

# Perceptions of Genetically Modified and Organic Foods and Processes

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Both organic production and the use of biotechnology have increased dramatically over the past decade. This study contributes to existing work on consumer acceptance of these practices and the resulting products through the use of twin survey instruments. Respondents indicated their level of agreement with statements about genetically modified (GM) or organic processes and products in the construct areas of health, environment, ethics, and risk. Organic food was perceived as healthier and safer. Organic practices were perceived to be more environmentally sound. Respondents expressed some level of concern over the unknown effects genetic modification could have on the environment and society as a whole. However, participants in general felt the technology could be used effectively and valued some of the associated benefits.

**Key Words:** Environment, genetically modified, health, organic, perceptions, risk.

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## Introduction

Consumers in industrialized countries enjoy a plethora of food choices, with increasing availability of both organic products and those resulting from biotechnology. Genetically modified (GM) crops were first made available in 1996 to producers for use in major crops. Since introduction, production has exploded. In 2005, 124 million acres of biotech crops were grown in the United States alone (James, 2005). An estimated 61% of all corn and 89% of all soybeans planted in the United States in 2006 were GM (National Agricultural Statistics Service [NASS], 2006). As a result of the rapid adoption of GM technologies, a majority of processed food products in the United States are thought to include GM ingredients (Hallman, Hebden, Aquino, Cuite, & Lang, 2003).

Similarly, the organic industry has also continued to grow and organic products are now common in retail food stores (Govindasamy, DeCongelio, & Bhuyan, 2005). Two-thirds of US consumers report using organic products, and 27% report being regular (weekly) users (The Hartman Group, 2002). The industry is expected to continue to increase its current annual growth of over 20% and reach \$30 billion in sales in the United States by the year 2007 (Scheel, 2004).

Both GM and organic foods and ingredients are thus increasingly available to consumers and for use by firms producing food products. The irony on the GM side is that growing segments of consumers seemingly want or potentially value a product that does not contain GM ingredients while producers have been producing record volumes of GM commodities and, with few notable

exceptions, processors have been using them without substantial market reaction. The challenge on the organic side is that consumer-level organic markets are growing but production and processing are more expensive and the organic identity of the resultant food products must be maintained. There is a growing demand for organic food products, even at a premium price (Oberholtzer, Dimitri, & Greene, 2005), but the additional cost of supplying them must be met by increased market premiums (Hill & Lynchehaun, 2002). And, there is some evidence that price sensitivity for organic foods may be high at retail stores, at least for some food categories (Glaser & Thompson, 2000).

A growing body of literature examines acceptance of and willingness to pay for non-GM and organic food products but it is still relatively limited and is often too general to be of much practical use or it is proprietary. And, to date, public domain research is limited which allows for direct comparison of attitudes about GM and organic foods and processes. This area of inquiry is particularly interesting because one of the unique attributes of, and one reason consumers may be moving towards, organic food is the absence of GM ingredients in them (Dhar & Foltz, 2005; Larue, West, Gendron, & Lambert, 2004) and there is some evidence that attitudes about organic foods can be a useful indicator of attitudes about GM foods (Burton, Rigby, Young, & James, 2001). Comparing attitudes about GM and organic foods and processes is the objective and major contribution of the current study.

## Background

It is estimated that 95% of total retail sales of organic food products occurs in the United States and the European Union (EU) (Dimitri & Oberholtzer, 2005). A review of selected literature from these markets provides insight into what *motivates* and what *impedes* the purchase of organic foods and thus aids in identification of relevant construct areas for consideration. Examination of the literature on purchase motivators associated with non-GM food products focuses on the US market where products containing GM ingredients are much more commonplace.

### Organic Food Market

The market for organic foods in the United States continues to rapidly grow, while it is relatively mature in other areas, particularly in parts of Western Europe.

**Evidence from Europe.** The EU actively promotes growth of the organic sector (Dimitri & Oberholtzer, 2005). Government subsidies and industry promotion have lowered price premiums (Thompson & Kidwell, 1998) and there is a higher level of consumer awareness than that found in the United States.

Grunert and Juhl (1995), Land (1998), and Wier and Andersen (2003) investigated organic purchase motivators in Denmark. Grunert and Juhl found willingness to pay for organic foods to be directly related to attitudes about, and behaviors reflective of, a concern for the environment. Land found consumers chose organic food because of associations with better health and improved taste, and that consumers considered "pesticide free" to be an important attribute of organic foods. Wier and Anderson found organic buyers to be mainly concerned about health and considered the absence of chemical residues to be the most preferred product attribute of organic food. Animal welfare, food origin, and environmental issues were also found to play a role in organic food purchasing decisions.

Hack (1993) identified the two primary motives for purchasing organic food products among Dutch consumers to be health and beneficial impacts on the environment. Four major impediments to the consumption of organic food were identified. Organic food was less familiar to consumers, generally not as available as its conventional counterpart, much more expensive, and perceived to be of lesser quality.

Bugge and Wandel (1995) investigated purchasing motives for organic food among Norwegians. The main purchasing motive for all users was health concern. The

primary constraints were identified as insufficient information, availability, and price. Among consumers in the United Kingdom, Latacz-Lohmann and Foster (1997) found health and food safety to be the two primary motivators for consumption of organic food.

Hill and Lynchehaun (2002) found health to be the (overwhelming) reason consumers were using organic milk. Taste and the perception organic production is better for the environment were also important. Makatouni (2002) also found the perceived healthfulness of organic food to be the main contributor to purchase, followed by the perception that organic food promotes a higher degree of animal welfare. Consumers were also concerned about negative environmental impacts when artificial fertilizers and chemicals were used in food production.

McEachern and McClean (2002) identified the top three purchase motivators for organic dairy products in Scotland to be taste, food safety, and health benefits. Respondents also noted environmental benefits and ethical considerations. As in other studies, price was identified as the primary deterrent to organic food purchases.

**Evidence from North America.** A number of studies have considered organic food markets and how demographic characteristics influence likelihood-of-purchase and willingness-to-pay for organic foods in the United States (e.g., see Thompson & Kidwell, 1998; Huang, 1996; Byrne, Toensmeyer, German, & Muller, 1991; Misra, Huang, & Ott, 1991). Those reviewed here have also considered purchase motivators.

Goldman and Clancy (1991) found that organic food purchasers frequenting an up-state New York cooperative were concerned about pesticide residues and the effects those residues may have on their health. Their primary reasons for purchasing organic food were food safety, protection of the environment, and the promotion of sustainable agricultural practices.

Jolly (1991) found that California consumers buying organic food were concerned about health and how it may be jeopardized by the presence of pesticides in their food. High prices and poor availability were two stated obstacles. These same obstacles were also identified by Buzby and Skees (1994) among Kentucky consumers.

Byrne, Bacon, and Toensmeyer (1994) and Groff, Kreidor, and Toensmeyer (1993) surveyed Delaware residents. Byrne et al. concluded that consumers wanted organic produce because of its perceived safety and higher nutritive value, because associated with it were fewer harmful effects on the environment, and due to a desire for an increased level of societal control over the

quality of the food supply. Groff et al. found the most important factors affecting organic food consumption were freshness, healthfulness, flavor, nutrition, and food safety.

Swanson and Lewis (1993) found organic food purchasers in Alaska to be primarily motivated by environmental and personal safety concerns. Organic food purchasers were more concerned about pesticide residues than non-purchasers. Overall, organic produce was perceived to be more expensive and less visually attractive.

Sloan (2002) identified health and nutrition as the main drivers behind the purchase of organic foods. Most organic users reported believing that organic products contribute to their *overall* health, rather than associating them with any specific health effect. Consumers were found to be very aware of chemical residues on their food, and a large number of consumers were found to seek out organic products specifically to avoid GM ingredients. Another important driver of organic food consumption was the perceived effect of production on the environment, with organic users more concerned about the environment and pollution than the general population. Organic food users felt that their food purchases would make a difference in helping sustain a healthy environment. The Hartman Group (2002) identified health and nutrition, taste, food safety, and environmental impact (in this order) as the most important motivators. Govindasamy et al. (2005) identified health and safety as the most important purchase motivators for organic produce.

Overall, motivating factors for purchase of organic food products do not differ substantially between US and European consumers. Dimitri and Oberholtzer (2005) note that, like their US counterparts, European consumers have shifted to self-interest motivations such as food safety and health, although they note that there sometimes seem to be important regional differences in the importance of motivating factors. Price is noted as the primary deterrent in both the United States and the EU.

### **The Market for (non) Genetically Modified Foods**

Consumer attitudes about biotechnology have been assessed since its initial commercialization (e.g., see Hoban, 1997). For reviews of the literature on consumer acceptance of GM food products, see Wachenheim (2004) and Ganiere, Chern, and Hahn (2006). Although there is considerably more recent literature on consumer

attitudes and intentions regarding GM versus organic food, less effort has been devoted to identifying specific purchase motivators. More carefully investigated have been consumer attitudes about and willingness to pay for non-GM foods, and the effect of various actions (e.g., media exposure) on such.

In general, we know that some Americans appear to have a basic understanding of biotechnology and may recognize that it has been used in food production, but that most are unaware of its prevalence in the US food supply (Hallman & Hebden, 2005; Thomson & Dininni, 2005). While the specifics differ, in general the literature concurs that Americans have very little knowledge about biotechnology. For example, Hallman et al. (2003) found that only one-fourth of US residents believed that they had ever consumed food containing GM ingredients. The lack of consumer awareness is not particularly surprising. Food product labels in the US do not indicate either presence or a lack of GM content (Hallman & Aquino, 2005). Thus, unless it is an organic product, consumers have no information about the product's GM content (Ganiere, et al. 2006).

It is also very well accepted that biotechnology is supported among consumers to a much greater extent for use in crops rather than animals (Ganiere et al., 2006). For example, Hallman et al. (2003) reported that one-half of Americans approved of plant-based genetic modification, where only one-quarter approved of it for use in animal agriculture. The literature also supports an age-old marketing guideline: consumers want benefits not features. Americans have a much higher acceptance level of GM products if certain benefits can be associated with its use, such as safer or more nutritious food (Wachenheim & Lesch, 2004; Lesch, Wachenheim, & Stillerud, 2005). And, there is some evidence that Americans believe genetic modification can and *will* make their lives better (Hallman et al.). However, in general there is also concern about the use of biotechnology, and when queried, most support labeling of products containing GM ingredients (e.g., see Hallman & Metcalfe, 2001; Onyango & Nayga, 2004; Wachenheim & Lesch, 2004).

In part because of the current lack of labeling, again, there is little literature specifically assessing purchase motivations associated with GM foods. However, the potential motivators that will arise as technologies develop and consumers become more informed will likely mirror those of the organic industry. Acceptance will probably be related to perceptions of the benefits and risks associated with human health and the environment (Larue et al., 2004; Moon & Balasubramanian,

2001; Onyango & Nayga, 2004). And, while perceptions about risk generally have not been considered with regards to organic production practices or food consumption, the literature suggests that perceived risk and ethical considerations are important for acceptance of biotechnology.

Consumer perceptions of organic processes and products and those involving biotechnology warrant further investigation and especially comparison. The concept areas of interest identified from the literature include health, environment, risk, and ethics. Past work has compared demand for organic and GM products (e.g., Larue et al., 2004; West, Gendron, Larue, & Lambert, 2002), and considered how demand for GM products is affected by organic food use classification (Burton et al., 2001). To our knowledge, no study has directly elicited comparable attitudes about organic and GM products and processes. That is the most important contribution of the current study.

## Methods

A written survey instrument was administered to students at two upper Midwestern universities in the United States. The sample was drawn from undergraduate general business classes as well as those in agribusiness. Students from one graduate course in organizational behavior were also included. While we do not argue the sample population is representative of any group beyond its definition, in a meta-analysis of findings of consumer acceptance of GM foods, Lusk et al. (2005) found that student populations did not differ from more general populations in their acceptance of GM products. However, the importance of market segments, particularly for organic foods (e.g., Larue et al., 2004) requires we emphasize the limited population participating in the current study.

Respondents were comprised of students in undergraduate classes in the subject matters of general business (56% of respondents), introductory economics (31%), and statistics (8%), and an MBA class on organizational behavior (5%). Fifty-five percent of participants were male. Four percent were 18 years of age or younger, 51% were 19 to 21, 39% were 21 to 29, and 6% were 30 and older. Ninety-two percent of respondents were undergraduates.

The instrument was built around the various constructs identified in the literature as related to acceptance and purchase of GM and organic food products. These included health, environment, risk, and ethical considerations. Participants were asked to indicate level

of agreement with statements using an 8-point Likert scale ranging from 1 (*strongly agree*) to 8 (*strongly disagree*). Participants were prompted to use 9 for statements about which they had no opinion. To allow for direct comparison of perceptions about organic and GM foods and processes, each instrument contained identical statements except for the use of the words *organic* and *genetically modified* (GM). Both positively- and negatively-worded statements were presented within each construct to reduce the potential for agreement bias. The resulting questions were randomly ordered throughout the forms, but question order for both instruments was identical.

The introduction of each survey instrument included a brief primer defining (as appropriate) genetic modification or organic concepts as follows:

### **What is organic food production?**

*Organic production is a system of farming that uses production methods which minimize the use of off-farm inputs. Certified organic means that agricultural products have been grown and processed according to the United States Department of Agriculture's national organic standards, and certified as such. The requirements apply to the production process rather than measurable characteristics of the product itself.*

*Certifying agents review applications from farmers and processors for eligibility, and qualified inspectors conduct annual on-site inspections of their operations. Inspectors talk with operators and observe their production and processing practices to determine if they are in compliance with organic standards. Organic standards for crops require, for example, that no prohibited substance be applied to the land during the previous three years and that crops not be genetically modified. Those for livestock require animals not be given hormones or antibiotics and that they have access to the outdoors.*

### **What is genetic modification?**

*Genetic modification refers to the process of modifying plants or animals by adding genes to change the makeup of the original organism.*

*The traditional plant development process uses cross breeding which requires plants to be sexually alike, transfers and sorts all genetic material, and it takes time. The genetic modification process moves genetic material from one organism to another such as from bacteria to plants, animals to plants, and between dissimilar plants. It produces plants or animals with desired characteristics faster than classical cross breeding methods. Sometimes the process of genetic modification is called bio-engineering, biotechnology, or genetic engineering.*

All respondents were urged to read the primer prior to completing the survey. Two separate samples were used in this design, one for each food condition. Data collection was conducted in the spring and early summer of 2004. A total of 340 completed questionnaires were collected: 167 organic and 173 GM. As a result of the data cleaning process, 42 organic and 40 GM survey respondent forms were eliminated from the final sample. Most of the eliminated responses answered all questions identically or provided responses outside the identified range. Finally, some questionnaires were deleted because responses were not internally valid (e.g., respondents strongly agreed with two opposing statements).

SPSS (v 9.0) was used to analyze the data. Means and frequencies of each organic and GM question were compared and are discussed within the relevant construct area. Parametric F tests were used to compare means.

## Results

Empirical results are presented by construct area. Responses to the organic forms are presented first, followed by responses to the GM instrument. Results within each construct area are compared.

### Health

**Organic.** The average participant slightly, but not strongly, agreed with the positively worded health attributes (e.g., organic food is healthier), and disagreed with the negatively worded health attributes (e.g., organic food is less healthy) (Table 1). A near majority agreed that consumption of organic foods can improve one's healthy appearance and that scientists believe health can be improved by organic foods. There were more neutral responses that organic foods are useful in preventing disease and that eating organic foods will increase lifespan, although there was a high level of agreement that if organic technologies could cure disease, that would be a good reason to use them. A majority disagreed that there was a danger associated with consumption of organic foods, ranging from lower nutrition to an undefined "grave danger."

Organic food was generally thought to have higher nutrient values than traditional food. Forty percent agreed that organic baby food has nutrients not found in traditional baby food and 48% agreed that organic food can improve the nutritional quality of convenience foods.

**Genetically Modified.** The average response about the healthfulness of GM foods was generally neutral. Respondents did not agree that they would live longer if they ate GM foods, but most agreed with, or were neutral to, the statement that GM foods are useful in preventing disease. And, most respondents agreed that an appropriate use of GM technology would be curing diseases. Interestingly, 80% agreed or were neutral that scientists believe that health can be improved with GM food, which was nearly the same percentage as organic. Most respondents did not agree with statements describing potential dangers associated with GM foods.

Forty-five percent of participants agreed that GM food improves the nutritional quality of foods, while only 19% disagreed. Half of consumers agreed that GM baby food can have nutrients not found in traditional baby food. However, 71% agreed or were neutral with respect to the assertion that GM baby food is not as healthy as traditional baby food. There are some apparent inconsistencies in respondent perceptions of the nutritional quality of GM foods, perhaps associated with the polarity of the statements.

Potential benefits were reported for GM foods. However, in general, participants did not see GM food to be as healthy as its traditional counterpart nor did they feel very strongly about the health attributes associated with GM food. The more negatively worded questions elicited a higher level of disagreement, suggesting that participants did not see GM as unhealthy, but rather as somewhat less healthy than traditional food.

**Comparison.** Results of the present study do not contradict previous work identifying health-related concerns associated with GM food products. However, there were smaller than expected associated perceptual differences between GM and organic foods and processes. Both were thought to have higher levels of nutrients than traditional food. They were seen as appropriate if they had potential to help cure diseases, although the average levels of agreement that GM or organic foods are in fact useful in preventing disease or combating obesity were neutral and were not different from one another.

Participants perceived organic food products to be more closely linked to positive health attributes than GM foods, with a relatively low range of unsure responses. As expected, organic food was perceived as

Table 1. Health statements.

Statement	A	B	N	Mean	C	Percentage*		
						Agree	Neutral	Disagree
<b>Organic</b>								
Consumption can improve your overall healthy appearance.	P	0.004	118	3.81	7	52.5	23.7	23.7
Scientists believe that health can be improved by Organic foods.	P	0.479	95	3.82	29	48.9	33.0	18.1
I will live longer if I eat Organic foods.	P	0.009	107	4.36	18	26.2	53.3	20.6
Overall health will decline if I consume Organic food.	N	0.009	117	5.99	8	7.7	24.8	67.5
Organic baby food is not as healthy as traditional.	N	0.007	105	5.26	20	20.0	29.5	50.5
Organic ingredients in food pose hidden dangers to my health.	N	0.000	114	5.47	11	11.4	34.2	54.4
Regularly eating Organic foods will harm my health.	N	0.000	111	6.03	14	9.9	18.0	72.1
Organic foods present a grave danger to my health.	N	0.000	110	6.23	14	8.2	20.0	71.8
Diseases such as Parkinson's might be cured.	P	0.223	120	2.29	4	85.8	6.7	7.5
Organic foods are useful in preventing disease.	P	0.429	86	4.28	39	31.4	43.0	25.6
Organic baby food ingredients can have nutrients not found in traditional food.	P	0.271	94	4.04	29	40.4	36.2	23.4
Organic ingredients improve the nutritional quality.	P	0.249	113	3.65	11	47.8	38.1	14.2
Organic foods may combat our nation's problem with obesity.	N	0.417	114	4.36	11	36.0	35.1	28.9
Foods contain fewer carbs and more protein if they contain Organic ingredients.	N	0.923	69	5.01	56	23.2	42.0	34.8
<b>GM</b>								
Consumption can improve your overall healthy appearance.	P	0.004	108	4.55	19	28.7	39.8	31.5
Scientists believe that health can be improved by GM foods.	P	0.479	91	4.01	32	41.8	38.5	19.8
I will live longer if I eat GM foods.	P	0.009	93	5.00	30	16.1	45.2	38.7
Overall health will decline if I consume GM food.	N	0.009	113	5.38	16	17.7	28.3	54.0
GM baby food is not as healthy as traditional.	N	0.007	111	4.57	17	27.9	43.2	28.8
GM ingredients in food pose hidden dangers to my health.	N	0.000	120	4.49	9.1	28.3	42.5	29.2
Regularly eating GM foods will harm my health.	N	0.000	102	4.92	24	23.5	38.2	38.2
GM foods present a grave danger to my health.	N	0.000	107	5.30	20	15.0	35.5	49.5
Diseases such as Parkinson's might be cured.	P	0.223	131	2.55	2.2	78.6	14.5	6.9
GM foods are useful in preventing disease.	P	0.429	91	4.08	32	30.8	53.8	15.4
GM baby food ingredients can have nutrients not found in traditional food.	P	0.271	101	3.74	25	49.5	33.7	16.8
GM ingredients improve the nutritional quality.	P	0.249	110	3.90	17	44.5	36.4	19.1
GM foods may combat our nation's problem with obesity.	N	0.417	110	4.15	18	40.0	35.5	24.5
Foods contain fewer carbs and more protein if they contain GM.	N	0.923	64	5.05	52	14.1	53.1	32.8

Column A: P = positively worded statement and N = negatively worded statement.

Column B: Significance is based on parametric f-test (2 tailed).

Column C: Number answered "Don't Know" or "No Opinion."

\* Agree is 1-3, Neutral is 4-5, and Disagree is 6-8 on the 8-point Likert scale.

Table 2. Environment statements.

Statement	A	B	N	Mean	C	Percentage*		
						Agree	Neutral	Disagree
<b>Organic</b>								
The balance of organisms is better managed by humans using Organic.	P	0.009	111	4.54	14	28.8	41.4	29.7
Organic will use lesser amounts of pesticide.	P	0.091	113	3.19	12	63.7	19.5	16.8
Production of Organic crops reduces unnecessary erosion of farmland.	P	0.914	90	4.67	34	25.6	41.1	33.3
Organic use will forever change our natural environment.	N	0.000	112	4.51	13	25.0	48.2	26.8
Organic will introduce new organisms that may harm our society.	N	0.000	97	5.46	28	12.4	40.2	47.4
I am worried about unknown effects.	N	0.000	120	4.84	5	29.2	31.7	39.2
The balance of nature has been upset by the use of Organic production.	N	0.000	112	5.60	13	12.5	35.7	51.8
It takes more chemicals to raise Organic crops.	N	0.006	102	5.85	23	13.7	26.5	59.8
<b>GM</b>								
The balance of organisms is better managed by humans using GM.	P	0.009	117	5.19	16	20.5	36.8	42.7
GM will use lesser amounts of pesticide.	P	0.091	99	3.65	35	51.5	33.3	15.2
Production of GM crops reduces unnecessary erosion of farmland.	P	0.914	82	4.70	51	23.2	46.3	30.5
GM use will forever change our natural environment.	N	0.000	113	3.41	20	48.7	45.1	6.2
GM will introduce new organisms that may harm our society.	N	0.000	95	4.17	39	35.8	41.1	23.2
I am worried about unknown effects.	N	0.000	129	3.64	4	51.2	31.8	17.1
The balance of nature has been upset by the use of GM production.	N	0.000	109	4.68	25	26.6	39.4	33.9
It takes more chemicals to raise GM crops.	N	0.006	90	5.11	44	20.0	41.1	38.9

Column A: P = positively worded statement and N = negatively worded statement.

Column B: Significance is based on parametric f-test (2 tailed).

Column C: Number answered "Don't Know" or "No Opinion."

\* Agree is 1-3, Neutral is 4-5, and Disagree is 6-8 on the 8-point Likert scale.

healthier than traditional food, and in general, the healthfulness of GM foods was not perceived to be substantially different than that of traditional foods. Seven of the eight statements directly associated with health had mean levels of agreement that were statistically different. Participants generally more strongly *agreed* with the *positive* health attributes and more strongly *disagreed* with the *negative* health attributes of organic food than those of GM food.

### Environment

**Organic.** The findings of this study concur with earlier findings that the organic process of producing food is perceived as advantageous for the environment. For

example, participants agreed that organic production uses less pesticides and disagreed that more chemicals are used than with traditional production methods (Table 2). Participants may have known or learned from reading the primer that organic production does not allow the use of pesticides. It is interesting to note that participants also agreed that production with biotechnology uses less pesticides. Respondents did not agree that organic production reduces erosion.

**Genetically Modified.** In terms of the environment and genetic modification, there is a high level of public disagreement amongst various stakeholders. Biotechnology companies and producers generally hold that the use of GM in the production of food is advantageous to

the environment, while environmental and several consumer advocate groups often argue the contrary. However, the literature confirms the notion that consumers are unaware of the potential benefits of GM to the environment (e.g., Hoban, 1997; Wachenheim & Lesch, 2004).

In the present study, findings in general neither support nor refute GM production as having an environmentally negative impact in the eyes of respondents. There seems to be some concern about the unknown long-term effects of the use of GM varieties in production agriculture. Fifty-one percent of respondents agreed that they are worried about the unknown effects that GM will have on our ecosystem. Half agreed that GM will forever change our natural environment and 36% agreed that GM will introduce new organisms that may harm our society.

**Comparison.** Generally, consumers perceive organic food production as environmentally friendly, while production involving GM varieties is perceived as less so than production of traditional food (Sloan, 2002). The current findings do not refute this, but the perceptions among the participants were more neutral than expected. With one exception for which there was no difference, for each positive statement about the effect of *organic* production on the environment, level of agreement was stronger than for *GM* (i.e., participants felt that organic food production is more environmentally friendly than its GM counterpart). The same was true for each *negative* statement, in that level of *disagreement* was stronger for organic than for GM. However, in this study, agreement with benefits of GM was stronger than in most other work, and the perceived concerns regarding GM were more moderate than expected.

### **Risk**

Risk is inherent in food consumption and today, more than ever, US consumers are exposed to information about those risks. Although there is evidence that Americans trust regulators to protect the safety of their food, consumers' risk perception of different food classes (e.g., organic and GM) may affect their willingness to buy. Several different levels of risk are considered, including general risk, consumption risk, long-term effects of the use of production practices on society, and the risk to plants and animals.

**Organic.** Slightly more than half of respondents agreed that there is little risk in the consumption of organic

foods, organic foods are completely safe to eat, and that they would be willing to serve organic food to their friends (Table 3). Sixty percent of participants disagreed that it is dangerous to use organic production techniques to alter what we eat. Seventy-five percent of participants disagreed that eating organic foods will subtract from their quality of life.

On average and in general, participants also did not have strong concerns about organic production. Two-thirds disagreed that organic foods will harm society more than help it. Seventy-five percent agreed or were neutral that organic foods hold no danger for future generations. Although 42% agreed that animals such as organic sheep and cattle may change the overall gene pool, only 10% agreed that raising organic species is dangerous to the gene pools. In general, most perceived little risk associated with the consumption or production of organic foods, although there were respondents who did perceive risk, especially longer-term risk.

**Genetically Modified.** Risks are a more prevalent concern with regard to GM foods and processes. This may be due to the overall lack of knowledge of GM varieties and their products (Wachenheim & Lesch, 2004). Average levels of agreement indicating a perceived risk associated with GM foods and their production were higher than for organic food. However, the level of perceived risk was less than may be expected given the findings from the literature and the content of popular press stories.

Level of consumption concern associated with GM foods was mixed. For example, one-third of participants agreed that there is no risk in consumption of GM food, while 30% disagreed. Thirty-five percent agreed that GM foods are completely safe to eat; 24% disagreed. Forty percent agreed they would be willing to serve GM foods to their friends; 20% disagreed.

Participants were asked how GM will affect themselves and others. Only 21% agreed that GM will harm society more than help it, but 42% disagreed that GM holds no danger for future generations. Only 16% agreed that eating GM foods will subtract from their quality of life. Risks in general appeared to be viewed on the aggregate versus individual level (e.g., a higher percentage agreed that GM foods are dangerous, than agreed that eating GM foods will subtract from the quality of their own life).

There is a perception that GM may change nature, but it depended on statement wording. Responses to three statements indicate concern. More than half agreed that GM crops could harm other species in ways we do



Table 3. Risk statements.

Statement	A	B	N	Mean	C	Percentage*		
						Agree	Neutral	Disagree
<b>Organic</b>								
I see no risks in the consumption of Organic foods.	P	0.000	115	3.44	10	52.2	34.8	13.0
I would be willing to serve Organic foods to my friends.	P	0.042	116	3.45	9	55.2	30.2	14.7
Organic foods are completely safe to eat.	P	0.007	117	3.61	7	55.6	24.8	19.7
The risks to people associated with Organic foods outweigh the benefits.	N	0.001	97	5.90	28	10.3	25.8	63.9
Consumption of regular foods is far more risky.	P	0.003	107	4.75	17	27.1	37.4	35.5
Raising Organic animals holds no potential danger to other species.	P	0.000	108	4.40	17	32.4	40.7	26.9
Scientists cannot predict the future outcomes of Organic.	N	0.007	112	3.96	13	47.3	31.3	21.4
Organic foods present no danger for future generations.	N	0.000	102	4.18	23	35.3	40.2	24.5
Organic will harm society more than help.	N	0.001	123	6.01	2	10.6	22.8	66.7
Eating Organic foods will subtract from my quality of life.	N	0.011	120	6.23	5	11.7	13.3	75.0
It is dangerous to use Organic to alter what we eat.	N	0.002	116	5.52	9	13.8	26.7	59.5
Production of Organic crops could harm other species in ways we do not understand.	N	0.000	114	4.61	9	29.8	40.4	29.8
Animals such as Organic sheep and cattle may change the overall gene pool.	N	0.000	105	4.12	19	41.9	31.4	26.7
Raising Organic species is dangerous to the gene pools of those species.	N	0.012	106	5.41	18	10.4	39.6	50.0
<b>GM</b>								
I see no risks in the consumption of GM foods.	P	0.000	16	4.43	16	32.8	37.1	30.2
I would be willing to serve GM foods to my friends.	P	0.042	13	3.95	13	40.0	40.0	20.0
GM foods are completely safe to eat.	P	0.007	21	4.30	21	35.4	40.7	23.9
The risks to people associated with GM foods outweigh the benefits.	N	0.001	35	5.03	35	22.2	36.4	41.4
Consumption of regular foods is far more risky.	P	0.003	27	5.50	27	13.2	33.0	53.8
Raising GM animals holds no potential danger to other species.	P	0.000	30	5.04	30	19.2	37.5	43.3
Scientists cannot predict future outcomes of GM.	N	0.007	17	3.29	17	56.4	30.8	12.8
GM foods present no danger for future generations.	N	0.000	30	5.08	30	17.5	40.8	41.7
GM will harm society more than help.	N	0.001	10	5.15	10	21.0	33.9	45.2
Eating GM foods will subtract from my quality of life.	N	0.011	10	5.62	10	16.1	28.2	55.6
It is dangerous to use GM to alter what we eat.	N	0.002	15	4.77	15	26.9	32.8	40.3
Production of GM crops could harm other species in ways we do not understand.	N	0.000	13	3.41	13	51.2	38.8	9.9
Animals such as GM sheep and cattle may change the overall gene pool.	N	0.000	12	3.29	12	55.7	38.5	5.7
Raising GM species is dangerous to the gene pools of those species.	N	0.012	22	4.39	22	26.1	48.6	25.2

Column A: P = positively worded statement and N = negatively worded statement.

Column B: Significance is based on parametric f-test (2 tailed).

Column C: Number answered "Don't Know" or "No Opinion."

\* Agree is 1-3, Neutral is 4-5, and Disagree is 6-8 on the 8-point Likert scale.

not understand. Fifty-six percent agreed that genetic modification in animals such as sheep and cattle will change the overall gene pool of those animals. And, 43% disagreed that GM animals hold no potential danger to other species. Somewhat to the contrary, only one-quarter agreed that the use of genetic modification is dangerous to the gene pool, albeit nearly half were neutral.

Respondents perceived GM foods as possessing a higher level of risk than other classes of food. As expected, most disagreed (54%) or were neutral (33%) that consumption of regular food is far more risky. A certain level of uncertainty was apparent in the relatively higher percentage of neutral and no opinion responses as compared to the organic survey. In terms of the risks to society and the world surrounding them, participants, in general, saw a higher level of risk than they saw for themselves. Participants did not appear to be frightened of GM foods, but rather uncertain about their potential and more widespread effects.

**Comparison.** There has been a relatively small amount of work done with regard to perceptions about the risk associated with organic food, but the conventional notion is that organic food is seen as a safer alternative than traditional food. In contrast, research and popular understanding supports a perceived risk associated with GM foods and production of those foods.

Indeed, organic foods and processes were perceived to be less risky than their GM counterparts. Fewer participants felt that GM food is safe to eat and participants were less willing to serve GM food than organic. However, respondents did not associate strong risks with GM food. Rather, they saw GM as a process with *uncertain* effects. The means for every question within the risk construct were statistically different for the GM and organic versions. Mean levels of agreement were stronger for organic with positively worded statements, and mean levels of agreement were *weaker* for organic with *negatively* worded statements.

### **Ethics**

**Organic.** Social acceptability is one motive driving the purchase of organic food. This was examined using the construct area of ethics. As expected, there was little ethical objection to organic food. Eighty-seven percent of those questioned agreed or were neutral that organic crop production is the right thing to do (Table 4). Few agreed that organic production was not morally acceptable or that it was unethical to use organic methods to

conduct research. The strongest level of agreement with *negatively* worded statements are for the five that do not explicitly mention the term organic.

**Genetically Modified.** Respondents also did not have major ethical objections to GM food. For example, 38% agreed that improving crop production by using GM is the right thing to do, while only 19% disagreed. As found in the literature, participants perceived the use of GM in plants as more acceptable than use in animals.

**Comparison.** Although respondents had fewer ethical objections to organic processes, they seemed to not have major ethical objections to either GM *or* organic food. Ethical objections were aroused when discussing *animals* in both organic and GM food; GM food had higher levels of objection. Seven of the 15 statements' means regarding ethics were found to be different. Higher levels of agreement for the positively worded questions were present for organic than for GM. Also, higher levels of *disagreement* for the *negatively* worded questions were present for organic than for GM.

There was no difference in average level of agreement between the organic and GM survey responses for any of the statements that did not explicitly mention organic or GM. Each dealt with the rights of animals or plants.

### **Other Considerations**

Some tested statements did not fit well into the above-referenced construct areas. Table 5 summarizes these responses. Half of participants agreed that plants can benefit from organic processes while nearly the same amount (45%) agreed with regard to GM processes. When asked if animals can benefit from these processes, a lower but similar level of agreement between organic (33% agreed) and GM (31% agreed) was found.

When asked if the tools of production will prompt breakthroughs in the understanding of life processes, 64% agreed for GM but only 40% agreed with regard to organic. Surprisingly, only 23% agreed that GM processes only speed up the process of change (nearly an equal percentage for organic).

The use of GM or organic technology to help people was found to be, on average, acceptable. Forty-five percent of participants agreed that GM is okay to use if it improves the lives of other people (62% for organic). Fifty-two percent agreed that GM can improve the quality of life (50% for organic). When asked if it is okay to

Table 4. Ethics statements.

Statement	A	B	N	Mean	Percentage*			
					C	Agree	Neutr al	Disag ree
<b>Organic</b>								
Animals have the basic right to exist without the manipulation of their genes.+	P	0.534	122	3.90	3	48.4	28.7	23.0
Improving crop production by using Organic methods is the right thing to do.	P	0.148	113	3.76	12	41.6	45.1	13.3
Introducing Organic into livestock gene pools improves the quality of life of animals.	P	0.079	113	4.34	12	34.5	38.9	26.5
Scientists are fulfilling moral obligations to society by improving food.	P	0.002	114	4.15	11	39.5	37.7	22.8
Organic is not morally acceptable.	N	0.012	118	5.39	7	12.7	41.5	45.8
Changing the makeup of animals is not morally acceptable.	N	0.202	120	4.95	5	25.8	34.2	40.0
It is inhumane to enhance livestock by Organic means.	N	0.009	121	5.60	4	14.0	26.4	59.5
It is unethical for scientists to conduct research.	N	0.024	121	6.01	3	7.4	25.6	66.9
Scientists are playing God when altering the genes of plants.+	N	0.751	123	4.85	2	33.3	26.8	39.8
Scientists are playing God when altering the genes of animals.+	N	0.877	118	4.37	7	40.7	28.8	30.5
Plants have the right to exist without manipulation by humans.+	N	0.850	120	5.03	5	30.0	26.7	43.3
Crops should only be enhanced by natural means.+	N	0.767	121	4.32	4	41.3	25.6	33.1
Organic foods threaten the natural order of things.	N	0.000	113	5.48	12	13.3	38.1	48.7
Organic will harm future generations.	N	0.001	108	5.57	16	13.0	30.6	56.5
Humans should not meddle with the natural order of plants and animals.+	N	0.650	117	4.45	7	26.5	45.3	28.2
<b>GM</b>								
Animals have the basic right to exist without the manipulation of their genes.+	P	0.534	123	3.74	11	48.8	34.1	17.1
Improving crop production by using GM methods is the right thing to do.	P	0.148	119	4.08	14	37.8	42.9	19.3
Introducing GM into livestock gene pools improves quality of life of animals.	P	0.079	117	4.76	16	28.2	35.9	35.9
Scientists are fulfilling moral obligations to society by improving food.	P	0.002	121	4.85	12	21.5	40.5	38.0
GM is not morally acceptable.	N	0.012	118	4.75	15	27.1	37.3	35.6
Changing the makeup of animals is not morally acceptable.	N	0.202	122	4.61	12	31.1	36.9	32.0
It is inhumane to enhance livestock by GM means.	N	0.009	126	4.95	8	23.0	33.3	43.7
It is unethical for scientists to conduct research.	N	0.024	131	5.50	3	13.7	33.6	52.7
Scientists are playing God when altering the genes of plants.+	N	0.751	130	4.77	4	29.2	30.8	40.0
Scientists are playing God when altering the genes of animals.+	N	0.877	127	4.33	7	33.9	34.6	31.5
Plants have the right to exist without manipulation by humans.+	N	0.850	128	4.98	6	32.0	24.2	43.8
Crops should only be enhanced by natural means.+	N	0.767	131	4.40	3	40.5	23.7	35.9
GM foods threaten the natural order of things.	N	0.000	118	4.29	16	29.7	44.9	25.4
GM will harm future generations.	N	0.001	109	4.77	25	22.9	42.2	34.9
Humans should not meddle with the natural order of plants and animals.*	N	0.650	123	4.56	10	30.1	39.8	30.1

Column A: P = positively worded statement and N = negatively worded statement.

Column B: Significance is based on parametric f-test (2 tailed).

Column C: Number answered "Don't Know" or "No Opinion."

\* Agree is 1-3, Neutral is 4-5, and Disagree is 6-8 on the 8-point Likert scale.

+ Statement did not indicate GM or organic.

Table 5. Other consideration statements.

Statement	A	B	N	Mean	C	Percentage*		
						Agree	Neutral	Disagree
<b>Organic</b>								
The tools of Organic production may prompt our breakthrough in the understanding of life.	P	0.000	111	4.07	13	39.6	41.4	18.9
Animals can benefit from Organic.	P	0.344	107	4.10	15	32.7	48.6	18.7
Plants can benefit from Organic.	P	0.524	111	3.69	14	49.5	37.8	12.6
Organic animals speed up the process of change.	P	0.797	102	4.76	22	21.6	45.1	33.3
Quality of life can be improved by using Organic.	P	0.134	113	3.73	12	49.6	35.4	15.0
Foods have the ability to enhance the quality of our lives.	P	0.514	115	3.85	10	41.7	43.5	14.8
It is okay to use Organic if it improves the lives of other people.	N	0.013	121	3.05	4	62.0	27.3	10.7
Organic lowers costs, therefore it is okay.	N	0.714	122	4.23	2	39.3	36.1	24.6
<b>GM</b>								
The tools of GM production may prompt our breakthrough in the understanding of life.	P	0.000	127	3.24	6	63.8	29.9	6.3
Animals can benefit from GM.	P	0.344	112	4.32	21	31.3	41.1	27.7
Plants can benefit from GM.	P	0.524	122	3.84	12	45.1	36.9	18.0
GM animals speed up the process of change.	P	0.797	109	4.83	24	22.9	37.6	39.4
Quality of life can be improved by using GM.	P	0.134	113	3.42	21	52.2	38.1	9.7
Foods have the ability to enhance the quality of our lives.	P	0.514	118	3.72	16	40.7	46.6	12.7
It is okay to use GM if it improves the lives of other people.	N	0.013	125	3.58	9	44.8	44.0	11.2
GM lowers costs, therefore it is okay.	N	0.714	129	4.32	4	31.8	38.0	30.2

Column A: P = positively-worded statement and N = negatively-worded statement.

Column B: Significance is based on parametric f-test (2 tailed).

Column C: Number answered "Don't Know" or "No Opinion."

\* Agree is 1-3, Neutral is 4-5, and Disagree is 6-8 on the 8-point Likert scale.

use the production process to lower the cost of foods, 32% agreed with GM and 39% agreed for organic.

## Discussion and Implications

### General Attitudes Towards GM and Organic Food Products

Organic food was perceived by respondents to be, in general, a healthier alternative to "regular food," including its effect on appearance and resulting from higher nutrient levels. This supports one of the primary marketing foci used by the organic industry, the purported health benefits associated with organic food. Respondents were found to be less critical of GM food than was expected. The sample population used in this study was generally neutral to the perception of GM food with regard to its effect on health.

Environmental benefits to organic production were perceived. For example, organic food production was

perceived as reducing pesticide use. Alternatively, some respondents expressed concern that GM food may have unknown effects on the environment. However, perceptions of several of the proclaimed advantageous effects of biotechnology on the environment were also found to hold (e.g., GM food uses less chemicals). Overall, organic food and its production were perceived to be environmentally appropriate, as expected. An unexpectedly large percentage of respondents believed there to be environmental benefits to using biotechnology in production agriculture as well.

Organic food was seen as a safer alternative to traditional food by respondents. Although a higher level of risk was associated with GM foods than traditional foods, this risk did not appear to affect personal behavior. Specifically, respondents tended to agree that there were unknowns involved in the GM process that elevate the risk associated with the food. However, given the possibilities (some of which were altruistic) of GM's

potential, respondents agreed it should be used. Participants did exhibit more concern about the “big picture” in terms of GM food. They identified risks associated with the aggregate (e.g., risks to society), but did not feel personally at risk.

The role that ethics plays on consumers’ decision-making process was interesting. The literature states that one of the reasons consumers choose organic food is that they believe it is the responsible thing to do (Byrne et al., 1994; Goldman & Clancy, 1991). On the other side of the spectrum is GM food. Few respondents had ethical objections to organic food. On the other hand, possible unknown consequences had students concerned about GM food. The use of biotechnology to enhance plants was much more favorable than its use in animals, consistent with existing literature.

### **Implications to Stakeholders**

Many members of the food industry marketing channel have an interest in the perceptions of consumers with regard to GM and organic foods. This sample of college students helps provide a look into the future.

For those supporting the use of biotechnology, the findings are favorable. It is sometimes argued that consumers will not accept GM foods. This common notion was neither supported nor refuted in the present case. However, college-age consumers did not possess the expected strong negative feelings about GM foods or processes. In fact, they often saw beneficial possibilities. The most notable concern of consumers with regard to GM foods was the unknown effects. They are unsure of what will happen generations down the road, but do not appear concerned enough to change their present behavior. More information is necessary about the long-term effects to address these concerns; this will come from additional research. The management of this information to influence consumer perceptions and behaviors will be important. Identifying and developing powerful and targeted food attributes, then linking the same to specific benefits sought by consumers should be undertaken. In short, one or more segments of consumers have yet to decide. Those who are interested in the future of GM would benefit from giving consumers favorable reasons to accept the technology.

Organic food stakeholders should also be encouraged with the findings. Credence attributes associated with organic food are well-entrenched in the minds of consumers, even college-age consumers. Organic food was thought to be more nutritious and healthier, to improve one’s appearance, and be more environmen-

tally friendly. In general, organic food production had virtually no negative perceived effects, although there was a small segment of students who held beliefs contrary to the mainstream. It is not possible to identify why (e.g., uninformed, misinformed, against organic production practices) from the current study. Further opportunities should be explored in the distribution of organic food. The organic industry could capitalize on the generally favorable perceptions, particularly in the area of health. For example, by “selling” the benefits of organic food to institutions, such as school lunch programs and elderly care facilities (in particular those that are concerned about the healthfulness of the food they are providing) and to health care professionals who influence the attitudes and behaviors of others.

Environmental perceptions of GM food in this study are surprisingly unrevealing. There were no strikingly adamant reactions towards the environment and GM food. However, much of the relevant literature identifies chemical residues in food as a major issue to consumers. Therefore, GM stakeholders would benefit from stressing the fact that GM food uses fewer chemicals than more traditional production practices in their integrated marketing communication (if, in fact, that is the case). Any other environmentally advantageous benefits should be prominently communicated to consumers. The organic food industry also needs to do a better job of addressing the issue of chemical residues. Thirty-six percent of participants were neutral or disagreed that organic food production uses less pesticides. That is a rather substantial number especially after they were asked and expected to read a primer stating that no artificial chemicals were used in the production of organic foods. The absence of chemicals in the production of organic food can be better highlighted and showcased. Still, many consumers do not know or understand what organic food or GM food is comprised of, or how it may benefit them directly.

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