

RURAL ECONOMY

**A Survey of Literature on Genetically Modified Crops:
Economics, Ethics and Society**

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Society**

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Abstract

This paper reports on a review of literature in the form of academic papers and published research on ethical and consumer issues for GM crops in North America, with particular emphasis on GM wheat. The issues raised in these papers and the findings and arguments posed by the authors are outlined. A general conclusion that can be drawn from this overview is that public attitudes toward GM foods are diverse and sometimes quite strongly held. The strong negative views of GM food held by some appear to be mainly grounded in individuals' ethical or moral values. Ethical and risk assessment issues have not been fully explored in the existing literature. There is a general consensus in the applied economics literature that GM crops result in economic benefits, although benefits to individual consumers may not be great enough to overcome perceived risk. Carefully planned provision of credible information informing members of the public of benefits and related issues of concern or costs associated with agricultural biotechnology may have benefits for farm and industry groups, but maintenance of trust in information sources and content is vital to credibility. The discovery and use of genomic techniques that express explicit consumer benefits may lead to more favourable attitudes by many consumers.

JEL Codes: I00, Q16, Q18

Introduction

Since genetically modified crops were first introduced, these have elicited strong feelings by many individuals, becoming a hot issue for politicians, consumers, and the food industry. Dissension about genetically modified food involves many different perspectives, raising some peoples' concerns about food safety and quality, as well as concerns about environmental impacts of the new technology. A variety of social issues and concerns have also been expressed about agricultural biotechnology. A new area of research by social scientists and humanists has developed which tries to understand the nature and effects of concerns about agricultural biotechnology. In Canada, this has been termed "GE³LS" research, an acronym for "Genomics, ethics, economics, environment, law and society". This paper focuses on and overviews published research that studies these issues

To aid research into the issues that shape attitudes toward agricultural biotechnology, an annotated bibliography has been created to present in organized form papers that have been written concerning these issues, with particular emphasis on ethical and consumer issues. This paper gives a summary of the issues stated in those papers and the findings and arguments of the authors. We outline literature that discusses consumer perceptions of biotechnology, how those perceptions are formed, and consumer willingness to pay for genetically modified (GM) food. The paper also presents research that assesses actual consumer behaviour when individuals are faced with the decision of whether or not to buy GM food. There is a brief presentation of the sources consumers look to for information about GM food. Literature outlining ethical issues in biotechnology is

outlined and these issues are discussed, together with arguments on how biotechnology can be evaluated. Factors that may advance acceptance of biotechnology by consumers are also discussed, as are arguments on how this should be regulated from the perspective of ethics, consumers, and politics. Finally, there is a discussion of issues concerning GM wheat and wheat products in particular, including existing literature on the predicted impacts of the approval and release of GM wheat, and consumer attitudes and behaviour toward GM wheat products.

Consumer Perceptions of Biotechnology

Consumer perceptions of biotechnology cover consumer views of and attitudes toward the genetic modification of crops and food derived from crops. There are three issues within this heading: what are consumer perceptions of GM food in general; what are consumer ethical perceptions of GM food; and, what are consumer risk perceptions.

There is general consensus that general consumer attitudes toward GM food are mixed (Hossain, et. al., 2002). A majority of consumers do not have strong views either for or against GM food (Veeman, et. al., 2005), though there is a vocal minority of people who strongly oppose GM food (James, 2004). Some studies suggest that the overall view of GM food is negative (Onyango, et. al., 2004), though there is a portion of the population that believes GM food can be used effectively and does have some value (Anderson, et. al., 2005; Hossain, et. al., 2002). Comparatively speaking, however, organic food is

viewed as healthier, safer, and more environmentally sound than GM food (Anderson, et. al., 2005).

Consumer ethical perceptions are complex. People do not have a simplistic view of science, and can therefore perceive both benefits and risks from biotechnology (Macer, 1997). Most people perceive more benefit than harm from science (Macer, 2001). This is important, because perceived risk has been found to be the best predictor of ethical orientations (Napier, et. al., 2004). Therefore, the less risk people perceive from scientific advances such as genetic modification, the more favourable their ethical views will be. Given the personal nature of ethical orientations, however, differences of view, not only from country to country but also within each country, run deep. This suggests people will always be divided (Macer, 1997).

Just as general attitudes toward GM food are diverse, so are risk attitudes (Hu, et. al., 2004). An appreciable number of consumers have been found to perceive GM foods as very risky (Veeman & Adamowicz, 2004). Even so, the majority of consumers tend to see only a medium level of risk from genetic modification (Traill, et. al., 2004). A further study found that 55% of consumers perceive little or no risk from GM food (Hu, et. al., 2004). The conclusion that can be drawn is that the general perception of risk from GM foods is at most moderate. This is supported by the finding that confronted with different food risk issues, pesticide residues and contamination of water generate higher levels of perceived risk, whereas mad cow disease and GM foods generate the lowest levels of perceived risk (Tucker, et. al., 2006; Veeman & Adamowicz, 2004). In general, GM food

is seen more as an environmental risk rather than a food safety risk (Veeman & Adamowicz, 2004).

In summary, consumer perceptions of GM food in North America are slightly negative overall. These negative views have been dampened by an optimistic view of scientific advances, reflected in more favourable ethical orientations, and a relatively low level of perceived risk from GM food. As will be seen later in this paper, this negative attitude does not spell the demise of GM food but means that GM food prices must be discounted in order to induce consumers to buy it.

Formation of Consumer Perceptions

This section discusses how consumer perceptions and attitudes are formed – what does and does not affect these attitudes. Research in this area has addressed the issues of what causes consumer concern about GM food, what causes consumer support of GM food, what, in general, does and does not affect consumer attitudes, what determines risk and benefit perceptions, and how does information affect consumer acceptance. These issues will be discussed in turn.

The first class of causes of consumer concern relates to information. Several studies have found consumers perceive GM food to be untrustworthy, due to its unknown effects (Anderson, et. al., 2005; Bredahl, 1999; Chen & Chern, 2002). Closely associated with this is concern about low levels of scientific knowledge and trust (Lusk & Rozan, 2005;

Costa-Font & Mossialos, 2005). In addition, because the majority of consumers are uninformed about GM, they are heavily influenced by anti-GM activist groups (James, 2004). The negative slant given by these groups influences consumers against GM food. Other consumers are concerned because of the lack of identification of GM products (Chen & Chern, 2002). A solution proposed to many of these concerns is to increase information and knowledge. Interestingly, however, one study found that those who tended to access information also tended to be in opposition to GM food (Veeman, et. al., 2005).

Other causes of concern over GM food are based in moral/religious, individual, and social/ethical values (Bredahl, 1999; Chen & Chern, 2002; Charles, 2001). The perceived unnaturalness of GM foods is included in this category (Bredahl, 1999). Other studies cite health issues and environmental issues as causes of concern (Veeman & Adamowicz, 2004; Chen & Chern, 2002). A final issue is the relationship between perceived benefits and risks. Overall, GM crops have been found to have appreciable benefits, however, these are seen to benefit only farmers and agribusiness firms, while benefits for individual consumers are viewed not to be significant, being only indirect or small. Consumers, therefore, do not perceive sufficient benefits to outweigh the perceived risks or uncertainties (Wu, 2004; Hall & Moran, 2006).

Factors associated with consumer support for GM food that have been assessed can be divided into demographics, attitudes, and information. Two demographic factors that are correlated with acceptance of GM food are youth and education (Hossain, et. al., 2002).

The younger or more educated a person the more likely he or she will be favourable to GM food.

Attitudes toward several factors related to GM foods have also been found to correlate with acceptance of GM food. One study found that a positive attitude toward technology in general suggested acceptance (Traill, et. al., 2004). Trust in scientists, corporations, and government was also found to be a predictor of acceptance (Hossain, et. al., 2003). High scores for the power value (dominance, submission) were correlated with positive ratings for GM foods (Dreezens, et. al., 2005). Finally, one study found that the extent to which GM food is perceived to be natural, but not the extent to which non-GM food is perceived to be natural, to affect acceptance of GM food (Tenbult, et. al., 2005).

In some of the literature noted above it is suggested that lack of information causes opposition to GM food. Although one study found that those who voluntarily access information are more likely to be opposed to GM food, others have found that increased knowledge of GM food is positively related to approval (Cuite, et. al., 2005). From a data-based regression model, however, it was found that only knowledge about potentially threatening aspects of GM food was significantly related to approval (Cuite, et. al., 2005). Frewer argues, however, that communication about the risks and benefits of GM food is not enough; that involving the public explicitly in the biotechnology debate is required to increase consumer acceptance (Frewer, 2003). A combination of the two approaches is likely the best answer.

Many factors have been found to have an affect, one way or another, on consumer acceptance, or at least to be correlated with acceptance of GM food. Again, these can be divided into the categories of demographics, attitudes, and information, along with a category for product characteristics.

Demographic factors that have been found to be correlated with the level of acceptance of GM food are: age (Hossain, et. al., 2002); gender (Hossain, et. al., 2002); racial background (Hossain, et. al., 2002); education (Hossain, et. al., 2002; House, et. al., 2004); and income (House, et. al., 2004).

One study concluded that 'attitudes' in general are predictive of acceptance or rejection of GM food (Cook, et. al., 2002). Other studies found that attitudes toward nature and technology (Bredahl, 2001), and religious views (Hossain, et. al., 2002) are important. Moral considerations (Frewer, 2003) and subjective norms (Cook, et. al., 2002) also play a role, along with self-identity (Cook, et. al., 2002). The degree of trust in the regulatory system is an important predictor (Frewer, 2003; House, et. al., 2004), sometimes associated with trust in activist groups (House, et. al., 2004). Risk preferences and perceptions have also been found to be relevant in several studies (Frewer, 1998; Lusk & Coble, 2005; Chen & Chern, 2002).

In the category of information, general awareness of biotechnology has been found to affect consumer attitudes (Fritz, et. al., 2003). As cited above, uncertainties in biotechnology and concern about unintended effects are also a factor (Frewer, 2003). It is

argued, too, that the analytical assessment of risks and benefits and the communication of that analysis will impact consumer acceptance (Frewer, 2003). One study found that verifiable information has a small, but positive value to consumers (Rousu, et. al., 2002). A rather different finding was that perceived behavioural control affects attitudes (Cook, et. al., 2002). Information to dissipate this perception, then, would likewise have an effect.

It should be no surprise that various product characteristics have an impact on how willing consumers are to purchase GM food. In general, perceived differences between GM and non-GM foods are a factor influencing consumers (Chen & Chern, 2002). As would be expected, potential benefits of GM food are an influence (Chen & Chern, 2002; Onyango, et. al., 2004), particularly direct health, environmental, and production benefits (Onyango, et. al., 2004). Price also has an effect (Onyango, et. al., 2004). The latter factor will be discussed in more detail in the section concerning willingness to pay.

Few factors have been found not to have an effect on consumer attitudes. The two that can be stated with certainty are regional differences (Hossain, et. al., 2002) and the degree of acceptance of novel products (Frewer, et. al., 1998). One study found income not to have an impact on acceptance (Hossain, et. al., 2002). This is in direct contradiction to the study cited above where income was found to have an impact. Regional and product differences may underlie these findings.

A further issue concerning the formation of consumer perceptions and attitudes is the question of what determines risk and benefit perceptions. A most important point relative to this issue is that risk and benefit perceptions are not independent but endogenously and simultaneously determined (Costa-Font & Mossialos, 2005). It is likely, therefore, that factors affecting either risk or benefit perceptions will affect both of these. One such factor is a person's attitude toward biotechnology. This has been found to be the strongest predictor of perceived risk (Tucker, et. al., 2006). Associated with this is the finding that the perceived level of risk increases with negative-biased information and decreases with positive-biased information (van Wechel, et. al., 2003). These authors concluded that different types of information are likely to affect attitudes toward biotechnology, supporting the conclusion of Tucker. An associated finding is that those who trust the government and food industry perceive less risk, while those who trust activist sources perceive more risk (Traill, et. al., 2004). Attitudes toward biotechnology and the sources of information that consumers trust are two factors that probably influence each other. A final finding concerning the formation of risk and benefit perceptions is that people rely mostly on magazines/newspapers for information about health risks and food benefits (Veeman, et. al., 2005). The information contained in these media, then, is expected to have a significant impact on consumer attitude formations.

This leads to the issue of how information affects consumer acceptance. The methods by which information can increase acceptance of GM food are as follows. Wachenheim proposes that providing information *can* increase willingness to pay (Wachenheim, 2004). Other studies have confirmed this. It has been found that increased information

leads to increased acceptance, but more so for women than men (Moerbeek & Casimir, 2005; Cuite, et. al., 2005). As cited above, however, regression analysis indicated that only knowledge about potentially threatening aspects of GM food was significantly related to approval (Cuite, et. al., 2005). Even so, other studies have found information in general to be effective. One group of researchers concluded that both positive and negative-biased information increased bids for GM products (van Wechel, et. al., 2003). Another study took a different view toward information. Rather than creating a positive-negative dichotomy, the different effects of subjective knowledge and objective knowledge were examined. The finding was that increased levels of subjective knowledge significantly increases willingness to accept, however, objective knowledge is not significantly related (House, et. al., 2004). In other words, how much consumers in fact know is not as important as how much consumers think they know. This has implications for how information is delivered.

Other studies have found ways by which information can decrease consumer acceptance. Information about GM food supplied from environmental groups, for example, increases the probability that consumers are out of the market for GM foods (Huffman, et. al., 2004). However, it was also found that the negative effect of information from environmental groups can be mostly dissipated by third party verifiable information (Huffman, et. al., 2004). Scholderer and Frewer indicated that government and food industries have used communication strategies focused on technology-driven, top-down practices. These strategies, they argue, have had the uniform effect of significantly

decreasing preferences for GM foods (Scholderer & Frewer, 2003). In general, the way information is communicated can have either a positive or negative effect on consumers.

The type of information also impacts consumer attitudes and perceptions. For example, in one study, information on environmental benefits, health benefits, and benefits to the Third World significantly decreased the amount of money demanded to consume GM food (Lusk, et. al., 2004). Another study concerned media coverage of biotechnology, comparing the methods used in Holland to those used in the United States. It was found that the substantial, negative media coverage given in Holland, sustained over 5 years, did not change Dutch purchasing patterns. The acute but brief negative media coverage in the United States did affect consumer demand, but in a limited way (Kalaitzandonakes, et. al., 2004). The conclusions to be drawn from this study, however, may be limited.

Finally, it has been found that the results of voluntary information provision studies differ from compulsory information provision studies (Hu, et. al., 2006). Consumers generally have choices about whether to access information and often do not do so. Their attitudes may influence this choice, reflecting that complex factors influence how information affects consumers. Another study found that initial attitudes toward biotechnology have a significant effect on how individuals respond to information (Lusk, et. al., 2004). These factors should be taken into consideration when planning information dissemination.

In conclusion, a number of studies suggest that there is the potential for appreciable returns from well planned communication and dissemination of positive GM information. It is observed, however, that negative information from a third party markedly decreases

this return (Huffman, et. al., 2003). Verifiable credible information for processed foods has been projected to increase commercial values (Rousu, et. al., 2002). It can be concluded that the careful provision of credible information about GM products to consumers can influence consumer's choices. Credibility and trustworthiness of information sources is of importance. This is likely to be enhanced by transparency and public consultation in regulating agricultural biotechnology.

Willingness to Pay Estimation

“Willingness to pay” for GM products is an important issue which directly quantifies how accepting consumers are of GM food and assists in determining how successful these products will be. Two issues are addressed in the literature: what is consumer willingness to pay (WTP) for GM food versus non-GM food, and what affects consumer WTP?

Two early studies found that consumers discount GM food by about 14% (Huffman, et. al., 2003; Tegene, et. al., 2003). (A third study concluded that respondents were willing to pay a premium of 50-62% of the price to avoid GM vegetable oil (Chern et. al., 2003). but these researchers acknowledge that this may be inflated since vegetable oil is inexpensive and the question was hypothetical). It seems likely that the discount rate for GM food in general is roughly 14%. There is no evidence that consumers place different values on foods with 1 or 5% GM content (Rousu, et. al., 2004), so this discount rate

applies to both threshold levels. It has been concluded that consumers reduce their demand by about 10% regardless of the threshold (Rousu, et. al., 2002).

A variety of factors affect consumer WTP and these are closely correlated with factors that affect consumer attitudes toward GM products. Of those that increase WTP, the most obvious is whether the product has explicit benefits to the consumer (Chern, et. al., 2003), such as a positive health effect (Veeman, et. al., 2005; Onyango, et. al., 2004), or modifications that increase flavour or enhance nutrition (Loureiro & Bugbee, 2005). Positive environmental effects (Veeman, et. al., 2005; Onyango, et. al., 2004) and production benefits (Onyango, et. al., 2004) also increase WTP estimates. Other studies have established that the provision of information will increase WTP (Wachenheim, 2004). For example, information on environmental benefits, health benefits, and benefits to the third world significantly decreased the amount of money consumers demanded to consume GM food in an experimental study (Lusk, et. al., 2004). It is argued, however, that simply making consumers aware of possible health benefits won't induce them to voluntarily pay more for GM products because the acceptability of novel hazards is more complex than suggested by such a hypothesis (Rowe, 2004). Factors that have been found to decrease WTP when respondents were explicitly queried on these issues include the feature that animal-to-plant gene transfers rather than plant-to-plant gene transfers are less acceptable (Onyango & Nayga, 2004). In addition, the perception of a health risk reduces WTP (Moon & Balasubramanian, 2001). Other factors that affect WTP one way or the other include product benefits (Onyango, et. al., 2004), the technology used (Onyango, et. al., 2004), the sequencing of food labels (Huffman, et. al., 2003), and

subjective risk and benefit perceptions (Moon & Balasubramanian, 2001). Risk perception has been found to play a more important role than benefit perception in determining WTP (Moon & Balasubramanian, 2001).

Consumer Behaviour

Determining likely actual consumer behaviour is more important and more difficult than determining consumer attitudes. Conclusions based on stated preference and revealed preference approaches can differ. Three issues are addressed by researchers concerning consumer behaviour: what is the relationship between consumer attitudes and consumer behaviour, how do labels affect consumer behaviour, and what is consumer behaviour in searching for information?

There are concerns that the relationship between elicited attitudes and actual behaviour is weak (Kalaitzandonakes, et. al., 2005). Two examples are given to support this conclusion. Europeans have consistently voiced strong opposition to GM foods. Yet for the brief time GM tomato puree was available in Great Britain, it out-sold competing non-GM brands, even though a significant segment of consumers was unreceptive to GM foods (Kalaitzandonakes, et. al., 2005). Likewise, studying aggregate behaviour in the Netherlands, it was found that, contrary to opinion surveys, a majority of consumers did not shift away from GM foods in the presence of alternatives (Kalaitzandonakes, et. al., 2005). These findings suggest that some consumers are more willing to buy GM food than may be indicated by opinion studies.

Such willingness may be affected by labels. Studies show that labels do matter. For example, goods labelled “GM” are discounted by 14% (Tegene, et. al., 2003). Similarly, where mandatory labelling is required, products labelled GM are viewed adversely (Veeman, et. al., 2005). Bids for presumed GM products are lower than for products labelled “non-GM” (van Wechel, et. al., 2003). These findings, combined with other work noted previously, suggest that if GM products are sold at a sufficient discount, many consumers will be willing to buy them. Other studies indicate that the necessary discount may be relatively minor—for example, one study found that sampled consumers did not express much more interest in foods labelled GM-free than in GM-labelled foods (Smyth & Phillips, 2003). What is contained in the label is expected to be important to consumer response. The message itself and its strength are affected by consumers’ perception of government and industry accountability, in turn affecting attitudes toward and willingness to purchase GM food (Irani & Sinclair, 2004). Overall, many consumers are willing to buy GM food provided a discount is high enough; regulations concerning labelling are important in this context.

Numbers of studies have found that knowledge concerning GM foods is low, and increasing knowledge does affect attitudes toward GM food. However, acquiring information takes effort and those without strong attitudes to GM food may not go to the trouble of seeking knowledge. A study probing this found less than half of respondents actually sought information when this was offered (Gao, et. al., 2005; Hu, et. al., 2006). Several factors have been found to affect whether an individual will seek information.

Generally it is expected that consumers will search for information only if the benefits to that person outweigh the costs (Veeman, et. al., 2005). In the studies referred to above, however, information was readily available, requiring only the click of the mouse to access a hyperlink and the time to read it. This suggests that despite the potential for high value of information, some consumers perceive only small benefits from seeking information. This may be because some consumers are not that interested in the issue. Alternatively, consumers may have formed their opinions of GM food earlier and, subjectively, consider those opinions to be well-founded. This hypothesis is consistent with the finding of another study that subjective knowledge has a more significant impact on attitudes than objective knowledge (House, et. al., 2004). Other factors that affect the probability of whether consumers will access information are gender, employment status, rural or urban residency, and the number of children in the household (Gao, et. al., 2005). However, if people do not consider the issue of GM food to be important to them, they may not seek knowledge on this.

Information Sources

Many groups that have a stake in the success or failure of GM foods attempt to influence consumer behaviour through the provision of information. An important issue, then, is who do consumers trust as a source of information about GM food? This is the only issue addressed in this section.

Surveys have found consumers generally place low trust in the food industry, farmers associations, and the federal government (Veeman, et. al., 2005). High trust is placed in research institutions (Veeman, et. al., 2005), consumer associations (Veeman, et. al., 2005), and scientists and other experts (Lang, et. al., 2003). Several factors appear to influence the degree of trust consumers place in these various sources. Increased levels of education, for example, reduces trust in government, private industry and environmental or consumer groups (Huffman, et. al., 2004). Those with informed prior beliefs place more trust in third-party information than in information from interested sources (Huffman, et. al., 2004). Consumers who claim to be informed are more likely to trust the government than third-party sources (Huffman, et. al., 2004). A progression can be mapped from this information. Individuals with a lower level of education and the subjective belief they are informed tend to trust the government rather than non-interested sources. As education and actual information are increased, individuals tend to trust government less and third-party sources more.

Studies show that who consumers trust is also correlated with acceptance of GM food. Those who trust in government sources are more willing to accept GM food, and those who trust in activist sources are less willing to accept GM food (House, et. al., 2004). This finding is not surprising, given that government information is generally supportive of GM food and activist sources are generally disparaging of GM food.

Ethical Considerations

The use of biotechnology pulls into play several political and social factors. Ethical considerations play an important part not only in affecting consumer attitudes toward GM food, but also in the framing of public policy. Researchers have addressed two general issues concerning the ethics of biotechnology: what ethical issues shape biotechnology, and how are ethical issues treated by biotechnology firms?

Intrinsic objections (those based on moral grounds) to GM food have been controversial. These have been widely criticized by some as unsound, incompatible with modern science, religious, inchoate, and based on emotion rather than reason and entirely irrelevant in the development of public policy (Streiffer & Hedemann, 2005). However, such objections may still have merit as ethical objections, and often have much political import. It is argued that discussion should not centre on the substantive merit of the intrinsic objections, but rather on appropriate political norms for achieving legitimate policy (Streiffer & Hedemann, 2005). In a democratic society, policies and laws are legitimate only insofar as they reflect the values and opinions of the people. Moral objections must therefore be considered in the formulation of policy in order to maintain that legitimacy.

Another similar ethical issue in biotechnology concerns personal integrity, and how this can be related to food choice. GM foods may threaten three types of personal integrity: religious, consumer, and other moral or metaphysical grounds (Pascalev, 2003). While

personal integrity may not be relevant in the advancing of science, it is relevant in political discussion concerning the making of policy. An understanding of this issue, then, is another way to maintain legitimacy in regulation.

Ethical issues have changed as biotechnology has developed. In the past, debate about biotechnology was centred on risks, benefits, and safety. As these factors have become more thoroughly established, debate has shifted to globalization and development issues (Levidow, 2001). GM crops have significant potential to aid developing countries by enabling them to produce more food to not only feed their own people but also to trade on the global market. They can therefore accomplish the social good of alleviating poverty. This ethical consideration must be accounted for as countries regulate the availability of GM foods in their domestic markets. How they regulate agricultural biotechnology may seriously affect poor countries' ability to use GM crops to aid in food production.

Ethical arguments used in support of GM crops and food have come under attack from several quarters. One argument asserts that proponents of GM have used utilitarian concepts to emphasize the tangible benefits of GM food, defined according to their own particular set of socio-economic assumptions. On this artificial foundation, the commodization process is naturalized, while any resistance is disparaged as illegitimate interference with progress (Levidow, 2001). It is argued that GM crops, after all, further the industrialization of agriculture while continuing to perpetuate the hazards of intensive monoculture. It is argued that the value judgments inherent in environmental ethics have

been downplayed by the portrayal of risk regulation as a matter of objective science. Risk and ethics have thus been fragmented (Levidow & Carr, 1997).

Ethical issues must be addressed by government and biotechnology firms. Research has found five approaches to such issues by the biotechnology industry (Mackie, et. al., 2006):

1. Ethical leadership;
2. External expertise (i.e. ethics consultant);
3. Internal ethics mechanisms (ethics education, ethical reinforcement);
4. External ethics engagement (ethics mechanisms with partners and suppliers, strategic philanthropy); and,
5. Ethics evaluation and reporting mechanisms.

These authors see the intent of biotechnology firms to answer the ethical concerns of consumers in industry practice. Firms are motivated to do so because addressing ethical concerns is the ‘right thing’ to do, firms want to maintain their reputation, they want to attract and keep the ‘right employees’, and they want to promote good science (Mackie, et. al., 2006). The remaining question is whether these motivations and mechanisms have pushed firms to address ethical issues in a satisfactory manner.

Evaluation of Biotechnology

In assessing the future of GM crops and determining how they will be regulated, it is important to evaluate past performance in order to identify the strengths that should be

nurtured and weaknesses that must be addressed. The issues addressed under this heading are: how can GM crops be evaluated, how can environmental risk be assessed, are there economic benefits to GM crops, and who benefits from GM crops?

Those who have addressed a means for evaluating biotechnology have advanced only ethical considerations, rather than economic or political perspectives. The research and arguments in this area seem to be lacking in disciplinary balance. From the point of view of ethics, a foundation for the evaluation of GM crops can be laid by first adopting a common language that speaks to basic human values (Ellerbrock, 2002), and building a conceptual framework based in enlightenment, liberal, political, and economic theory (Fraser, 2001). One researcher suggests that the narrative and feminist critiques of bioethics are a good place to start (Fraser, 2001). Others have argued that, regardless of the particular critique employed, the principles of social ethics must be involved, as well as moral and spiritual criteria (Ellerbrock, 2002). Such an approach is likely to address the ethical issues discussed above, but may be wanting in the area of political and economic concerns.

Another element of GM crops that must be assessed is environmental risk of specific crops. This has received relatively light treatment in the literature surveyed. It is argued that such an assessment must be made against the background of current agricultural management practices and ecosystems to allow a determination of whether particular GM crops improve environmental conditions or further degrade them. (Barton & Dracup, 2000). Furthermore, interested groups must consider the specific nature of the genetic

modification, the context of the biology of the particular plant and the particular environment in which it will be grown (Barton & Dracup, 2000). This should allow determination of the likely impact of a particular variety on the immediate environment, allowing specific, rather than general, conclusions.

A primary question that many parties are interested in is whether there are economic benefits to GM crops. Research does not provide a simple answer. For example, one economic study has found both positive and negative effects on capital stocks, efficiency and equity (Otsuka, 2003). On the whole, however, the balance appears to favour the conclusion that GM crops are economically beneficial rather than detrimental. One recent study found substantial *net* economic benefits (Brooks & Barfoot, 2005). Another group concluded that, in the long run, GM crops almost always benefit society (Lence & Hayes, 2002). One such means by which society is benefited is by a significant reduction in pesticide spraying and the release of greenhouse gases (Brooks & Barfoot, 2005). Conclusions based on one assessment are that introducing GM technology increases aggregate welfare unless production cost savings are small and consumers are seriously concerned about GM foods (Lence & Hayes, 2005).

One group has argued that GM crops have not resulted in economic benefits; that they are not a success in North America. These authors argue that GM crops have disrupted GM-free production, destroyed trade and undermined international competitiveness (Meziani & Warwick, 2002). Overall, however, the majority of assessments do not deny the

existence of negative effects, but have found that the *net* economic effect of GM crops is positive.

A valid concern, however, is raised in terms of who receives these economic benefits.

Little research has been done to answer this question, but preliminary studies suggest that growers, consumers, and industry all benefit (Wu, 2004). The gain to individual consumers, however, is small, and may not compensate for perceived risks (Wu, 2004). This may explain the tendency for stated aversions to GM foods.

Advancing Biotechnology

Given that, in theory and practice, the general conclusion is that GM crops have a positive economic effect, a majority of economists who conduct research in this area are concerned with how to advance biotechnology and increase its use. Several proposals consider the issue of how to increase consumer acceptance of GM foods.

There are three prongs to efforts to increase consumer acceptance of biotechnology: the use of information, regulation regimes, and the product itself. Two arguments have been advanced on how to use information to improve consumer attitudes. The first is to educate consumers with non-biased scientific information (Chen & Chern, 2002). As noted above, consumers place high trust in scientists as a source of information about GM food. Another study concludes that this information would be best delivered through the internet and newspapers (Fritz, et. al., 2003), as these are the sources consumers look

to the most. Another argument on how to use information is to involve the public explicitly in the biotechnology debate (Frewer, 2003). It is not enough, it is argued, to develop best practice in science communications about the risks and benefits of GM food. Consumers must not only be informed, but must also be involved in the formulation of policy.

Policies and regulations chosen may increase consumer trust in GM products. Linked to the argument that the public should be involved in the biotechnology debate is recognition that the acceptance of novel products is related to risk-benefit perceptions. There must, therefore, be effective risk-benefit communication strategies and methods for receiving communication from the public (Frewer, et. al., 1998). This will allow the inclusion of public values in the risk analysis process (Frewer, et. al., 2004). With this as the foundation, it is argued that labelling should be provided to establish consumer confidence (Chen & Chern, 2002).

Clearly, the product itself and the types of genetic modifications will affect how willing consumers are to purchase the good. The development of technologies and products that explicitly benefit the consumer have been found to increase consumer acceptance (Lusk & Rozan, 2005).

Regulation of Biotechnology

The regulation of biotechnology continues to be a major issue. The disparity in opinions regarding GM foods internationally and domestically has led to difficulty in coordinating regulatory approaches internationally. Part of this problem is the variety of perspectives on the issue. This paper will divide the treatment of regulation into four sections: the ethical perspective, the consumer's perspective, the political perspective, and a final section treating solely the question of labelling.

The Ethical Perspective

Ethics raises two issues regarding the regulation of biotechnology: how should biotechnology be regulated, and how should the Precautionary Principle be employed?

Ethics attacks the employment of the Harm Principle as the basis for regulation of GM products. The Harm Principle states that an activity should not be allowed if it causes harm to other individuals. It is argued, however, that the concept of harm cannot be plausibly specified, nor does the principle account for expected benefits (Holtug, 2001). A different ethical foundation must be used for regulation, one that evaluates the values at the basis of decisions (Carr & Levidow, 2000).

This has led to the use of the Precautionary Principle which calls for precaution in the face of scientific uncertainty. In the context of the argument that long term effects of GM crops are unknown, as is the risk they present to the environment, the Precautionary Principle would require strict regulation to limit potential harm. It is argued that because there is a significant void in scientific understanding of the risks associated with GM food, this uncertainty must be communicated to policymakers and the public, and further research must be done (Myrh & Traavik, 2002). The lack of data and information concerning ecological effects is argued to require the use of the Precautionary Principle (Myrh & Traavik, 2003). Uncertainty can be seen in the differences of opinions about the relevance of putative hazards, the definition of potential “adverse effects”, and whether actions should be taken to prevent harm (Myrh & Traavik, 2003). To use the Precautionary Principle in the development of regulation, the government must develop risk assessment criteria and more long-term conceptions of risk, uncertainty, and ignorance (Myrh & Traavik, 2003).

The Consumer Perspective

This section considers the issue of consumer preferences for regulation. There are studies with interesting, and somewhat conflicting results. One such study found that relative to two other policy stances, consumers were willing to pay the least for regulation that restricts biotechnology. Rather, they preferred a policy providing more information about biotechnology on food labels and more emphasis on food inspection (Veeman & Adamowicz, 2004). It has also been concluded that consumers want labels to indicate the

risks and benefits of GM foods (Teisl, et. al., 2003). They also want to know why the genetic modification was done (Teisl, et. al., 2002).

These studies would suggest that consumers prefer a labelling regime. Supporting this are findings that suggest stricter regulation is less preferred than more rigorous inspection, which in turn is less preferred than a labelling system that gives more information about agricultural biotechnology (McCann-Hiltz et al., 2004; Veeman & Adamowicz, 2004).

Several studies conclude that there is wide support for mandatory labelling (Chern, et. al., 2003; Teisl, et. al., 2003; Teisl, et. al., 2002). Consumers are split, however, over whether they are willing to pay higher food costs to cover the costs of this (Teisl, et. al., 2002).

Some consumers are willing to pay a premium for information about GM content (Smyth & Phillips, 2003).

The cited findings come from studies examining consumer attitudes. Some research into actual behaviour has provided different results. For example, examining the Ohio referendum concerning the labelling of GM food, it was found that a significant majority of voters voted against mandatory labelling (Raab & Grobe, 2003). This will be discussed in more detail in the section concerning labelling. Finally, if a labelling program is to be introduced, consumers prefer it be administered by a federal agency rather than any other organization (Teisl, et. al., 2003).

The Political Perspective

This section focuses on literature on the issue of regulation of biotechnology. Regulation must be determined through a comprehensive public policy analysis, identifying both risks and benefits (Isaac & Hobbes, 2002). The starting point involves analysis of the appropriate role of science and technology, followed by substantial equivalence, the Precautionary Principle, and mandatory labelling (Isaac & Hobbes, 2002). In practice, many systems use the Risk Analysis Framework – basing public policy on scientific principles by developing policy through three stages: risk assessment, risk management, and risk communication (Issac, 2001). Despite the wide use of this approach, there is a disparity among policies, largely because of the different ways in which this approach can be employed.

Labelling

Labelling is an important and widely discussed topic in the literature relating to biotechnology regulation. Several questions have been discussed in the literature:

- What considerations are involved in choosing a labelling regime?
- Is mandatory labelling “better” than voluntary labelling?
- Is voluntary labelling “better” than mandatory labelling?

- Should GM foods or non-GM foods be labelled?
- What tolerance level for accidental contamination should a labelling regime use?

There is a little discussion in the economics literature about limitations of voluntary labelling, and very little explicit discussion about the use of voluntary labelling in Canada and the United States, perhaps reflecting the interests in GM crop production in these nations and since both countries are currently in voluntary labelling regimes; debate tends to focus on whether there should be a switch to a mandatory regime. The question, then, is whether such a switch is welfare improving.

Many considerations apply in discussions of labelling regimes. A primary question is what should be labelled (Einsiedel, 2000)? A regime could require the labelling of GM foods, non-GM foods, or neither. Other considerations include when labelling would be required (tolerance levels) (Einsiedel, 2000; Veeman, 2003), and whether labelling should be mandatory or voluntary (Veeman, 2003). If it is determined that GM foods should be labelled, other considerations come into effect, such as whether labelling should be for GM content or GM processes (Veeman, 2003), and how the GM food should be labelled (Einsiedel, 2000). A final question is whether it is possible for a label to be truthful and still mislead (Einsiedel, 2000).

The primary debate concerning the labelling of products is whether labelling should be mandatory or voluntary. Those who support mandatory labelling have advanced several persuasive arguments. The first is that consumers want to know what they're eating (Grobe & Raab, 2004; Raab & Grobe, 2003). This is based on a principle of consumer

autonomy. It must be pointed out, however, that consumer autonomy cannot by itself justify mandatory labelling. The market cannot comply with all consumers' information demands (Hansen, 2004). Other arguments have been put forward: one study found that information from a mandatory labelling regime is valued more than information from a voluntary labelling regime (Hu, et. al., 2005). In addition, the cost of such labelling is not great, it is argued, and more than a small minority of people desire information about GM content (Rubel & Streiffer, 2005). The conclusion drawn from these studies, then, is that potential labelling benefits appear to outweigh costs.

There is a group that strongly argues against these conclusions, however. Mandatory labelling does not in practice provide consumer choice, they argue, since GM foods have disappeared from countries with mandatory labelling (Carter & Gruere, 2003), reducing the choices available to consumers. This causes losses to those consumers that prefer to buy lower priced GM foods (Carter & Gruere, 2003). In addition, it is argued that a mandatory labelling regime will incur additional taxpayer costs (Carter & Gruere, 2003) and premiums that consumers are willing to pay for non-GM foods will be lower than the expected costs (Loureiro & Hine, 2004). Thus, although the cost of positive labelling may not be great, it seems that many consumers are not willing to foot the bill for this.

One study concluded that consumers do not interpret voluntary and mandatory market signals identically and that because of this, it is more welfare improving to continue a voluntary labelling policy (Huffman, et. al., 2004). There are several instances where mandatory labelling is concluded to cause a loss of welfare. For example, this acts as an

import barrier and diverts trade (Carter & Gruere, 2003). In addition, it is argued to impose excessive costs on producers, threatening research and commercialization (Phillips & Isaac, 1998).

A final argument against mandatory labelling, at least in the North American context, is that this is too late. Most prepared foods now contain some GM content. Organic foods are already positively labelled, and such voluntary labelling provides an alternative to consumers who want to avoid GM foods (Raab & Grobe, 2003).

In addition to these arguments against mandatory labelling, some studies have concluded that voluntary labelling results in higher welfare (Huffman, et. al., 2002). This conclusion requires, however, that consumers accurately read the signals in each market (Huffman, et. al., 2002). These authors concluded that consumers behave as though they can accurately identify signals (Huffman, et. al., 2002).

A related fierce debate associated with the question of mandatory or voluntary labelling, is the issue of whether GM food or non-GM food should be labelled. Once again, the principle of consumer autonomy is proposed as an important consideration. Some argue the labelling of non-GM foods does not support consumer autonomy as well as positive labelling (Rubel & Streiffer, 2005). Others argue otherwise, maintaining that consumer choice can be secured by either labelling system (Hansen, 2004) and since negative labelling has a lower cost, it is preferable. In addition, it is argued that those consumers interested only in non-GM foods have the clearest interest in labelling, whereas

ambivalent consumers do not and that those with the interest should be the ones to pay the cost of labelling, a conclusion that favours voluntary labelling (Hansen, 2004).

Other considerations also play a part in preferences for a labelling regime. If willingness-to-pay does not have a strong correlation with either positive or negative labelling (Smyth & Phillips, 2003), neither regime will appreciably affect the amount consumers are willing to pay for GM food. This is related to the observation that many consumers do not express more interest in foods labelled GM-free than in foods labelled GM. Further, GM-free claims are viewed with skepticism (Teisl, et. al., 2002) and in practice, within North America, labelling for GM content is largely irrelevant (Smyth & Phillips, 2003). It is also argued that there is no duty to label GM foods based on danger since most researchers do not see significant health risks from consuming GM foods (Hansen, 2004).

Regardless of which labelling regime is used, an important question is what tolerance level should apply? It is difficult for any food to be completely GM free. It is therefore important to set an amount that divides the line between what must be labelled GM, or what can be labelled GM-free. Two studies provide insight on this issue. One found that consumers place the same value on foods with 1% or 5% genetically modified content (Rousu, et. al., 2004). The other study found an appreciable increase in cost as threshold levels tighten from 5% to 0.1% (Huygen, et. al., 2003). This reasoning is consistent with the use of a 5% tolerance level that is specified in Canada's (voluntary) GM food labelling regulations.

GM Wheat

Most of the issues discussed above also concern GM wheat. The studies considered in this section are those that used GM wheat products as a focus of socio-economic research. Issues discussed, then, relate to literature that has at least some focus on:

- What will be the impact of introducing GM wheat?
- What are consumer attitudes toward GM wheat products?
- What is consumer behaviour in searching for information about GM wheat products?
- How does information about GM wheat products affect consumer behaviour and how do consumers respond to this information?
- What is consumer willingness-to-pay for GM wheat products?
- How will different labelling regimes affect GM wheat products?

The means to estimate the impact of introducing GM wheat is an important question. One study proposes a model for estimation of demand and supply equations using existing supply, demand, and elasticity estimates and reliance on composite supply and demand functions. This approach is used in a model of world wheat trade, and the impact of several possible GM wheat adoption and consumer acceptability scenarios are analyzed (DeVuyst, et. al., 2001). The reader is referred to the study for the results and conclusions from this exercise.

Other studies conclude large distributional effects from the introduction of GM wheat (Furtan, et. al., 2005). These authors reasoned that this would create a market for “lemons”, resulting in the loss of export markets (Furtan, et. al., 2005). Loss in export markets would also be due to trade barriers imposed by the stance other countries take on GM foods, rather than being specific to GM wheat. In terms of economic benefits, it was concluded that wheat producers would lose economic surplus, while consumers and biotech companies would gain economic surplus (Furtan, et. al., 2005). A question is whether the loss of surplus by producers is greater or less than the gain by consumers and biotech companies. Finally, it is also been concluded that producers who didn’t produce GM wheat would face externalities associated with GM wheat contamination (Taylor, et. al., 2003). It can be observed that none of these predicted problems is specific to GM wheat, but could apply to the introduction of GM varieties for any major export crop. In the longer term, given adjustment in facilities and infrastructure and assuming that all countries are adopters, the net benefit from introduction of GM wheat could be expected to increase.

Consumer attitudes toward GM wheat products are much the same as they are for GM food in general. A major conclusion is a great diversity in attitudes and associated segmentation of preferences (Hu, et. al., 2004). This diversity exhibits itself in many ways, as, for example, in preferences concerning GM wheat products and the associated perceived risks of the product (Veeman, et. al., 2005). Likewise, there is substantial heterogeneity among tastes for different bread attributes, including the presence or absence of GM ingredients (Hu, et. al., 2005). However, the majority of consumers do

not express strong views either for or against GM bread (Veeman, et. al., 2005). Some consumers are indifferent (Hu, et. al., 2004). Studies do find, however, that consumers are less likely to choose wheat products with GM ingredients (Veeman, et. al., 2005). Aversion is reduced if there is a positive health or environmental effect (Veeman, et. al., 2005). Acceptance of GM wheat products is most dependent on the extent to which the GM food is perceived to be natural, not on the extent to which non-GM food is perceived to be natural (Tenbult, et. al., 2005). Health and environmental issues are identified as areas of major concern for GM wheat products (Veeman & Adamowicz, 2004).

A previously noted study of consumer behaviour involved searching for information about GM foods. This was conducted using wheat products as the example studied. To restate, the findings were that relatively few individuals (as few as one third) accessed information provided on modified wheat products (Hu, et. al., 2006; Gao, et. al., 2005).

There are few studies concerning the effect of information about GM wheat products but these are encouraging. Both positive and negative information increased bids for GM wheat products (van Wechel, et. al., 2003). Furthermore, information on environmental benefits, health benefits, and benefits to the third world significantly decreased the amount of money consumers demanded to consume GM wheat products (Lusk, et. al., 2004). It is clear that different types of information do impact product choices. The nature of these effects is influenced by voluntary access to information (Hu, et. al., 2006).

The one study that estimated consumer willingness-to-pay for GM wheat products found an average discount of 0.50 CAD per loaf of GM bread (Hu, et. al., 2004).

The final issue discussed relates to impacts of labelling regime for GM wheat products. The first finding is that where labelling is mandatory, GM breads are adversely viewed (Veeman, et. al., 2005). However, overall, information from a mandatory labelling regime for bread is more valued than the information in a voluntary labelling regime (Hu, et. al., 2005). Studies concerning labelling regimes for GM wheat products are not extensive enough in terms of the wheat products considered to be conclusive.

Conclusion

This paper is the result of an effort to collect and overview the academic papers and published research concerning ethical and consumer issues for GM crops in North America, with particular emphasis on GM wheat. The issues raised in these papers and the findings and arguments posed by the authors have been outlined. In summary, a general conclusion can be drawn that public attitudes toward GM foods are diverse and sometimes quite strongly held. There is not universal agreement about such regulatory issues as labelling, and ethical and risk assessment issues have not been fully explored. There is general consensus that GM crops result in economic benefits, though the individual benefits to consumers may not be great enough to overcome perceived risk. Carefully planned credible information provision and GM applications with distinct explicit benefits to consumers may lead to changes in attitudes. Having trust in the food and regulatory system is an important influence on attitudes.

Many of the issues for GM wheat are analogous to the issues for GM crops as a whole. There is some indication in published applied economic research studies that the impact of GM wheat may be negative, however the nature of potential negative effects may not differ greatly from issues affecting other GM crops. If buyers find the product acceptable and the product is viewed to be beneficial by consumers, potential benefits are likely to outweigh negative effects.

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Genetically Modified Food and Ethics

Author	Date	Title	Source	Comments
Burkhardt, J.	2001	The Genetically Modified Organism and Genetically Modified Foods Debates: Why Ethics Matters	<i>Transactions of the Wisconsin Academy of Sciences, Arts and Letters</i> , Vol. 89, p. 63-82	Discusses the ethics of GM food and the factors that affect public acceptance. Presents three ethical paradigms: Consequentialist Ethics, Ethics of Autonomy/Consent, and Ethics of Virtue/Tradition
Carr, S. & Levidow, L.	2000	Exploring the Links Between Science, Risk, Uncertainty, and Ethics in Regulatory Controversies about Genetically Modified Crops	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 12(1), p. 29-39	Argues risk assessment decisions must be based in science. Examines how ethical decisions are being suppressed in the regulatory scheme. Discusses how a check on the values at the basis of decisions, using boundary-testing questions, can contribute to a more constructive regulatory dialogue.
Ellerbrock, M.	2002	Metaphysical Keys to Evaluating Agricultural Biotechnology: Eschatological Myths & Epistemological Tests	Joint Annual Meetings of the <i>Association for the Study of Food and Society and Agriculture, Food, and Human Values Society</i> , Chicago, IL, June 13-16, 2002	Argues that, in order to assess agricultural biotechnology, it is necessary to adopt a common language that speaks to basic human values. Proposes that myth is suitable. Argues that evaluating the social context in which biotechnology is developed involves principles of social ethics and epistemological tests. Proposes a set of moral and spiritual criteria for evaluating the impact of biotechnology on indigenous societies.
Fraser, V.	2001	What's the Moral of the GM Food Story?	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 14(2), p. 147-159	Examines the issues and problems raised by agricultural biotechnology in the context of ethical theory. Argues that many of the negative aspects do not come from the unintended effects of biotechnology. Argues that if ethics is to address the adverse impacts of agricultural biotechnology, it must consider its conceptual framework emerging from Enlightenment, liberal, political and economic theory. Suggests that narrative and feminist critiques of medical bioethics are a good place to start this project.
Holtug, N.	2001	The Harm Principle and Genetically Modified Food	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 14(2), p. 169-178	Argues the Harm Principle is the moral basis on which GM food is currently regulated, but that the concept of harm cannot be specified such that the Harm Principle is a plausible political principle. In addition, the Harm Principle does not express concern for the expected benefits of GM food. Because of these two points, the Harm Principle cannot be used to

				justify regulation.
Levidow, L.	2001	Utilitarian Bioethics? Market Fetishism in the GM Crops Debate	<i>New Genetics and Society</i> , Vol. 20(1), p. 75-84	Proposes three main ethical principles guiding GM crops: the principle of general human welfare; the maintenance of people's rights; and the principle of justice. Argues that mass protest has changed the form of ethics debate such that utilitarian ethics pervades market relations today.
Levidow, L. & Carr, S.	1997	How Biotechnology Regulation Sets a Risk/Ethics Boundary	<i>Agriculture and Human Values</i> , Vol. 14(1), p. 29-43	Suggests critics of biotechnology have challenged the biotechnological R&D agenda for attributing socio-agronomic problems to genetic deficiencies, while perpetuating the hazards of intensive monoculture. They see ominous links between technological dependency and tangible harm from biotechnology products. Criticizes the European Community for devising an official bioethics that judges where to 'draw the line', as if the science were value-free. Criticizes the separation of risks and ethics.
Macer, D.	1997	Biotechnology in Agriculture: Ethical Aspects and Public Acceptance	<i>Biotechnology in Agriculture</i> , ed. A. Altman (Marcel Dekker, New York 1997) p. 661-690, online at: www2.unescobkk.org/eubios/Papers/agbio.htm	Expounds the historical background of bioethics. Discusses the public perception of benefits and risks in biotechnology. Discusses an international bioethics survey covering: <ul style="list-style-type: none"> • Knowledge and awareness of biotechnology; • Benefits and risks of biotechnology; • Food concerns and human health; • Environmental concerns; • Source of information and trust in authorities; and, • Economic concerns and patenting life. Discusses bioethical principles for biotechnology. Determines that people do not have a simplistic view of science and technology, and can perceive both risks and benefits. Found the differences of view within each country run deep, suggesting people will always be divided.
Macer, D.	2001	Bioethics: Perceptions of Biotechnology and Policy Implications	<i>International Journal of Biotechnology</i> , Vol. 3(1-2), p. 116-133	Argues that most people in industrialized countries perceive more benefit than harm from science. Looks at public awareness and concerns about biotechnology around the world and discusses the implications for education and information. Assesses the issue of risk assessment for environmental impact and the safety of GM foods. Discusses equity and the patenting of living organisms.
Mackie, J.;	2006	Lessons on Ethical	<i>PloS Medicine</i> , Vol. 3(5), p. 1-	Sought to determine how bioscience companies address ethical issues.

Taylor, A.; Finegold, D.; Daar, A. & Singer, P.		Decision Making from the Bioscience Industry	6	<p>Found five approaches:</p> <ol style="list-style-type: none"> 1. Ethical Leadership 2. External Expertise (i.e. ethics consultant) 3. Internal Ethics Mechanisms (ethics education, ethical reinforcement) 4. External Ethics Engagement (ethics mechanisms with partners and suppliers, strategic philanthropy) 5. Ethics Evaluation and Reporting Mechanisms <p>Found they address ethics issues because it is the ‘right thing’, they want to keep their reputation, to attract and keep the ‘right employees’, and to promote good science.</p>
Melin, A.	2004	Genetic Engineering and the Moral Status of Non-Human Species	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 17(6), p. 479-495	<p>Argues the concept that collective entities such as species belong to the moral sphere.</p> <p>Analyzes what the practical consequences of this position would be on genetically engineered food.</p>
Myrh, A. & Traavik, T.	2002	The Precautionary Principle: Scientific Uncertainty and Omitted Research in the Context of GMO Use and Release	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 15(1), p. 73-86	<p>Argues there is scientific uncertainty and ambiguity, omitted research areas, and lack of basic knowledge crucial to risk assessments in the GM controversy.</p> <p>Concludes that the void in scientific understanding concerning risks warrants further research.</p> <p>Argues that scientists have a responsibility to address and communicate uncertainty to policymakers and the public.</p>
Myrh, A. & Traavik, T.	2003	Genetically Modified (GM) Crops: Precautionary Science and Conflicts of Interests	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 16(3), p. 227-247	<p>Argues that the lack of data and insufficient information concerning ecological effects of GM food call for the application of the Precautionary Principle.</p> <p>Recognizes differences of opinions among scientists about the relevance of putative hazards, definition of potential “adverse effects”, and whether actions should be taken to prevent harm.</p> <p>Recognizes that value assumptions embedded in a scientific framework may be a barrier for employment of the precautionary principle.</p> <p>Concludes that precautionary GM usage requires risk assessment criteria yet undeveloped and more long-term conceptions of risk, uncertainty, and ignorance.</p>
Napier, T.; Tucker, M.; Henry, C. & Yang, X.	2004	Ethical Orientations of Ohio Residents toward Genetically Engineered Plants and Animals: an	<i>Journal of Food, Agriculture and Environment</i> , Vol. 2(2), p. 400-411	<p>Collected data concerning ethical orientations using a structured questionnaire. Assessed the orientations using a Likert-type scale.</p> <p>Found the theoretical model was effective for predicting variability in ethical orientations toward GE plants and animals.</p>

		Urban/Rural Comparison		Found that perceived risk was the best predictor of ethical orientations. Found differences between rural and urban respondents.
Pascalev, A.	2003	You Are What you Eat: Genetically Modified Foods, Integrity, and Society	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 16(6), p. 583-594	Argues food choice can be connected to a person's personal integrity. Identifies three types of integrity threatened by GM foods: religious, consumer, and other moral or metaphysical grounds. Develops a set of objections to GM grounded in the concept of integrity. Argues these types of integrity are important enough to justify actions to protect these individuals' interests.
Prakash, C.	2001	The Genetically Modified Crop Debate in the Context of Agricultural Evolution	<i>Plant Physiology</i> , Vol. 126(1), p. 8-15	Discusses plant biotechnology in the context of consumer concern and the need for increased consumer education. Considers ethical and safety concerns, environmental hazards, gene transfer technologies as a logical extension of prior crop breeding strategies, and the historical background of eventual consumer acceptance of new food-related technologies.
Reiss, M.	2001	Ethical Considerations at the Various Stages in the Development, Production, and Consumption of GM Crops	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 14(2), p. 179-190	Seeks to clarify the ethical issues surrounding GM crops. Examines the development, production, and consumption of GM crops separately. Argues one cannot use the binary categorization of "good" and "bad" in assessing GM crops. Looks particularly at the duties of scientists, companies, regulatory systems, farmers, retailers, and consumers.
Rousu, M. & Huffman, W.	2001	GM Food Labelling Policies of the U.S. and its Trading Partners	Staff Paper Series, Department of Economics, Iowa State University, (344)	Examines the labelling policies of the USA, EU, Australia, Japan, Canada, and China. Discusses how different policies are due to different ethical concerns and the difference in perceived risks posed to health, the environment, and trade.
Streiffer, R. & Hedemann, T.	2005	The Political Import of Intrinsic Objections to Genetically Engineered Food	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 18(2), p. 191-210	Points out that intrinsic objections to GM have been widely criticized as unsound, incompatible with modern science, religious, inchoate, and based on emotion rather than reason and entirely irrelevant in the development of public policy. Argues they may have some merit as ethical objections, and have greater political import than previously recognized. Argues discussion should not centre on the substantive merit of the intrinsic objections, but rather on appropriate political norms for achieving legitimate policy.

Consumer Issues in Genetically Modified Food – Consumer Acceptance – General

Author	Date	Title	Source	Comments
Anderson, J.; Wachenheim, C. & Lesch, W.	2005	Perceptions of Genetically Modified and Organic Foods and Processes: North Dakota College Students	<i>Agribusiness and Applied Economics Report</i> , Department of Agribusiness and Applied Economics, North Dakota State University	North Dakota college students responded to a survey either about GM food or organic food. Found organic food was perceived as healthier, safer, and more environmentally sound. Found concern over unknown effects of GM foods. Found participants thought GM could be used effectively and did have some value.
Charles, D.	2001	Why North Americans Think what they do About GM Food	<i>Biotechnology and Development Monitor</i> , Iss. 47, p. 10-12	Discusses the issues and controversies surrounding GM food. Concludes those who oppose GM food are a minority.
D'Souza, C. & Quazi, A.	2005	The Dynamics of Exploring Future Market Potential of Genetically Modified Foods	<i>Nutrition and Food Science</i> , Vol. 35(2), p. 95-108	Reviews consumer opinions about GM foods to gain insight into how these goods can be marketed more effectively. Considers: consumer perceptions of GM foods, problems in marketing GM foods, external influences that affect consumer perceptions of GM technology, consumer value expectations, and consumer attitudes and intentions to purchase GM foods.
Fischhoff, B. & Fischhoff, I.	2001	Publics' Opinions about Biotechnologies	<i>AgBioForum</i> , Vol. 4(3&4), p. 155-162	Concludes different people have different views about biotechnologies, those views are strongly held, and people have complex evaluative schemes. As a result, it is not possible to make any broad statement about 'the public's opinion of biotechnology'.
Groth, E.	2001	The Debate over Food Biotechnology in the United States: Is a Societal Consensus Achievable?	<i>Science and Engineering Ethics</i> , Vol. 7(3), p. 327-346	Considers the debate over acceptance of GM in the context of previous technological innovations that also caused controversy. Presents some characteristics of a process for seeking a societal consensus.
Hossain, F.; Onyango, B.; Adelaja, A.; Schilling, B. & Hallman, W.	2002	Public Perceptions of Biotechnology and Acceptance of Genetically Modified Food	Working Paper (Rutgers University, Food Policy Institute), Jun. 2002, available online at: http://www.foodpolicyinstitute.org/docs/working/Approval%20of%20Food%20Biotech%20WP-0602-002.pdf	Analyzes public acceptance of biotechnology in food production. Found that while there is general optimism about biotechnology, and support for its use in plants, public approval of its use in animals is more limited. Found that younger and more educated people are generally more supportive of biotechnology. Found income and regional differences do not have a significant effect on attitude.

Hossain F.; Onyango, B.; Adelaja, A.; Schilling, B. & Hallman, W.	2002	Uncovering Factors Influencing Public Perceptions of Food Biotechnology	Working Paper (Rutgers University, Food Policy Institute), Jun. 2002, available online at: http://www.foodpolicyinstitute.org/docs/working/Perception%20of%20Food%20Biotech-WP-0602-003.pdf	Conducted a survey to determine consumer attitudes toward genetic modifications to plants and animals that bring specific health and economic benefits, moral and ethical concerns about plant and animal genetics, perceptions of health and environmental risks, and willingness to accept GM products. Also collected socio-economic and value characteristics. Found public attitudes toward biotechnology are mixed. Found public attitude is based on six factors, ranging from excitement about biotechnology and its benefits to fear and distrust of the technology, with undecided people in between. Found public opinion is influenced by age, gender, racial background, education and religious views.
James, J.	2004	Consumer Knowledge and Acceptance of Agricultural Biotechnology Vary	<i>California Agriculture</i> , Vol. 58(2), p. 99-105	Conducted consumer surveys in the USA. Found consumers don't agree about whether biotechnology is good or bad. Found a small group of people strongly opposes GM food. Found the majority of consumers are uninformed about biotechnology. Argues small anti-biotechnology activist groups are therefore able to influence public opinion.
Kalaitzandonakes, N.; Marks, L. & Vickner, S.	2005	Sentiments and Acts Towards Genetically Modified Foods	<i>International Journal of Biotechnology</i> , Vol. 7(1-3), p. 161-177	Argues theoretical and methodological reasons why stated and revealed consumer preference toward GM food diverge. Provides empirical evidence of consumer revealed preferences. Found that a majority of consumers did not shift away from GM foods even in the presence of alternatives.
Lea, E.	2005	Beliefs About Genetically Modified Foods: A Qualitative and Quantitative Exploration	<i>Ecology of Food and Nutrition</i> , Vol. 44(6), p. 437- 454	Conducted a questionnaire based survey in Australia. Participants were generally negative about GM foods. Found some misconceptions among respondents.
Paparini, A. & Romano-Spica, V.	2004	Public Health Issues Related with the Consumption of Food Obtained from Genetically Modified Organisms	<i>Biotechnology Annual Review</i> , Vol. 10, p. 85-122	Argues that public opinion looks at biotechnology with either growing concern or disapproval. Argues risk assessment is of primary importance for acquiring knowledge on GMO production, GM food consumption, and GMO interaction with humans and the environment. Focuses on public health risks related with a GM foods diet. Summarizes research, provides technical information, and points out problems and perspectives.

Prakash, C.	2001	The Genetically Modified Crop Debate in the Context of Agricultural Evolution	<i>Plant Physiology</i> , Vol. 126(1), p. 8-15	Discusses plant biotechnology in the context of consumer concern and the need for increased consumer education. Considers ethical and safety concerns, environmental hazards, gene transfer technologies as a logical extension of prior crop breeding strategies, and the historical background of eventual consumer acceptance of new food-related technologies.
Veeman, M.; Adamowicz, W; Hu, W. & Hunnemeyer, A.	2005	Canadian Attitudes to Genetically Modified Food	<i>Crossing Over</i> (E. Einsiedel & F. Timmermans, Eds.) University of Calgary Press, 2005: 99-113	Conducted a Canada-wide survey to test the effects of different types of information for pre-packaged sliced bread. One experiment focused on the influence of different types of information from different sources. The second experiment focused specifically on the effects of different labelling policies. Found low trust in the food industry, farmers associations and the federal government as sources of information. Found high trust in research institutions and consumer associations. Found a majority do not have strong views either for or against GM foods. Found strong support for mandatory labelling, though a majority preferred stricter regulation to mandatory labelling. Found respondents were less likely to purchase GM bread, though this aversion was reduced if there was a positive health or environmental effect. Found those who accessed further information were more opposed to GM ingredients than those who did not access further information. Found the loss in welfare from labelling GM foods was higher than the gain in welfare from labelling non-GM foods.
Verdurme, A. & Viaene, J.	2003	Consumer Beliefs and Attitude Towards Genetically Modified Food: Basis for Segmentation and Implications for Communication	<i>Agribusiness</i> , Vol. 19(1), p. 91-113	Based on a survey, created four consumer segments: Halfhearted, Green Opponents, Balancers, and Enthusiasts. Found 23.5% Enthusiasts, 15.5% Reluctant, and 61% Balancers or Halfhearted. Each identified segment can be further profiled in terms of socio-economic and demographic characteristics.
Watkins, C.	2002	GM: To Eat or not to Eat? Consumer Perceptions of GM Food	<i>INFORM International News on Fats, Oils and Related Materials</i> , Vol. 13(6), p. 444-452	Conducted surveys on attitudes toward GM foods. Found consumers are becoming less confident in biotechnology. Found understanding of biotechnology remains low. Found Australian, US, and Canadian consumers have a high level of trust in regulatory systems, compared to Europe and Japan.

Consumer Issues in Genetically Modified Food – Consumer Acceptance – Risk/Benefit Perception

Author	Date	Title	Source	Comments
Costa-Font, J. & Mossialos, E.	2005	Are Perceptions of 'Risks' and 'Benefits' of Genetically Modified Food (In)Dependent?	<i>Food Quality and Preference</i> , In Press, Corrected Proof, Available Online 4 November 2005 (http://www.sciencedirect.com/science/article/B6T6T-4HGM76R-1/2/1b850de642535e77f044170490eaa412)	A study on the formation of risk and benefit perceptions of genetically modified food. Found that risks and benefits perceptions are not independent. They are endogenously and simultaneously determined.
Frewer, L.	2003	Societal Issues and Public Attitudes Towards Genetically Modified Foods	<i>Trends in Food Science and Technology</i> , Vol. 14(5-8), p. 319-332	Discusses how people think about the genetic modification of food, and the implications public attitudes have for the development of regulations, with emphasis on public risk perception and why attitudes to risk may differ from those held by technical risk experts. Discusses the development of institutional mechanisms that can be used to integrate the values held by consumers. Argues important determinants of consumer acceptance are: the analytical assessment of risk and benefit and communication of that analysis, ethical and moral considerations, uncertainties and concerns about unintended effects, and trust in the regulatory system. Argues developing best practice in science communication about the risks and benefits of GM food is not enough to foster public confidence, that we must involve the public explicitly in the biotechnology debate.
Frewer, L.; Howard, C. & Aaron, J.	1998	Consumer Acceptance of Transgenic Crops	<i>Pesticide Science</i> , Vol. 52(4), p. 388-393	Argues that a key determinant of the future of genetically modified food is consumer acceptance. Argues that acceptance of novel products is not related to general attitudes toward genetic engineering, rather, it is people's perceptions of risks and benefits. Argues there must, therefore, be effective risk-benefit communication strategies, and methods for receiving communication from the public.
Frewer, L.; Lassen, J.; Kettlitz, B.; Scholderer, J.;	2004	Societal Aspects of Genetically Modified Foods	<i>Food and Chemical Toxicology</i> , Vol. 42(7), p. 1181-1193	Examines the reasons behind the public controversy over genetically modified foods in Europe in the context of risk perceptions and attitudes, public trust in regulatory institutions, scientists, and industry, and the need to develop communication strategies.

Beekman, V. & Berdal, D.				Recommends that new methods be developed to include public values better in risk analysis processes.
Hu, W.; Hunnemeyer, A.; Veeman, M.; Adamowicz, W. & Srivastava, L.	2004	Trading Off Health, Environmental and Genetic Modification Attributes in Food	<i>European Review of Agricultural Economics</i> , Vol. 31(3), p. 389-401	Examines the trade-offs between risks and benefits of GM foods, using a survey with bread as the specific food object. Uses a latent class model to analyze consumers' preferences for GM foods. Found some consumers are indifferent to GM ingredients. Found considerable diversity in risk attitudes towards GM foods. Found 55% of consumers perceive little or no risk to GM foods. The remainder are distinctly adverse or perceive significant risks. Found the trade-offs between risks and benefits depend upon individual characteristics. Found an average discount of 0.50 CAD per GM loaf of bread.
Madsen, K. & Sandoe, P.	2005	Ethical Reflections on Herbicide-Resistant Crops	<i>Pest Management Science</i> , Vol. 61(3), p. 318-325	Proposes that risk perception of scientific experts differs from that of the public. Presents risks of herbicide-resistant crops from both points of view. Argues there is common ground in the issue of the uncertainty inherent in risk assessment.
Moon, W. & Balasubramanian, S.	2001	Public Perceptions and Willingness-to-Pay a Premium for non-GM Foods in the US and UK	<i>AgBioForum</i> , Vol. 4(3&4), p. 221-231	Conducted a survey to measure acceptance of GM, risk-benefit perceptions, and willingness to pay. Found that subjective risk and benefit perceptions affect behavioural intentions as measured by willingness to pay a premium. Found particularly that the stronger the perception of a health risk the greater the willingness to pay a premium for non-GM foods. Found risk perception plays a more significant role than benefit perception in determining willingness to pay.
Napier, T.; Tucker, M.; Henry, C. & Whaley, S.	2004	Consumer Attitudes toward GMOs: the Ohio Experience	<i>Journal of Food Science</i> , Vol. 69(3), p. CRH69-CRH76	Collected data from urban residents of Ohio to assess attitudes toward the production of GM foods, using Likert-type attitude statements. Created a theoretical model from diffusion and risk perception theories. Regression found the theoretical model was very good for predicting variability in attitudes toward GM foods. Results discussed in the context of the social acceptability of GM foods.
Onyango, B.; Govindasamy, R. & Nayga, R., Jr.	2004	Measuring U.S. Consumer Preferences for Genetically Modified Foods Using Choice Modeling	Working Paper, Food Policy Institute, 2004, (WP1104-017)	Models consumer willingness to trade off the potential risks of GM foods with the possibility of significant benefits. Results show how different attributes of price, product benefits and technology influence consumer demand for GM foods. Found direct health, environmental and production benefits have a positive

		Experiments: the Role of Price, Product Benefits and Technology		effect on choice. Found genetic modification is viewed negatively, with genetic modification of animals being viewed more negatively than genetic modification of plants.
Traill, W.; Jaeger, S.; Yee, W.; Valli, C.; House, L.; Lusk, J.; Moore, M. & Morrow, J. Jr.	2004	Categories of GM Risk-Benefit Perceptions and their Antecedents	<i>AgBioForum</i> , Vol. 7(4), p. 176-186	Hypothesizes that consumer risk-benefit perceptions cover up to eight dimensions: risks to business, benefits to business, risks and benefits to the environment, risks and benefits to the developing world, and risks and benefits to self and family. These different dimensions are investigated. Found the majority of consumers perceived only a medium level of risk from GM. Found those with a positive attitude toward technology in general tend to have a positive attitude toward GM. Found those who trust the government and food industry perceive less risk, while those who trust activists perceive more risk.
Tucker, M.; Whaley, S. & Sharp, J.	2006	Consumer Perceptions of Food-Related Risks	<i>International Journal of Food Science and Technology</i> , Vol. 41(2), p. 135-146	Purpose was to assess perceptions of various food safety risks and to identify factors influencing risk judgements. Found pesticide residues in food and contamination of water generated the highest levels of perceived risk. Found mad cow disease and GM foods generated the lowest levels of perceived risk. Found that attitude toward biotechnology was the strongest predictor of perceived risk.
Veeman, M. & Adamowicz, W.	2004	Genetically Modified Foods: Consumers' Attitudes and Labeling Issues	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2004, (04-01)	Gave two hypothetical scenarios: <ul style="list-style-type: none"> • The first was to assess preference for a policy that would place regulatory restrictions on the production, processing or marketing of food, versus a policy that would increase food inspection. • The second assessed preferences for a policy that would regulate restrictions on the production, processing or marketing of food, versus a policy for developing a labelling system for food that gives information on the effects of agricultural biotechnology. Results suggest that many consumers are prepared to make trade-offs for higher levels of information or assurance of food quality. Results suggest that Alberta consumers are more willing to pay for a policy that would provide more information about agricultural biotechnology on food labels, and for more emphasis on food inspection. They were willing to pay the least amount for a policy that would restrict biotechnology.

				<p>Participants in focus groups identified health and environmental issues as areas of major concern for GM food.</p> <p>Also did a survey of Canadian households in general.</p> <p>Survey found that GM foods were believed to be very risky by an appreciable number of respondents, but less risky for food safety than most other food risks. Respondents tended to see agricultural biotechnology of somewhat more of an environmental risk issue than an issue of food safety.</p>
Veeman, M.; Adamowicz, W. & Hu, W.	2005	Risk Perceptions, Social Interactions and the Influence of Information on Social Attitudes to Agricultural Biotechnology	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2005, (05-02)	<p>Conducted experiments to determine Canadian perceptions of the risk of GM food and how their opinions are formed, and how they affect their choices.</p> <p>Found biotechnology for animals is a more important food safety issue than biotechnology for plants, though neither was the most pressing food safety issue.</p> <p>Found people rely mostly on magazines/newspapers for information about health risks and food benefits.</p> <p>Found Canadians are not well informed about genetic modification.</p> <p>Found the majority do not have strong views either for or against genetic modification.</p> <p>Found that preferences concerning GM food and the associated perceived risks of the product are diverse.</p> <p>Found that consumers will search for information only if the benefits outweigh the costs.</p>
Wachenheim, C.	2004	Consumer Acceptance of Genetically Modified Food Products	<i>AgBiotechNet</i> , 6(ABN 126), p. 6	<p>Proposes consumers are not well informed about biotechnology applications although they perceive themselves to be more informed than demonstrated.</p> <p>Argues risks that are perceived as involuntary are especially troublesome to consumers, supporting the labelling of products.</p> <p>Proposes that providing information can increase willingness to pay.</p> <p>Proposes that there are certain market segments more open to different types of biotechnology.</p>
Wu, F.	2004	Explaining Public Resistance to Genetically Modified Corn: An Analysis of	<i>Risk Analysis</i> , Vol. 24(3), p. 715-726	<p>Argues a cause of public hesitation to GM crops may be that consumers do not perceive significant benefits to themselves from GM crops, while fearing certain risks.</p> <p>Conducts an economic analysis to determine whether the benefits of one</p>

		the Distribution of Benefits and Risks		type of GM corn outweigh the potential risks, and who bears those benefits and risks. Found that growers, consumers, and industry all benefit. Found the welfare gain to individual consumers is small and may not make up for perceived risks.
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Consumer Issues in Genetically Modified Food – Consumer Acceptance – Attitude Formation

Author	Date	Title	Source	Comments
Bredahl, L.	2001	Determinants of Consumer Attitudes and Purchase Intentions with regard to Genetically Modified Foods – Results of a Cross-National Survey	<i>Journal of Consumer Policy</i> , Vol. 24(1), p. 23-61	Conducted a survey to investigate the formation of consumer attitudes toward GM foods in Denmark, Germany, Italy, and the UK. Found the attitude towards GM was embedded in more general attitudes held by the consumers, particularly towards nature and towards technology. Found attitudes are particularly strong despite having no basis in actual product experience.
Cook, A.; Kerr, G. & Moore, K.	2002	Attitudes and Intentions towards Purchasing GM Food	<i>Journal of Economic Psychology</i> , Vol. 23(5), p. 557-572	Identifies the nature, strength, and relative importance of influences on intentions to purchase GM food. Develops a model of intention to purchase GM food. Found that self-identity, attitude, subjective norm and perceived behavioural control were significant in determining intention.
Cuite, C.; Aquino, H. & Hallman, W.	2005	An Empirical Investigation of the Role of Knowledge in Public Opinion About GM Food	<i>International Journal of Biotechnology</i> , Vol. 7(1/2/3), p. 178-194	Examines the hypothesis that the most effective method of increasing approval of GM foods is to provide education about them. Conducted a telephone survey in the USA. Found that all knowledge measures were positively related to approval. Found when knowledge variables were entered in a regression model, only knowledge about potentially threatening aspects of GM food was significantly related to approval. Concludes knowledge is just one of many factors influencing opinion of GM food.
Frewer, L.	2003	Societal Issues and Public Attitudes Towards Genetically Modified Foods	<i>Trends in Food Science and Technology</i> , Vol. 14(5-8), p. 319-332	Discusses how people think about the genetic modification of food, and the implications public attitudes have for the development of regulations. Emphasizes public risk perception and why attitudes to risk may differ from those held by technical risk experts. Discusses the development of institutional mechanisms that can be used to integrate the values held by consumers. Proposes that important determinants of consumer acceptance are: the analytical assessment of risk and benefit and communication of that analysis, ethical and moral considerations, uncertainties and concerns about unintended effects, and trust in the regulatory system. Argues developing best practice in science communication about the risks and benefits of GM food is not enough to foster public confidence.

				Argues we must involve the public explicitly in the biotechnology debate.
Honkanen, P. & Verplanken, B.	2004	Understanding Attitudes towards Genetically Modified Food: The Role of Values and Attitude Strength	<i>Journal of Consumer Policy</i> , Vol. 27(4), p. 401-420	Conducted a questionnaire measuring attitudes toward GM food, attitude strength, intention to buy such food, and their personal values. Found values and attitude strength are important constructs when explaining the attitudes. Estimated a structural model and found that negative attitudes were embedded in universalism and hedonism values. Found central attitudes mediated the relation between values and behavioural intention.
De Liver, Y.; van der Pligt, J. & Wigboldus, D.	2005	Unpacking Attitudes towards Genetically Modified Food	<i>Appetite</i> , Vol. 45(3), p. 242-249	Conducted a questionnaire examining overall attitude, cognition and affect toward GM food. Found the data was best accounted for using a model with distinct positive and negative, and affective and cognitive components, and a separate parameter for perceived risk and worry. Found behavioural intentions were directly influenced by negative, but not positive components.
Lusk, J. & Coble, K.	2005	Risk Perceptions, Risk Preference, and Acceptance of Risky Food	<i>American Journal of Agricultural Economics</i> , Vol. 87(2), p. 393-405	Found that risk preferences are significantly related to consumers' stated preferences for GM food. Found that risk perceptions and risk preferences are significant determinants of acceptance of GM food.
Spence, A. & Townsend, E.	2006	Implicit Attitudes Towards Genetically Modified (GM) Foods: A Comparison of Context-Free and Context-Dependent Evaluations	<i>Appetite</i> , Vol. 46(1), p. 67-74	Compared implicit attitudes toward GM food with explicit attitudes. Found explicit attitudes toward GM foods were neutral. Found positive implicit attitudes toward GM foods when assessed in a context free manner.
Veeman, M.; Adamowicz, W. & Hu, W.	2005	Risk Perceptions, Social Interactions and the Influence of Information on Social Attitudes to Agricultural Biotechnology	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2005, (05-02)	Did experiments to determine Canadian perceptions of the risk of GM food and how their opinions are formed, and how they affect their choices. Found biotechnology for animals is a more important food safety issue than biotechnology for plants, though neither was the most pressing food safety issue. Found the majority of Canadians do not have strong views either for or against genetic modification. Found that preferences concerning GM food and the associated perceived risks of the product are diverse. Found those who did seek information about GM food were more strongly

				<p>opposed to it. Found consumers are less likely to choose food with GM ingredients. Found that where mandatory labelling is required, GM labelled products are adversely viewed. Found that attitudes to GM ingredients can be negative, neutral, or positive.</p>
<p>Veeman, M.; Adamowicz, W; Hu, W. & Hunnemeyer, A.</p>	<p>2005</p>	<p>Canadian Attitudes to Genetically Modified Food</p>	<p><i>Crossing Over</i> (E. Einsiedel & F. Timmermans, Eds.) University of Calgary Press, 2005: 99-113</p>	<p>Conducted a Canada-wide survey to test the effects of different types of information for pre-packaged sliced bread. One experiment focused on the influence of different types of information from different sources. The second experiment focused specifically on the effects of different labelling policies. Found low trust in the food industry, farmers associations and the federal government as sources of information. Found high trust in research institutions and consumer associations. Found a majority do not have strong views either for or against GM foods. Found strong support for mandatory labelling, though a majority preferred stricter regulation to mandatory labelling. Found respondents were less likely to purchase GM bread, though this aversion was reduced if there was a positive health or environmental effect. Found those who accessed further information were more opposed to GM ingredients than those who did not access further information. Found the loss in welfare from labelling GM foods was higher than the gain in welfare from labelling non-GM foods.</p>

Consumer Issues in Genetically Modified Food – Consumer Acceptance – Reasons for Acceptance/Attitude

Author	Date	Title	Source	Comments
Anderson, J.; Wachenheim, C. & Lesch, W.	2005	Perceptions of Genetically Modified and Organic Foods and Processes: North Dakota College Students	<i>Agribusiness and Applied Economics Report</i> , Department of Agribusiness and Applied Economics, North Dakota State University	North Dakota college students responded to a survey either about GM food or organic food. Found organic food was perceived as healthier and safer, and more environmentally sound. Found concern over unknown effects of GM foods. Found participants thought GM could be used effectively and did have some value.
Bredahl, L.	1999	Consumers' Cognitions with Regard to Genetically Modified Foods. Results of a Qualitative Study in Four Countries	<i>Appetite</i> , Vol. 33(3), p. 343-360	Objective was to gain insight into consumer attitudes toward GM food. Used means-end chain theory as a basis for interviewing participants. In all four countries genetic modification was associated with unnaturalness and low trustworthiness of the product. Found concerns based in moral, individual, and social values.
Chen, H. & Chern, W.	2002	Consumer Acceptance of Genetically Modified Foods	Paper prepared for presentation at the Annual Meeting of the American Agricultural Economics Association, Long Beach, California, July 28-31, 2002, online at agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=4339	Argues consumer concerns include uncertainty about the effects of GM food on health, religious and ethical concerns, lack of identification of these products, and potential environmental danger. Found that consumer acceptance is determined by attitudinal factors such as risk perception, environmental impacts, perceived difference between GM and non-GM foods, and the potential benefits of GM foods. Found a necessity to educate the general public about GM foods with non-biased scientific information. Argues a need to provide labelling to establish consumer confidence. Found a willingness to pay a premium to differentiate between GM and non-GM food.
Dreezens, E.; Martijn, C.; Tenbult, P.; Kok, G. & de Vries, N.	2005	Food and Values: An Examination of Values Underlying Attitudes toward Genetically Modified and Organically Grown Food Products	<i>Appetite</i> , Vol. 44(1), p. 115-122	Examined whether attitudes to GM food and organic food are influenced by specific values and beliefs. Found that high scores for the value power (dominance, submission) were associated with positive ratings for GM foods and more negative ratings for organic foods. Concludes that values may contribute to explaining attitudes toward GM and organic foods.
Hall, C. & Moran, D.	2006	Investigating GM Risk Perceptions: A Survey of Anti-GM and	<i>Journal of Rural Studies</i> , Vol. 22(1), p. 29-37	Investigates how members of anti-GM campaign groups and environment groups perceive the risks and benefits of GM technology. Found respondents were unconvinced that future GM technology will provide

		Environmental Campaign Group Members		additional consumer (or environmental) benefit. Found an inverse relationship between perceived risk and perceived benefit.
Hossain, F.; Onyango, B.; Adelaja, A.; Schilling, B. & Hallman, W.	2003	Consumer Acceptance of Food Biotechnology: Willingness to Buy Genetically Modified Food Products	<i>Journal of International Food and Agribusiness Marketing</i> , Vol. 15(1/2), p. 53-76	Examines consumer acceptance of genetically modified food by modeling consumers' willingness to buy. Found that younger, white, male and college educated people are more likely to accept food biotechnology. Found confidence in scientists, corporations and government has a significant effect on consumer acceptance.
Hossain, F.; Onyango, B.; Adelaja, A.; Schilling, B. & Hallman, W.	2002	Uncovering Factors Influencing Public Perceptions of Food Biotechnology	Working Paper (Rutgers University, Food Policy Institute), Jun. 2002, available online at: http://www.foodpolicyinstitute.org/docs/working/Perception%20of%20Food%20Biotech-WP-0602-003.pdf	Conducted a survey to determine consumer attitudes toward genetic modifications to plants and animals that bring specific health and economic benefits, moral and ethical concerns about plant and animal genetics, perceptions of health and environmental risks, and willingness to accept GM products. Also collected socio-economic and value characteristics. Found public attitudes toward biotechnology are mixed. Found public attitude is based on six factors, ranging from excitement about biotechnology and its benefits to fear and distrust of the technology, with undecided people in between. Found public opinion is influenced by age, gender, racial background, education and religious views.
House, L.; Lusk, J.; Jaeger, S.; Traill, W.; Moore, M.; Valli, C.; Morrow, B. & Yee, W.	2004	Objective and Subjective Knowledge: Impacts on Consumer Demand for Genetically Modified Foods in the United States and the European Union	<i>AgBioForum</i> , Vol. 7(3), p. 113-123	Found higher education increased acceptance, found higher income decreased acceptance. Found those who trust government sources are more accepting, and those who trust activist sources are less accepting.
Lassen, J.; Madsen, K. & Sandoe, P.	2002	Ethics and Genetic Engineering – Lessons to be Learned from GM Foods	<i>Bioprocess and Biosystems Engineering</i> , Vol. 24(5), p. 263-271	Argues the failure of GM foods in Europe is due to the failure of industry, researchers and public authorities to address the concerns of the general public. Using quantitative and qualitative studies, provides an in-depth understanding of the concerns of the general public regarding GM food.
Lusk, J. & Coble, K.	2005	Risk Perceptions, Risk Preference, and Acceptance of Risky Food	<i>American Journal of Agricultural Economics</i> , Vol. 87(2), p. 393-405	Found that risk preferences are significantly related to consumers' stated preferences for GM food. Found that risk perceptions and risk preferences are significant determinants of acceptance of GM food.
Lusk, J.;	2004	Effect of Information	<i>European Review of</i>	Used an incentive compatible auction mechanism to assess consumer willingness to

House, L.; Valli, C.; Jaeger, S.; Moore, M.; Morrow, J. & Traill, W.		about Benefits of Biotechnology on Consumer Acceptance of Genetically Modified Food: Evidence from Experimental Auctions in the United States, England, and France	<i>Agricultural Economics</i> , Vol. 31(2), p. 179-204	accept compensation to consume GM food. Found information on environmental benefits, health benefits, and benefits to the third world significantly decreased the amount of money consumers demanded to consume GM food. Found initial attitudes toward biotechnology have a significant effect on how individuals respond to information.
Lusk, J. & Rozan, A.	2005	Consumer Acceptance of Biotechnology and the Role of Second Generation Technologies in the USA and Europe	<i>Trends in Biotechnology</i> , Vol. 23(8), p. 386-387	Addresses issues concerning consumer willingness to pay for GM foods. Found a fundamental issue to consumer resistance to biotechnology is low levels of scientific knowledge and trust. Found best way to increase consumer acceptance of biotechnology is the development of technologies that clearly benefit the consumer.
Moerbeek, H. & Casimir, G.	2005	Gender Differences in Consumers' Acceptance of Genetically Modified Foods	<i>International Journal of Consumer Studies</i> , Vol. 29(4), p. 308-318	Identifies that research has shown men are more accepting of GM food than women. Postulates that, because long term effects of GM foods are unknown, more knowledge about GM food would cause less acceptance. Postulates that women do most of the grocery shopping and there is a reluctance toward food innovation when buying for children. Study results confirmed women are less accepting of GM food. Found that, contrary to the hypothesis, increased information does lead to greater acceptance, but more so for men than women.
Onyango, B.; Govindasamy , R. & Nayga, R., Jr.	2004	Measuring U.S. Consumer Preferences for Genetically Modified Foods Using Choice Modeling Experiments: the Role of Price, Product Benefits and Technology	Working Paper, Food Policy Institute, 2004, (WP1104-017)	Models consumer willingness to trade off the potential risks of GM foods with the possibility of significant benefits. Results show how different attributes of price, product benefits and technology influence consumer demand for GM foods. Found direct health, environmental and production benefits have a positive effect on choice. Found genetic modification is viewed negatively, with genetic modification of animals being viewed more negatively than genetic modification of plants.
Tenbult, P.; de Vries, N.; Dreezens, E. & Martijn, C.	2005	Perceived Naturalness and Acceptance of Genetically Modified Food	<i>Appetite</i> , Vol. 45(1), p. 47-50	Examines people's acceptance of GM food. Found that acceptance of GM foods was most dependent on the extent to which GM food is perceived to be natural but not on the extent to which non-GM food is perceived to be natural.
Veeman, M.; Adamowicz,	2005	Risk Perceptions, Social Interactions and	Rural Economy Project Report, Department of Rural	Did experiments to determine Canadian perceptions of the risk of GM food and how their opinions are formed, and how they affect their choices.

W. & Hu, W.		the Influence of Information on Social Attitudes to Agricultural Biotechnology	Economy, University of Alberta, 2005, (05-02)	<p>Found people rely mostly on magazines/newspapers for information about health risks and food benefits.</p> <p>Found Canadians are not well informed about genetic modification.</p> <p>Found the majority do not have strong views either for or against genetic modification.</p> <p>Found that preferences concerning GM food and the associated perceived risks of the product are diverse.</p> <p>Found that consumers will search for information only if the benefits outweigh the costs.</p> <p>Found those who did seek information about GM food were more strongly opposed to it.</p> <p>Found consumers are less likely to choose food with GM ingredients. Found that where mandatory labelling is required, GM labelled products are adversely viewed.</p> <p>Found that attitudes to GM ingredients can be negative, neutral, or positive.</p> <p>Found the information provided under mandatory labelling is valued more than the information provided under voluntary labelling.</p>
Wu, F.	2004	Explaining Public Resistance to Genetically Modified Corn: An Analysis of the Distribution of Benefits and Risks	<i>Risk Analysis</i> , Vol. 24(3), p. 715-726	<p>Argues a cause of public hesitation to GM crops may be that consumers do not perceive significant benefits to themselves from GM crops, while fearing certain risks.</p> <p>Conducts an economic analysis to determine whether the benefits of one type of GM corn outweigh the potential risks, and who bears those benefits and risks.</p> <p>Found that growers, consumers, and industry all benefit.</p> <p>Found the welfare gain to individual consumers is small and may not make up for perceived risks.</p>

Consumer Issues in Genetically Modified Food – Consumer Acceptance – Willingness to Pay

Author	Date	Title	Source	Comments
Chern, W.; Rickertsen, K.; Tsuboi, N. & Fu, T.	2003	Consumer Acceptance and Willingness to Pay for Genetically Modified Vegetable Oil and Salmon: A Multiple-Country Assessment	<i>AgBioTech</i> , Vol. 5(3), p. 105-112	Found the willingness to consume GM food increased notably if it contained explicit benefits to the consumer. Found wide support for a mandatory labelling system. Found, in the US, respondents were willing to pay a premium of 50-62% to avoid buying GM vegetable oil. Recognize this may be inflated, however, because vegetable oil is inexpensive and the question was hypothetical.
Hossain, F.; Onyango, B.; Adelaja, A.; Schilling, B. & Hallman, W.	2003	Consumer Acceptance of Food Biotechnology: Willingness to Buy Genetically Modified Food Products	<i>Journal of International Food and Agribusiness Marketing</i> , Vol. 15(1/2), p. 53-76	Examines consumer acceptance of genetically modified food by modeling consumers' willingness to buy. Finds that younger, white, male and college educated people are more likely to accept food biotechnology. Confidence in scientists, corporations and government has a significant effect on consumer acceptance.
Huffman, W.; Rousu, M.; Shogren, J. & Tegene, A.	2004	The Effects of Prior Beliefs and Learning on Consumers' Acceptance of Genetically Modified Foods	Working Paper, Department of Economics, Iowa State University, 2004 (04029)	Objective is to examine the effect of prior beliefs of genetic modification and of new information on willingness to pay for foods that might be genetically modified. Found that consumers who had informed prior beliefs behaved as if they placed more trust in third-party information than in information from interested parties. Founds participants whose prior beliefs were uninformed had greater variation in their bidding behaviour than informed participants.
Huffman, W.; Shogren, J.; Rousu, M. & Tegene, A.	2003	Consumer Willingness to Pay for Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions	<i>Journal of Agricultural and Resource Economics</i> , Vol. 28(3), p. 481-502	Examines how willingness to pay changes when GM labels are introduced. Found participants discounted GM products by about 14%. Found the sequencing of food labels affects willingness to pay.
Loureiro, M. & Bugbee, M.	2005	Enhanced GM Foods: Are Consumers Ready to Pay for the Potential Benefits of Biotechnology?	<i>Journal of Consumer Affairs</i> , Vol. 39(1), p. 52-70	Analyzes and compares willingness to pay estimates for different genetic modifications of a tomato plant. Found consumers are willing to pay the highest premiums for modifications that increase flavour or enhance nutrition. Found premiums were fairly small.

Moon, W. & Balasubramanian, S.	2001	Public Perceptions and Willingness-to-Pay a Premium for non-GM Foods in the US and UK	<i>AgBioForum</i> , Vol. 4(3&4), p. 221-231	Conducted a survey to measure acceptance of GM, risk-benefit perceptions, and willingness to pay. Found that subjective risk and benefit perceptions affect behavioural intentions as measured by willingness to pay a premium. Found particularly that the stronger the perception of a health the risk the greater the willingness to pay a premium for non-GM foods. Found risk perception plays a more significant role than benefit perception in determining willingness to pay.
Onyango, B. & Nayga, R. Jr.	2004	Consumer Acceptance of Nutritionally Enhanced Genetically Modified Food: Relevance of Gene Transfer Technology	<i>Journal of Agricultural and Resource Economics</i> , Vol. 29(3), p. 567-583	Examines willingness to consume nutritionally enhanced foods derived from grains genetically modified using plant-to-plant or animal-to-plant gene transfer technology. Found consumers were less willing to consume if it was an animal-to-plant transfer rather than a plant-to-plant transfer. Found there are consumers who will not approve of either type of transfer technology despite the nutritional benefit.
Rousu, M.; Huffman, W.; Shogren, J. & Tegene, A.	2004	Are United States Consumers Tolerant of Genetically Modified Foods?	<i>Review of Agricultural Economics</i> , Vol. 26(1), p. 19-31	Using data from experimental auctions, tests whether consumers prefer foods with 0, 1 or 5% tolerance levels for genetically modified material. Found consumers would pay less for food that tolerates genetically modified material. Found no evidence that consumers place different values on foods with 1 and 5% genetically modified content.
Rousu M.; Huffman, W.; Shogren, J. & Tegene, A.	2002	Are US Consumers Tolerant of GM Foods?	Paper prepared for presentation at the Annual Meeting of the American Agricultural Economics Association, Long Beach, California, July 28-31, 2002, online at agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=4463	Addresses the question of how US consumers react to a positive tolerance standard for GM ingredients in a labelling regime. Used an experimental auction to test: <ul style="list-style-type: none"> • The mean consumer bids for the GM-free product equals the mean bid for the GM-threshold products, set at either 1% or 5% • The mean bids for the 1%-GM-product equals the mean bids for the 5%-GM-product threshold Found the first hypothesis can be rejected, but not the second. Found consumers reduce their demand by about 10% relative to the baseline irrespective of whether the GM threshold is set at 1 or 5%. Argues, therefore, a threshold of 5% is more efficient because it is less costly to meet.
Rowe, G.	2004	How can Genetically Modified Foods be Made Publicly Acceptable	<i>Trends in Biotechnology</i> , Vol. 22(3), p. 107-109	Argues against the proposition that consumers might voluntarily pay more for GM food if made aware of the possible health benefits. Proposes the acceptability of novel hazards is more complex than that suggests.

Tegene, A.; Huffman, W.; Rousu, M. & Shogren, J.	2003	The Effects of Information on Consumer Demand for Biotech Foods: Evidence from Experimental Auctions	Technical Bulletin, ERS Research Briefs, US Department of Agriculture, (1903): 28, 2003, online at: www.ers.usda.gov/publications/tb1903	Presents empirical evidence on consumers' willingness to pay for biotechnology foods based on the presence or absence of labels. Found that labels matter. Found consumers discounted food items labelled "GM" by an average of 14%. Found information from interested parties and independent sources has a strong impact.
Veeman, M. & Adamowicz, W.	2004	Genetically Modified Foods: Consumers' Attitudes and Labeling Issues	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2004, (04-01)	Gave two hypothetical scenarios: <ul style="list-style-type: none"> • The first was to assess preference for a policy that would place regulatory restrictions on the production, processing or marketing of food, versus a policy that would increase food inspection. • The second assessed preferences for a policy that would regulate restrictions on the production, processing or marketing of food, versus a policy for developing a labelling system for food that gives information on the effects of agricultural biotechnology. Results suggest that many consumers are prepared to make trade-offs for higher levels of information or assurance of food quality. Results suggest that Alberta consumers are more willing to pay for a policy that would provide more information about agricultural biotechnology on food labels, and for more emphasis on food inspection. They were willing to pay the least amount for a policy that would restrict biotechnology.
Wachenheim, C.	2004	Consumer Acceptance of Genetically Modified Food Products	<i>AgBiotechNet</i> , 6(ABN 126), p. 6	Proposes consumers are not well informed about biotechnology applications although they perceive themselves to be more informed than demonstrated. Argues risks that are perceived as involuntary are especially troublesome to consumers, supporting the labelling of products. Proposes that providing information can increase willingness to pay. Proposes that there are certain market segments more open to different types of biotechnology.

<p>van Wechel, T.; Wachenheim, C.; Schuck, E. & Lambert, D.</p>	<p>2003</p>	<p>Consumer Valuation of Genetically Modified Foods and the Effect of Information Bias</p>	<p>Agricultural and Applied Economics Report, Department of Agribusiness and Applied Economics, North Dakota State University, (513)</p>	<p>Conducted an experimental auction using cookies, muffins, and crisps to estimate the influence of information bias. Used a standard Nutrition Facts label and those indicating they did not contain GM ingredients. Found bids for presumed GM products were lower than for products labelled as non-GM. Found positive and negative-biased information both increased bids for GM products. Found the perceived level of risk increased with negative-biased information and decreased with positive-biased information. Concludes the effect of biased-information on acceptability and willingness-to-pay for non-GM products may differ by product type.</p>
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Consumer Issues in Genetically Modified Food – Sources of Information

Author	Date	Title	Source	Comments
Costa-Font, J. & Mossialos, E.	2005	Is Dread of Genetically Modified Food Associated with the Consumers' Demand for Information?	<i>Applied Economics Letters</i> , Vol. 12(14), p. 859-863	<p>Argues that dread of GM food is an expression of demand for information.</p> <p>Empirically examines the determinants of the demand for information about GM food, undertaking a multivariate analysis of information-related survey responses.</p> <p>Found some evidence that demand for information is a self-protective attitude that occurs in the absence of information.</p> <p>Found that knowledge of science and information channels are associated with a larger demand for information and lower dread of GM food.</p>
Fritz, S.; Husmann, D.; Wingenbach, G.; Rutherford, T.; Egger, V. & Wadhwa, P.	2003	Awareness and Acceptance of Biotechnology Issues among Youth, Undergraduates, and Adults	<i>AgBioForum</i> , Vol. 6(4), p. 178-184	<p>Found adults were much more aware of the effects of biotechnology than youth.</p> <p>Found a positive relationship between awareness and acceptance levels.</p> <p>Concludes consumers would be most impacted by accurate, unbiased information delivered through the internet and newspapers.</p>
Gao, G.; Veeman, M. & Adamowicz, W.	2005	Consumers' Search Behaviour for GM Food Information	<i>Journal of Public Affairs</i> , Vol. 5(3/4), p. 217-226	<p>Conducted a computer-based survey of Canadian respondents to determine behaviour in searching for information about GM foods.</p> <p>Found that slightly less than half actually sought the information.</p> <p>Uses cost-benefit reasoning to assess the patterns of information access seen.</p> <p>Found the probability that respondents would access information was affected by gender, employment status, rural or urban residency, and the number of children in the household.</p>
House, L.; Lusk, J.; Jaeger, S.; Traill, W.; Moore, M.; Valli, C.; Morrow, B. & Yee, W.	2004	Objective and Subjective Knowledge: Impacts on Consumer Demand for Genetically Modified Foods in the United States and the European Union	<i>AgBioForum</i> , Vol. 7(3), p. 113-123	<p>Proposes that the reason studies of the impact of knowledge on consumer acceptance have given contradictory results is the manner in which knowledge is measured. This study examines the different impacts of subjective and objective knowledge.</p> <p>Found increased levels of subjective knowledge significantly increased willingness to accept. Objective knowledge was not significantly related to willingness to accept.</p> <p>Found those who trust in government sources are more willing to accept, and those who trust in activist sources are less willing to</p>

				accept.
Hu, W.; Veeman, M. & Adamowicz, W.	2005	Labelling Genetically Modified Food: Heterogeneous Consumer Preferences and the Value of Information	<i>Canadian Journal of Agricultural Economics</i> , Vol. 53(1), p. 83-102	Analyzes consumer choices of bread under different GM food labelling policies. Found substantial heterogeneity among tastes for different bread attributes, including the presence or absence of GM ingredients. Estimates the value of information using a simulation-based bias-adjusted measure. Found information from a mandatory labelling regime is more valued than the information in a voluntary labelling regime. Estimates consumer benefits from labelling policies in terms of average market prices for comparison in cost-benefit analysis.
Hu, W.; Veeman, M.; Adamowicz, W. & Gao, G.	2006	Consumers' Food Choices with Voluntary Access to Genetic Modification Information	Working Paper, Department of Rural Economy, University of Alberta Pending acceptance in the <i>Canadian Journal of Agricultural Economics</i> 2006 special issue on demand	Studies information access behaviour and its effects on product choices. Used bread as the study product. Studies the effects of information voluntarily obtained rather than required. Applies three different approaches to model this behaviour in a Bayesian estimation framework. Found less than 1/3 actually accessed the information provided. Found different types of information do impact consumer product choices. The nature of these effects is influenced by voluntary access to information. Found there is a difference in the results of voluntary information provision studies compared to compulsory information provision.
Huffman, W.; Rousu, M.; Shogren, J. & Tegene, A.	2003	The Public Good Value of Information from Agribusinesses on Genetically Modified Foods	<i>American Journal of Agricultural Economics</i> , Vol. 85(5), p. 1309-1315	Subjects were given different types of information about GM foods and then asked to bid in an auction on GM-labelled and plain-labelled foods. Found a large public good value for positive GM information, however, the presence of 3 rd party information decreased the large public good value markedly.
Huffman, W.; Rousu, M.; Shogren, J. & Tegene, A.	2004	Consumer's Resistance to Genetically Modified Foods: the Role of Information in an Uncertain Environment	<i>Journal of Agricultural and Food Industrial Organization</i> , Vol. 2(2), p. 1-13	Argues information issues are central to the GM food debate. Reports results of a statistical analysis of the market characteristics that push consumers to resist GM food. Found that GM information supplied by environmental groups increases the probability that consumers are out of the market for GM foods. Found that third party verifiable information dissipates most of the negative effect of environmental groups.

Huffman, W.; Rousu, M.; Shogren, J. & Tegene, A.	2004	The Effects of Prior Beliefs and Learning on Consumers' Acceptance of Genetically Modified Foods	Working Paper, Department of Economics, Iowa State University, 2004 (04029)	Objective is to examine the effect of prior beliefs of genetic modification and of new information on willingness to pay for foods that might be genetically modified. Found that consumers who had informed prior beliefs behaved as if they placed more trust in third-party information than in information from interested parties. Founds participants whose prior beliefs were uninformed had greater variation in their bidding behaviour than informed participants.
Huffman, W.; Rousu, M.; Shogren, J. & Tegene, A.	2004	Who do Consumers Trust for Information: The Case of Genetically Modified Foods?	<i>American Journal of Agricultural Economics</i> , Vol. 86(5), p. 1222-1229	Obtained sociodemographic information and information on prior beliefs about GM technologies from a random sample of adults in the US. Also obtained information on which sources they trust for information about GM foods. Tests a model of relative trust in five different sources of information on GM. Found that an increased level of education reduced trust in government, private industry and environmental or consumer groups. Found those who claimed to be informed about GM foods were more likely to trust the government than 3 rd party sources. Found older consumers have lower odds of trusting nobody relative to an independent, third-party source. Found conservative religious affiliation reduces the odds of a consumer trusting private industry/organization and increases the odds of trusting nobody relative to an independent, third-party source.
Kalaitzandonakes, N.; Marks, L. & Vickner, S.	2004	Media Coverage of Biotech Foods and Influence on Consumer Choice	<i>American Journal of Agricultural Economics</i> , Vol. 86(5), p. 1238-1246	Examines consumer response to GM foods in the US and the Netherlands. In the Dutch case, media coverage of GM foods was substantial and sustained over a 5-year period. The tone was generally negative. Found Dutch consumers did not respond to the media coverage and did not change purchasing patterns. In the US case, media coverage was acute but brief, and negative. US consumer demand was affected by media coverage, but the response was limited.
Lang, J.; O'Neill, K. & Hallman, W.	2003	Expertise, Trust, and Communication about Food Biotechnology	<i>AgBioForum</i> , Vol. 6(4), p. 185-190	Found scientists and other experts are believed to be the most likely to tell the truth about biotechnology. Found many respondents thought consumers were most influenced by mass media and critics of biotechnology.
Rousu, M.;	2002	The Value of	Working Paper, Department of	Identifies two main interested parties in debate on GM foods:

Huffman, W.; Shogren, J. & Tegene, A.		Verifiable Information in a Controversial Market: Evidence from Lab Auctions of Genetically Modified Food	Economics, Iowa State University, (02003), 2002	environmental groups and agribusiness companies. Examines the effects of information on consumers' demand for GM foods where information from one or more interested parties is provided. Found that verifiable information has a small but positive value to consumers. Found that verifiable information gives a relatively large projected annual social value to all processed foods consumed.
Scholderer, J. & Frewer, L.	2003	The Biotechnology Communication Paradox: Experimental Evidence and the Need for a New Strategy	<i>Journal of Consumer Policy</i> , Vol. 26(2), p. 125-157	Proposes that communication strategies aimed at increasing acceptance of GM food have focused on technology-driven, top-down practices. Tested the effect of these practices in influencing consumers. Found that all strategies tested had a uniform effect of significantly decreasing preferences for GM foods.
Tegene, A.; Huffman, W.; Rousu, M. & Shogren, J.	2003	The Effects of Information on Consumer Demand for Biotech Foods: Evidence from Experimental Auctions	Technical Bulletin, ERS Research Briefs, US Department of Agriculture, (1903): 28, 2003, online at: www.ers.usda.gov/publications/tb1903	Presents empirical evidence on consumers' willingness to pay for biotechnology foods based on the presence or absence of labels. Found that labels matter. Found consumers discounted food items labelled "GM" by an average of 14%. Found information from interested parties and independent sources has a strong impact.
Veeman, M.; Adamowicz, W. & Hu, W.	2005	Risk Perceptions, Social Interactions and the Influence of Information on Social Attitudes to Agricultural Biotechnology	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2005, (05- 02)	Did experiments to determine Canadian perceptions of the risk of GM food and how their opinions are formed, and how they affect their choices. Found people rely mostly on magazines/newspapers for information about health risks and food benefits. Found Canadians are not well informed about genetic modification. Found that consumers will search for information only if the benefits outweigh the costs. Found those who did seek information about GM food were more strongly opposed to it. Found the information provided under mandatory labelling is valued more than the information provided under voluntary labelling.
Veeman, M.; Adamowicz, W; Hu, W. &	2005	Canadian Attitudes to Genetically Modified Food	<i>Crossing Over</i> (E. Einsiedel & F. Timmermans, Eds.) University of Calgary Press,	Conducted a Canada-wide survey to test the effects of different types of information for pre-packaged sliced bread. One experiment focused on the influence of different types of information from different

Hunnemeyer, A.			2005: 99-113	<p>sources. The second experiment focused specifically on the effects of different labelling policies.</p> <p>Found low trust in the food industry, farmers associations and the federal government as sources of information. Found high trust in research institutions and consumer associations.</p> <p>Found a majority do not have strong views either for or against GM foods.</p> <p>Found strong support for mandatory labelling, though a majority preferred stricter regulation to mandatory labelling.</p> <p>Found respondents were less likely to purchase GM bread, though this aversion was reduced if there was a positive health or environmental effect.</p> <p>Found those who accessed further information were more opposed to GM ingredients than those who did not access further information.</p> <p>Found the loss in welfare from labelling GM foods was higher than the gain in welfare from labelling non-GM foods.</p>
van Wechel, T.; Wachenheim, C.; Schuck, E. & Lambert, D.	2003	Consumer Valuation of Genetically Modified Foods and the Effect of Information Bias	Agricultural and Applied Economics Report, Department of Agribusiness and Applied Economics, North Dakota State University, (513)	<p>Conducted an experimental auction using cookies, muffins, and crisps to estimate the influence of information bias. Used a standard Nutrition Facts label and those indicating they did not contain GM ingredients.</p> <p>Found bids for presumed GM products were lower than for products labelled as non-GM.</p> <p>Found positive and negative-biased information both increased bids for GM products.</p> <p>Found the perceived level of risk increased with negative-biased information and decreased with positive-biased information.</p> <p>Concludes the effect of biased-information on acceptability and willingness-to-pay for non-GM products may differ by product type.</p>

Consumer Issues in Genetically Modified Food – Other Matters

Author	Date	Title	Source	Comments
Macer, D.	2001	Bioethics: Perceptions of Biotechnology and Policy Implications	<i>International Journal of Biotechnology</i> , Vol. 3(1-2), p. 116-133	Argues that most people in industrialized countries perceive more benefit than harm from science. Looks at public awareness and concerns about biotechnology around the world and discusses the implications for education and information. Assesses the issue of risk assessment for environmental impact and the safety of GM foods. Discusses equity and the patenting of living organisms.
Miller, J.; Annou, M. & Wailes, E.	2003	Communicating Biotechnology: Relationships Between Tone, Issues, and Terminology in U.S. Print Media Coverage	<i>Journal of Applied Communications</i> , Vol. 87(3), p. 29-40	Performed a content analysis on two years of print news coverage of biotechnology, and examined it for common issues, tone, and terminology. Understanding the relationships may help in choosing terminology to achieve communication goals and in developing survey instruments.

Consumer Issues in Genetically Modified Food – Consumer Perceptions of Biotechnology

Author	Date	Title	Source	Comments
Anderson, J.; Wachenheim, C. & Lesch, W.	2005	Perceptions of Genetically Modified and Organic Foods and Processes: North Dakota College Students	<i>Agribusiness and Applied Economics Report</i> , Department of Agribusiness and Applied Economics, North Dakota State University	North Dakota college students responded to a survey either about GM food or organic food. Found organic food was perceived as healthier, safer, and more environmentally sound. Found concern over unknown effects of GM foods. Found participants thought GM could be used effectively and did have some value.
Hossain, F.; Onyango, B.; Adelaja, A.; Schilling, B. & Hallman, W.	2002	Public Perceptions of Biotechnology and Acceptance of Genetically Modified Food	Working Paper (Rutgers University, Food Policy Institute), Jun. 2002, available online at: http://www.foodpolicyinstitute.org/docs/working/Approval%20of%20Food%20Biotech%20WP-0602-002.pdf	Analyzes public acceptance of biotechnology in food production. Found that while there is general optimism about biotechnology, and support for its use in plants, public approval of its use in animals is more limited. Found that younger and more educated people are generally more supportive of biotechnology. Found income and regional differences do not have a significant effect on attitude.
Hossain F.; Onyango, B.; Adelaja, A.; Schilling, B. & Hallman, W.	2002	Uncovering Factors Influencing Public Perceptions of Food Biotechnology	Working Paper (Rutgers University, Food Policy Institute), Jun. 2002, available online at: http://www.foodpolicyinstitute.org/docs/working/Perception%20of%20Food%20Biotech-WP-0602-003.pdf	Conducted a survey to determine consumer attitudes toward genetic modifications to plants and animals that bring specific health and economic benefits, moral and ethical concerns about plant and animal genetics, perceptions of health and environmental risks, and willingness to accept GM products. Also collected socio-economic and value characteristics. Found public attitudes toward biotechnology are mixed. Found public attitude is based on six factors, ranging from excitement about biotechnology and its benefits to fear and distrust of the technology, with undecided people in between. Found public opinion is influenced by age, gender, racial background, education and religious views.
Hu, W.; Hunnemeyer, A.; Veeman, M.; Adamowicz, W. & Srivastava, L.	2004	Trading Off Health, Environmental and Genetic Modification Attributes in Food	<i>European Review of Agricultural Economics</i> , Vol. 31(3), p. 389-401	Examines the trade-offs between risks and benefits of GM foods, using a survey with bread as the specific food object. Uses a latent class model to analyze consumers' preferences for GM foods. Found some consumers are indifferent to GM ingredients. Found considerable diversity in risk attitudes towards GM foods.

				<p>Found 55% of consumers perceive little or no risk to GM foods. The remainder are distinctly adverse or perceive significant risks.</p> <p>Found the trade-offs between risks and benefits depend upon individual characteristics.</p> <p>Found an average discount of 0.50 CAD per GM loaf of bread.</p>
James, J.	2004	Consumer Knowledge and Acceptance of Agricultural Biotechnology Vary	<i>California Agriculture</i> , Vol. 58(2), p. 99-105	<p>Conducted consumer surveys in the USA.</p> <p>Found consumers don't agree about whether biotechnology is good or bad.</p> <p>Found a small group of people strongly opposes GM food.</p> <p>Found the majority of consumers are uninformed about biotechnology.</p> <p>Argues small anti-biotechnology activist groups are therefore able to influence public opinion.</p>
Macer, D.	2001	Bioethics: Perceptions of Biotechnology and Policy Implications	<i>International Journal of Biotechnology</i> , Vol. 3(1-2), p. 116-133	<p>Argues that most people in industrialized countries perceive more benefit than harm from science.</p> <p>Looks at public awareness and concerns about biotechnology around the world and discusses the implications for education and information.</p> <p>Assesses the issue of risk assessment for environmental impact and the safety of GM foods.</p> <p>Discusses equity and the patenting of living organisms.</p>
Macer, D.	1997	Biotechnology in Agriculture: Ethical Aspects and Public Acceptance	<i>Biotechnology in Agriculture</i> , ed. A. Altman (Marcel Dekker, New York 1997) p. 661-690, online at: www2.unescobkk.org/eubios/Papers/agbio.htm	<p>Expounds the historical background of bioethics.</p> <p>Discusses the public perception of benefits and risks in biotechnology.</p> <p>Discusses an international bioethics survey covering:</p> <ul style="list-style-type: none"> • Knowledge and awareness of biotechnology; • Benefits and risks of biotechnology; • Food concerns and human health; • Environmental concerns; • Source of information and trust in authorities; and, • Economic concerns and patenting life. <p>Discusses bioethical principles for biotechnology.</p> <p>Determines that people do not have a simplistic view of science and technology, and can perceive both risks and benefits.</p> <p>Found the differences of view within each country run deep, suggesting people will always be divided.</p>
Napier, T.; Tucker, M.; Henry, C. &	2004	Ethical Orientations of Ohio Residents toward Genetically	<i>Journal of Food, Agriculture and Environment</i> , Vol. 2(2), p. 400-411	<p>Collected data concerning ethical orientations using a structured questionnaire. Assessed the orientations using a Likert-type scale.</p> <p>Found the theoretical model was effective for predicting variability in</p>

Yang, X.		Engineered Plants and Animals: an Urban/Rural Comparison		ethical orientations toward GE plants and animals. Found that perceived risk was the best predictor of ethical orientations. Found differences between rural and urban respondents.
Onyango, B.; Govindasamy, R. & Nayga, R., Jr.	2004	Measuring U.S. Consumer Preferences for Genetically Modified Foods Using Choice Modeling Experiments: the Role of Price, Product Benefits and Technology	Working Paper, Food Policy Institute, 2004, (WP1104-017)	Models consumer willingness to trade off the potential risks of GM foods with the possibility of significant benefits. Results show how different attributes of price, product benefits and technology influence consumer demand for GM foods. Found direct health, environmental and production benefits have a positive effect on choice. Found genetic modification is viewed negatively, with genetic modification of animals being viewed more negatively than genetic modification of plants.
Traill, W.; Jaeger, S.; Yee, W.; Valli, C.; House, L.; Lusk, J.; Moore, M. & Morrow, J. Jr.	2004	Categories of GM Risk-Benefit Perceptions and their Antecedents	<i>AgBioForum</i> , Vol. 7(4), p. 176-186	Hypothesizes that consumer risk-benefit perceptions cover up to eight dimensions: risks to business, benefits to business, risks and benefits to the environment, risks and benefits to the developing world, and risks and benefits to self and family. These different dimensions are investigated. Found the majority of consumers perceived only a medium level of risk from GM. Found those with a positive attitude toward technology in general tend to have a positive attitude toward GM. Found those who trust the government and food industry perceive less risk, while those who trust activists perceive more risk.
Tucker, M.; Whaley, S. & Sharp, J.	2006	Consumer Perceptions of Food-Related Risks	<i>International Journal of Food Science and Technology</i> , Vol. 41(2), p. 135-146	Purpose was to assess perceptions of various food safety risks and to identify factors influencing risk judgements. Found pesticide residues in food and contamination of water generated the highest levels of perceived risk. Found mad cow disease and GM foods generated the lowest levels of perceived risk. Found that attitude toward biotechnology was the strongest predictor of perceived risk.
Veeman, M. & Adamowicz, W.	2004	Genetically Modified Foods: Consumers' Attitudes and Labelling Issues	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2004, (04-01)	Gave two hypothetical scenarios: <ul style="list-style-type: none"> The first was to assess preference for a policy that would place regulatory restrictions on the production, processing or marketing of food, versus a policy that would increase food inspection.

				<ul style="list-style-type: none"> The second assessed preferences for a policy that would regulate restrictions on the production, processing or marketing of food, versus a policy for developing a labelling system for food that gives information on the effects of agricultural biotechnology. Purpose was to study public concern associated with genetically engineered foods as compared to other food safety concerns. Assesses major issues that affect consumers' motivation and behaviour related to alternative labelling policies. Results suggest that many consumers are prepared to make trade-offs for higher levels of information or assurance of food quality. Results suggest that Alberta consumers are more willing to pay for a policy that would provide more information about agricultural biotechnology on food labels, and for more emphasis on food inspection. They were willing to pay the least amount for a policy that would restrict biotechnology. Part of the experiment used focus groups, for which GM bread was given as an example. Participants in focus groups identified health and environmental issues as areas of major concern for GM food. Also did a survey of Canadian households in general. Survey found that GM foods were believed to be very risky by an appreciable number of respondents, but less risky for food safety than most other food risks. Respondents tended to see agricultural biotechnology of somewhat more of an environmental risk issue than an issue of food safety.
Veeman, M.; Adamowicz, W; Hu, W. & Hunnemeyer, A.	2005	Canadian Attitudes to Genetically Modified Food	<i>Crossing Over</i> (E. Einsiedel & F. Timmermans, Eds.) University of Calgary Press, 2005: 99-113	<p>Conducted a Canada-wide survey to test the effects of different types of information for pre-packaged sliced bread. One experiment focused on the influence of different types of information from different sources. The second experiment focused specifically on the effects of different labelling policies.</p> <p>Found low trust in the food industry, farmers associations and the federal government as sources of information. Found high trust in research institutions and consumer associations.</p> <p>Found a majority do not have strong views either for or against GM foods.</p> <p>Found strong support for mandatory labelling, though a majority</p>

				<p>preferred stricter regulation to mandatory labelling.</p> <p>Found respondents were less likely to purchase GM bread, though this aversion was reduced if there was a positive health or environmental effect.</p> <p>Found those who accessed further information were more opposed to GM ingredients than those who did not access further information.</p> <p>Found the loss in welfare from labelling GM foods was higher than the gain in welfare from labelling non-GM foods.</p>
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Consumer Issues in Genetically Modified Food – Consumer Behaviour

Author	Date	Title	Source	Comments
Gao, G.; Veeman, M. & Adamowicz, W.	2005	Consumers' Search Behaviour for GM Food Information	<i>Journal of Public Affairs</i> , Vol. 5(3/4), p. 217-226	Conducted a computer-based survey of Canadian respondents to determine behaviour in searching for information about GM foods, using bread as the relevant product. Found that slightly less than half actually sought the information. Uses cost-benefit reasoning to assess the patterns of information access seen. Found the probability that respondents would access information was affected by gender, employment status, rural or urban residency, and the number of children in the household.
Hu, W.; Veeman, M.; Adamowicz, W. & Gao, G.	2006	Consumers' Food Choices with Voluntary Access to Genetic Modification Information	Working Paper, Department of Rural Economy, University of Alberta Pending acceptance in the <i>Canadian Journal of Agricultural Economics</i> 2006 special issue on demand	Studies information access behaviour and its effects on product choices. Used bread as the study product. Studies the effects of information voluntarily obtained rather than required. Applies three different approaches to model this behaviour in a Bayesian estimation framework. Found less than 1/3 actually accessed the information provided. Found different types of information do impact consumer product choices. The nature of these effects is influenced by voluntary access to information. Found there is a difference in the results of voluntary information provision studies compared to compulsory information provision.
Irani, T. & Sinclair, J.	2004	The Effect of Labelling Genetically Modified Food on Perceptions of Accountability	<i>Journal of Applied Communications</i> , Vol. 88(1), p. 29-42	Conducted an experiment to examine the impact of different types of GM food labels. Found the labelling message and strength affected perception of government and industry accountability, in turn affecting attitude toward and willingness to purchase GM foods. Found the manufacturer's product claim label created a stronger perception of accountability than the mandatory FDA label.
Kalaitzandonak es, N.; Marks, L. & Vickner, S.	2005	Sentiments and Acts Towards Genetically Modified Foods	<i>International Journal of Biotechnology</i> , Vol. 7(1-3), p. 161- 177	Argues theoretical and methodological reasons why stated and revealed consumer preference toward GM food diverge. Provides empirical evidence of consumer revealed preferences. Found that a majority of consumers did not shift away from GM foods even in the presence of alternatives.

Smyth, S. & Phillips, P.	2003	Labelling to Manage Marketing of GM Foods	<i>Trends in Biotechnology</i> , Vol. 21(9), p. 389-393	Refers to a survey showing that terminology such as GM, non-GM, or GM free is not effective in providing product information to consumers. Studies have shown no preference for a tolerance level of 1% over 5%. Studies show that consumers are willing to pay a premium for information about GM content, but are inconclusive about the amount. Found willingness to pay does not have a strong correlation with labelling for either GM or non-GM foods. Refers to an experiment finding that, despite indicating GM-free ingredients were very desirable, consumers did not express more interest in the foods labelled GM-free than in foods labelled GM. Concludes that, despite stated preferences, actual behaviour indicates that within North America labelling for GM content is largely irrelevant.
Tegene, A.; Huffman, W.; Rousu, M. & Shogren, J.	2003	The Effects of Information on Consumer Demand for Biotech Foods: Evidence from Experimental Auctions	Technical Bulletin, ERS Research Briefs, US Department of Agriculture, (1903): 28, 2003, online at: www.ers.usda.gov/publications/tb1903	Presents empirical evidence on consumers' willingness to pay for biotechnology foods based on the presence or absence of labels. Found that labels matter. Found consumers discounted food items labelled "GM" by an average of 14%. Found information from interested parties and independent sources has a strong impact.
van Wechel, T.; Wachenheim, C.; Schuck, E. & Lambert, D.	2003	Consumer Valuation of Genetically Modified Foods and the Effect of Information Bias	Agricultural and Applied Economics Report, Department of Agribusiness and Applied Economics, North Dakota State University, (513)	Conducted an experimental auction using cookies, muffins, and crisps to estimate the influence of information bias. Used a standard Nutrition Facts label and those indicating they did not contain GM ingredients. Found bids for presumed GM products were lower than for products labelled as non-GM. Found positive and negative-biased information both increased bids for GM products. Found the perceived level of risk increased with negative-biased information and decreased with positive-biased information. Concludes the effect of biased-information on acceptability and willingness-to-pay for non-GM products may differ by product type.
Veeman, M.; Adamowicz, W. & Hu, W.	2005	Risk Perceptions, Social Interactions and the Influence of Information on Social Attitudes to Agricultural Biotechnology	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2005, (05-02)	Conducted experiments to determine Canadian perceptions of the risk of GM food and how their opinions are formed, and how they affect their choices. GM bread was used as an example in the experiments. Found biotechnology for animals is a more important food safety issue than biotechnology for plants, though neither was the most pressing food safety issue.

				<p>Found people rely mostly on magazines/newspapers for information about health risks and food benefits.</p> <p>Found Canadians are not well informed about genetic modification.</p> <p>Found the majority do not have strong views either for or against genetic modification.</p> <p>Found that preferences concerning GM food and the associated perceived risks of the product are diverse.</p> <p>Found that consumers will search for information only if the benefits outweigh the costs.</p> <p>Found those who did seek information about GM food were more strongly opposed to it.</p> <p>Found consumers are less likely to choose food with GM ingredients.</p> <p>Found that where mandatory labelling is required, GM labelled products are adversely viewed.</p> <p>Found that attitudes to GM ingredients can be negative, neutral, or positive.</p> <p>Found the information provided under mandatory labelling is valued more than the information provided under voluntary labelling.</p>
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Advancing Biotechnology

Author	Date	Title	Source	Comments
Chen, H. & Chern, W.	2002	Consumer Acceptance of Genetically Modified Foods	Paper prepared for presentation at the Annual Meeting of the American Agricultural Economics Association, Long Beach, California, July 28-31, 2002, online at agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=4339	<p>Argues consumer concerns include uncertainty about the effects of GM food on health, religious and ethical concerns, lack of identification of these products, and potential environmental danger.</p> <p>Found that consumer acceptance is determined by attitudinal factors such as risk perception, environmental impacts, perceived difference between GM and non-GM foods, and the potential benefits of GM foods.</p> <p>Found a necessity to educate the general public about GM foods with non-biased scientific information.</p> <p>Argues a need to provide labelling to establish consumer confidence.</p> <p>Found a willingness to pay a premium to differentiate between GM and non-GM food.</p>
Deckers, J.	2005	Are Scientists Right and Non-Scientists Wrong? Reflections on Discussions of GM	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 18(5), p. 451-478	<p>Explores three examples of ways in which the “GM is unnatural” view has been treated by UK policy makers:</p> <ul style="list-style-type: none"> • The Government’s position; • Nuffield Council on Bioethics; and, • Nigel Halford, a scientist with an advisory role to the government. <p>Argues all three fail to provide a convincing critique.</p> <p>Discusses an empirical research project concerning scientist responses to “GM is unnatural”.</p> <p>Found scientists who reject it struggle to do so consistently.</p>
Frewer, L.	2003	Societal Issues and Public Attitudes Towards Genetically Modified Foods	<i>Trends in Food Science and Technology</i> , Vol. 14(5-8), p. 319-332	<p>Discusses how people think about the genetic modification of food, and the implications public attitudes have for the development of regulations, with emphasis on public risk perception and why attitudes to risk may differ from those held by technical risk experts.</p> <p>Discusses the development of institutional mechanisms that can be used to integrate the values held by consumers.</p> <p>Argues important determinants of consumer acceptance are: the analytical assessment of risk and benefit and communication of that analysis, ethical and moral considerations, uncertainties and concerns about unintended effects, and trust in the regulatory system.</p> <p>Argues developing best practice in science communication about the</p>

				risks and benefits of GM food is not enough to foster public confidence, that we must involve the public explicitly in the biotechnology debate.
Frewer, L.; Howard, C. & Aaron, J.	1998	Consumer Acceptance of Transgenic Crops	<i>Pesticide Science</i> , Vol. 52(4), p. 388-393	Argues that a key determinant of the future of genetically modified food is consumer acceptance. Argues that acceptance of novel products is not related to general attitudes toward genetic engineering, rather, it is people's perceptions of risks and benefits. Argues there must, therefore, be effective risk-benefit communication strategies, and methods for receiving communication from the public.
Frewer, L.; Lassen, J.; Kettlitz, B.; Scholderer, J.; Beekman, V. & Berdal, D.	2004	Societal Aspects of Genetically Modified Foods	<i>Food and Chemical Toxicology</i> , Vol. 42(7), p. 1181-1193	Examines the reasons behind the public controversy over genetically modified foods in Europe in the context of risk perceptions and attitudes, public trust in regulatory institutions, scientists, and industry, and the need to develop communication strategies. Recommends that new methods be developed to include public values better in risk analysis processes.
Fritz, S.; Husmann, D.; Wingenbach, G.; Rutherford, T.; Egger, V. & Wadhwa, P.	2003	Awareness and Acceptance of Biotechnology Issues among Youth, Undergraduates, and Adults	<i>AgBioForum</i> , Vol. 6(4), p. 178-184	Found adults were much more aware of the effects of biotechnology than youth. Found a positive relationship between awareness and acceptance levels. Concludes consumers would be most impacted by accurate, unbiased information delivered through the internet and newspapers.
Lence, S. & Hayes, D.	2002	Impact of Biotech Grains on Market Structure and Societal Welfare	<i>Agbioforum</i> , Vol. 5(3), p. 85-89	Quantifies the economic impact of introducing GM crops. Found it optimal to maintain the identity of a greater proportion of non-GM grain than is currently demanded by non-GM consumers. In the long run, GM crops almost always benefit society. There is one scenario where overall welfare falls.
Lusk, J. & Rozan, A.	2005	Consumer Acceptance of Biotechnology and the Role of Second Generation Technologies in the USA and Europe	<i>Trends in Biotechnology</i> , Vol. 23(8), p. 386-387	Addresses issues concerning consumer willingness to pay for GM foods. Found a fundamental issue to consumer resistance to biotechnology is low levels of scientific knowledge and trust. Found best way to increase consumer acceptance of biotechnology is the development of technologies that clearly benefit the consumer.

Economic Issues in Genetically Modified Food

Author	Date	Title	Source	Comments
Brooks, G. & Barfoot, P.	2005	GM Crops: The Global Economic and Environmental Impact – the First Nine Years 1996-2004	<i>Agbioforum</i> , Vol. 8(2-3), p. 187-196	Studies global economic impacts on farm income and environmental impacts. Shows substantial net economic benefits. Shows significant reduction in pesticide spraying and the release of greenhouse gases.
Dale, P.	2002	The Environmental Impact of Genetically Modified (GM) Crops: a Review	<i>The Journal of Agricultural Science</i> , Vol. 138(3), p. 245-248	Addresses the difficulty in determining environmental impact when including the requirements for an assessment of indirect effects and post-commercialization monitoring. Addresses socio-economic impacts. Argues that some tolerance for GM products must be tolerated in “non-GM” foods.
Lence, S. & Hayes, D.	2005	Genetically Modified Crops: Their Market and Welfare Impacts	<i>American Journal of Agricultural Economics</i> , Vol. 87(4), p. 931-950	Develops a framework for examining price and welfare effects of the introduction of GM products. Found that introducing GM technology increases aggregate welfare, unless production cost savings are small and consumers are seriously concerned about GM foods.
Lence, S. & Hayes, D.	2002	Impact of Biotech Grains on Market Structure and Societal Welfare	<i>Agbioforum</i> , Vol. 5(3), p. 85-89	Quantifies the economic impact of introducing GM crops. Found it optimal to maintain the identity of a greater proportion of non-GM grain than is currently demanded by non-GM consumers. In the long run, GM crops almost always benefit society. There is one scenario where overall welfare falls.
Meziani, G. & Warwick, H.	2002	Seeds of Doubt: North American Farmers’ Experiences of GM Crops	<i>Soil Association</i> , 2002, online at: www.soilassociation.org/sa/web.nsf/d9976776970e3680256b4c0040ab74/9ce8a24d75d3f65980256c370031a2d0!OpenDocument	Purpose was to assess the success of GM crops in North America and what problems have occurred. Argues the evidence shows GM food crops are not a success. Argues GM has disrupted GM-free production, destroyed trade and undermined international competitiveness. Analyzes farming impacts, contamination, economic impacts, legal issues, and farmers’ responses.
Otsuka, Y.	2003	Socioeconomic Considerations Relevant to the Sustainable Development, Use and Control of Genetically Modified Foods	<i>Trends in Food Science and Technology</i> , Vol. 14(5-8), p. 294-318	Reviews economic and social concerns about GM food with reference to sustainable agriculture and rural development. Suggests GM food has both positive and negative effects on capital stocks, efficiency and equity. Examines three problematic policy options: intellectual property protection, trade liberalization, and biosafety implementation.

Political Issues in Genetically Modified Food - General

Author	Date	Title	Source	Comments
Barton, J. & Dracup, M.	2000	Genetically Modified Crops and the Environment	<i>Agronomy Journal</i> , Vol. 92(4), p. 797-803	Presents a balanced appraisal of environmental issues. Proposes that environmental assessment must consider the nature of the genetic modification, the context of the biology of the plant and the environment in which it will be grown. Argues that the environmental risk of releasing a GMO must be assessed against the background of current agricultural management practices and ecosystems.
Dale, P.	2002	The Environmental Impact of Genetically Modified (GM) Crops: a Review	<i>The Journal of Agricultural Science</i> , Vol. 138 (pt. 3), May 2002, p. 245-248	Addresses the difficulty in determining environmental impact when including the requirements for an assessment of indirect effects and post-commercialization monitoring. Addresses socio-economic impacts. Argues that some tolerance for GM products must be tolerated in “non-GM” foods.
Deckers, J.	2005	Are Scientists Right and Non-Scientists Wrong? Reflections on Discussions of GM	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 18(5), p. 451-478	Explores three examples of ways in which the “GM is unnatural” view has been treated by UK policy makers: <ul style="list-style-type: none"> • The Government’s position; • Nuffield Council on Bioethics; and, • Nigel Halford, a scientist with an advisory role to the government. Argues all three fail to provide a convincing critique. Discusses an empirical research project concerning scientist responses to “GM is unnatural”. Found scientists who reject it struggle to do so consistently.
Isaac, G. & Hobbs, J.	2002	GM Food Regulations: Canadian Debates	<i>Canadian Journal of Policy Research</i> , Vol. 3(2), p. 105-113	Argues regulation must be determined through a comprehensive public policy analysis identifying both risks and benefits. In Canada, such analysis was the task of three separate regulatory reviews, yet the mandates of each review were inappropriately set. Argues a comprehensive analysis of the Canadian trajectory is required. This must begin with an analysis of the appropriate role of science and technology in society, followed by substantial equivalence, the precautionary principle, and mandatory labelling.
Issac, G.	2001	Regulating Biotechnology	<i>AgBiotech Bulletin</i> , Vol. 9(7), p. 1-4	Proposes a common foundation for biotechnology regulation has been the <i>Risk Analysis Framework</i> . Argues two approaches have come from this: a Scientific Rationality Approach and a Social Rationality Approach. Argues the heart of the difference is the belief about the appropriate role of science and technology in society.

				Addresses the different approaches to the role of technology and mandatory labelling.
Tansey, J.	2003	The Prospects for Governing Biotechnology in Canada	Electronic Working Papers Series, W. Maurice Young Centre for Applied Ethics, Paper No. DEG 001	<p>Argues decision makers must recognize they cannot forestall public controversies by using weak consultative approaches.</p> <p>Examines Canadian governance of biotechnology.</p> <p>Gives a model of government with particular attention to the historical foundation.</p> <p>Examines the idea that modern societies are governable in a deterministic fashion.</p> <p>Gives an overview of environmental and risk assessment techniques.</p> <p>Argues technologies are socially embedded. Understanding the governance of biotechnology involves considering the role of the capitalist infrastructure.</p> <p>Argues the techniques used to assess the effects of biotechnology are weakly predictive and operate under conditions of great uncertainty.</p> <p>Argues safety is only one of the factors influencing the emergence of public controversies about biotechnology.</p>
Thorpe, A. & Robinson, C.	2004	The Biotechnological Food Revolution: Exploring the Governance Issues	<i>International Journal of Agricultural Resources, Governance and Ecology</i> , Vol. 3(1/2), p. 11-32	<p>Reviews the evolution of GM foods and identifies scientific risks.</p> <p>Reviews the domestic legislative and international governance frameworks in the US and the EU.</p> <p>Argues these fundamentally different approaches will seriously impede attempts to derive global standards.</p>

Political Issues in Genetically Modified Food – Labelling

Author	Date	Title	Source	Comments
Carter, C. & Gruere, G.	2003	Mandatory Labelling of Genetically Modified Foods: Does it Really Provide Consumer Choice	<i>AgBioForum</i> , Vol. 6(1-2)	Indicates that mandatory labelling is often justified as a means of fortifying consumer choice. Argues mandatory labelling does not provide consumer choice. In countries with mandatory labelling, GM foods have disappeared from the market. The policy results in additional taxpayer costs, there are losses to those consumers who would prefer to buy lower-priced GM food, and mandatory labelling acts as an import barrier and diverts trade. This all serves to reduce consumer choice.
Einsiedel, E.	2000	Consumer and GM Food Labels: Providing Information or Sowing Confusion?	<i>AgBioForum</i> , Vol. 3(4), p. 231-235	Identifies some of the issues to be determined in a labelling policy are: what is being labelled, when would labelling be required, how should GM food be labelled, and is it possible for a label to be truthful and still mislead?
Grobe, D. & Raab, C.	2004	Voters' Response to Labelling Genetically Engineered Foods: Oregon's Experience	<i>Journal of Consumer Affairs</i> , Vol. 38(2), p. 320-331	An Oregon measure to label genetically engineered foods was defeated. Conducted a survey to explore how and why voters voted the way they did. Found concern with costs, questions about necessity, concern with how the measure was worded, and the impact the measure would have on farmers. Those who supported the measure wanted to know what they were eating.
Hansen, K.	2004	Does Autonomy Count in Favour of Labelling Genetically Modified Food	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 17(1), p. 67-76	Argues consumer autonomy does not support the labelling of GM foods rather than the labelling of non-GM foods. Consumer choice can be secured by either labelling system. There is no duty to label GM foods based on danger. Argues autonomy by itself does not require mandatory labelling. The market cannot comply with all consumers' information demands. Argues other considerations support the view that non-GM foods should be labelled. Those consumers interested only in non-GM foods have a clear interest in labelling whereas those who are ambivalent to GM foods do not. The former should therefore pay for a labelling policy.
Harrison, R. & Han, J.	2005	The Effects of Urban Consumer Perceptions on Attitudes for Labelling of Genetically	<i>Journal of Food Distribution Research</i> , Vol. 36(2), p. 29-38	Considers consumer attitudes toward the US FDA labelling policy for GM foods with regard to the influence of consumer perceptions of GM foods. Found that as concerns regarding potential adverse effects of GM crops on wildlife and the environment increase, consumers are less likely to support the FDA labelling policy.

		Modified Foods		
Hu, W.; Veeman, M. & Adamowicz, W.	2005	Labelling Genetically Modified Food: Heterogeneous Consumer Preferences and the Value of Information	<i>Canadian Journal of Agricultural Economics</i> , Vol. 53(1), p. 83-102	Analyzes consumer choices of bread under different GM food labelling policies. Found substantial heterogeneity among tastes for different bread attributes, including the presence or absence of GM ingredients. Estimates the value of information using a simulation-based bias-adjusted measure. Found information from a mandatory labelling regime is more valued than the information in a voluntary labelling regime. Estimates consumer benefits from labelling policies in terms of average market prices for comparison in cost-benefit analysis.
Huffman, W.; Rousu, M.; Shogren, J. & Tegene, A.	2002	Should the United States Regulate Mandatory Labelling for Genetically Modified Foods?	Staff Paper Series, Department of Economics, Iowa State University (02013)	Develops a model showing voluntary labelling results in higher welfare than mandatory labelling, provided consumers can accurately read the signals in each market. Found consumers behave as though they can accurately identify signals for GM foods. Concludes the US should maintain a voluntary labelling policy.
Huffman, W.; Rousu, M.; Shogren, J. & Tegene, A.	2004	The Welfare Effects of Implementing Mandatory GM Labelling in the USA	<i>Consumer Acceptance of Genetically Modified Foods</i> (R. Evenson & V. Santaniello, Eds.) Oxford University Press, 2004: 41-51	Examines the welfare effects of imposing mandatory labelling. Discusses when such a policy is likely to benefit consumers. Conducted an experimental auction to test whether consumers will benefit from mandatory labelling. Found consumers do not interpret voluntary and mandatory market signals identically. Concludes it is more welfare improving for the USA to continue a voluntary labelling policy.
Huffman, W.; Shogren, J.; Rousu, M. & Tegene, A.	2003	Consumer Willingness to Pay for Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions	<i>Journal of Agricultural and Resource Economics</i> , Vol. 28(3), p. 481-502	Examines how willingness to pay changes when GM labels are introduced. Found participants discounted GM products by about 14%. Found the sequencing of food labels affects willingness to pay.
Irani, T. & Sinclair, J.	2004	The Effect of Labelling	<i>Journal of Applied Communications</i> , Vol. 88(1),	Conducted an experiment to examine the impact of different types of GM food labels.

		Genetically Modified Food on Perceptions of Accountability	p. 29-42	Found the labelling message and strength affected perception of government and industry accountability, in turn affecting attitude toward and willingness to purchase GM foods. Found the manufacturer's product claim label created a stronger perception of accountability than the mandatory FDA label.
Loureiro, M. & Hine, S.	2004	Preferences and Willingness to Pay for GM Labelling Policies	<i>Food Policy</i> , Vol. 29(5), p. 467-483	Uses contingent valuation to determine whether US consumers prefer mandatory or voluntary labelling, and calculates the premium they are willing to pay for their choice. Found the premium associated with mandatory labelling is lower than expected costs.
McCann-Hiltz, D.; Veeman, M.; Adamowicz, W. & Hu, W.	2004	Agricultural Biotechnology: A Comparison of Consumers' Preferences for Selected Policy Options	<i>Canadian Journal of Agricultural Economics</i> , Vol. 52(3), p. 333-350	Studies consumers' preferences for regulatory policies by use of a telephone survey. Uses conditional and mixed logit models to assess the influence of different socio-economic factors on choices of policy options. The two policy options explored were: 1. A labelling system giving more information about biotechnology for food. 2. More food inspection Both options were preferred over more restrictive regulation of agricultural biotechnology. The most preferred policy was a labelling system with more information.
Phillips, P. & Isaac, G.	1998	GMO Labelling: Threat or Opportunity?	<i>AgBioForum</i> , Vol. 1(1)	Examines the potential impact of mandatory and voluntary labelling regimes. Reviews consumer demand and assesses GMO labelling. Concludes mandatory labelling will impose excessive costs on producers, threatening research and commercialization.
Raab, C. & Grobe, D.	2003	Labelling Genetically Engineered Food: The Consumer's Right to Know?	<i>AgBioForum</i> , Vol. 6(4), p. 155-161	Discusses Oregon's Ballot Measure 27 from November 2002, in which citizens voted on whether to legislate mandatory labelling of GM foods. 30% of voters were in favour of labelling, and 70% were against it. A primary reason for those in favour of labelling was the consumer's right to know. Other reasons included simply it was a good idea, or it was the right thing to do. Others had safety or environmental concerns. A major concern of those voting against labelling was cost, particularly to farmers. Others didn't think labelling was necessary. Organic food is already positively labelled and provides an alternative. If the measure were brought when most foods were not genetically modified, it would be appropriate. But now it's too late.
Rousu, M. &	2001	GM Food Labelling	Staff Paper Series, Department	Examines the labelling policies of the USA, EU, Australia, Japan, Canada, and

Huffman, W.		Policies of the U.S. and its Trading Partners	of Economics, Iowa State University, (344)	China. Discusses how different policies are due to different ethical concerns and the difference in perceived risks posed to health, the environment, and trade.
Rousu, M.; Huffman, W.; Shogren, J. & Tegene, A.	2004	Are United States Consumers Tolerant of Genetically Modified Foods?	<i>Review of Agricultural Economics</i> , Vol. 26(1), p. 19-31	Using data from experimental auctions, tests whether consumers prefer foods with 0, 1 or 5% tolerance levels for genetically modified material. Found consumers would pay less for food that tolerates genetically modified material. Found no evidence that consumers place different values on foods with 1 and 5% genetically modified content.
Rousu M.; Huffman, W.; Shogren, J. & Tegene, A.	2002	Are US Consumers Tolerant of GM Foods?	Paper prepared for presentation at the Annual Meeting of the American Agricultural Economics Association, Long Beach, California, July 28-31, 2002, online at agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=4463	Addresses the question of how US consumers react to a positive tolerance standard for GM ingredients in a labelling regime. Used an experimental auction to test: <ul style="list-style-type: none"> • The mean consumer bids for the GM-free product equals the mean bid for the GM-threshold products, set at either 1% or 5% • The mean bids for the 1%-GM-product equals the mean bids for the 5%-GM-product threshold Found the first hypothesis can be rejected, but not the second. Found consumers reduce their demand by about 10% relative to the baseline irrespective of whether the GM threshold is set at 1 or 5% Argues, therefore, a threshold of 5% is more efficient because it is less costly to meet.
Rubel, A. & Streiffer, R.	2005	Respecting the Autonomy of European and American Consumers: Defending Positive Levels on GM Foods	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 18(1), p. 75-84	Argues against the view that negative labelling of non-GM foods respects the autonomy of consumers as well as positive labelling of GM foods, and is preferable because of lower cost. Argues the cost of positive labelling is not great, and that more than a small minority of people desire information about GM content. Argues that a discussion of the relationship between autonomy and labelling should include not just discussions of consumer autonomy, but also what the authors call <i>citizen autonomy</i> .
Runge, C. & Jackson, L.	1999	Labelling, Trade and Genetically Modified Organisms (GMOs): A Proposed Solution	Working Paper, Center for International Food and Agricultural Policy, University of Minnesota (WP99-4)	Offers a solution to the potential injury to the global trading system caused by the introduction of GM foods. Discusses labelling of GM agricultural products, arguing in favour of a negative label rather than a positive label. Discusses the issues left unresolved by the labelling proposal.
Smyth, S. & Phillips, P.	2003	Labelling to Manage Marketing	<i>Trends in Biotechnology</i> , Vol. 21(9), p. 389-393	Refers to a survey showing that terminology such as GM, non-GM, or GM free is not effective in providing product information to consumers.

		of GM Foods		<p>Studies have shown no preference for a tolerance level of 1% over 5%. Studies show that consumers are willing to pay a premium for information about GM content, but are inconclusive about the amount.</p> <p>Found willingness to pay does not have a strong correlation with labelling for either GM or non-GM foods.</p> <p>Refers to an experiment finding that, despite indicating GM-free ingredients were very desirable, consumers did not express more interest in the foods labelled GM-free than in foods labelled GM.</p> <p>Concludes that, despite stated preferences, actual behaviour indicates that within North America labelling for GM content is largely irrelevant.</p>
Tegene, A.; Huffman, W.; Rousu, M. & Shogren, J.	2003	The Effects of Information on Consumer Demand for Biotech Foods: Evidence from Experimental Auctions	Technical Bulletin, ERS Research Briefs, US Department of Agriculture, (1903): 28, 2003, online at: www.ers.usda.gov/publications/tb1903	<p>Presents empirical evidence on consumers' willingness to pay for biotechnology foods based on the presence or absence of labels.</p> <p>Found that labels matter.</p> <p>Found consumers discounted food items labelled "GM" by an average of 14%.</p> <p>Found information from interested parties and independent sources has a strong impact.</p>
Teisl, M.; Garner, L.; Roe, B. & Vayda, M.	2003	Labelling Genetically Modified Foods: How do US Consumers want to See it Done	<i>AgBioForum</i> , Vol. 6(1-2)	<p>Conducted a survey of US adults.</p> <p>Found most respondents want a labelling program for GM foods, with a majority of those respondents wanting labelling to be mandatory.</p> <p>Found consumers are not aware of the extent to which GM food is already being sold.</p> <p>Found the use of GM ingredients was not the highest food production concern.</p> <p>Argues labelling may cause a short-run decrease in sales, but a broader long-run acceptance.</p> <p>Most respondents favoured a federal agency to administer the labelling program.</p> <p>Found a strong desire for labels to indicate the risks and benefits of the GM foods.</p>
Teisl, M.; Halverson, L.; O'Brien, K.; Roe, B.; Ross, N. & Vayda, M.	2002	Focus Group Reactions to Genetically Modified Food Labels	<i>AgBioForum</i> , Vol. 5(1)	<p>Used focus groups to gauge US consumer reactions to different GM food labelling policies.</p> <p>Found participants were unaware of the extent to which GM ingredients are used in processed foods.</p> <p>Found GM-free claims are viewed with skepticism.</p> <p>Found most participants favoured a mandatory labelling system, though they were split on whether they were willing to pay higher food costs to cover it.</p> <p>Found most participants want the label to indicate whether the food contains</p>

				GM ingredients and why the genetic modification was done.
Veeman, M.	2003	Labelling Policy for GM Foods: Pragmatism in Action or Policy Failure?	<i>Current Agriculture, Food & Resource Issues</i> , No. 4, p. 107-115	Regardless of the labelling regime, there are added costs for those producers choosing to label. There are identity preservation costs for those choosing to identify themselves as non-GM. Canada has had difficulty creating a labelling regime due to disagreement on the multitude of issues, such as mandatory vs. voluntary, whether to include only GM content or GM processes, maximum and minimum tolerance levels.
Veeman, M. & Adamowicz, W.	2004	Genetically Modified Foods: Consumers' Attitudes and Labelling Issues	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2004, (04-01)	Gave two hypothetical scenarios: <ul style="list-style-type: none"> • The first was to assess preference for a policy that would place regulatory restrictions on the production, processing or marketing of food, versus a policy that would increase food inspection. • The second assessed preferences for a policy that would regulate restrictions on the production, processing or marketing of food, versus a policy for developing a labelling system for food that gives information on the effects of agricultural biotechnology. Results suggest that many consumers are prepared to make trade-offs for higher levels of information or assurance of food quality. Results suggest that Alberta consumers are more willing to pay for a policy that would provide more information about agricultural biotechnology on food labels, and for more emphasis on food inspection. They were willing to pay the least amount for a policy that would restrict biotechnology. Participants in focus groups identified health and environmental issues as areas of major concern for GM food. Also did a survey of Canadian households in general. Survey found that GM foods were believed to be very risky by an appreciable number of respondents, but less risky for food safety than most other food risks. Respondents tended to see agricultural biotechnology of somewhat more of an environmental risk issue than an issue of food safety. Found a strong preference for mandatory labelling over voluntary labelling, though stricter regulation was found to be most preferred.
Veeman, M.; Adamowicz, W. & Hu, W.	2005	Risk Perceptions, Social Interactions and the Influence of Information on Social Attitudes to Agricultural Biotechnology	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2005, (05-02)	Did experiments to determine Canadian perceptions of the risk of GM food and how their opinions are formed, and how they affect their choices. Found biotechnology for animals is a more important food safety issue than biotechnology for plants, though neither was the most pressing food safety issue. Found the majority of Canadians do not have strong views either for or against genetic modification.

				<p>Found that preferences concerning GM food and the associated perceived risks of the product are diverse.</p> <p>Found those who did seek information about GM food were more strongly opposed to it.</p> <p>Found consumers are less likely to choose food with GM ingredients.</p> <p>Found that where mandatory labelling is required, GM labelled products are adversely viewed.</p> <p>Found the information provided under mandatory labelling is valued more than the information provided under voluntary labelling.</p> <p>Found that attitudes to GM ingredients can be negative, neutral, or positive.</p>
Veeman, M.; Adamowicz, W.; Hu, W. & Hunnemeyer, A.	2005	Canadian Attitudes to Genetically Modified Food	<i>Crossing Over</i> (E. Einsiedel & F. Timmermans, Eds.) University of Calgary Press, 2005: 99-113	<p>Conducted a Canada-wide survey to test the effects of different types of information for pre-packaged sliced bread. One experiment focused on the influence of different types of information from different sources. The second experiment focused specifically on the effects of different labelling policies.</p> <p>Found low trust in the food industry, farmers associations and the federal government as sources of information. Found high trust in research institutions and consumer associations.</p> <p>Found a majority do not have strong views either for or against GM foods.</p> <p>Found strong support for mandatory labelling, though a majority preferred stricter regulation to mandatory labelling.</p> <p>Found respondents were less likely to purchase GM bread, though this aversion was reduced if there was a positive health or environmental effect.</p> <p>Found those who accessed further information were more opposed to GM ingredients than those who did not access further information.</p> <p>Found the loss in welfare from labelling GM foods was higher than the gain in welfare from labelling non-GM foods.</p>
van Wechel, T.; Wachenheim, C.; Schuck, E. & Lambert, D.	2003	Consumer Valuation of Genetically Modified Foods and the Effect of Information Bias	Agricultural and Applied Economics Report, Department of Agribusiness and Applied Economics, North Dakota State University, (513)	<p>Conducted an experimental auction using cookies, muffins, and crisps to estimate the influence of information bias. Used a standard Nutrition Facts label and those indicating they did not contain GM ingredients.</p> <p>Found bids for presumed GM products were lower than for products labelled as non-GM.</p> <p>Found positive and negative-biased information both increased bids for GM products.</p> <p>Found the perceived level of risk increased with negative-biased information and decreased with positive-biased information.</p> <p>Concludes the effect of biased-information on acceptability and willingness-to-pay for non-GM products may differ by product type.</p>

Regulation

Author	Date	Title	Source	Comments
Carr, S. & Levidow, L.	2000	Exploring the Links Between Science, Risk, Uncertainty, and Ethics in Regulatory Controversies about Genetically Modified Crops	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 12(1), p. 29-39	Argues risk assessment decisions must be based in science. Examines how ethical decisions are being suppressed in the regulatory scheme. Discusses how a check on the values at the basis of decisions, using boundary-testing questions, can contribute to a more constructive regulatory dialogue.
Carter, C. & Gruere, G.	2003	Mandatory Labelling of Genetically Modified Foods: Does it Really Provide Consumer Choice	<i>AgBioForum</i> , Vol. 6(1-2)	Indicates that mandatory labelling is often justified as a means of fortifying consumer choice. Argues mandatory labelling does not provide consumer choice. In countries with mandatory labelling, GM foods have disappeared from the market. The policy results in additional taxpayer costs, there are losses to those consumers who would prefer to buy lower-priced GM food, and mandatory labelling acts as an import barrier and diverts trade. This all serves to reduce consumer choice.
Chern, W.; Rickertsen, K.; Tsuboi, N. & Fu, T.	2003	Consumer Acceptance and Willingness to Pay for Genetically Modified Vegetable Oil and Salmon: A Multiple-Country Assessment	<i>AgBioTech</i> , Vol. 5(3), p. 105-112	Found the willingness to consume GM food increased notably if it contained explicit benefits to the consumer. Found wide support for a mandatory labelling system. Found, in the US, respondents were willing to pay a premium of 50-62% to avoid buying GM vegetable oil. Recognize this may be inflated, however, because vegetable oil is inexpensive and the question was hypothetical.
Einsiedel, E.	2000	Consumer and GM Food Labels: Providing Information or Sowing Confusion?	<i>AgBioForum</i> , Vol. 3(4), p. 231-235	Identifies some of the issues to be determined in a labelling policy are: what is being labelled, when would labelling be required, how should GM food be labelled, and is it possible for a label to be truthful and still mislead?
Grobe, D. & Raab, C.	2004	Voters' Response to Labelling	<i>Journal of Consumer Affairs</i> , Vol. 38(2), p. 320-331	An Oregon measure to label genetically engineered foods was defeated. Conducted a survey to explore how and why voters voted the way they did.

		Genetically Engineered Foods: Oregon's Experience		Found concern with costs, questions about necessity, concern with how the measure was worded, and the impact the measure would have on farmers. Those who supported the measure wanted to know what they were eating.
Hansen, K.	2004	Does Autonomy Count in Favour of Labelling Genetically Modified Food	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 17(1), p. 67-76	Argues consumer autonomy does not support the labelling of GM foods rather than the labelling of non-GM foods. Consumer choice can be secured by either labelling system. There is no duty to label GM foods based on danger. Argues autonomy by itself does not require mandatory labelling. The market cannot comply with all consumers' information demands. Argues other considerations support the view that non-GM foods should be labelled. Those consumers interested only in non-GM foods have a clear interest in labelling whereas those who are ambivalent to GM foods do not. The former should therefore pay for a labelling policy.
Harrison, R. & Han, J.	2005	The Effects of Urban Consumer Perceptions on Attitudes for Labelling of Genetically Modified Foods	<i>Journal of Food Distribution Research</i> , Vol. 36(2), p. 29-38	Considers consumer attitudes toward the US FDA labelling policy for GM foods with regard to the influence of consumer perceptions of GM foods. Found that as concerns regarding potential adverse effects of GM crops on wildlife and the environment increase, consumers are less likely to support the FDA labelling policy.
Holtug, N.	2001	The Harm Principle and Genetically Modified Food	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 14(2), p. 169-178	Argues the Harm Principle is the moral basis on which GM food is currently regulated, but that the concept of harm cannot be specified such that the Harm Principle is a plausible political principle. In addition, the Harm Principle does not express concern for the expected benefits of GM food. Because of these two points, the Harm Principle cannot be used to justify regulation.
Hu, W.; Veeman, M. & Adamowicz, W.	2005	Labelling Genetically Modified Food: Heterogeneous Consumer Preferences and the Value of Information	<i>Canadian Journal of Agricultural Economics</i> , Vol. 53(1), p. 83-102	Analyzes consumer choices of bread under different GM food labelling policies. Found substantial heterogeneity among tastes for different bread attributes, including the presence or absence of GM ingredients. Estimates the value of information using a simulation-based bias-adjusted measure. Found information from a mandatory labelling regime is more valued than the information in a voluntary labelling regime. Estimates consumer benefits from labelling policies in terms of average market prices for comparison in cost-benefit analysis.
Huffman, W.; Rousu, M.;	2002	Should the United States Regulate	Staff Paper Series, Department of Economics, Iowa State	Develops a model showing voluntary labelling results in higher welfare than mandatory labelling, provided consumers can accurately read the signals in

Shogren, J. & Tegene, A.		Mandatory Labelling for Genetically Modified Foods?	University (02013)	each market. Found consumers behave as though they can accurately identify signals for GM foods. Concludes the US should maintain a voluntary labelling policy.
Huffman, W.; Rousu, M.; Shogren, J. & Tegene, A.	2004	The Welfare Effects of Implementing Mandatory GM Labelling in the USA	<i>Consumer Acceptance of Genetically Modified Foods</i> (R. Evenson & V. Santaniello, Eds.) Oxford University Press, 2004: 41-51	Examines the welfare effects of imposing mandatory labelling. Discusses when such a policy is likely to benefit consumers. Conducted an experimental auction to test whether consumers will benefit from mandatory labelling. Found consumers do not interpret voluntary and mandatory market signals identically. Concludes it is more welfare improving for the USA to continue a voluntary labelling policy.
Huffman, W.; Shogren, J.; Rousu, M. & Tegene, A.	2003	Consumer Willingness to Pay for Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions	<i>Journal of Agricultural and Resource Economics</i> , Vol. 28(3), p. 481-502	Examines how willingness to pay changes when GM labels are introduced. Found participants discounted GM products by about 14%. Found the sequencing of food labels affects willingness to pay.
Huygen, I.; Veeman, M. & Lerohl, M.	2003	Cost Implications of Alternative GM Tolerance Levels: Non-Genetically Modified Wheat in Western Canada	<i>AgBioForum</i> , Vol. 6(4), p. 169-177	Estimated cost differences for non-GM wheat at different levels of tolerance. Found an appreciable increase in cost as threshold levels tighten from 5% to 0.1%.
Irani, T. & Sinclair, J.	2004	The Effect of Labelling Genetically Modified Food on Perceptions of Accountability	<i>Journal of Applied Communications</i> , Vol. 88(1), p. 29-42	Conducted an experiment to examine the impact of different types of GM food labels. Found the labelling message and strength affected perception of government and industry accountability, in turn affecting attitude toward and willingness to purchase GM foods. Found the manufacturer's product claim label created a stronger perception of accountability than the mandatory FDA label.
Issac, G.	2001	Regulating Biotechnology	<i>AgBiotech Bulletin</i> , Vol. 9(7), p. 1-4	Proposes a common foundation for biotechnology regulation has been the <i>Risk Analysis Framework</i> . Argues two approaches have come from this: a Scientific

				<p>Rationality Approach and a Social Rationality Approach.</p> <p>Argues the heart of the difference is the belief about the appropriate role of science and technology in society.</p> <p>Addresses the different approaches to the role of technology and mandatory labelling.</p>
Isaac, G. & Hobbs, J.	2002	GM Food Regulations: Canadian Debates	<i>Canadian Journal of Policy Research</i> , Vol. 3(2), p. 105-113	<p>Argues regulation must be determined through a comprehensive public policy analysis identifying both risks and benefits. In Canada, such analysis was the task of three separate regulatory reviews, yet the mandates of each review were inappropriately set.</p> <p>Argues a comprehensive analysis of the Canadian trajectory is required. This must begin with an analysis of the appropriate role of science and technology in society, followed by substantial equivalence, the precautionary principle, and mandatory labelling.</p>
Lence, S. & Hayes, D.	2002	Impact of Biotech Grains on Market Structure and Societal Welfare	<i>Agbioforum</i> , Vol. 5(3), p. 85-89	<p>Quantifies the economic impact of introducing GM crops.</p> <p>Found it optimal to maintain the identity of a greater proportion of non-GM grain than is currently demanded by non-GM consumers.</p> <p>In the long run, GM crops almost always benefit society. There is one scenario where overall welfare falls.</p>
Loureiro, M. & Hine, S.	2004	Preferences and Willingness to Pay for GM Labelling Policies	<i>Food Policy</i> , Vol. 29(5), p. 467-483	<p>Uses contingent valuation to determine whether US consumers prefer mandatory or voluntary labelling, and calculates the premium they are willing to pay for their choice.</p> <p>Found the premium associated with mandatory labelling is lower than expected costs.</p>
McCann-Hiltz, D.; Veeman, M.; Adamowicz, W. & Hu, W.	2004	Agricultural Biotechnology: A Comparison of Consumers' Preferences for Selected Policy Options	<i>Canadian Journal of Agricultural Economics</i> , Vol. 52(3), p. 333-350	<p>Studies consumers' preferences for regulatory policies by use of a telephone survey.</p> <p>Uses conditional and mixed logit models to assess the influence of different socio-economic factors on choices of policy options.</p> <p>The two policy options explored were:</p> <ol style="list-style-type: none"> 1. A labelling system giving more information about biotechnology for food. 2. More food inspection <p>Both options were preferred over more restrictive regulation of agricultural biotechnology.</p> <p>The most preferred policy was a labelling system with more information.</p>
Myrh, A. & Traavik, T.	2002	The Precautionary Principle: Scientific	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 15(1), p. 73-86	<p>Argues there is scientific uncertainty and ambiguity, omitted research areas, and lack of basic knowledge crucial to risk assessments in the GM controversy.</p> <p>Concludes that the void in scientific understanding concerning risks warrants</p>

		Uncertainty and Omitted Research in the Context of GMO Use and Release		further research. Argues that scientists have a responsibility to address and communicate uncertainty to policymakers and the public.
Myrh, A. & Traavik, T.	2003	Genetically Modified (GM) Crops: Precautionary Science and Conflicts of Interests	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 16(3), p. 227-247	Argues that the lack of data and insufficient information concerning ecological effects of GM food call for the application of the Precautionary Principle. Recognizes differences of opinions among scientists about the relevance of putative hazards, definition of potential “adverse effects”, and whether actions should be taken to prevent harm. Recognizes that value assumptions embedded in a scientific framework may be a barrier for employment of the precautionary principle. Concludes that precautionary GM usage requires risk assessment criteria yet undeveloped and more long-term conceptions of risk, uncertainty, and ignorance.
Phillips, P. & Isaac, G.	1998	GMO Labelling: Threat or Opportunity?	<i>AgBioForum</i> , Vol. 1(1)	Examines the potential impact of mandatory and voluntary labelling regimes. Reviews consumer demand and assesses GMO labelling. Concludes mandatory labelling will impose excessive costs on producers, threatening research and commercialization.
Raab, C. & Grobe, D.	2003	Labelling Genetically Engineered Food: The Consumer’s Right to Know?	<i>AgBioForum</i> , Vol. 6(4), p. 155-161	Discusses Oregon’s Ballot Measure 27 from November 2002, in which citizens voted on whether to legislate mandatory labelling of GM foods. 30% of voters were in favour of labelling, and 70% were against it. A primary reason for those in favour of labelling was the consumer’s right to know. Other reasons included simply it was a good idea, or it was the right thing to do. Others had safety or environmental concerns. A major concern of those voting against labelling was cost, particularly to farmers. Others didn’t think labelling was necessary. Organic food is already positively labelled and provides an alternative. If the measure were brought when most foods were not genetically modified, it would be appropriate. But now it’s too late.
Rousu, M. & Huffman, W.	2001	GM Food Labelling Policies of the U.S. and its Trading Partners	Staff Paper Series, Department of Economics, Iowa State University, (344)	Examines the labelling policies of the USA, EU, Australia, Japan, Canada, and China. Discusses how different policies are due to different ethical concerns and the difference in perceived risks posed to health, the environment, and trade.
Rousu, M.; Huffman, W.; Shogren, J. &	2004	Are United States Consumers Tolerant of	<i>Review of Agricultural Economics</i> , Vol. 26(1), p. 19-31	Using data from experimental auctions, tests whether consumers prefer foods with 0, 1 or 5% tolerance levels for genetically modified material. Found consumers would pay less for food that tolerates genetically modified

Tegene, A.		Genetically Modified Foods?		material. Found no evidence that consumers place different values on foods with 1 and 5% genetically modified content.
Rousu M.; Huffman, W.; Shogren, J. & Tegene, A.	2002	Are US Consumers Tolerant of GM Foods?	Paper prepared for presentation at the Annual Meeting of the American Agricultural Economics Association, Long Beach, California, July 28-31, 2002, online at agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=4463	Addresses the question of how US consumers react to a positive tolerance standard for GM ingredients in a labelling regime. Used an experimental auction to test: <ul style="list-style-type: none"> • The mean consumer bids for the GM-free product equals the mean bid for the GM-threshold products, set at either 1% or 5% • The mean bids for the 1%-GM-product equals the mean bids for the 5%-GM-product threshold Found the first hypothesis can be rejected, but not the second. Found consumers reduce their demand by about 10% relative to the baseline irrespective of whether the GM threshold is set at 1 or 5%. Argues, therefore, a threshold of 5% is more efficient because it is less costly to meet.
Rubel, A. & Streiffer, R.	2005	Respecting the Autonomy of European and American Consumers: Defending Positive Levels on GM Foods	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 18(1), p. 75-84	Argues against the view that negative labelling of non-GM foods respects the autonomy of consumers as well as positive labelling of GM foods, and is preferable because of lower cost. Argues the cost of positive labelling is not great, and that more than a small minority of people desire information about GM content. Argues that a discussion of the relationship between autonomy and labelling should include not just discussions of consumer autonomy, but also what the authors call <i>citizen autonomy</i> .
Runge, C. & Jackson, L.	1999	Labelling, Trade and Genetically Modified Organisms (GMOs): A Proposed Solution	Working Paper, Center for International Food and Agricultural Policy, University of Minnesota (WP99-4)	Offers a solution to the potential injury to the global trading system caused by the introduction of GM foods. Discusses labelling of GM agricultural products, arguing in favour of a negative label rather than a positive label. Discusses the issues left unresolved by the labelling proposal.
Smyth, S. & Phillips, P.	2003	Labelling to Manage Marketing of GM Foods	<i>Trends in Biotechnology</i> , Vol. 21(9), p. 389-393	Refers to a survey showing that terminology such as GM, non-GM, or GM free is not effective in providing product information to consumers. Studies have shown no preference for a tolerance level of 1% over 5%. Studies show that consumers are willing to pay a premium for information about GM content, but are inconclusive about the amount. Found willingness to pay does not have a strong correlation with labelling for either GM or non-GM foods. Refers to an experiment finding that, despite indicating GM-free ingredients

				were very desirable, consumers did not express more interest in the foods labelled GM-free than in foods labelled GM. Concludes that, despite stated preferences, actual behaviour indicates that within North America labelling for GM content is largely irrelevant.
Tansey, J.	2003	The Prospects for Governing Biotechnology in Canada	Electronic Working Papers Series, W. Maurice Young Centre for Applied Ethics, Paper No. DEG 001	Argues decision makers must recognize they cannot forestall public controversies by using weak consultative approaches. Examines Canadian governance of biotechnology. Gives a model of government with particular attention to the historical foundation. Examines the idea that modern societies are governable in a deterministic fashion. Gives an overview of environmental and risk assessment techniques. Argues technologies are socially embedded. Understanding the governance of biotechnology involves considering the role of the capitalist infrastructure. Argues the techniques used to assess the effects of biotechnology are weakly predictive and operate under conditions of great uncertainty. Argues safety is only one of the factors influencing the emergence of public controversies about biotechnology.
Tegene, A.; Huffman, W.; Rousu, M. & Shogren, J.	2003	The Effects of Information on Consumer Demand for Biotech Foods: Evidence from Experimental Auctions	Technical Bulletin, ERS Research Briefs, US Department of Agriculture, (1903): 28, 2003, online at: www.ers.usda.gov/publications/tb1903	Presents empirical evidence on consumers' willingness to pay for biotechnology foods based on the presence or absence of labels. Found that labels matter. Found consumers discounted food items labelled "GM" by an average of 14%. Found information from interested parties and independent sources has a strong impact.
Teisl, M.; Garner, L.; Roe, B. & Vayda, M.	2003	Labelling Genetically Modified Foods: How do US Consumers want to See it Done	<i>AgBioForum</i> , Vol. 6(1-2)	Conducted a survey of US adults. Found most respondents want a labelling program for GM foods, with a majority of those respondents wanting labelling to be mandatory. Found consumers are not aware of the extent to which GM food is already being sold. Found the use of GM ingredients was not the highest food production concern. Argues labelling may cause a short-run decrease in sales, but a broader long-run acceptance. Most respondents favoured a federal agency to administer the labelling program. Found a strong desire for labels to indicate the risks and benefits of the GM foods.

Teisl, M.; Halverson, L.; O'Brien, K.; Roe, B.; Ross, N. & Vayda, M.	2002	Focus Group Reactions to Genetically Modified Food Labels	<i>AgBioForum</i> , Vol. 5(1)	Used focus groups to gauge US consumer reactions to different GM food labelling policies. Found participants were unaware of the extent to which GM ingredients are used in processed foods. Found GM-free claims are viewed with skepticism. Found most participants favoured a mandatory labelling system, though they were split on whether they were willing to pay higher food costs to cover it. Found most participants want the label to indicate whether the food contains GM ingredients and why the genetic modification was done.
Veeman, M.	2003	Labelling Policy for GM Foods: Pragmatism in Action or Policy Failure?	<i>Current Agriculture, Food & Resource Issues</i> , No. 4, p. 107-115	Regardless of the labelling regime, there are added costs for those producers choosing to label. There are identity preservation costs for those choosing to identify themselves as non-GM. Canada has had difficulty creating a labelling regime due to disagreement on the multitude of issues, such as mandatory vs. voluntary, whether to include only GM content or GM processes, maximum and minimum tolerance levels.
Veeman, M. & Adamowicz, W.	2004	Genetically Modified Foods: Consumers' Attitudes and Labelling Issues	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2004, (04-01)	Gave two hypothetical scenarios: <ul style="list-style-type: none"> • The first was to assess preference for a policy that would place regulatory restrictions on the production, processing or marketing of food, versus a policy that would increase food inspection. • The second assessed preferences for a policy that would regulate restrictions on the production, processing or marketing of food, versus a policy for developing a labelling system for food that gives information on the effects of agricultural biotechnology. Purpose was to study public concern associated with genetically engineered foods as compared to other food safety concerns. Assesses major issues that affect consumers' motivation and behaviour related to alternative labelling policies. Results suggest that many consumers are prepared to make trade-offs for higher levels of information or assurance of food quality. Results suggest that Alberta consumers are more willing to pay for a policy that would provide more information about agricultural biotechnology on food labels, and for more emphasis on food inspection. They were willing to pay the least amount for a policy that would restrict biotechnology. Part of the experiment used focus groups, for which GM bread was given as an example. Participants in focus groups identified health and environmental issues as areas of major concern for GM food.

				<p>Also did a survey of Canadian households in general. Survey found that GM foods were believed to be very risky by an appreciable number of respondents, but less risky for food safety than most other food risks. Respondents tended to see agricultural biotechnology of somewhat more of an environmental risk issue than an issue of food safety. Found a strong preference for mandatory labelling over voluntary labelling, though stricter regulation was found to be most preferred.</p>
<p>Veeman, M.; Adamowicz, W.; Hu, W. & Hunnemeyer, A.</p>	<p>2005</p>	<p>Canadian Attitudes to Genetically Modified Food</p>	<p><i>Crossing Over</i> (E. Einsiedel & F. Timmermans, Eds.) University of Calgary Press, 2005: 99-113</p>	<p>Conducted a Canada-wide survey to test the effects of different types of information for pre-packaged sliced bread. One experiment focused on the influence of different types of information from different sources. The second experiment focused specifically on the effects of different labelling policies. Found low trust in the food industry, farmers associations and the federal government as sources of information. Found high trust in research institutions and consumer associations. Found a majority do not have strong views either for or against GM foods. Found strong support for mandatory labelling, though a majority preferred stricter regulation to mandatory labelling. Found respondents were less likely to purchase GM bread, though this aversion was reduced if there was a positive health or environmental effect. Found those who accessed further information were more opposed to GM ingredients than those who did not access further information. Found the loss in welfare from labelling GM foods was higher than the gain in welfare from labelling non-GM foods.</p>

Evaluation of Biotechnology

Author	Date	Title	Source	Comments
Barton, J. & Dracup, M.	2000	Genetically Modified Crops and the Environment	<i>Agronomy Journal</i> , Vol. 92(4), p. 797-803	Presents a balanced appraisal of environmental issues. Proposes that environmental assessment must consider the nature of the genetic modification, the context of the biology of the plant and the environment in which it will be grown. Argues that the environmental risk of releasing a GMO must be assessed against the background of current agricultural management practices and ecosystems.
Brooks, G. & Barfoot, P.	2005	GM Crops: The Global Economic and Environmental Impact the First Nine Years 1996-2004	<i>Agbioforum</i> , Vol. 8(2-3), p. 187-196	Studies global economic impacts on farm income and environmental impacts. Shows substantial net economic benefits. Shows significant reduction in pesticide spraying and the release of greenhouse gases.
Ellerbrock, M.	2002	Metaphysical Keys to Evaluating Agricultural Biotechnology: Eschatological Myths & Epistemological Tests	Joint Annual Meetings of the <i>Association for the Study of Food and Society</i> and <i>Agriculture, Food, and Human Values Society</i> , Chicago, IL, June 13-16, 2002	Argues that, in order to assess agricultural biotechnology, it is necessary to adopt a common language that speaks to basic human values. Proposes that myth is suitable. Argues that evaluating the social context in which biotechnology is developed involves principles of social ethics and epistemological tests. Proposes a set of moral and spiritual criteria for evaluating the impact of biotechnology on indigenous societies.
Fraser, V.	2001	What's the Moral of the GM Food Story?	<i>Journal of Agricultural and Environmental Ethics</i> , Vol. 14(2), p. 147-159	Examines the issues and problems raised by agricultural biotechnology in the context of ethical theory. Argues that many of the negative aspects do not come from the unintended effects of biotechnology. Argues that if ethics is to address the adverse impacts of agricultural biotechnology, it must consider its conceptual framework emerging from Enlightenment, liberal, political and economic theory. Suggests that narrative and feminist critiques of medical bioethics are a good place to start this project.
Lence, S. & Hayes, D.	2002	Impact of Biotech Grains on Market Structure and Societal Welfare	<i>Agbioforum</i> , Vol. 5(3), p. 85-89	Quantifies the economic impact of introducing GM crops. Found it optimal to maintain the identity of a greater proportion of non-GM grain than is currently demanded by non-GM consumers. In the long run, GM crops almost always benefit society. There is one scenario where overall welfare falls.
Lence, S. &	2005	Genetically Modified	<i>American Journal of</i>	Develops a framework for examining price and welfare effects of the

Hayes, D.		Crops: Their Market and Welfare Impacts	<i>Agricultural Economics</i> , Vol. 87(4), p. 931-950	introduction of GM products. Found that introducing GM technology increases aggregate welfare, unless production cost savings are small and consumers are seriously concerned about GM foods.
Meziani, G. & Warwick, H.	2002	Seeds of Doubt: North American Farmers' Experiences of GM Crops	<i>Soil Association</i> , 2002, online at: www.soilassociation.org/sa/saweb.nsf/d9976776970e3680256b4c0040ab74/9ce8a24d75d3f65980256c370031a2d0!OpenDocument	Purpose was to assess the success of GM crops in North America and what problems have occurred. Argues the evidence shows GM food crops are not a success. Argues GM has disrupted GM-free production, destroyed trade and undermined international competitiveness. Analyzes farming impacts, contamination, economic impacts, legal issues, and farmers' responses.
Otsuka, Y.	2003	Socioeconomic Considerations Relevant to the Sustainable Development, Use and Control of Genetically Modified Foods	<i>Trends in Food Science and Technology</i> , Vol. 14(5-8), p. 294-318	Reviews economic and social concerns about GM food with reference to sustainable agriculture and rural development. Suggests GM food has both positive and negative effects on capital stocks, efficiency and equity. Examines three problematic policy options: intellectual property protection, trade liberalization, and biosafety implementation.
Wu, F.	2004	Explaining Public Resistance to Genetically Modified Corn: An Analysis of the Distribution of Benefits and Risks	Explaining Public Resistance to Genetically Modified Corn: An Analysis of the Distribution of Benefits and Risks	Argues a cause of public hesitation to GM crops may be that consumers do not perceive significant benefits to themselves from GM crops, while fearing certain risks. Conducts an economic analysis to determine whether the benefits of one type of GM corn outweigh the potential risks, and who bears those benefits and risks. Found that growers, consumers, and industry all benefit. Found the welfare gain to individual consumers is small and may not make up for perceived risks.

Genetically Modified Wheat and Wheat Products

Author	Date	Title	Source	Comments
DeVuyst, E.; Koo, W.; DeVuyst, C. & Taylor, R.	2001	Modeling International Trade Impacts of Genetically Modified Wheat Introductions	Agribusiness and Applied Economics Report, Department of Agribusiness and Applied Economics, North Dakota State University	Proposes a model for estimation of demand and supply equations using existing supply, demand, and elasticity estimates and relying on composite supply and demand functions. Uses this approach in a model of world wheat trade and analyzes the impact of several plausible GM wheat adoption and consumer acceptability scenarios.
Furtan, W.; Gray, R. & Holzman, J.	2005	Regulatory Approval Decisions in the Presence of Market Externalities: The Case of Genetically Modified Wheat	<i>Journal of Agricultural and Resource Economics</i> , Vol. 30(1), p. 12-27	Examines the optimal approval strategy for GM wheat in the US and Canada. Uses a differentiated product trade model with endogenous technology pricing. Found there are large distributional effects. Found the introduction of GM wheat will create a market for “lemons”, resulting in the loss of export markets. Generates a payoff matrix for the possible approval outcomes. Found wheat producers lose economic surplus, while consumers and biotech companies gain economic surplus.
Gao, G., Veeman, M. & Adamowicz, W.	2005	Consumers’ Search Behaviour for GM Food Information	<i>Journal of Public Affairs</i> , Vol. 5(3/4), p. 217-226	Conducted a computer-based survey of Canadian respondents to determine behaviour in searching for information about GM foods, using bread as the relevant product. Found that slightly less than half actually sought the information. Uses cost-benefit reasoning to assess the patterns of information access seen. Found the probability that respondents would access information was affected by gender, employment status, rural or urban residency, and the number of children in the household.
Hu, W.; Hunnemeyer, A.; Veeman, M.; Adamowicz, W. & Srivastava, L.	2004	Trading Off Health, Environmental and Genetic Modification Attributes in Food	<i>European Review of Agricultural Economics</i> , Vol. 31(3), p. 389-401	Examines the trade-offs between risks and benefits of GM foods, using a survey with bread as the specific food object. Uses a latent class model to analyze consumers’ preferences for GM foods. Found some consumers are indifferent to GM ingredients. Found considerable diversity in risk attitudes towards GM foods. Found 55% of consumers perceive little or no risk to GM foods. The remainder are distinctly adverse or perceive significant risks. Found the trade-offs between risks and benefits depend upon individual characteristics. Found an average discount of 0.50 CAD per GM loaf of bread.

Hu, W.; Veeman, M. & Adamowicz, W.	2005	Labelling Genetically Modified Food: Heterogeneous Consumer Preferences and the Value of Information	<i>Canadian Journal of Agricultural Economics</i> , Vol. 53(1), p. 83-102	Analyzes consumer choices of bread under different GM food labelling policies. Found substantial heterogeneity among tastes for different bread attributes, including the presence or absence of GM ingredients. Estimates the value of information using a simulation-based bias-adjusted measure. Found information from a mandatory labelling regime is more valued than the information in a voluntary labelling regime. Estimates consumer benefits from labelling policies in terms of average market prices for comparison in cost-benefit analysis.
Hu, W.; Veeman, M.; Adamowicz, W. & Gao, G.	2006	Consumers' Food Choices with Voluntary Access to Genetic Modification Information	Working Paper, Department of Rural Economy, University of Alberta Pending acceptance in the <i>Canadian Journal of Agricultural Economics</i> 2006 special issue on demand	Studies information access behaviour and its effects on product choices. Used bread as the study product. Studies the effects of information voluntarily obtained rather than required. Applies three different approaches to model this behaviour in a Bayesian estimation framework. Found less than 1/3 actually accessed the information provided. Found different types of information do impact consumer product choices. The nature of these effects is influenced by voluntary access to information. Found there is a difference in the results of voluntary information provision studies compared to compulsory information provision.
Huygen, I.; Veeman, M. & Leroth, M.	2003	Cost Implications of Alternative GM Tolerance Levels: Non-Genetically Modified Wheat in Western Canada	<i>AgBioForum</i> , Vol. 6(4), p. 169-177	Estimated cost differences for non-GM wheat at different levels of tolerance. Found an appreciable increase in cost as threshold levels tighten from 5% to 0.1%.
Lusk, J., House, L., Valli, C., Jaeger, S., Moore, M., Morrow, J. & Traill, W.	2004	Effect of Information about Benefits of Biotechnology on Consumer Acceptance of Genetically Modified Food: Evidence from Experimental Auctions in the United States, England, and France	<i>European Review of Agricultural Economics</i> , Vol. 31(2), p. 179-204	Used an incentive compatible auction mechanism to assess consumer willingness to accept compensation to consume GM food, using cookies as the food. Found information on environmental benefits, health benefits, and benefits to the third world significantly decreased the amount of money consumers demanded to consume GM food. Found initial attitudes toward biotechnology have a significant effect on how individuals respond to information.
Taylor, R.; DeVuyst, E. & Koo, W.	2003	Potential Impacts of GM Wheat on United States and Northern Plains Wheat Trade	Agricultural and Applied Economics Report, Department of Agribusiness and Applied Economics, North Dakota	Uses a spatial equilibrium model to evaluate the trade impacts of introducing GM wheat. Found that producers who don't produce GM wheat would face externalities associated with GM wheat contamination.

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Tenbult, P.; de Vries, N.; Dreezens, E. & Martijn, C.	2005	Perceived Naturalness and Acceptance of Genetically Modified Food	<i>Appetite</i> , Vol. 45(1), p. 47-50	Examines people's acceptance of GM food. Food examples used were 'butter', 'mars', 'tomato', 'crisps', 'fish fingers', and 'bread'. Found that acceptance of GM foods was most dependent on the extent to which GM food is perceived to be natural but not on the extent to which non-GM food is perceived to be natural.
Veeman, M. & Adamowicz, W.	2004	Genetically Modified Foods: Consumers' Attitudes and Labelling Issues	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2004, (04-01)	Purpose was to study public concern associated with genetically engineered foods as compared to other food safety concerns. Assesses major issues that affect consumers' motivation and behaviour related to alternative labelling policies. Part of the experiment used focus groups, for which GM bread was given as an example. Participants in focus groups identified health and environmental issues as areas of major concern for GM food.
Veeman, M.; Adamowicz, W. & Hu, W.	2005	Risk Perceptions, Social Interactions and the Influence of Information on Social Attitudes to Agricultural Biotechnology	Rural Economy Project Report, Department of Rural Economy, University of Alberta, 2005, (05-02)	Did experiments to determine Canadian perceptions of the risk of GM food and how their opinions are formed, and how they affect their choices. GM bread was used as an example in the experiments. Found biotechnology for animals is a more important food safety issue than biotechnology for plants, though neither was the most pressing food safety issue. Found Canadians are not well informed about genetic modification. Found the majority do not have strong views either for or against genetic modification. Found that preferences concerning GM food and the associated perceived risks of the product are diverse. Found consumers are less likely to choose food with GM ingredients. Found that where mandatory labelling is required, GM labelled products are adversely viewed.
Veeman, M.; Adamowicz, W.; Hu, W. & Hunnemeyer, A.	2005	Canadian Attitudes to Genetically Modified Food	<i>Crossing Over</i> (E. Einsiedel & F. Timmermans, Eds.) University of Calgary Press, 2005: 99-113	Conducted a Canada-wide survey to test the effects of different types of information for pre-packaged sliced bread. One experiment focused on the influence of different types of information from different sources. The second experiment focused specifically on the effects of different labelling policies. Found low trust in the food industry, farmers associations and the federal government as sources of information. Found high trust in research institutions and consumer associations. Found a majority do not have strong views either for or against GM foods. Found strong support for mandatory labelling, though a majority preferred

				<p>stricter regulation to mandatory labelling.</p> <p>Found respondents were less likely to purchase GM bread, though this aversion was reduced if there was a positive health or environmental effect.</p> <p>Found those who accessed further information were more opposed to GM ingredients than those who did not access further information.</p> <p>Found the loss in welfare from labelling GM foods was higher than the gain in welfare from labelling non-GM foods.</p>
van Wechel, T.; Wachenheim, C.; Schuck, E. & Lambert, D.	2003	Consumer Valuation of Genetically Modified Foods and the Effect of Information Bias	Agricultural and Applied Economics Report, Department of Agribusiness and Applied Economics, North Dakota State University, (513)	<p>Conducted an experimental auction using cookies, muffins, and crisps to estimate the influence of information bias. Used a standard Nutrition Facts label and those indicating they did not contain GM ingredients.</p> <p>Found bids for presumed GM products were lower than for products labelled as non-GM.</p> <p>Found positive and negative-biased information both increased bids for GM products.</p> <p>Found the perceived level of risk increased with negative-biased information and decreased with positive-biased information.</p> <p>Concludes the effect of biased-information on acceptability and willingness-to-pay for non-GM products may differ by product type.</p>
Wilson, W.; Janzen, E. & Dahl, B.	2003	Issues in Development and Adoption of Genetically Modified (GM) Wheats	<i>Agbioforum</i> , Vol. 6(3), p. 101-112	<p>Summarizes information and important issues concerning GM wheats, including the evolution of GM wheats, agronomic competitiveness, consumer acceptance, traits, regulatory issues, segregation, identity preservation, production and marketing risks, and discusses the marketing system likely to evolve.</p>

Notes

The research for this bibliography was conducted using databases of journal articles available online from the University of Alberta libraries website. The databases used include: Agricola, CAB Abstracts, Agricultural and Environmental Biotechnology Abstracts, Biological and Agricultural Index, and EconLit. These databases are highly comprehensive covering journals published domestically and internationally.

Various search terms were employed with the intent of being efficient in the search without excluding any relevant articles. Searches began with more general queries and then increased in specificity. Examples of queries used are: “genetically modified” and consumer; “genetically modified” and ethics not consumer; “genetically modified” and labelling; crops and bioethics; bioethics not animal not genetically modified; and, “genetically modified” and wheat. Additional articles were found with help from Dr. Michele Veeman, pointing me to additional resources.

Articles were included in the bibliography if they contained an appreciable treatment of consumer or ethical issues. Those articles that did not include such issues, or did so only in passing, were excluded. Furthermore, articles concerned solely with genetic modification of animals were not included. This was particularly important in the area of ethics, as an appreciable number of articles were excluded on this basis. Articles dealing with both animal and plant biotechnology, or that were no specific to either, were included. Though political and economic issues were not the focus of this project, a number of articles concerned with such issues were included as a matter of interest. Those included constitute a general survey of the literature, but are not comprehensive.

Emphasis was placed on articles concerning North America. Articles dealing exclusively with a country or countries outside North America were not, in general, included. If the article was highly informative for understanding similar issues within North America, it was included.

Particular care was taken to find articles concerning genetically modified wheat or wheat products. The requirements for inclusion in the bibliography were relaxed if the article concerned wheat or used it in experiments. This was due to this project's concern with GM wheat as an emerging product.

Once the articles were collected they were surveyed for common themes and issues. This led to the groupings as found in the bibliography. Many articles will be found under more than one heading. The comments on these articles may differ slightly depending on which heading they are found under, to provide emphasis on those features relevant to the grouping.