

Consumer Acceptance of Genetically Modified Food Products in the Developing World

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Worldwide consumer response toward food products made from genetically modified (GM) ingredients has been largely negative. However, the majority of the previous studies on consumer attitudes towards food products were conducted in developed countries in Europe as well as Japan. The small number of studies conducted in developing nations obtain different results from those of the developed world. This paper considers the motivations for consumer attitudes towards GM foods in developing nations. We conclude that the generally positive perception towards genetically modified foods in developing nations stems from more urgent needs in terms of food availability and nutritional content. Additionally, perceived levels of risk may be smaller due to trust in government, positive perceptions of science, and positive media influences. This is contrary to the smaller benefits and higher perceived risks found in many developed countries, and hence, the rationale for low or non-acceptance of GM foods in those countries.

Key words: biotechnology, developing nations, genetically modified foods.

Introduction

The use of genetically modified (GM) ingredients in food products has been highly controversial. Consumer attitudes toward GM food products are largely negative in many of the developed countries in the European Union as well as Japan. Consumer skepticism in these countries is usually attributed to the unknown environmental and health consequences of genetically modified crops. Such consequences include, but are not limited to, unanticipated allergic responses, the spread of pest resistance or herbicide tolerance to wild plants, and inadvertent toxicity to wildlife.

Studies in Europe and Japan provide strong evidence that consumers are willing to take on the unknown risks of consuming genetically modified foods only if these products are offered at significant cost savings over non-GM foods. One study conducted in Norway by Grimsrud, McCluskey, Loureiro, and Wahl (2003) concluded that consumers in Norway were willing, on average, to purchase bread made with GM wheat only if it were offered at a 49.5% discount over non-GM bread. Burton, Rigby, Young, and James (2001), in a study of consumer attitudes toward genetically modified foods in the United Kingdom, concluded that male shoppers were willing to pay an extra 26% to avoid animal and plant GM technology, whereas female shoppers were willing to pay an extra 49.3%. McCluskey, Grimsrud, Ouchi, and Wahl (in press) found that Japanese consumers in their sample, on average, required a discount of greater

than 50% for noodles made with GM ingredients relative to GM-free noodles.

Studies in the United States find consumers to be more accepting of genetically modified foods compared with consumers in Europe and Japan. For example, a study by Lusk, Daniel, Mark, and Lusk (2001) found that 70% of their respondents were not willing to pay a premium for non-GM corn chips. A Canadian study (International Centre for Agricultural Science and Technology, 1995) found that consumers were willing to purchase genetically modified potatoes if offered at equal or slightly discounted prices.

Although there has been little research conducted on consumer attitudes towards genetically modified foods in developing countries, recent studies in China and Columbia found similar results. Li, Curtis, McCluskey, and Wahl (2003) concluded that Chinese consumers, on average, were willing to pay a 16% premium for GM soybean oil and a 38% premium for GM rice over the non-GM alternatives. Curtis (2003) found that Chinese consumers, on average, were willing to pay a 35% premium for genetically modified processed potato products such as French fries, mashed potatoes, and potato chips. Pachico and Wolf (2002) found that 66% of the survey respondents in Colombia were willing to try genetically modified foods, and the willingness to purchase genetically modified foods was high among those who felt they did not have adequate or high quality foods available at home.

Figure 1. Risk matrix.

		Opportunity	
		Yes	No
Danger	Yes	1. Fungability (costs and benefits)	2. "Better safe than sorry" (only costs)
	No	3. "Waste not, want not" (only benefits)	4. Indifference (neither costs nor benefits)

Note. From Margolis, 1996.

The disparity between consumer attitudes toward genetically modified foods worldwide is obviously large, ranging from price discounts of greater than 50% to price premiums of 38%. In recent research aimed at explaining the differences between the United States and Europe, Nelson (2001) concluded that European consumers generally focused on the unknown risks associated with genetically modified products, not the benefits, whereas US consumers generally evaluated neither the risks nor the benefits. Nelson, using the risk matrix presented by Margolis (1996) and shown in Figure 1, argued that European consumers fall into Cell 2 ("Better safe than sorry") because they treat the potential harm of genetically modified foods as certain, so they avoid them at all costs. This better-safe-than-sorry approach is basically the "Precautionary Principle," which dominates European GM labeling policy. The Precautionary Principle calls for preventive measures to be taken when an activity raises threats even if a direct cause-effect relationship has not been scientifically proven. In its strongest and most distinctive forms, the principle imposes a burden of proof on those who create potential risks, and it requires regulation of activities even if it cannot be shown that those activities are likely to produce significant harm (Sunstein, 2002).

Nelson argued that US consumers fall into Cell 4 ("Indifference"), because Americans typically feel that genetically modified foods are no different from other foods and are evaluated with equal standards. However, when one examines the benefits and perceived risks of genetically modified foods stemming from trust in government regulators, attitudes toward scientific discovery, and media influences, it is highly plausible that consumers in the United States and Europe consider both the benefits and the potential costs of genetically modified foods. Differing perceived risks explain the rationale behind their differing attitudes. Using the same approach, one might conclude that consumers in developing countries are also evaluating the benefits and potential costs of genetically modified foods. Developing countries have more urgent needs in terms of food availability, nutritional content, and income to pay for

food. If there is decreasing marginal utility in calorie consumption per capita, the marginal utility of the last calorie consumed is much higher in developing countries.

Risks and Benefits Associated with Consumer Choice in the Developing World

The rational consumer makes decisions under uncertainty by assigning probabilities of occurrence to uncertain outcomes. Analysis of the benefits and potential costs of an action—such as consuming genetically modified foods—results in an expected utility payoff for each action.

Factors Affecting Risk Perceptions

The consumer weighs the expected benefits and expected costs depending on his or her risk tolerance. The scientific consensus is that GM foods do not pose any risk to consumers. However, there is a distinction between scientifically assessed risk and perceived risk. The public's beliefs about risk are often very different from the beliefs of experts. (In the environmental risk literature, see Jenkins-Smith & Bassett, 1994; Lindell & Earle, 1983; McClelland, Schulze, & Hurd, 1990.) These perceived risks are seen as potential future costs by the consumer and carry probabilities of occurrence assigned by the consumer, and are thus subjective. We argue that the probability that the consumer assigns to each potential cost or risk primarily stems from three sources: (a) the level of trust in government regulators regarding food supply safety; (b) attitudes toward scientific discovery; and (c) the influence of media coverage (Table 1).

Trust in Government. Conclusions based on our survey (see Li et al., 2003; Curtis, 2003) of 599 Chinese consumers in Beijing, China, support this theory. Survey respondents were found to be trusting of government regulators concerning the safety of the food supply and very positive towards science, including the use of biotechnology in agriculture. When asked why they would be willing to pay a premium for genetically modified foods, many responded that they felt positively about science, were willing to try new products, or the price change was not enough to keep them from purchasing the products.

Positive Attitudes toward Science. European countries and Japan gradually developed modern capitalist societies while taking great concern and pride in preserving

Table 1. Influences on risk perceptions associated with GM foods.

Representative countries	Government regulation	Media coverage	Attitudes toward science
China/Colombia "Developing nations"	+	+	+
USA/Canada	+	+/-	+
Europe/Japan	-	-	-

Note. + positive influence; - negative influence; +/- ambiguous.

cultural traditions. For many developing countries, history took another turn. For example, in China, a decade of Cultural Revolution from 1966 to 1976 systematically tore down historical and traditional structures in the society. The past was condemned as "feudal and superstitious" (Beech, 2002). The vacuum remaining was to some extent replaced by the communist state. Now, with a highly desired and incredibly rapid transition to capitalism, and with much of the old Chinese tradition crushed by the Cultural Revolution, the Chinese are forward looking. Technological novelties from the rest of the world are often considered much-needed improvements, rather than reasons for concern.

In Colombia, Pachico and Wolf (2002) found that a positive predisposition towards scientific innovation was demonstrated by a strong agreement among 68% of the respondents that science improves the quality of life. Additionally, 75% of respondents agreed or strongly agreed that their government provides an adequate level of safety in their food supply.

Media Coverage. Information from media is provided either by private firms with their own profit-maximizing and ideological objectives or by public sources that may have the formal goal of providing objective information, but administrators and governments may have their own (private) incentives to bias the information (Swinnen, McCluskey, & Francken, 2003). This issue is particularly relevant for consumers' associated risk perceptions of biotechnology. Over 90% of consumers receive information about food and biotechnology primarily through the popular press and television (Hoban & Kendall, 1993). Extensive media coverage can contribute to heightened perceptions of risk. For example, the media coverage of bovine spongiform encephalopathy (BSE), commonly known as "mad cow disease," in Europe, Japan, and now Canada, resulted in declining beef demand. Verbeke, Ward, and Viaene (2000) found that television coverage on meat safety had a negative effect

on demand for red meat after the BSE outbreak in Belgium. Younger people and households with young children were the most susceptible to such negative media coverage. Frewer, Howard, and Shepherd (1998) concluded that television, radio, and newspapers, followed by discussion with other people, were the main information channels by which people base their decisions about biotechnology.

Government-controlled media coverage in China concerning genetically modified crops has been very positive. China is the fourth largest producer of genetically modified crops in the world and continues to support biotechnology research in an effort to sustain food self-sufficiency policies. Thus, it is not surprising that in our Chinese study only 9.3% of the survey respondents had a somewhat negative or very negative opinion concerning the use of biotechnology in foods. Fifty-four percent claimed to have no knowledge of genetically modified products at all, and only 7.8% associated high risk with genetically modified foods. Additionally, 64.6% of the respondents considered advertising in their food choice decisions. In Colombia, Pachico and Wolf's (2002) respondents also indicated that television is their major information source concerning genetically modified foods, with peer discussion and radio following in at second and third place. Nearly 75% of the consumers surveyed agreed that there may be some risk associated with genetically modified foods, but almost as many were willing to try genetically modified foods in any case.

Factors Affecting Perceived Benefits for Developing Countries

The benefits of genetically modified crops and, hence, genetically modified foods are mainly cost-reducing and/or yield-enhancing attributes. The benefits of genetically modified foods to the developing world concern food availability, nutrition, and economic advantage. Food availability is a large problem in the developing world. Forty percent of the survey participants in the Pachico and Wolf (2002) study in Colombia felt that they did not have adequate food for their family. China currently has almost 1.3 billion people and is likely to exceed 1.4 billion by 2050 (Population Reference Bureau, 2002). China recognizes that if it is going to continue to feed its people, it must find more efficient agricultural production methods. Additionally, more than a dozen genetically modified crops have been approved for development in China (Huang, Rozelle, Pray, & Wang, 2001). Increased yields provided by

many GM crops may provide answers to food availability issues in the developing world. James and Krattiger (1999) estimate that transgenic technology may increase rice production in Asia alone by 10-20% in the next decade.

A second major problem in the developing world is malnutrition, especially Vitamin A deficiency (VAD). It is estimated that a quarter to half a million Vitamin A deficient children go blind each year (Zimmerman & Qaim, 2002). Because rice is widely consumed in developing countries, golden rice was genetically engineered to provide Vitamin A and thus reduce VAD. Zimmerman and Qaim (2002) estimate that golden rice could reduce related health care costs in the Philippines by up to 32% and avert from 2,200 to 10,200 cases of blindness each year. Consumers in developing countries are concerned with their nutritional intake. Li et al. (2003) found that consumers in China were willing to pay more for genetically modified rice than for genetically modified soybean oil, due to the existence of additional vitamin content in the rice product.

A third problem facing developing nations is economic advantage. In order to be competitive in world markets, growers must find cost-efficient production methods. Genetically modified soybeans, also known as Roundup Ready (RR) soybeans, have provided Argentina an increase in total factor productivity in soybean production of 10% due to cost savings (Qaim & Traxler, 2002). A study by Kirsten, Gouse, and Jenkins (2002) found that both large and small-scale Bt (*Bacillus thuringiensis*) cotton farmers in South Africa realized net income gains due to higher yields and savings on pesticides. These gains prevailed even with higher seed costs and technology fees not found with traditional seed varieties. The use of insect-resistant Bt cotton in China reduced production costs by 14-33% (Pray, 2000).

Weighing the Perceived Costs and Benefits in Developing Countries

As is evident from the above discussion, the developing world may benefit greatly from transgenic technology. When such benefits are compared with the relatively small perceived costs associated with GM foods due to consumer risk perceptions stemming from a trust in government regulation, positive media attention, and a positive predisposition for scientific discovery, it makes sense that consumers in developing countries would accept GM food products through cost-benefit analysis.

Although genetically modified food acceptance is thus far relatively high in developing nations, recent sur-

veys show that consumers wish to know which foods contain GM ingredients. Pachico and Wolf (2002) show that 90.7% of their survey respondents in Colombia considered mandatory labeling of GM foods very or somewhat important. However, only 64% of the respondents said they read food labels very or somewhat often. Curtis (2003) found that 89.8% of the survey respondents in China considered labeling foods with GM ingredients somewhat or very important. In response to these concerns, China has required, since June 2001, that all GM products entering China for research, production, or processing have safety certificates from the agricultural ministry to ensure that they are safe for human consumption, animals, and the environment. China also requires that all listed transgenic biological products be labeled.

Developed World Comparisons

Both the United States and Europe benefit from GM technology through more efficient production stemming from decreased input costs. Because nutritious food in both the United States and Europe is readily available, consumers in these countries do not perceive the same benefits from GM foods as those in developing countries. In Japan and Europe, food scares and scandals have affected consumer trust. For example, in Japan, the disappointing economy, government scandals, and the government's handling of the discovery of bovine spongiform encephalopathy may have caused consumers to be less trusting of government reassurances and GM food products.

Further, European and Japanese cultures tend to take pride in traditional ways of doing things and do not necessarily see scientific discovery as life-improving. Europeans are often skeptical of new developments and have a "Why fix our food system if it isn't broken?" attitude. It is for these reasons that the Europeans and Japanese assign high probabilities to the potential risks of consuming GM foods. The Eurobarometer surveys in 2000 and 2001 found that 59.4% of Europeans thought genetic modification could have negative impacts on the environment, and 70.9% did not want to see living organisms genetically modified in any way. High potential risk perceptions, coupled with minor benefits of GM foods, provide a strong argument for the anti-GM food sentiments in Europe attained through cost-benefit analysis. As a result, the European Union (EU) has imposed mandatory labeling for some foods that contain GM ingredients. In October 1999, the EU gave preliminary approval to a law that requires labels on all foods con-

taining more than 1% GM ingredients. In Japan, authorities have ordered mandatory labeling for 29 food categories that may contain any GM ingredients.

In the United States, consumer concerns regarding GM foods are generally limited. A small number of activist groups have spoken out against GM technology, and there has been little media attention given to transgenic technology. Additionally, consumer trust in government authorities regarding food safety is relatively high due to the prevalence of regulatory agencies. The Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), and the US Department of Agriculture (USDA) all evaluate GM organisms for food, environmental, and public health safety. Hence, the minor benefits from GM foods for US consumers, combined with the minor potential costs fostered by a lack of media attention, positive disposition towards scientific innovation, and trust in government regulators concerning food safety, provide evidence for a general acceptance of genetically modified foods without large price premiums or discounts.

Conclusions

The concerns of food availability and nutritional intake are much greater in lesser-developed countries (LDCs) compared to the United States, Europe, and Japan. Increased crop yields and dietary supplements provided by genetically altered foods would be of greater benefit in terms of food availability and nutrition problems for LDCs, while the potential drawbacks are similar. These potential benefits, along with lower perceived risks, have contributed to generally more positive attitudes toward GM foods in developing nations. Still, the risks must be carefully assessed. Rissler and Mellon (1996) argued that the United Nations should develop international biosafety protocols to ensure that developing countries prevent the risk of genetically engineered crops endangering domestic crop diversity. Nelson (2001) concluded that public evaluation of GM organisms that considers the costs and benefits with a special preference for public health protection is necessary prior to future development.

A second issue of concern for LDCs, especially those which depend on food exports to developed areas such as Europe and Japan, is the potential for market loss due to new regulations requiring labeling and traceability on all foods with GM ingredients. In an effort to ensure GM-free exports, LDCs may be discouraged from planting GM crops due to the extraordinary expense involved in segregating GM and GM-free

crops. This strategy has already been seen in Brazil's recent capture of a US \$6–7 per ton premium over US corn sales to Spain and Japan due its GM-free corn status. The Codex committees of the World Trade Organization are working on harmonizing international standards and resolving trade disputes associated with food labeling to promote fair trade of foods while protecting consumer health. If Codex is successful in its efforts, pressure to remain "GM-free" may be dampened. As evidence, the results of an empirical study completed by Nielsen, Robinson, and Thierfelder (2001) indicate that global markets will adjust to segregation of GM and GM-free foods, with South America and low-income Asia benefiting the most.

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