
American Consumers' Awareness and Acceptance of Biotechnology¹

THOMAS J. HOBAN

*North Carolina State University
Raleigh, NC*

Over the past two years, agricultural biotechnology has captured public attention in the United States, notably with news stories on the monarch butterfly studies and StarLink™ corn. In addition, interest groups have been engaged in an intensive struggle for consumers' hearts and minds. Opponents of biotechnology, such as Greenpeace and the organic-farming industry, have used a variety of tactics to frighten consumers about potential risks. On the other side, the biotechnology industry, through the Council for Biotechnology Information, has launched an intensive public-information campaign stressing potential benefits. Therefore, it is helpful at this stage to evaluate available survey research concerning American consumers' awareness and acceptance of agricultural biotechnology and foods with genetically modified (GM) ingredients.

Before beginning this assessment, it will be useful to put agricultural biotechnology into the larger context of innovation diffusion, which has been the subject of over 50 years of research (Rogers, 1995). The basic conclusion from that work was that anything new takes time to garner awareness and gain acceptance and adoption. Early studies of hybrid corn conducted in central Iowa during the 1930s found that over a decade passed before farmers in general were using the higher-yielding varieties. Some farmers objected to the fact that they could no longer save their seed for planting—similar to technology fees and crop-protection technology (*i.e.* the “terminator” gene) associated with modern plant biotechnology.

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Consumer adoption of new food technologies also takes time. The microwave oven is an interesting example. When introduced, there were concerns over risks of radiation leakage into the kitchen. Over time, as consumers recognized the benefits and when concerns over risks were addressed, most people accepted microwave ovens in their homes. It is interesting that adoption of a new technology varies between cultures. French consumers are much less accepting of foods prepared by microwave than are Americans. Also, the French are appalled by another American innovation: the drive-through restaurant. Another example of societal resistance to new technology is pasteurization, as described by Joseph Hotchkiss in this volume.

Given the fact that no new technology will ever be 100% accepted by the public, it is important to examine some unique characteristics of the biotechnology controversy that make associated innovations more likely to meet with consumer resistance. First, agricultural biotechnology is a relatively complex subject. Full understanding of the technical issues associated with benefits and risks requires at least some knowledge of agriculture, food processing, and of the biological sciences. Not many consumers in the United States or elsewhere have direct connection with agriculture and food processing. Most take it for granted that food will be readily available and do not think, or care, much about how it gets to the store or restaurant. In addition, most people are unfamiliar with the advances in the biological sciences that have occurred over the past two decades. This lack of literacy makes some consumers apprehensive about developments in food biotechnology.

It is also important to consider how consumers receive information about food biotechnology, and the messages that they are hearing. Most of what consumers learn about any innovation comes through the filter of the mass media, which have a tendency to feature sensational news stories. Also, the media oversimplify issues to fit within their sound-bite framework. Stories about agricultural biotechnology tend to have a tone of conflict and controversy that makes people concerned. Once something is in the media it becomes part of the public agenda. Up to that point, most people have little awareness of, or interest in, a particular subject. Clearly, media coverage of biotechnology in the United States has increased over the past few years.

Another major factor that is slowing consumer acceptance of biotechnology involves the aggressive campaigns of a variety of special interest groups (Hoban, 1995). Groups such as Greenpeace and the Earth Liberation Front are trying to shake public confidence in science and the federal regulatory process. They do not find it necessary to prove their assertions, but are satisfied to raise doubts and fear. They also capture media attention with extreme tactics, such as destroying research plots, harassing food companies, and engaging in street theater. These groups have a variety of motives for their campaigns, including anti-corporate and anti-globalization ideologies. They have a vested interest in

building the controversy since it increases their donations and membership. In addition, the organic food industry supports the anti-biotechnology movement because some consumers are motivated to spend more money on organic foods.

Another problem for agricultural biotechnology is that benefits to consumers from the early products were not obvious. Many observers note that agricultural biotechnology tends to be less acceptable to consumers than is medical biotechnology. This makes sense given the fact that sick people are likely to accept risk from a medical treatment in order to regain health. Patients are likely to trust their doctors and follow their advice without question. The situation is quite different with food. People feel qualified to make their own decisions and are more risk-averse, especially when they see few direct benefits from a new food-production technology.

For the most part, new medicines developed through biotechnology have been well accepted by consumers. However, developments in human genetics and genomics may prove to be even more controversial than food biotechnology. For example, media coverage of human cloning and stem-cell research has captured public attention recently, tending to push agricultural biotechnology into the background. Society has some important and real concerns to deal with. Policy makers and scientists are only now beginning to grapple with questions about genetic privacy, genetic discrimination, and eugenics. Given that the public and the media have a limited attention span, it is possible that agricultural biotechnology may well be viewed as more acceptable by comparison.

With this background in mind, I now turn to an assessment of recent research on consumer awareness and attitudes about agricultural biotechnology. In general, the studies that I will review involved telephone surveys of the Americans. Most involved approximately 1,000 interviews, representing a confidence level of just over 3%. Where possible, I will highlight trends in the results over time.

CONSUMER AWARENESS OF BIOTECHNOLOGY

The process of innovation adoption starts with awareness. For almost a decade, consumers have been asked in various surveys, “How much have you heard or read about biotechnology—a lot, some, a little, or nothing?” (Hoban, 1996, 2001; IFIC, 2001.) It is reasonable to equate awareness with having heard something or a lot (Figure 1). There are several notable trends in consumer awareness of biotechnology in the United States. For the first half of the 1990s, it remained rather low at about one-third. It hit a peak in 1997 when a survey was conducted soon after the news about Dolly, the cloned sheep. Then awareness dropped until May 2000, but has grown gradually since, to 53% in June 2001.



Figure 1. American consumers' awareness of biotechnology, 1992–2001 (Hoban, 1996, 2001; IFIC, 2001).

Most Americans are not aware of the extent to which biotechnology has become part of their food supply. According to a January 2001 survey conducted by the Pew Foundation for Agricultural Biotechnology, few consumers believed that GM foods are in wide use in the food supply, and even fewer believed that they have eaten them (Pew, 2001). Most consumers, 60%, believed that less than half of the food in grocery stores contains GM ingredients, while 38% thought that less than a quarter of food contains such ingredients. Only 14% of consumers believed that more than half of our food contains GM ingredients, which was the correct answer. Additionally, few Americans recognized that they had already eaten GM foods. Only 19% said they had eaten GM foods, 62% said they had not, and 19% said they did not know.

At the same time, consumers were uncertain about how safe GM foods are. When asked initially, with little background information, whether GM foods are safe, almost half said that they did not know, 29% said they are basically safe, and 25% said they are basically unsafe. However, after being informed that more than half of the products at the grocery store contain GM ingredients, almost half said that GM foods are safe, only 21% said that they are unsafe, and 31% said they were unsure (Figure 2). In fact, one in five of those who initially said GM foods were unsafe, changed their minds. Thus, when some consumers learn how widespread are GM foods, they are more likely to believe they are safe. However, it is also true that some consumers become angry when they realize that they have not been told about the widespread presence of GM ingredients.

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Figure 2. American consumers' views on the safety of genetically modified foods (Pew, 2001).

CONSUMER ACCEPTANCE OF BIOTECHNOLOGY

Consumer acceptance has been measured in a variety of ways in different surveys. I have had the opportunity to repeat the same set of questions with three surveys through my own research (Hoban and Kendall, 1994), as well as in a survey conducted by Angus Reid, Inc. in 2000 (personal communication). The objective was to assess the level of consumer acceptance of three applications of biotechnology (Figure 3). In the case of insect-protected crops, acceptance was higher in 1992 (63%) and 1994 (67%) than in 2000 (51%). The same overall trend was noted for disease resistance in farm animals and for larger, faster-growing fish; but these applications were relatively less acceptable than plants at all points in time. This is of particular concern, because disease-resistant animals and faster-growing fish are either on the market or close to commercialization.



Figure 3. American consumers' acceptance of three applications of biotechnology (Hoban and Kendal, 1994; Angus Reid, Inc., pers. comm.).

Surveys conducted by Hoban and Miller (1998) and by Priest (2000) evaluated more-recent trends in American consumers' support for four applications of biotechnology (Figure 4). Compared to 1998, a greater percentage of consumers in 2000 believed that applications of biotechnology to crops and foods should be encouraged. It is interesting to note that consumers tended to view insect-protected crops as more acceptable than improved foods. Support for development of new human genetic screening techniques rose significantly between 1998 and 2000 (Figure 4). At the same time, concerns have been raised in the media about loss of genetic privacy and the potential for discrimination that could result from increased access to such genetic information.



Figure 4. American consumers' support for four applications of biotechnology (Hoban and Miller, 1998; Priest, 2000).

It is instructive to compare these results from the United States with trends for the same questions asked on the Eurobarometer² in 1996 and 1999 (Figure 5). In Europe, public support for all four applications of biotechnology dropped significantly during this period, which corresponds to the growth of the public controversy. It is understandable that agricultural and food applications would become less acceptable given the fact that they were the focus of opponents' campaigns. However, it is noteworthy that support for the two medical applications of biotechnology also dropped significantly. Such a pattern could mean some difficult challenges for the European economy and diminished prospects for new advances in health care.

²European Commission public-opinion surveys, <http://europa.eu.int/comm/dg10/epo/>.



Figure 5. European consumers' support for four applications of biotechnology, 1996 and 1999 (Eurobarometer).

IMPACTS OF THE STARLINK™ CORN CONTROVERSY

One incident that captured the attention of the media in the United States involved the discovery in food of a protein from a corn variety that had not been approved for human consumption, i.e., StarLink™. To evaluate consumer response to the story, I conducted a survey for the Grocery Manufacturers of America in October 2000, immediately after the taco-shell recall was announced. Most of the questions were asked again in January 2001 by the International Food Information Council (IFIC, 2001). These results indicate no significant impact from the StarLink™ controversy on consumers' attitudes or behavior.

Early in the interview, before any mention of StarLink™ or biotechnology, respondents were asked the open-ended question, "Over the past few months, what, if anything, have you been avoiding or eating less of?" (Figure 6). The largest percentage indicated that they had not changed their eating habits in any way. This was particularly true in January, which may reflect holiday eating patterns. Of those who had limited their consumption of a particular food, responses were almost evenly divided among fats, carbohydrates, or meat and dairy products. No one in either survey said they had stopped eating taco shells or corn, nor was there any other reference to biotechnology. The next open-ended question was, "What if anything are you most concerned about when it comes to food safety?" The most common responses involved microbial contamination or pesticides. Only 2 to 3% mentioned anything related to biotechnology or genetic modification.

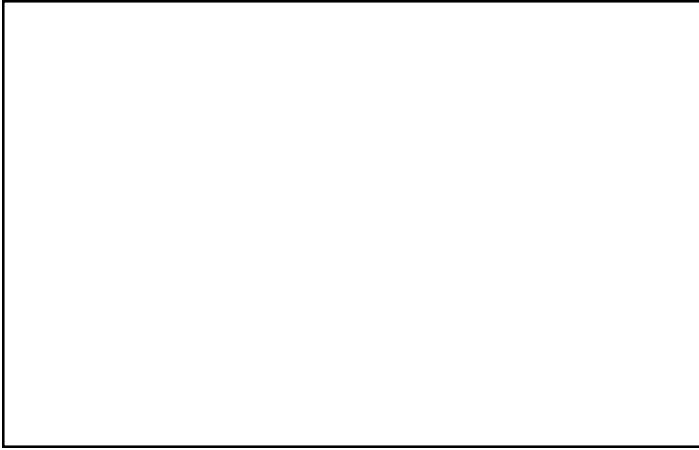


Figure 6. Foodstuff avoidance over the previous few months (Hoban, 2000; IFIC, 2001).

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The interview later posed specific questions about biotechnology and the StarLink™ issue. One question that I developed in 1995 has been repeated in other surveys (FMI, 1997; IFIC, 2001) to indicate the extent to which consumers are willing to buy tomatoes or potatoes developed through biotechnology for enhanced protection against insects (Figure 7). Overall, there was a modest drop in willingness to buy such products from the highest levels found between 1995 and early 1999. However, the results for October 2000 and January 2001 showed that consumers were just as willing to consume insect-protected plants after the StarLink™ incident as before.

As a final question, respondents were asked, “During the past few months have you done anything or taken any action because of any concerns you may have about genetically modified foods?” Despite this clear opportunity to answer “yes,” only 5% of the respondents in the October 2000 and January 2001 surveys said they had done anything. In my October survey, we followed up and asked that small pool of respondents what they had done. Mainly, they had sought out more information or had talked to someone. No one reported boycotting any food company or changing their food-consumption behavior.

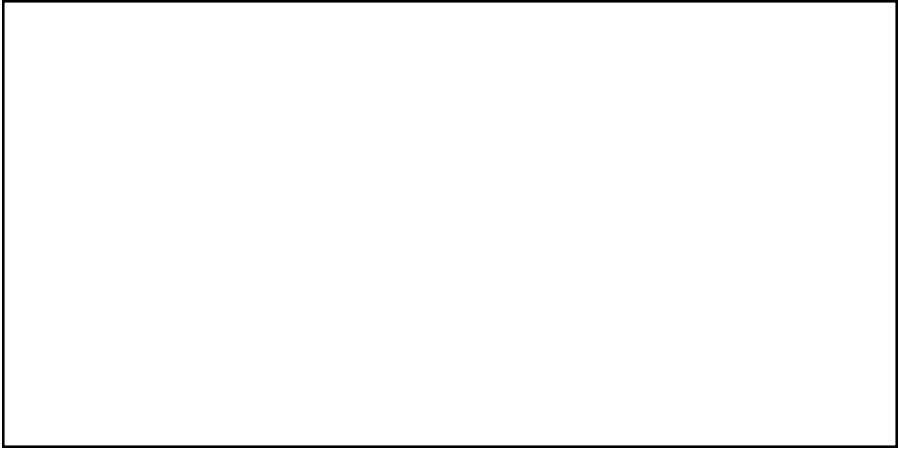


Figure 7. American consumers' willingness to buy potatoes or tomatoes genetically modified for enhanced resistance to insects (Hoban, 1996; FMI, 1997; IFIC, 2001).

CONSUMER VIEWS ON FOOD LABELING

A complex and contentious issue in the United States is whether foods developed through biotechnology should accordingly carry some type of label. On this particular subject, how questions are asked clearly has a major impact on how consumers respond. One neutral way is to simply ask, in an open-ended question, if they can think of any information not currently included that they would like to see on food labels. Surveys conducted in October 2000 (Hoban, 2000) and January 2001 (IFIC, 2001) found that only 2% of the people surveyed responded "genetically modified." In both cases, three-quarters of the respondents said they could not think of any additional information they would like to see on food labels. This is noteworthy in that the interviews took place after the StarLink™ controversy became a public issue.

Many consumers claim to want information on food labels about how foods and their ingredients are produced. The Center for Science in the Public Interest (CSPI) found in May of 2001 that about two-thirds of consumers wanted foods containing genetically engineered ingredients to be labeled (see pages 31, 32; CSPI, 2001). However, even more consumers (76%) wanted labeling for crops grown using pesticides, 65% for crops grown using plant hormones, and 56% for crops that are imported. In fact, 40% of respondents said that they would like products containing hybrid corn to be labeled, which would apply to any food containing oil, high-fructose syrup, or any other ingredients derived from corn.

One way to measure consumers' desire for labeling is to determine willingness to pay for that information. The CSPI survey found that 44% of consumers would pay "nothing" and another 17% would pay \$10 per year on top of their family's current annual food bill for such labeling. Only 28% were willing to pay \$50 or more. In fact, of the 17% of consumers who said that their highest labeling priority was genetic engineering, 50% would pay nothing or \$10 per year for that labeling. Similarly, of the people who believed that labeling genetically engineered foods should be required, 56% would pay nothing or \$10 per year for it. Although as many as two-thirds of consumers may desire labeling of GM foods, few appear willing to pay the real costs for that information, which would result from the need for identity preservation, testing, certification, *etc.*

One concern about labeling is that consumers may perceive the information to be a warning. In fact, when respondents to the CSPI survey were asked whether foods labeled as containing GM ingredients were just as safe as, not as safe as, or safer than, similar products without such a label, about 30% said that the labeled product was less safe. Only 7% said that the GM-labeled product was safer, and about 33% said that the labeled product was equally safe.

CONCLUSIONS AND IMPLICATIONS

Review of recent research makes it possible to anticipate future consumer acceptance of agricultural biotechnology in the United States. Given that public perception of plant biotechnology has not changed much over the past few years, it is unlikely that acceptance will change much in the future, provided that no real health problems are encountered with GM foods. Research into food-shopping preferences and behavior shows that consumers in the United States tend to be pragmatic in their choices. They select food based upon taste, value (price), convenience, and nutrition. No one spontaneously reports that seed genetics influenced their purchasing.

However, animal biotechnology will raise a host of complex issues that will make it less acceptable than plant biotechnology. Some people view animals as having feelings and due more respect than plants. Also, animal-rights activists will step up their protests as new products arrive on the market. Consumer reaction to transgenic animals, such as those used to produce human organs, will likely be extreme, particularly if the meat enters the food supply. Faster-growing fish may meet with poor acceptance, especially if they are labeled accordingly and/or the opposition groups have a significant impact on media coverage. Clearly, animal and veterinary scientists should learn from the experience of plant scientists about the importance of ongoing communication and social science research. Unfortunately, this may not be the case as evidenced by their lack of communication on these issues.

Media coverage of agricultural biotechnology over the past few years has generally been balanced in the United States, at least compared to Europe. It

seems that the media's focus is shifting to the range of complex issues related to human genomics, including the controversies of stem-cell research and human cloning. These issues may generate public concern as the products of medical biotechnology and genomics come to the market place. In particular, diagnostic tests and other screening tools will make it possible to identify genetic traits that predispose humans to disease. This will be controversial if people do not want to know, particularly where there is no cure for the disease that could be diagnosed. Also, concerns are already being raised about genetic privacy and the possibility for genetic discrimination by employers and health-insurance providers.

Relatively little social-science research has been done to assess public perceptions of either animal biotechnology or human genomics. Clearly, we need to start addressing these issues to understand public concerns and hopes, as well as information needs. In addition, no organizations have stepped forward to begin the challenging, but vital, job of informing the public about the future of animal biotechnology and human genetics, as the Council for Biotechnology Information, NABC, and others have done for plant biotechnology. We may look back and realize that the issues associated with plant biotechnology were easier to address than those with animal or human applications.

There are many reasons why opinion has remained more positive in America than in Europe, despite the best attempts of activist groups to promote fear and uncertainty. American consumers tend to have a greater level of confidence in scientists and government regulatory agencies, whereas in Europe confidence has been seriously eroded by mad cow disease and other problems. Scientists and others have been actively committed to providing the American public with information for over a decade, whereas EU leaders and scientists have generally been silent or ineffective. The activists who oppose biotechnology have relatively little credibility in the United States, partly as a result of terrorist tactics. In Europe these groups have filled the information vacuum and established credibility with the public.

America's relatively young culture tends to focus on the future, whereas Europeans generally look to the past. Our cultural values include a much greater appreciation for the role of science and technology in progress and economic growth. Americans also have feelings about agriculture and food that differ from those of Europeans. Many Europeans *live to eat* whereas most Americans *eat to live*. European consumers are more concerned with how food

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is produced and by whom, and they have closer connection to farming, due in part to the fact that they have few public wilderness areas. Their concept of natural is tied to small-scale farming. This ideology is also present in the United States among the relatively elite consumers of organic food.

Research and experience have provided some guidelines for providing relevant information to interested consumers about agricultural biotechnology. The first thing that people generally want to know is why scientists are using biotechnology. In other words, what are the benefits? In fact, many American consumers appreciate the potential of biotechnology for helping people in developing countries to feed themselves, which is a less persuasive message for Europeans. American consumers also have a greater appreciation of the fact that food produced with biotechnology is as safe as, or safer than, food produced through traditional breeding methods and grown with more chemical inputs. It is also important to make the point that no technology is without risk and that those associated with biotechnology are being managed and regulated.

Finally it is worth considering the implications of consumer attitudes toward biotechnology for land grant university research and extension programs. For the past year I have been chairing a national task force looking at ways in which universities can play a more meaningful and credible role in the discussions and deliberations about biotechnology. In some respects the future of biotechnology is closely linked to the future of our colleges of agriculture. Most universities have made major investments in biotechnology research and now have obligations to openly explain what they are doing and to ensure they are providing benefits to society in an ethical manner. We also will have a major role in developing and implementing education programs and fostering two-way communication. This is appropriate because American consumers and leaders still trust our universities. We must make sure we maintain that level of confidence.

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