified. Typically these involve methods of “identity preservation” based on product segregation, with associated procedures for monitoring and certification.

The variety of different national reports of government-commissioned or arms-length consultations on GM foods, and the differences in the resulting political decisions to follow particular regulatory policies, provide one means of assessing the nature of consumers’ perceptions of food biotechnology. The differences in these policies in different nations suggest that there are appreciable national differences in consumers’ perceptions and attitudes to agricultural biotechnology. There have been fairly recent regulatory decisions in numbers of countries that will provide for mandatory labeling of genetically modified foods, in regions as diverse as the European Union, Switzerland, Japan, South Korea, Australia and New Zealand (OECD, 2000a,d). Although mandatory labeling of food derived from agricultural biotechnology has been advocated by some groups in North America, this is not expected to occur in the United States (USDA, 2000).

A policy of providing for voluntary rather than mandatory GM labelling has been proposed by Canada’s federal government. However, a private member’s bill that would amend the Food and Drugs Act to provide mandatory labelling for GM foods (Bill C-278) was tabled for first reading in the Parliament of Canada in early 2001. In April 2001, the Government of British Columbia also proposed, for first reading, an “exposure bill” (Bill18-

⁹ In practice a de minimus or tolerance level, ie a criterion to specify the absence of a particular component or ingredient, needs to be defined since an absolute definition of “zero-content” is infeasible to achieve or guarantee. The tolerance level of 2% GM content of foods for a claim of absence of GM content was originally discussed for use in the EU, but this threshold limit has subsequently been specified as 1%.

2001), directed at eliciting public discussion, which outlines provincial-level legislation for mandatory labelling of GM foods sold within that province (BC Gov., 2001). Legislative proposals for mandatory labelling have also been made, but not approved, in the United States.

Approaches to Regulation of Agricultural Biotechnology and Associated Attitudes

Overview

The long-standing view of consumers' interests in food safety and the associated process of regulation of agricultural biotechnology in North America has placed most focus on characteristics of food products, rather than the processes by which products have been developed. The approach to food regulation in Europe has tended to place more focus on process than in North America. This difference is also seen in labelling regulations. Increasingly labelling in the EU includes statements on how food products are produced or made (for example, free-range fowl and eggs) and identification of regions where they are grown or produced. Many of these are voluntary labelling statements. Mandatory labelling of foods derived from modern agricultural biotechnology was adopted in the EU in 1998.

In North America, regulatory focus has tended to be placed on the product and whether this is appreciably changed by biotechnology, rather than on whether or not the process of biotechnology has been used in production or processing of food ingredients. Consequently, in North America, labelling of GM foods is only necessary if there are health or safety concerns (as from allergens) or significant compositional or nutritional changes in food from GM processes. The difference in the approaches to GM foods in Europe and North America has been suggested to represent a more "demand oriented approach" that focuses on consumer and social concerns and preferences in Europe and a more "supply oriented approach" in North America that focuses on supply efficiency (Haniotis, 2001). This characterisation is too simple to provide a full explanation of the differences in approach.

Differences in regulatory procedures and in activist environmental groups in Europe, versus the United States have been commented on as expressions of deep-lying cultural differences between these regions (Zechendorf, 1998). Differences in approaches to regulation and differences in the institutions and organisations that are associated with regulation tend to become entrenched over time; in effect, they reflect local history, culture and traditions. These characteristics, and the distinct differences in trust in government and its regulatory system in North America, as versus Western Europe, also seem to be important influences on the different approaches to food safety and to food biotechnology in these different regions.

Some dozen GM crop varieties, including four corn varieties and one soybean variety, had been approved for use in the European Union (EU) by 1998 (Goodloe, 1999). However the higher level of sensitivity to food biotechnology by consumers and environmental groups in Western Europe, and the numbers of protests and demonstrations, especially in the United Kingdom and France, led to a de facto moratorium of EU approval processes for GM foods from 1999. By 2000, some 14 applications for GM licensing were reported to be pending (Agra, 2000). A particularly high level of concern and a high level of activism by environmental groups directed at food biotechnology has been seen in the United Kingdom. GM crop production has not been approved. Small GM crop trials to assess pollen drift and

weediness led to highly publicised demonstrations by Greenpeace activists and incidents where these GM plots were trashed by anonymous activists (Zechendorf, 1998; Myers, 2001). Greenpeace activists were charged with theft and damage for the 1999 destruction and removal of GM plants from trial plots; the jury that heard this case acquitted these individuals of the theft charge and failed to reach a verdict on the charge of damage (Greenpeace, 2000). In early 2001, the European Parliament approved proposals to tighten the use of GM foods that may pave the way for the moratorium on licensing to be lifted. The EU rules would require mandatory labelling and monitoring of GM foods, feeds, seeds and pharmaceuticals (OECD, 2000e; Europa, 2000a; Agra, 2000; CBC, 2001).

Increased levels of interest and concern about food biotechnology have led to various types of consultations by the food regulatory bodies in both Canada and the United States. Mandatory process-based labelling of GM foods has been discussed but not introduced in either nation. In recognising the increasing level of public interest in labelling of GM foods, Canadian food safety regulators moved to provide for a policy of voluntary labelling related to GM foods. This is also the policy toward labelling of GM foods in the United States. Efforts to develop a consultative process to establish guidelines for voluntary GM labelling have been pursued through consultative discussions of the Canadian General Standards Board (CGSB) that have involved the Canadian Council of Grocery Distributors and numbers of other stakeholder and interest groups. Meetings of CGSB on voluntary labelling began in 1999 and proceeded throughout 2000. Consensus on a code of practice for GM labelling had not been achieved by early 2001. One issue of dispute related to the definition of GM (National Dairy Council, 2001).

Dispute about the definition of GM reflects fears by producers and the food industry that potential statements of “contains GM ingredients”¹⁰ may raise a red flag suggestive of impaired food safety. This is, for example, reported from a 1999 study, based on focus group assessments, conducted by the National Institute of Nutrition (NIN, 1999). Assessments of unexplained phrases “genetically modified” or “biotechnology” usually prompted a defensive reaction. The term “genetically modified” was associated with chemicals or additives and as something to avoid (NIN, 1999). The term “genetically engineered” also seems to elicit negative connotations.¹¹

A major issue that arises from the interpretations of possible GM labelling declarations relates to the different approaches involved in mandatory versus voluntary labelling of GM foods. Underlying this is the balancing of the consumer’s “right to know” versus concerns that consumers not be misinformed or misled (described by some as the consumer’s “need to know”). As noted above, this issue hinges largely on concerns that in view of longstanding policy on labelling, consumers will anticipate that they are being warned of appreciable food safety consequences by label declarations such as “contains GM

¹⁰ Many consumers groups are very critical about label statements “may contain...”. These are viewed as inadequate and informative or reflective of incompetence by the manufacturer (CAC, 2000; Loader and Hensen, 1998; NIN, 1999)

¹¹ The descriptor “biotechnology” may not be as unfavourably viewed as the term “genetically modified” since “biotechnology” may imply the application of science, rather than implying gene manipulation, which is viewed as unnatural (NIN, 1999). It is of interest that the market intelligence firm Nielson tracked 5 products containing soy labelled as “produced using modern biotechnology” for 10 weeks in 1997 in the Netherlands and found no difference in market shares for these labelled products (Marshall, 1998). The term “genetically engineered” may be viewed in a more negative manner.

ingredients”. Thus, producers and processors of foods with GM ingredients, and most government agencies associated with food regulation in North America, do not favour mandatory labelling, despite the feature that opinion polls that ask the question: “should GM foods be labelled?” typically obtain positive responses. In contrast, producers and processors of foods with ingredients that are not classified as GM appear to anticipate a possible competitive advantage from being able to label their foods as “contains no GM ingredients”.

Negative labelling claims are expected to adhere to protocols intended to reduce misleading inferences of reduced food safety from the claim. In early 2001, these protocols were still to be established in Canada, where the process of developing principles to guide GM food labelling had not yet reached consensus. The conventional wisdom that GM labelling may cause adverse reactions by consumers has, however, been queried on the basis that lack of familiarity is a source of public fear of harm. It may be that more familiarity, as through labelling, may reduce fear (Chess, 1998). It is of interest that mandatory labelling has been introduced in both Canada and the United States for food that has been irradiated (Royal Society, 2001) which represents a precedent for mandatory process-based food labelling in both these countries.

Regulatory procedures for food safety in Canada

The legislative basis for regulation of food risks and the application of procedures directed at food safety involves the overlapping authority and actions of federal, provincial and municipal governments. At each level, this involves more than one agency/government department. Even so, Canada is one of a number of countries that have moved towards a centralised federal-level food inspection agency, the Canadian Food Inspection Agency (CFIA), as a means to streamline the process of food inspection (USGAO, 1999). CFIA focuses on the federal-level inspection activities associated with food safety. Health Canada is mandated to set the regulatory standards which CFIA is charged with enforcing. Health Canada also is mandated to assess CFIA activities; however, CFIA reports through the Ministry of Agriculture. Since 1997, CFIA has brought together food inspection services previously provided through four federal government departments (Agriculture and Agri-Food Canada, Fisheries and Oceans Canada, Health Canada and Industry Canada) to consolidate delivery of federal food, animal and plant health inspection programs (CFIA, 1999).

The division of responsibilities between Health Canada and CFIA also applies to the regulation of food labelling. Health Canada is responsible for labelling of health, safety, nutrition and composition changes. CFIA is responsible for general food labelling requirements, setting policy to prevent false and misleading labelling, and enforcement and compliance monitoring.

Canada’s auditor-general assessed in 1999 that CFIA reporting is such that it is difficult to determine how well this agency is doing its job (CFIA, 1999, annex), suggesting a need for more transparency in operations and more emphasis on reporting. The assessment for 2000 of CFIA by the auditor-general lists several areas where more effort is viewed as necessary to meet performance expectations. This assessment is that CFIA needs to: relate levels of inspection to risks; assess related areas of food risks in the non-federally-registered sector of the food industry; collate and report on food borne illness and pathogen prevalence;

and meet targets for performance reporting (Auditor-General, 2001). In general, however, there has been little public criticism of this agency.

Many aspects of regulation of food risks, including the approval processes for foods derived from biotechnology, are responsibilities shared by Health Canada and CFIA. Health Canada is responsible for assessing all new foods, including those derived from biotechnology, while CFIA has responsibility to perform environmental safety assessments on all agricultural products, including biotechnology-based products (CFIA, 1999). If the recommendations of the recent Royal Society panel report on agricultural biotechnology were to be followed, this process would provide more publicly-available information and be subject to independent review (Royal Society, 2001).

Consumers' Attitudes to Biotechnology : What do Recent Public Polls and Studies Tell Us?

Attitudes toward food biotechnology in the United States and Europe are highlighted by a number of recent surveys of public opinion. Public opinions on a variety of social issues have been probed in the EU since 1973 through periodic government-sponsored polls that provide the basis for cross-national comparisons of attitudes within the EU. Four of the Eurobarometer polls have probed attitudes to biotechnology. These were conducted in 1991, 1993, 1996 and most recently, in late 1999 (Europa, 2000b). Public opinions of biotechnology in the United States and Canada have also been surveyed using a number of comparable questions to the Eurobarometer poll. The results for Canada, for both 1997 and 2000, are reported by Einsiedel (1997; 2000). Comparisons of some results of the Eurobarometer and the comparable US poll have been summarised by Gaskell et al (1999). Public opinions and attitudes to biotechnology in the United States and for some other nations have also been reported by Hoban (1998). Numerous other assessments of public opinion have also been undertaken. These include a recent assessment of US opinions in a Gallup poll conducted in October 1999 and polls by Environics which probe attitudes to GM in a number of countries.

Despite the fact that many consumers report a lack of knowledge of biotechnology, there seems to be consistency in perceptions of the relative importance of different issues of food safety in numbers of different countries. Thus, Hoban reports that US respondents to Food Market Institute surveys ranked microbial contamination and pesticides to be the most severe of a number of food safety risks. Relatively few Americans (fewer than one in five) saw biotechnology as a serious food safety risk. A similar pattern of responses was reported for Europe (Hoban, 1998). This type of pattern in assessment of relative health risks is also seen in Canada. Surveys of Alberta consumers conducted in 1995 and 1999, in which people were asked to rank specified health risk factors, led to the highest rankings being given to dietary fat and cholesterol, followed by bacteria in food, then pesticides. Specified forms of agricultural biotechnology and food additives were ranked lower by most respondents in these two studies (Kuperis et al, 1996; McCann et al, 2001).

Contrasting opinions and attitudes to agricultural biotechnology in North America, as versus in Europe, have been stressed by some assessments, which have typified European attitudes to be very critical of GM and sceptical of its benefits, in contrast to more favourable or indifferent attitudes to biotechnology in the United States and Canada. There is appreciably less support for food biotechnology in Europe than in the United States

However, the typification of sharply different European and American attitudes to GM needs some qualification (Europa, 2000a). In particular, there are sharp differences in some attitudes to biotechnology within Europe (Hoban, 1998; Zechdorf, 1998; Joly and Lemarie, 1998; Gaskell et al, 1999). While attitudes vary somewhat according to the particular applications of biotechnology, relatively more favourable views to some applications tend to be shown in Spain, Portugal and Finland, according to the latest Eurobarometer report, while much more negative assessments tend to be seen in Greece and Austria (Europa, 2000b; Gaskell, 1999). Generally there is a more favourable response to medical applications of biotechnology and a less favourable response to food biotechnology or crop biotechnology (both these terms are used, separately, in the Eurobarometer poll). The Eurobarometer responses suggest a less favourable reaction to the use of modern biotechnology in the production of food than to its use in crops. The wording of questions matters in this context and perhaps the concept of GM use in food, rather than crops, seems more likely to be imposed or involuntary, as well as being more immediate to many people.

Hoban (1998) notes that in the three years, 1992, 1994 and 1998, some 70 percent of American respondents to telephone surveys were positively disposed to plant biotechnology. While the level of knowledge of biotechnology is not high, the evidence from repeated polls, such as reported by Hoban and from the Eurobarometer polls, indicate that over time, more people report that they have heard about or know something about biotechnology. This also appears to be the case in Canada and in numbers of other countries. Canadians are increasingly aware of biotechnology, but their images of biotechnology have been described as nebulous (Einsiedel, 1997). The fact that many Canadians lack precise knowledge of food biotechnology is confirmed by the reports of focus group assessments, such as reported by Sheehy et al (1998) and the National Institute of Nutrition (NIN, 1999). Increasingly, however, more Canadians and more Americans report some knowledge of biotechnology. Even so, in the US assessment in late 1999 by Gallup, only 10 % of the Gallup respondents stated that they had heard “a great deal about” genetically modified foods. A bare majority (51%) of respondents to the 1999 US Gallup poll said they supported the use of biotechnology in food production (Gallup, 1999).

Some of the discrepancy between the results of US public support for food biotechnology reported by Hoban and Gallup may reflect differences in questioning, as in the wording of “food biotechnology” (Gallup) rather than “agricultural biotechnology” (Hoban). However, it seems that public support for food biotechnology may have slipped somewhat in the US in 1999. This seems to be the case also in Europe, where the proportion of people who responded positively to questions on crop and food biotechnology was lower in 1999 than in 1996 (Europa, 2000b). Einsiedel (2000) also observes a perceptible shift towards less acceptance overall of biotechnology applications in the Canada-wide surveys that were conducted in 1997 and 1999. An increase in public caution about agricultural biotechnology is also suggested by a more recent public opinion poll in Canada by Pollara (2000).

In contrast to the responses reported by Gallup for the United States, which reported that a slight majority of Americans favour food biotechnology, the Eurobarometer 1999 survey for biotechnology, indicated that only 31 percent of surveyed Europeans believe that food biotechnology should be encouraged, while 37 percent viewed food biotechnology to be morally acceptable. Some 43 % of surveyed Europeans considered food biotechnology to be useful (Europa, 2000b; OECD 2000d). The comparable 1999 poll of Canadians reported by

Einsiedel (2000) suggests that 49 percent of Canadians favour the encouragement of food biotechnology; 57 percent consider food biotechnology to be useful; while 55 percent consider it to be morally acceptable. [In each case, following the pattern for Europeans, somewhat higher percentages of people favour the encouragement of plant biotechnology for pest resistance and consider this to be useful than is the case for responses to these issues for food biotechnology; the associated percentages favouring this form of crop biotechnology are 61%; 72%; and 55% (Einsiedel, 2000)].

Information from the comparable US survey, reported by Gaskell et al. (1999) shows a similar pattern to Canada, relative to Europe. Public support is considerably higher in the US than in Europe for food and crop biotechnology. Overall, although the reaction of the public to agricultural biotechnology seems to have become somewhat more wary over time, this is still viewed much more positively in the United States than in most European countries---and it seems that this is also the case in Canada. However, it may be that Canadians are somewhat more wary of GM food than in the US. A 1999 Environics International opinion poll asked respondents in five nations “how concerned are you about genetically engineered foods or biotechnology?” The reply of “very concerned” was given by 47 percent of the German respondents; 37 percent of Canadians; 28 percent of Americans; and 23 percent of the Chinese respondents. However, the proportion of those who responded that they were either “very concerned” or “concerned” was virtually the same for both Canadian and American respondents, at 74 percent and 73 percent, respectively (Environics, 1999).

The potential benefits to individuals from biotechnology are expected to influence people’s approval of particular applications (Bredahl et al, 1998). Many US respondents to opinion surveys feel that they have benefited or will benefit from plant biotechnology and this is concluded to be a major element in peoples’ attitudes (Hoban, 1998). Perceived benefit is also considered to be the major reason for the higher levels of approval of medical biotechnology, especially for the development of medicines and vaccines and for genetic testing, relative to the lower levels of support for agricultural biotechnology that are reported in many nations. (Eurbarometer, 2000, Gaskell et al, 1999; Einsiedel, 2000). Focus group discussions in Canada reported by Sheehy et al (1998) also indicate that new technologies, like biotechnology, must provide clear product improvements or consumer benefits to be considered acceptable by many consumers. Even so, Einsiedel (2000) and Gaskell et al (1999) conclude that peoples’ assessments of the moral acceptability of particular biotechnology applications contributes to these attitudes.

There are indications in numbers of countries that animal biotechnology is less acceptable than crop biotechnology (Hoban, 1998; McCann, 2001). This may reflect that benefits of animal biotechnology are less clear to consumers, that issues of animal welfare are important, and that this type of biotechnology application seems more unnatural or less ethical than is the case for plant biotechnology. Animal cloning and xenotransplantation (cross-species transplantation) are the least acceptable of various biotechnology applications considered in the recent Eurobarometer and companion US and Canadian polls (Gaskell et al, 1999; Einsiedel, 2000).

One aspect of the public debate about biotechnology relates to the feature that those who oppose it seem to express stronger reactions than those who support it. This is, for example, discerned for Canadians’ responses to genetically modified foods by Einsiedel (2000), who found that those who see GM food to have negative impacts appear to be more

emphatic about their views than those who see more benefits and fewer risks from these foods. Scrutiny of the report of results from the 1999 Eurobarometer poll on biotechnology (Europa, 2000b) indicates a similar tendency for Europeans. To assess acceptability of animal cloning and GM food, the Eurobarometer poll specifies 13 statements to which people were asked to respond to a five-point rating, ranging from totally agreement with the statements, to totally disagreement. Examples of the statements are: “GM food will benefit many people;” “the risks of GM food are acceptable;” “if something went wrong with GM food it would be a global disaster;” and “the idea of GM food causes me great alarm.” As was observed by Einsiedel for Canada, the responses that reflect concern tend to express a stronger degree of alarm than the extent to which approval is indicated for those who are less concerned about GM food.

A similar difference in intensity that reflects stronger negative views, relative to those who express positive responses to biotechnology, was also discerned in the US Gallup poll (Gallup, 1999). As in all surveys of public policy issues, there is a question of whether such patterns of responses do in fact reflect differences in the intensity of respondents’ attitudes or whether this reflects a strategic bias whereby those people opposed to a change in existing circumstances emphasise or overstate their reactions in an attempt to influence policy outcomes

Another feature of interest from the Gallup poll is that those who reported having heard a great deal of information about biotechnology tended to be most supportive of this technology. This has also been observed in a number of other polls and studies, as has the feature that more opposition tends to come from those with lower incomes and lower levels of education. The tendency for women to express a higher level of concern with issues that may be associated with food safety is also seen in numbers of these polls and associated studies (Hoban, 1998; Europa, 2000b; Einsiedel, 2000; Gallup, 1999; Kuperis et al, 1996, 1999, McCann et al, 2001).

Several of the polls noted above have queried perceptions of risk for GM foods. Some 58 percent of responding Canadians agreed, in early 2000, that there are risks in using food biotechnology; 49 percent of respondents agreed that plant biotechnology involves risk¹² (Einsiedel, 2000). It is of interest that these are about the same percentages reported for EU respondents, on average, from the 1999 Eurobarometer poll. This poll indicated that food biotechnology was viewed to be risky by 59 percent of EU respondents while crop biotechnology was viewed as risky by 49 percent; these percentages for the EU had not changed appreciably from 1996 (Europa, 2000b). Despite the views of many scientists and regulators that to this point, foods derived from approved agricultural biotechnology are equivalent to their traditional forms, the possibility of some risk is perceived by numbers of people.

Studies of risk perception show that the type of risk that consumers face has a large impact on their risk tolerance. People typically have much higher levels of aversion to involuntary risks than to voluntary risks. With involuntary risk situations, it is not possible for individuals to control the level of risk to which they and their family members are exposed. It can, therefore, be expected that consumers will not favour the introduction of new

¹² In the 1999 US Gallup poll, 27% of the Gallup respondents agreed that they believed food biotechnology poses a serious health hazard to consumers (Gallup, 1999). It is not clear that this figure can be directly compared to the risk perceptions cited here for the EU and Canada which are based on “mostly or totally agree” responses (Europa, 2000b).

food technologies that may have a potential possibility of increasing involuntary risk, unless the new food technologies are seen to offer them direct benefits of some form. This does not yet seem to be the case for agricultural biotechnology.

The literature on risk perception also indicates that perceptions of outrage and dread can arise when risks are imposed, poorly understood and may have (or be perceived to have) dire consequences (Fischhoff et al, 1978; Slovic, 1987; and Hadden, 1989). Recognition of the influence of these factors on individual's risk perceptions helps to explain consumers' wariness about biotechnology and food (Wohl, 1998). Overall, the increasing awareness of issues of food safety, the increasing numbers of media stories on biotechnology, the fact that for most people, biotechnology is a poorly understood process that is seen to be "unnatural", combined with the feature that food is a basic necessity of human life, seem to be significant factors that contribute to an apparent trend of increasing unease of numbers of consumers with genetically modified foods.

An important facet of the differences between attitudes in North America and Europe to biotechnology seems to be the level of trust in government and in its regulatory systems. There appears to be a high level of scepticism of the capabilities and effectiveness of the scientists, bureaucrats and elected politicians that operate or oversee the regulatory system for food safety in Europe. Faith in scientists and the food safety regulatory system in many European nations has been greatly eroded due to a series of food safety problems, particularly the British "mad cow" crisis, involving transmissible Bovine Spongiform Encephalopathy (BSE), which subsequently also emerged as a food safety problem in continental Europe. Other food safety scares and crises have included dioxin-contaminated livestock feed in Belgium. It seems likely that the level of public belief in the ability of officials to assure safety of foods was severely harmed by the persistent initial dismissal of human health implications of BSE in the United Kingdom.

The European public expresses much less trust in national governments and industry than in the United States. Most trust seems to be expressed in consumer and environmental groups in Europe (Hoban, 1998). From the 1999 Eurobarometer poll, the most trusted of listed sources of information on modern biotechnology were, in order, consumers' associations, just ahead of the medical profession, followed by environmental protection associations. (The Eurobarometer also shows that Europeans' trust in environmental associations as a source of information on agricultural and food biotechnology has fallen appreciably from earlier levels). Public authorities are not rated highly; national public authorities are assessed to be trustworthy by only 15 percent of respondents to the 1999 Eurobarometer poll; the same proportion of respondents that expressed trust in farmers' associations. The figures for consumer associations and environmental protection organisations are 53 percent and 45 percent respectively. (Europa, 2000c).

In contrast to Western Europe, at this point in time, there does not seem to be widespread distrust in the system of food safety regulation in the United States. Hoban found acceptance of food biotechnology to increase appreciably when consumers could be told that groups like the American Medical Association and the Food and Drug Administration (FDA) had determined particular foods from agricultural biotechnology to be safe (Hoban, 1998). In the 1999 US poll that followed the pattern of the Eurobarometer, those interviewed were also asked "if the US Department of Agriculture (USDA) made a public statement about the safety of biotechnology, would you have a lot, some, or no trust in the statement about biotechnology?" Ninety percent of respondents indicated that they would trust USDA

statements. A similar question was asked about the FDA and this agency was supported as a source of trustworthy information by 84 percent of US respondents (Gaskell et al, 1999). Overall, there appears to be a relatively high level of trust in the regulatory procedures for food safety in the US. Even so, FDA noted in May 2000 that in response to input from public outreach meetings, it will increase its level of scrutiny of bio-engineered food and animal feeds (EPA, 2000).

Although there are suggestions that some Canadians may be slightly less comfortable with agricultural biotechnology than is the case for many Americans, the level of trust in the regulatory system for food safety in Canada seems to be as high, or even slightly higher than in the United States. This is suggested by the 1999 Environics International poll, which queried people in different countries on their views of the safety of food from different sources. A high proportion of Canadians answered that they were “very confident” of the safety of food from Canada (59%); the proportion of Americans that responded that they were “very confident” of the safety of US food was somewhat lower (46%). Overall, however, the total proportion of both Canadians and Americans that indicated they were either “very confident” or “confident” in the safety of food from their own country was remarkably similar---98 percent of Canadians and 96 percent of Americans gave these responses (Environics, 1999).¹³

Most food safety incidents in Canada that have originated in the food processing sector have involved microbial contamination, typically of meat. Product recalls, allied with trace back procedures, have been applied and there appear to have been few incidents of regulatory failure. Nonetheless, there have been criticisms of slowness in Canadian regulatory procedures and confusion in communications in the public debate over whether or not Canada would follow the lead of the US in licensing rBST as a means to stimulate milk output of dairy cows (Powell and Leiss, 1997). In 1999 Canada determined not to license rBST for use in Canada, largely on animal welfare grounds (Kuperis et al, 1999).

One instance of failure in the regulatory and marketing system for GM food occurred in the United States, in Fall 2000, with Aventis’ StarLink corn, a GM crop variety that had been genetically modified to introduce insect (European corn borer) resistance. StarLink had received regulatory approval for commercial use by the US Environmental Protection Agency as a livestock feed and in industrial uses (ie for ethanol production), but this corn variety had not been approved for food, since it contained a modified protein (Cry-9C) that could possibly cause allergic reactions for humans. Traces of this modified protein were, however, found in taco shells and other foods. Product recalls were instituted by US regulators and Aventis engaged in a “buyback” program for corn from affected farmers, including those with bordering crops of corn. Subsequently traces of the modified protein were also found in a corn cargo exported to Japan, although reportedly this had been tested in the United States. This touched off a reduction in purchases of US corn by importers in both Japan and Korea. Aventis subsequently requested cancellation of the registration for StarLink; three senior US managers lost their jobs with the company. Aventis, which is a

¹³ Even so, the responses of Canadians to a section of the Eurobarometer poll that asked whether named groups were “doing a good job for society” ranked “government in making regulations on biotechnology” below eight other named groups (Einsiedel, 2000). These groups were, in order of assessment of “doing a good job”: farmers (thought by 72 % to be doing a good job); scientists (70%), consumer organisations (62%), shops (54%), media reporting (50%); industry (50%); and government (32 %).

major European (French)-based “life sciences” firm, separated its crop science division from the parent company, reportedly in order to focus on pharmaceutical products (EPA, 2000b; Reuters, 2001a,b; Forbes, 2001; Business Journal, 2000).

The extent of the impact of the StarLink incident on US consumers’ trust in the marketing system and regulatory processes for GM foods remains to be seen. In general, adverse effects on levels of trust can be expected in situations where trust is found to have been misplaced or violated. Also to be seen is whether there is a spill-over effect in a loss of trust from StarLink onto the marketing and regulatory systems for GM food in Canada. StarLink was not licensed for use in Canada; spokesmen for Canada’s regulators claim that Canada’s policy on licensing of GM crops is more rigorous than in the US; food products with the suspect ingredient were not manufactured in Canada and imports, if any, were minor (Manitoba Co-operator, 2000b; CBC, 2000). These factors may reduce potential adverse spill-over effects of the StarLink situation on Canadian attitudes to trust in the food regulatory system in this country. Most Canadians seem to trust the safety of their food system, but numbers of people indicate that food safety issues are more of a concern to them than in earlier years (Angus Reid, 2001). While public knowledge of the technology involved in new foods is not widespread, public wariness of agricultural biotechnology seems to be increasing (Pollara, 2000).

Further Discussion, Summary and Conclusions

Differences in the regulation of agricultural biotechnology in different regions of the world suggest that attitudes of different groups of people to biotechnology can vary greatly. However, perceptions of risks associated with agricultural biotechnology seem to be increasing as more people hear something about or learn something about biotechnology. Thus the level of concern about agricultural biotechnology seems to be increasing as public awareness of this new technology increases. Much of the increased awareness may have come from the increased numbers of newspaper headlines and from television stories on biotechnology. Even so, consumers’ views on biotechnology evidently show considerable variation. Some of these differences have been ascribed to differences in the cultural and regulatory environments of people in different regions and countries. It seems that differences in the regional location of consumers, their ethnicity and their level of confidence in the regulatory system (and thus whether there is a history of any errors or problems in their national food safety systems), are important features that affect attitudes to food biotechnology.

Increased public interest is seen on issues of food labelling and polls have suggested that many members of the public agree with statements that biotechnology- derived food should be labelled. In Europe, in particular, labelling is being viewed as a means to provide for the fundamental right of consumers to knowledge about the products that they may purchase and mandatory labelling is being pursued. In North America, industry and regulators do not view labelling as the best means to provide information that relates to process, rather than content, of food and voluntary labelling seems more likely to be adopted for GM foods. This decision is motivated, at least in part by the concern that unnecessary scare messages may be interpreted from label statements of genetically modified foods. Mandatory labeling that signifies the possibility of allergens or appreciable differences in product composition or nutrition is, however, a standard requirement of food safety

regulations in Canada, as well as in the United States and in Western Europe, and this requirement is seen to be of particular importance to consumer groups.

Detailed studies of consumers' attitudes to possible food risks suggest that differences in attitudes are associated with gender, education and with the level of income of the consumer (Hoban, 1998; Kuperis et al. 1996, 1999; Gallup, 1999; Eurobarometer, 2000b). Typically women appear to express more concern about issues of food safety. People with higher levels of income also tend to express more concern about food safety but there is also evidence that this group of people tends to be less concerned about food biotechnology. People with lower levels of education tend to express more concern about food biotechnology.

The level of trust in the regulatory system to ensure food safety evidently varies in different nations and this feature seems to be one of the important determinants of cross-national differences in perceptions of biotechnology. While most Canadians appear to trust the safety of the food system, there are indications that trust in the regulatory system of government may be somewhat less than in earlier years. Differences in consumers' views of biotechnology can be seen both within and across national borders, but one common feature of these views since the later 1990's is an increasing awareness of biotechnology and an increasing wariness of this. It seems that the differences between nations in consumers' attitudes to food biotechnology may be growing somewhat narrower, rather than widening. It may follow that the cross-national differences that have existed in regulatory approaches and procedures related to food biotechnology may also move somewhat closer over time.

A second common feature of consumers' attitudes to biotechnology seems to involve the differentiation in attitudes towards the focus of biotechnology. People are more concerned about some forms of biotechnology. Thus, while there is increased consumer awareness of both agricultural and medical biotechnology, there seems to be a considerably higher level of acceptance of pursuit of biotechnological procedures in the medical area, while rather more concern tends to be expressed by some consumers about agricultural technology. More concern seems to be expressed about agricultural biotechnology involving animals than plants.

Amongst the broad issues of public policy relating to food, questions of public policy relating to genetically modified foods are particularly complex. Consumers' attitudes seem to be changing and regulations are changing in response to this. There seems to be an increasing level of interest of many members of the public in food policy. This is tending to extend beyond narrow questions of food safety to encompass ethical, social and environmental aspects of food production and processing. There are pressures for increased public participation in and transparency of regulatory processes for food risks and food biotechnology.

A further element of complexity is that government policies and regulations must necessarily be considered in a global context that recognises the multilateral relationships between food policy and trade policy. Fears that food policy may be used as a disguised means to maintain or increase agricultural protectionism by some nations are of concern to farmers and governments in many agricultural exporting nations.

Consumers' perceptions of biotechnology are evidently complex and these attitudes and perceptions are changing. Biotechnology raises complex questions and issues of ethics, environment, economics and law. One challenge is to develop appropriate public policy that will encourage the potential benefits of the powerful new tools of molecular biology that give

effect to biotechnology in ways that will optimise benefits to society. Issues related to this are likely to be a major facet of public policy for food, agriculture, and industry as well as for medical biotechnology, at both national and international levels, in the coming decades.

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