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**PERCEPTIONS OF GENETICALLY MODIFIED
AND ORGANIC FOODS AND PROCESSES:
NORTH DAKOTA COLLEGE STUDENTS**

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ABSTRACT

Perceptions of genetically modified (GM) and organic food among North Dakota college students were elicited and compared. Participants responded to one of two survey instruments containing identical wording except for reference to genetic modification or organic, after reading a primer defining the term used in their instrument. Participants' indicated their level of agreement with statements in the construct areas of health, environment, ethics, regulation, and risk. Responses were compared among survey instruments and to responses to previous surveys of Americans and of shoppers in North Dakota. Organic food was perceived as a healthier and safer choice. Organic practices were perceived to be more environmentally sound. Respondents expressed a level of concern over the unknown effects GM food could have on the environment and society as a whole. However, participants generally felt that genetic modification could be used effectively and valued some of the associated benefits. Reliability assessment revealed that statements within each construct area are reliable and can be used in future surveys.

Key Words: Genetically Modified, Consumer Perceptions, Organic

HIGHLIGHTS

INTRODUCTION

Foods produced using organic techniques or genetic modification processes are increasingly available to consumers. Organic is defined as process-based and refers to products originating from a system of farming that uses production methods which minimize the use of off-farm inputs. Genetically modified (GM) is product-based and refers to products originating from the modification of plants or animals by adding genes to change the makeup of the original organism. The purpose of this study was to obtain primary information on the level of awareness of, knowledge about, and attitudes and potential behaviors toward foods containing organic or GM ingredients. The study was conducted among students attending the two largest universities in North Dakota. Specific goals of the project were to:

- Ascertain general attitudes toward GM and organic food products in various construct areas (health, environment, risk, ethics, and regulation),
- Compare attitudes toward GM and organic food products, and
- Compare North Dakota college student shopper opinions with those from recent surveys of North Dakota residents and of Americans.

METHODS

Perceptions of students about GM and organic foods and processes were elicited. A written survey instrument was administered to a sample of convenience that included students in classes at North Dakota State University in Fargo and the University of North Dakota in Grand Forks. The instrument was designed around the various constructs identified in the literature as motivating acceptance of and purchase decisions regarding GM and organic food products. These included health, environment, risk, and ethical considerations. Participants were also asked for their perceptions of and thoughts about regulation of GM and organic food products. Participants were asked to indicate level of agreement with statements using an 8-point Likert scale. To observe comparable answers between perceptions about organic and GM foods, two survey instruments were developed. Each contained identical statements except for the use of the words organic and genetically modified (or GM). A brief primer was provided defining GM or organic at the beginning of the survey instrument. Data was collected from 340 questionnaires in the spring of 2004.

CONSUMER PERCEPTIONS

- Organic food was perceived by the student population surveyed to be, in general, a healthier alternative to “traditional food,” including its effect on appearance and its higher nutrient levels. This supports one of the primary marketing foci used by the organic industry, the purported health benefits associated with organic food. Students surveyed were found to be less critical of the health effects of GM food than was expected.
- Organic food was perceived as environmentally friendly. Alternatively, some students expressed concern that GM food may have unknown effects on the environment. However, an unexpected and large percentage of students also believed there to be environmental benefits to using biotechnology in production agriculture.

- Organic food was seen as a safer alternative to traditional food by respondents. While students associated a higher level of risk with GM foods than traditional foods, this risk did not appear to affect their personal behavior. And, given the potential of biotechnology, students in general agreed it should be used. Although differences in perception of risk associated with the two classes of food existed, they did not seem to affect respondent beliefs about or perceptions of regulation.
- Few students in this study 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, supporting existing literature.

CONCLUSIONS

- For those supporting the use of biotechnology, the findings are favorable. It is sometimes argued that consumers will not accept GM foods. 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. Students indicated uncertainty about what will happen to future generations, but this did not appear to affect their present behavior.
- 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 those of college age. Organic food was thought to be more nutritious and healthier, improve one's appearance, and be more environmentally friendly. In general, organic food production had virtually no negative perceived effects. 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, matching efforts may be focused on those that are concerned about the healthfulness of the food they are providing. The industry can also benefit from more effectively utilizing the current health food distribution channel.
- The current study was found to contain very reliable constructs. The statements used, therefore, would be a logical cornerstone for further research.

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**Jon C. Anderson, Cheryl J. Wachenheim,
and William C. Lesch¹**

INTRODUCTION

Firms must decide what food products to produce and make available, and how to price, promote, and distribute them. Success in doing so depends on a firm's ability to understand and competitively satisfy consumers' preferences. These preferences increasingly include consideration of credence attributes of the ingredients used in production or of the food itself. Two credence attributes of particular interest, because of their increasing availability in the form of ingredients available to food processing firms and their prevalence in North Dakota, are organic and genetically modified (GM).

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 U.S. Department of Agriculture's (USDA) national organic standards, and certified as such. The requirements apply to the production process rather than being 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 the farm and processing 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 GM. Those for livestock require animals not be given hormones or antibiotics and that they have access to the outdoors (USDA, 2003).

Genetic modification refers to the process of modifying plants or animals by adding genes to change the makeup of the original organism. Genetic material is moved 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 is called bio-engineering, biotechnology, or genetic engineering (Wachenheim and Lesch, 2004). Genetic modification is product rather than process defined. The seed stock being used in the production of GM plants is GM, and, unlike organic, no particular production practices are required and GM can be a "testable" attribute. Unprocessed commodities and ingredients from them that contain proteins can be tested to identify whether or not they are GM or contain GM ingredients. The testability allows for identification of commodities without the strict traceability standards required for organic.

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GM crops were first made available in 1996 to U.S. producers for use in major crops. Since this introduction, production has exploded. In 2003, 105.7 million acres of corn, soybeans, and cotton were grown using GM varieties (Wachenheim and Lesch, 2004). Producers continue to increase their GM plantings of these and other crops because of agronomic, economic, and environmental advantages. As a result, it is estimated that between 60% and 70% of processed food products available in the United States are derived from GM ingredients (Hallman et al., 2003). Alternatively, the marketplace and policy environments have, in the case of some other crops, impeded or restricted adoption of GM varieties (e.g., sugarbeets, wheat).

Analogously, the organic industry has also continued to grow, but without any notable market or policy-based resistance. The organic industry in the United States is expected to reach \$30 billion by the year 2007 (Scheel, 2004). Growth is expected to continue at its current annual pace of over 20%.

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, but the cost of supplying organic products must be met by increased market premiums (Hill and Lynchehaun, 2002). It is of interest to reconcile demand and supply within both the GM and organic markets and compare consumer perceptions of them. We find an increasing body of literature on 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 is proprietary.

The purpose of this study is to obtain primary information on the level of awareness of, knowledge about, and attitudes and potential behaviors toward foods containing organic or GM ingredients. The study was conducted among students attending the two largest universities in North Dakota. Specific goals of the project were to:

- Ascertain general attitudes toward GM and organic food products in various construct areas (health, environment, risk, ethics, and regulation),
- Compare attitudes toward GM and organic food products, and
- Compare North Dakota college student shopper opinions with those from recent surveys of North Dakota residents and of Americans.

LITERATURE

Consumers in industrialized countries enjoy a plethora of food choices. These choices are at times in part defined by credence attributes, which are not apparent through product observation or consumption. Two such attributes are a result of how the food product or its ingredients were produced and processed (organic) or the nature of the varieties used to develop

the product or its ingredients (GM). Organic food is that produced using no synthetic fertilizer or chemicals and following other specific guidelines. Genetically modified food is that which has been produced using varieties developed with biotechnology. Evidence about consumer perceptions of and preferences for organic and GM food products is considered here.

ORGANIC FOOD MARKET

The consumer market for organic foods appears to be in an introductory-to-growth phase. The U.S. organic market is projected to grow at an annual rate of 21.4% from 2002 to 2007 and exceed \$30 billion by the year 2007 (Scheel, 2004). Recent growth has been achieved even with a substantial price premium.

In spite of the promising market, analyses of consumer behavior in the area of organic food consumption are lacking. Limited research has focused on willingness to pay. There is little work on what drives consumer purchasing decisions. Work is especially lacking for markets within the United States, and that which has been done is often proprietary. Here, attitudes towards organic food products in Denmark, where organic markets are relatively well established, are first considered. Evidence from other European studies, and those from North America, are then considered.

Denmark

Denmark has been progressive in promoting the organic food product market. Government subsidies and industry promotion have lowered price premiums (Thompson and Kidwell, 1998). In part and as a result, the Danish market for organic foods is relatively mature, meaning that it does not exhibit the supply shortages and barriers which dominate most markets outside Denmark (Wier and Andersen, 2003). Danish studies provide some insight into attributes that drive organic purchasing behavior.

Grunert and Juhl (1995) considered the attitudes about and willingness to pay for organic foods among Danish schoolteachers, investigating the effect of green attitudes on willingness to pay. Green attitudes were defined as a general concern for the environment and reflect those of consumers making buying decisions based on the well-being of the environment and also reflect an individual's self-reported behavior or willingness to behave to improve the environment. Willingness to pay for organic food products was found to be directly related to green attitudes.

Land (1998) conducted personal interviews of households in Denmark to ascertain purchasing motives, diet and shopping patterns, and willingness to pay for organic food. The sample size was limited to twelve households. He concluded that pesticide-free was a very important attribute of organic food for consumers and that they choose organic food because of associations with better health and improved taste.

Wier and Andersen (2003) assessed the attitudes, values, and behavior of organic food users and non-users in Denmark. Organic buyers were found to be mainly concerned about health. The absence of chemical residues was the most preferred product attribute of organic food. Animal welfare, food origin, and environmental issues also played a role in organic food

purchasing decisions. Organic buyers were less concerned about price. However, origin was more important than the organic label; 72% of consumers reported they would rather buy Danish conventional food than imported organic food. Buyers of organic food were more often members of organizations with objectives associated with protecting animal welfare and nature than non-buyers.

In general, Danes have a higher level of awareness of what constitutes organic foods than U.S. consumers (Weir and Andersen, 2003). Perceived health benefits have been identified as a key purchasing motive for Danes in regard to organic products. The absence of pesticides is an important attribute. Organic purchasers appear to consider that organic production practices are beneficial to the environment when making their purchasing decisions.

Additional European Evidence

The government's contribution to awareness of organic food products does not play as significant of a role throughout the European Union as it does in Denmark (Weir and Andersen, 2003). Other European work has focused on price sensitivity and overall market size of organic food products rather than consumption drivers or willingness-to-pay. Literature regarding the latter provides some insight into the organic consumer in Europe.

Hack (1993) conducted extensive personal interviews in the Netherlands. He set out to identify why Dutch consumers were purchasing organic food and constraints to such. The two primary motives were also identified in the Danish studies: health and beneficial impacts on the environment. The Dutch also in general expressed the perception that prices of organic food were too high (80%) and that organic food did not taste as good (80%) as conventionally produced food. Hack found four major impediments to the consumption of organic food. 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 and willingness to pay a premium for organic food among Norwegians. Age was not related to willingness to pay. Females and higher-educated consumers displayed more willingness to purchase organic foods at a premium price. The main purchasing motive for all users was health concerns. Younger consumers displayed a deeper concern for the environment and animal welfare. The major constraints to purchasing organic food were identified as insufficient information, availability, and price.

Latacz-Lohmann and Foster (1997) conducted an extensive literature review and semi-structured interviews concerning the marketing of organic food. Health and food safety were identified as the two main reasons consumers were using organic food in the United Kingdom. Health was also found to be the (overwhelming) reason consumers in the U.K. were using organic milk (Hill and Lynchehaun, 2002). Taste and the perception organic production is better for the environment were the second and third most common reasons, respectively.

Makatouni's (2002) findings of what drives consumers to choose organic food in the United States echo those of other research. The perceived healthfulness of organic food was the

main motivation behind its purchase. That organic food promotes a higher degree of animal welfare was the second most mentioned response in an aided questionnaire. Consumers were also concerned about the negative environmental impact when artificial fertilizers and chemicals are used in the production of food.

The Western European studies identified health concern as the primary motivator for the purchase of organic food. Environmental impact and animal welfare were also found to be motivators. Impact of food quality is unclear. Hack (1993) identified the quality of organic food to be less than that of conventional foods while a later study suggests that taste and quality of organic food is superior (Hill and Lynchehaun, 2002). These conflicting findings may be due to an increase in both consumers' awareness of organic food and processes as well as an increase in the quality of organic food. Also, the Hill and Lynchehaun (2002) study primarily dealt with milk. Quality of milk is perhaps less distinguishable to consumers. Price was found to be the most prevalent constraint to the purchase of organic food.

Evidence from North America

Most research regarding organic food markets in the United States has focused on willingness to pay for organic food products. There has been minimal work devoted to assessing organic food consumption motivators. Generally, the literature includes attitudes on consumption derived from research with a different primary focus.

Huang (1993, 1996) reports on consumers' attitudes towards pesticide residues and how they affect attitudes towards organic food. A mail questionnaire of consumers in Georgia was used. The results (1993) suggest that personal experience with pesticides reduces consumers' fears about residues on produce. Females and consumers who were married, have one or more children, and are employed, have higher probabilities to be concerned about pesticide residues than their counterparts.

Age, race, household size, and education affected a consumer's attitude toward pesticide use, but not necessarily their willingness to pay for certified residue-free produce. Age, household size, marriage status, and urbanity did not affect willingness to pay. Females and those with higher education and income levels were more willing to pay premiums for pesticide-free food.

Misra, Huang, and Ott (1991) used the same questionnaire data to determine whether consumers were willing to pay for produce that is certified as free of pesticide residues (FPR). Data supported the hypotheses that the probability a consumer will pay more for FPR produce increases with concern that pesticide residues and with the degree of importance assigned to testing and certification. Female consumers were more inclined to purchase organic food than males. Higher income level and white consumers were more willing to pay a premium. Middle-aged people and those with a college education were less willing to pay a premium than their younger and older and not college educated counterparts, respectively.

Goldman and Clancy (1991) surveyed customers of an up-state New York co-op, which was one of the largest purveyors of organic food in the area. They considered willingness to pay

for organic food products, consumer concerns about their food, and what type of product defects they were willing to accept. Younger people were more willing to pay a premium for organic food products, but income and education level did not affect the willingness to pay.

Results concurred with most existing literature in finding that organic purchasers were concerned about pesticide residues and the effects those residues may have on their health. Organic purchasers were less concerned with cosmetic defects and insect damage. The main reasons consumers purchased organic food as marked in an aided question were food safety, protection of the environment, and the promotion of sustainable agricultural practices.

Jolly (1991) ascertained consumer attitudes towards organically grown products using a random mail survey of 1,950 California households. High prices and poor availability were two stated obstacles to the purchase of organic food. Younger, less urban consumers were more apt to make organic food purchases. Those with higher education levels and income were willing to pay more for organic products. Consumers buying organic food were concerned about health and how the use of pesticides in their food may jeopardize their health.

Byrne, Bacon and Toensmeyer (1994) and Byrne et al. (1991) sent questionnaires to Delaware residents. Consumer attitudes about and purchasing actions considering the use of pesticides in food were elicited. Byrne et al. (1991) examined demographic characteristics of consumers of organic foods. Younger people and those with a lower level of income were more willing to purchase organic food products, although higher income individuals have more ability to pay premiums. Older people, males, and people with a higher education level were less inclined to purchase organic food.

Byrne, Bacon, and Toensmeyer (1994) considered pesticide-free produce. Concerns over pesticide use did not differ by income level. However, younger individuals, females, and those with large households were more concerned. Generally, the more educated, the less concerned were residents over the use of pesticides. Elderly, married, and female consumers reported a higher likelihood of choosing stores that offer organic products. Byrne, Bacon, and Toensmeyer (1994) concluded that consumers wanted organic produce because of its perceived safety and higher level of 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, Kreidor, and Toensmeyer (1993) considered consumer group preferences for organic food products using the same data as Byrne, Bacon, and Toensmeyer (1994). The most important factors affecting organic food consumption were freshness, healthfulness, flavor, nutrition, and food safety. Where the food was grown and the brand name were of least concern to consumers. Younger and less well educated consumers were shown to have a higher likelihood of purchasing organic food products.

Baker and Crosbie (1993) circulated a questionnaire at two supermarkets in the Bay Area of California to investigate consumer segments for apples. Surface damage to the fruit's skin was the most important factor in consumers' decision making. The segment most concerned with pesticides consisted of more women and high-income consumers. Although this segment

consisted of only 16% of participants, pesticide usage had a high relative level of importance to them involving apples. A majority of respondents, however, favored reducing pesticide usage only if it did not increase apple skin damage. Overall, Baker and Crosbie found consumers wanted lower pesticide use in the production of food, but they were not willing to pay for it with increased price or decreased quality.

Swanson and Lewis (1993) conducted a mail survey of direct market consumers in Alaska, 65% had purchased organic produce within the past year. Those with a higher education level reported organic foods were a greater percentage of their overall food purchases. Purchasers of organic products were more concerned about pesticide residues than non-purchasers. Overall, organic produce was perceived to be more expensive and less visually attractive. Environmental and personal safety concerns were the primary motivators for organic buyers. Availability, season, and cost were major determining factors mentioned by those not planning near-term purchase of organic produce. Freshness and flavor ranked highest in terms of selection criteria for fresh produce overall.

Buzby and Skees (1994) conducted telephone interviews in Kentucky to identify consumer concerns about food and their willingness to pay for food products with certain attributes. Main concerns of consumers were fat, food poisoning, and pesticides. Pesticide-free products were preferred to those labeled organic. Freshness and nutrition were the main criteria in consumers' self-reported decisions on any food. Size of the household, race, and income level did not affect willingness to pay for organic food. Younger and less educated people were more inclined to pay a premium for organic foods. Women reported a willingness to pay higher premiums than men. Fifty percent of respondents said that they prefer organic food, although only 17% reported ever purchasing it. Buzby and Skees concluded that high prices and poor availability restricted organic food sales.

The Hartman Group (1997) reported on what consumers were thinking about the environment and how this affected their food choices. There was considerable disparity between consumers' environmental beliefs and actual purchase behavior. Fifty-five percent of consumers believed growth hormones and antibiotics to be unnecessary in meat production, although only 17% reported purchasing meat free of such technology. Sixty-seven percent of consumers supported environmental stewardship on farms by actually purchasing food products that explain the environmentally beneficial production practices used. Sixty-three percent of consumers expressed a willingness to pay a premium for environmentally friendly food products. Only 7% of consumers reported being committed to choosing organic food products. An equal percentage of consumers were not concerned about the environment and felt that their individual food choice would not really make a substantial difference (45%) as reported being concerned and feeling their actions could make a difference. Females and those with higher levels of income and education were more likely to purchase organic food products. Married couples were less likely to purchase organic food. Overall, consumers were found to be very interested in how their food purchases affect the environment.

Thompson and Kidwell (1998) circulated questionnaires in both co-op and specialty stores. Their objectives were to elicit propensity to buy, store choice, and the effects of cosmetic defects on the decision to buy organic produce. Larger households were more likely to purchase

organic produce, while higher-educated consumers were less likely. Age and gender did not affect propensity to buy. Co-op customers were much more likely to purchase organic food products than specialty store customers.

Glaser and Thompson (2000) examined retail sales of organic and conventional frozen vegetables using supermarket scanner data from 1988-1999. Price sensitivity was high for organic frozen vegetables. Organic products extracted premiums and the market was growing although it made up a very small percentage of sales. Because the data came from supermarket scanners, results may be skewed because many organic food purchases take place at farmers' markets and similar outlets.

Veeman and Adamowicz (2000) interviewed Canadian consumers by phone to better understand their concerns with regard to their food choices. Consumers believed dietary fat and pesticide residues in their food had the highest health risk. More well-educated individuals were less concerned about their food and women were more concerned than men.

Sloan (2002) identified health and nutrition as the main drivers behind purchasing decisions for 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. 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. Organic users were 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 four most important determinants of demand identified were health, avoidance of chemical residues, avoidance of GM ingredients, and environmental concern.

Summarizing the North American literature, female consumers were generally more inclined to purchase organic goods. Psychographic characteristics of consumers were important. The most notable motivation in organic food purchasing in the studies was consumer concern for their health and safety. Environmental concern was also identified as important. Consumers are now beginning to purchase organic foods in order to ensure themselves that no GM ingredients exist in their food. There were some findings that suggested organic purchases were motivated by social responsibility. Price and poor availability were found to restrict purchasing of organic food products.

CONSUMERS AND GENETICALLY MODIFIED FOOD PRODUCTS

Adoption of biotechnology in crop production has been growing at a substantial pace while consumer awareness and perceptions of this technology are still rather low, particularly in the United States. Burton et al. (2001) and Grimsrud et al. (2002) considered consumers in the U.K. and Norway, respectively. Burton et al. found attitudes toward GM food in the U.K. differed between those consumers who bought organic foods and those who did not. Committed organic food shoppers were willing to increase their food expenditures by 352% (for males) and 471% (for females) to ensure that no plant and animal GM technology was used in the food.

With non-frequent organic shoppers, the percentages were sharply lower, but still significant. Infrequent male (female) shoppers would increase their food bill by 26% (49%).

Grimsrud et al. (2002) studied consumer attitudes towards GM foods in Norway. They found a high level of skepticism existed, but that it may be fading. In their sample of Norwegian consumers, a 48% discount would be required to purchase GM bread while a 56% discount would be needed for GM salmon. Younger people required less of a discount to purchase GM products suggesting that a generation gap may exist and that there may indeed be a future for GM foods in Norway.

Evidence from North America

Relative to the organic market, there has been more work in the area of market acceptability of GM food products and more of the information is publicly available and focused on the U.S. market. However, the work is still somewhat limited and the results are far from conclusive.

Studies assessing consumer attitudes about biotechnology have been conducted since the technology's first commercialization (e.g., see Hoban, 1997). The focus here is on two of the most recent studies of Americans and one of North Dakota shoppers.

Hallman and Metcalfe (2001) conducted a comprehensive survey of 1,200 Americans to identify perceptions about biotechnology. Most Americans had very little knowledge about biotechnology and genetic modification. Biotechnology was supported to a much greater extent for use in crops rather than animals.

The Hallman data supports an age-old marketing guideline: consumers want benefits not features. Americans had a much higher acceptance level of GM products if certain benefits could be associated with its use. For example, consumers supported the use of biotechnology if it could be used to make food safer and more nutritious. A slight majority of Americans (60%) believed that biotechnology would make their lives better. However, in general, Americans expressed concern. A segment of Americans felt that biotechnology may impact the balance of nature in a negative manner. Americans had mixed feelings and attitudes towards the use of biotechnology in their food and most (90%) felt that foods containing biotechnology should be labeled as such.

Hallman et al. (2003) conducted a follow-up survey, also of 1,200 Americans. They examined how American perceptions had changed. They found Americans' awareness and knowledge of biotechnology to again be low. Only one-fourth of consumers believed that they had ever consumed food containing GM ingredients despite the prevalence of GM ingredients in processed foods.

Acceptance and overall perceptions of GM food were split. One-half approved of plant-based genetic modification, where only 25% approved it for use in animal agriculture. The approval level for use in plants was down from 2001 while that for animals remained the same. Opinions of GM were influenced by context and wording. Mentioning of the possible benefits

that GM has to offer improved the approval rating for GM. The term biotechnology promoted acceptance to a greater extent than genetic modification and genetic engineering. Previous purchase decisions and demographics also influenced perceptions of GM foods. Women, consumers over 64 years of age, and consumers with low levels of education, naturalness and healthfulness as values, and previous purchasers of organic products were less likely to show approval for foods containing GM ingredients.

Wachenheim and Lesch (2004) expanded on work by Hallman et al. They studied North Dakota shoppers' perceptions of GM foods. Their findings were similar to those of Hallman and Metcalfe (2001) and Hallman et al. (2003) although the population surveyed by Wachenheim and Lesch was considerably more rural. Wachenheim and Lesch found awareness and general knowledge of GM food products to be very low even in the largely agrarian state. Shoppers had very little knowledge of the existence of GM ingredients in their food products. They viewed biotechnology much more favorably when it was applied to plants rather than animals, and tended to agree the use of genetic modification would be appropriate for altruistic applications such as helping feed the hungry.

In addition to survey work, a growing body of research has been devoted to assessing revealed preference for GM foods, especially through the use of experimental auctions. These studies have concluded that there exists a market segment of consumers willing to pay a premium for food that is presumed to be GM free (for example, see: VanWechel and Wachenheim, 2004; Huffman et al., 2002; Burton et al., 2001; Lusk et al., 2001; Fox et al., 1994).

The use of GM has been flourishing in the realm of production agriculture since its advent. However, Americans continue to have very little knowledge of GM and many consumers in fact do not believe that they have ever consumed GM food. When associated benefits are identified, consumers are apparently more accepting of GM technologies than otherwise. And, they appear to be more comfortable with the use of GM in plants than in animals. In addition to application, the language used to describe GM also appears to affect consumers' perceptions. Finally, perceptions differ based upon user demographics. Women, older people, and consumers with low levels of education, those who view healthfulness as their primary food value, and previous purchasers of organic food apparently are less likely to approve the use of GM.

SUMMARY

It is paramount that those marketing food products understand the drivers behind changing consumer perceptions. With regard to food purchase decisions, consumers appear to be concerned about their health, impacts on the environment, perceived risk, and ethical responsibility. Consumer preferences of two types of food products, GM and organic, warrant future investigation and comparison. The resulting information will lend itself useful to all participants throughout all channels of food distribution.

METHODS

Perceptions of students about GM and organic foods and processes were elicited. Methods used closely parallel those employed by Hallman and Metcalfe (2001), Hallman et al. (2003), and Wachenheim and Lesch (2004). Hallman et al. surveyed 1,200 Americans about biotechnology and GM products by telephone in each study. They used the genetic modification and its acronym GM to describe the technology under consideration but also evaluated the effect of using alternative terminology on perception. Because previous research had indicated a low level of knowledge about biotechnology among consumers, a brief primer was given to respondents after they had a chance to answer a few questions without this information. Wachenheim and Lesch (2004) surveyed shoppers in the state of North Dakota. They adopted the same standards of terminology and also provided a definition for genetic modification and used a telephone survey.

INSTRUMENT SELECTION

A written survey was selected for the current study because of cost considerations. The survey method also allowed for direct comparison of responses to those elicited by Hallman and Metcalfe (2001), Hallman et al. (2003), and Wachenheim and Lesch (2004).

In a pilot study, 15 individuals in the target population (North Dakota college students) were administered a preliminary instrument to determine completion time and any problems with questions or questionnaire design. The pilot test was conducted from March 18 to 22, 2004. Slight revisions were made, particularly in the wording of statements.

The revised survey instrument was administered to a sample of convenience that included students in classes at North Dakota State University (NDSU) in Fargo and the University of North Dakota (UND) in Grand Forks. Classes were selected to include a diversity of students. Surveys were administered at UND to undergraduate general business classes. Students were offered extra credit to participate. At NDSU, surveys were distributed in undergraduate courses in economics, statistics, and college algebra. Surveys were also administered to an MBA class (organizational behavior). NDSU students were provided an incentive of \$2 to participate in the survey. Different incentives were required because of differences in instructors' policy (i.e., NDSU instructors would not give extra credit). Students were instructed to complete the survey on their own time but by a specific date and return it to their instructor.

The instrument was built around the various constructs identified in the literature as motivating acceptance of and purchase decisions regarding GM and organic food products. These included health, environment, risk, and ethical considerations. Participants were also asked for their perceptions of and thoughts about regulation of GM and organic food products. Participants were asked to indicate level of agreement with statements using an 8-point Likert scale where "1" was strongly agree and "8" was strongly disagree. Participants were prompted to use "9" for statements about which they had no opinion. To observe comparable answers between perceptions about organic and GM foods, two survey instruments were developed. Each contained identical statements except for the use of the words organic and genetically modified (or GM). Both positively and negatively worded statements were presented within

each construct to reduce the potential for agreement bias. The resulting 75 questions were randomly ordered throughout the survey, although the resulting question order for both surveys was identical.

An expert panel was assembled to ascertain face validity among the construct areas. Experts included an agricultural producer, a health professional, a policy professional, and a nutrition expert. Their classifications were combined with initial researcher classification and differences resolved. Two statements had very substantial levels of disagreement and no consensus was reached: “Using biotechnology/organic methods to change the makeup of animals in our environment is likely to be more harmful than helpful to society” and “it would be good to use genetic modification/organic techniques in animals to develop cancer curing agents beneficial to humans.” These two statements were dropped from the analysis.

A brief primer was provided defining GM or organic at the beginning of the survey instrument. These primers defined organic and GM and spoke to their use in production agriculture and were 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.**

It was recommended by the language of the survey and reinforced when the surveys were administered that participants should read the primer prior to completing the survey.

Data collection was conducted from April 22 through June 15, 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 surveys were eliminated from the sample. Most of the eliminated responses answered all questions identically or provided responses outside the identified range. Some surveys were also dropped because responses were not internally valid. To test this, individual responses to like but oppositely worded questions were compared. The surveys of any individual with inconsistent responses were dropped from the data set (e.g., if they strongly agreed with two opposite statements).

Responses were entered by participants on scantron sheets. These were read by the NDSU Information Technology Services (ITS) department and results were provided in an excel file. SPSS® was used to analyze the data. Means and frequencies of each organic and GM question were compared and discussed within the relevant construct area (health, environment, risk, regulation, and ethics). Means were also compared between respondent groups defined by student level and gender. Parametric F tests were used to compare means. Cluster analysis was conducted to identify groups of consumers by their responses, but the large percentage of “no opinion” responses (ranging from 2% to 30% of valid responses) to several questions did not accommodate reliable results.

RESULTS

Empirical results are first presented by construct area. A reliability analysis of the construct areas follows. Construct areas include health, environment, risk, ethics, and regulation. Statements used that addressed these constructs were obtained from previous studies or developed by using known associations with the construct (e.g., statements regarding nutrition were placed in the health construct).

Respondents from North Dakota State University (NDSU) and the University of North Dakota (UND) were 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 percent were 19 to 21, 39% were 21 to 29, and 6% were 30 and older. Sixteen percent were freshmen, 15% were sophomores, 30% were juniors, 31% were seniors, and 8% were graduate students. Two percent considered themselves to be vegetarian.

Results are presented by construct area. A brief review of existing perceptions from the literature is presented, followed by findings from the current study with regard to organic, GM, and a comparison of perceptions of organic and GM. Differences between gender and/or student education level are also presented.

CONSUMER PERCEPTIONS

Health

Average levels of agreement with statements related to health factors associated with the consumption of organic and GM foods and percentages of respondents by strength of agreement are presented in Table 1.

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). Figure 1 shows the percentage of respondents agreeing with, neutral to, or disagreeing with each positively worded health statement. Figure 2 shows the same for the negatively worded statements. A (near) majority agreed (defined as a response of 1, 2, or 3 on the 8-point Likert scale) 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. Between 54 and 72 percent disagreed that there was a danger associated with consumption of organic foods ranging from lower nutrition to an undefined "grave danger."

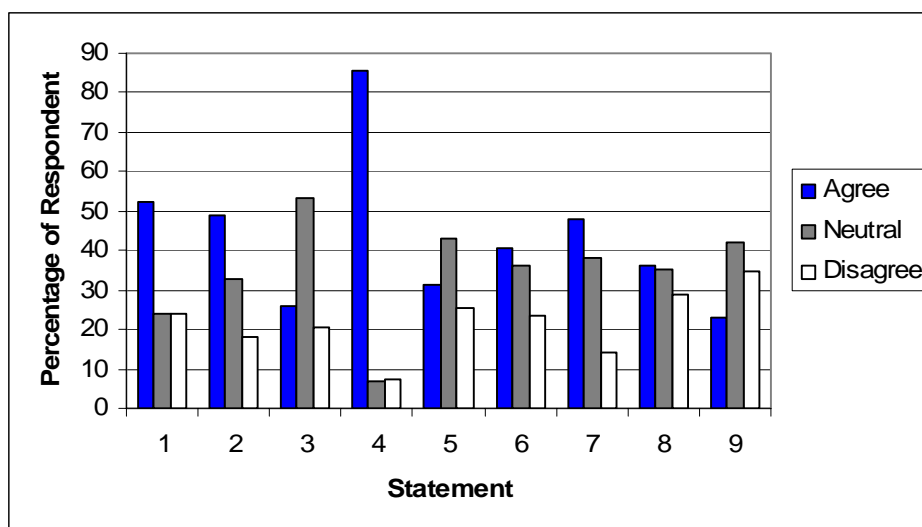


Figure 1. Organic Health Statements Positively Worded

STATEMENT

1. Consumption can improve your overall healthy appearance.
2. Scientists believe that health can be improved by organic foods.
3. I will live longer if I eat organic foods.
4. If human diseases such as Parkinson's might be cured using organic technologies, that would be a good reason to use them.
5. Organic foods are useful in preventing disease.
6. Organic baby food ingredients can have nutrients not found in traditional food.
7. Organic food can help improve the nutritional quality of convenience foods.
8. Organic foods may combat our nation's problem with obesity.
9. Foods contain fewer carbohydrates and more protein if they contain organic ingredients.

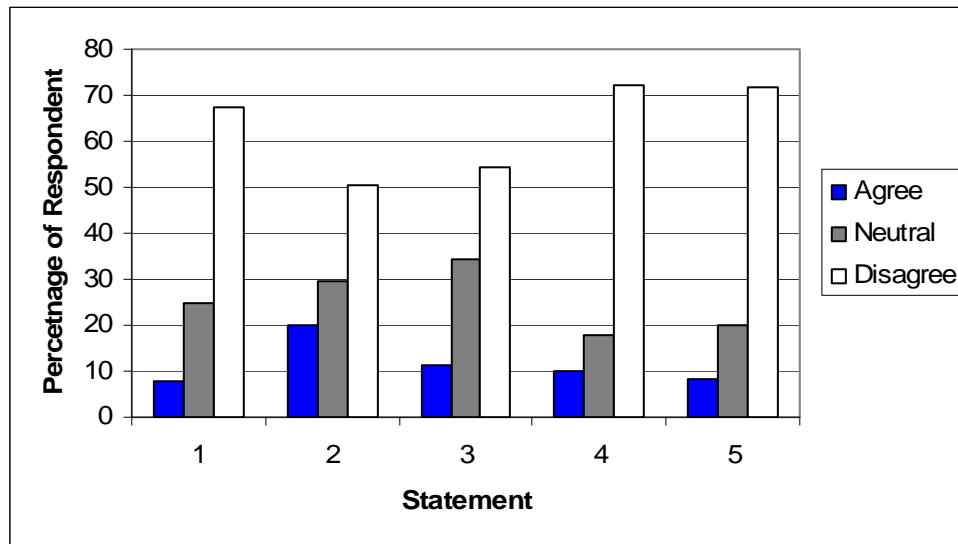


Figure 2. Organic Health Statements Negatively Worded

STATEMENT

1. My overall health will decline if I consume organic food.
2. Organic baby food is not as healthy as traditional.
3. Organic ingredients in food pose hidden dangers to my health.
4. Regularly eating organic foods will harm my health.
5. Organic foods present a grave danger to my health.

Associated with health are perceived nutritional characteristics. 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; only 23% disagreed. Forty-eight percent agreed that organic food can improve the nutritional quality of convenience foods, while only 14% disagreed. Participants were in general split as to whether organic foods will combat our nation’s problem with obesity, and only 23% agreed that organic foods contain fewer carbohydrates and more protein while 35% disagreed.

Table 1. Health Statements										
Statement	Organic									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
Consumption can improve your overall healthy appearance	2	H1	P	0.004	118	3.81	7	52.5	23.7	23.7
Scientists believe that health can be improved by Organic foods	10	H3	P	0.479	95	3.82	29	48.9	33.0	18.1
I will live longer if I eat Organic foods	48	H7	P	0.009	107	4.36	18	26.2	53.3	20.6
Overall health will decline if I consume Organic Food	20	H5	N	0.009	117	5.99	8	7.7	24.8	67.5
Organic baby food is not as healthy as traditional	3	H2	N	0.007	105	5.26	20	20.0	29.5	50.5
Organic ingredients in food pose hidden dangers to my health	16	H4	N	0.000	114	5.47	11	11.4	34.2	54.4
Regularly eating Organic foods will harm my health	46	H6	N	0.000	111	6.03	14	9.9	18.0	72.1
Organic foods present a grave danger to my health	57	H8	N	0.000	110	6.23	14	8.2	20.0	71.8
Diseases such as Parkinson's might be cured	43	B8	P	0.223	120	2.29	4	85.8	6.7	7.5
Organic foods are useful in preventing disease	66	B14	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	37	B7	P	0.271	94	4.04	29	40.4	36.2	23.4
Organic ingredients improve the nutritional quality	28	B4	P	0.249	113	3.65	11	47.8	38.1	14.2
Organic foods may combat our nation's problem with obesity	64	B13	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	75	B15	N	0.923	69	5.01	56	23.2	42.0	34.8

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. 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 1. (continued)										
Statement	GM									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
Consumption can improve your overall healthy appearance	2	H1	P	0.004	108	4.55	19	28.7	39.8	31.5
Scientists believe that health can be improved by GM foods	10	H3	P	0.479	91	4.01	32	41.8	38.5	19.8
I will live longer if I eat GM foods	48	H7	P	0.009	93	5.00	30	16.1	45.2	38.7
Overall health will decline if I consume GM Food	20	H5	N	0.009	113	5.38	16	17.7	28.3	54.0
GM baby food is not as healthy as traditional	3	H2	N	0.007	111	4.57	17	27.9	43.2	28.8
GM ingredients in food pose hidden dangers to my health	16	H4	N	0.000	120	4.49	9.1	28.3	42.5	29.2
Regularly eating GM foods will harm my health	46	H6	N	0.000	102	4.92	24	23.5	38.2	38.2
GM foods present a grave danger to my health	57	H8	N	0.000	107	5.30	20	15.0	35.5	49.5
Diseases such as Parkinson's might be cured	43	B8	P	0.223	131	2.55	2.2	78.6	14.5	6.9
GM foods are useful in preventing disease	66	B14	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	37	B7	P	0.271	101	3.74	25	49.5	33.7	16.8
GM ingredients improve the nutritional quality	28	B4	P	0.249	110	3.90	17	44.5	36.4	19.1
GM foods may combat our nation's problem with obesity	64	B13	N	0.417	110	4.15	18	40.0	35.5	24.5
Foods contain fewer carbs and more protein if they contain GM	75	B15	N	0.923	64	5.05	52	14.1	53.1	32.8

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. 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.

Genetically Modified. The average response about the healthfulness of GM foods was in general neutral (Figures 3 and 4). Figures 3 and 4 show the percentage of respondents agreeing with, neutral to, or disagreeing with each positively worded and negatively worded health statement for GM. Respondents did not agree that they would live longer if they ate GM foods and most agreed with or were neutral to the statement that GM foods are useful in preventing disease, although most 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, nearly the same percentage as organic. Most respondents did not agree with statements describing potential dangers associated with GM foods and only 15% agreed that GM foods present grave danger to their health; half disagreed.

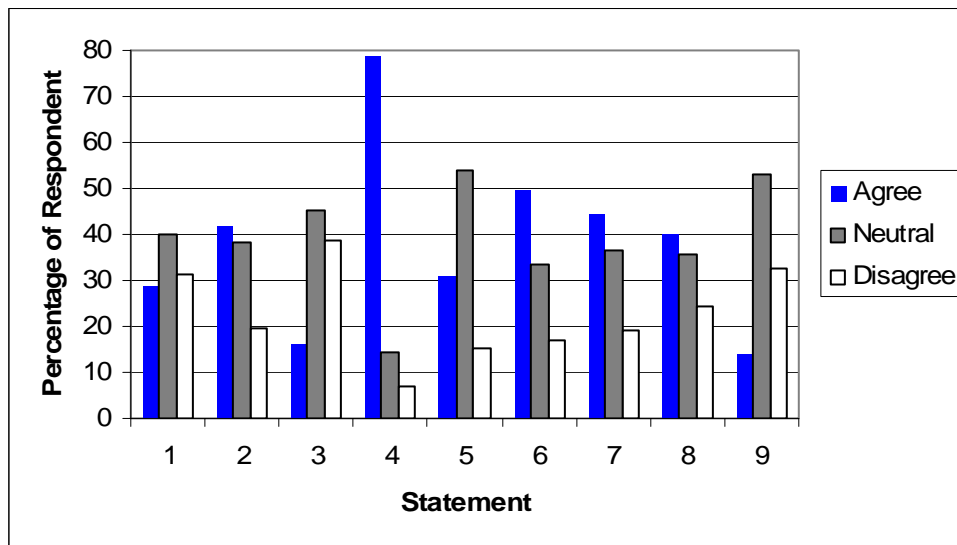


Figure 3. GM Health Statements Positively Worded

STATEMENT

1. Consumption of GM foods can improve your overall healthy appearance.
2. Scientists believe that health can be improved by GM foods.
3. I will live longer if I eat GM foods.
4. If human diseases such as Parkinson’s might be cured using GM technologies, that is a good reason to use them.
5. GM foods are useful in preventing disease.
6. GM baby food ingredients can have nutrients not found in traditional food.
7. GM ingredients improve the nutritional quality of convenience foods.
8. GM foods may combat our nation’s problem with obesity.
9. Foods contain fewer carbohydrates and more protein if they contain GM ingredients.

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 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 caused or enhanced by the positive or negative bias of the statement.

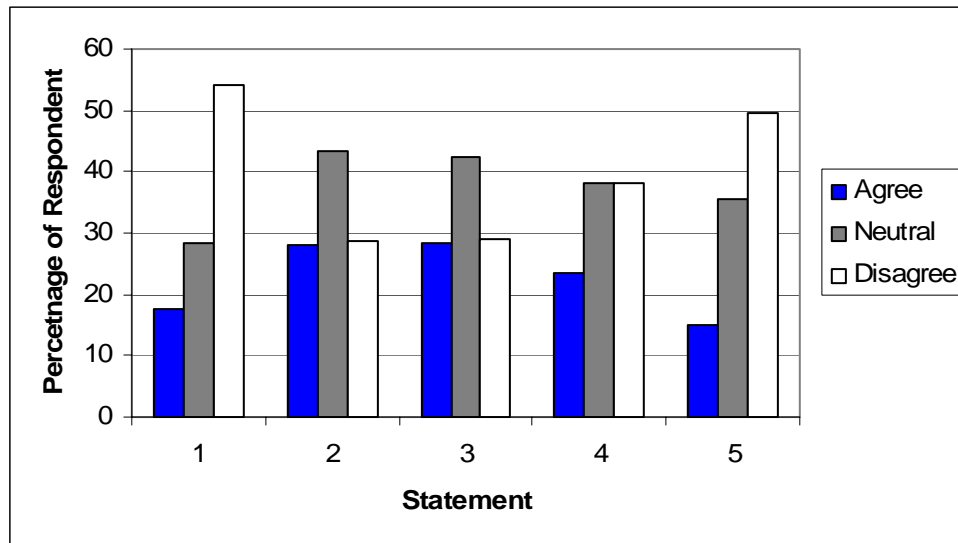


Figure 4. GM Health Statements Negatively Worded

STATEMENT

1. My overall health will decline if I consume GM food.
2. GM baby food is not as healthy as traditional.
3. GM ingredients in food pose a hidden danger to my health.
4. Regularly eating GM foods will harm my health.
5. GM foods present a grave danger to my health.

Consumers associated several benefits with GM food. Fifty-two percent agreed that the quality of life can be improved by the use of GM, although only 16% believed that GM foods will enable people to live longer. Sixty-four percent of consumers agreed that the use of GM may prompt breakthroughs in our understanding of life processes (see Table 2). Similarly, consumers supported more altruistic goals associated with the use of GM. Seventy-nine percent agreed that if GM could cure diseases such as Parkinson’s, it would be a good reason to use GM.

Potential benefits are seen from 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.

Table 2. Other Benefits Statements										
Statement	Organic									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
The tools of Organic production may prompt our breakthrough in the understanding of life	34	B5	P	0.000	111	4.07	13	39.6	41.4	18.9
Animals can benefit from Organic	59	B12	P	0.344	107	4.10	15	32.7	48.6	18.7
Plants can benefit from Organic	19	B1	P	0.524	111	3.69	14	49.5	37.8	12.6
Organic animals speed up the process of change	26	B3	P	0.797	102	4.76	22	21.6	45.1	33.3
Quality of life can be improved by using Organic	51	B9	P	0.134	113	3.73	12	49.6	35.4	15.0
Foods have the ability to enhance the quality of our lives	52	B10	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	56	B11	N	0.013	121	3.05	4	62.0	27.3	10.7
Organic lowers costs, therefore it is okay	25	B2	N	0.714	122	4.23	2	39.3	36.1	24.6
Statement	GM									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
The tools of GM production may prompt our breakthrough in the understanding of life	34	B5	P	0.000	127	3.24	6	63.8	29.9	6.3
Animals can benefit from GM	59	B12	P	0.344	112	4.32	21	31.3	41.1	27.7
Plants can benefit from GM	19	B1	P	0.524	122	3.84	12	45.1	36.9	18.0
GM animals speed up the process of change	26	B3	P	0.797	109	4.83	24	22.9	37.6	39.4
Quality of life can be improved by using GM	51	B9	P	0.134	113	3.42	21	52.2	38.1	9.7
Foods have the ability to enhance the quality of our lives	52	B10	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	56	B11	N	0.013	125	3.58	9	44.8	44.0	11.2
GM lowers costs, therefore it is okay	25	B2	N	0.714	129	4.32	4	31.8	38.0	30.2

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. 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.

Comparing Organic and Genetically Modified. 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.

Participants perceived organic food products to be more closely linked to positive health attributes compared to GM foods, with a relatively low range of unsure responses (most fell within the range of 10% to 15%). As expected, organic food was perceived as 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.

Both GM and organic food have definite health benefits in the eyes of the participant population. Both are thought to have higher levels of nutrients than traditional food. Organic and GM food are seen as appropriate if they had potential to help cure diseases, although average level 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.

Perceptions differed by gender and class for GM but not organic foods with regard to health. Men were less concerned about the negative effects of GM food than women. Graduate students more strongly agreed that GM foods can increase the nutritional quality of foods than undergraduates and were more in favor of GM foods as a whole. Graduate students were rather indifferent to organic foods when compared to undergraduates.

Environment

Average levels of agreement with statements related to environmental factors associated with the production of organic and GM foods and percentages of respondents by strength of agreement are presented in Table 3. Figures 5 and 6 show agreement of respondents to positively and negatively worded statements, respectively.

Organic. The present study supports literature reviewed that the organic process of producing food is perceived as advantageous for the environment and that organic production does not have negative effects on the environment. For example, participants agreed that organic production uses less pesticides and disagreed that more chemicals are used. This supports that participants knew or learned from reading the primer that organic production does not allow the use of pesticides. It may also indirectly support existing evidence regarding consumer concern about residues and overall effects of pesticides being used in the production of food. Respondent did not agree that organic production reduces erosion.

Average level of agreement was stronger that organic production will change the environment than it will do so negatively.

Table 3. Environment Statements										
Statement	Organic									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
The balance of organisms is better managed by humans using Organic	30	V3	P	0.009	111	4.54	14	28.8	41.4	29.7
Organic will use lesser amounts of pesticide	17	V2	P	0.091	113	3.19	12	63.7	19.5	16.8
Production of Organic crops reduces unnecessary erosion of farmland	62	V7	P	0.914	90	4.67	34	25.6	41.1	33.3
Organic use will forever change our natural environment	76	V9	N	0.000	112	4.51	13	25.0	48.2	26.8
Organic will introduce new organisms that may harm our society	38	V4	N	0.000	97	5.46	28	12.4	40.2	47.4
I am worried about unknown effects	71	V8	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	47	V5	N	0.000	112	5.60	13	12.5	35.7	51.8
It takes more chemicals to raise Organic crops	50	V6	N	0.006	102	5.85	23	13.7	26.5	59.8
Statement	GM									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
The balance of organisms is better managed by humans using GM	30	V3	P	0.009	117	5.19	16	20.5	36.8	42.7
GM will use lesser amounts of pesticide	17	V2	P	0.091	99	3.65	35	51.5	33.3	15.2
Production of GM crops reduces unnecessary erosion of farmland	62	V7	P	0.914	82	4.70	51	23.2	46.3	30.5
GM use will forever change our natural environment	76	V9	N	0.000	113	3.41	20	48.7	45.1	6.2
GM will introduce new organisms that may harm our society	38	V4	N	0.000	95	4.17	39	35.8	41.1	23.2
I am worried about unknown effects	71	V8	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	47	V5	N	0.000	109	4.68	25	26.6	39.4	33.9
It takes more chemicals to raise GM crops	50	V6	N	0.006	90	5.11	44	20.0	41.1	38.9

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. 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.

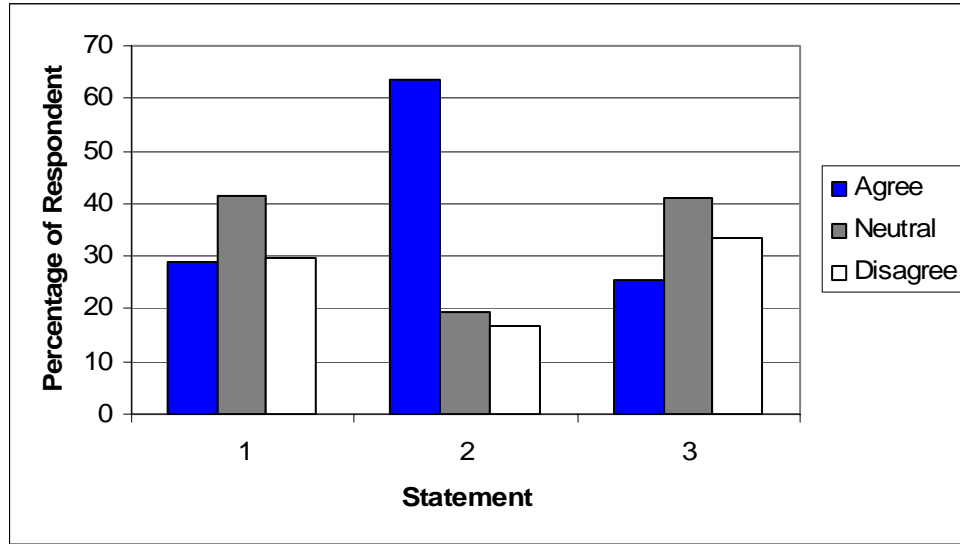


Figure 5. Organic Environment Statements Positively Worded

STATEMENT

1. The balance of organisms is better managed by humans using organic techniques.
2. Organic crops use lesser amounts of pesticides.
3. Production of organic crops reduces unnecessary erosion of farmland.

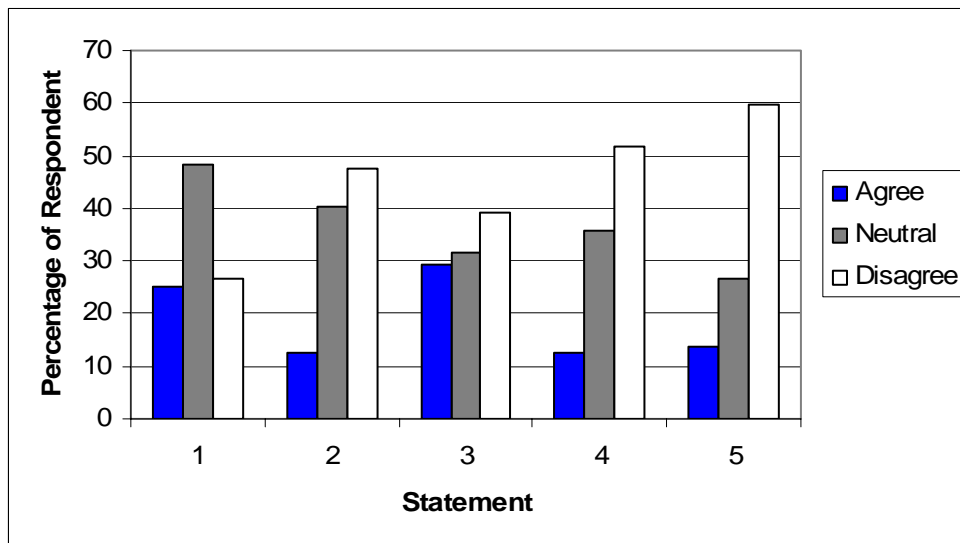


Figure 6. Organic Environment Statements Negatively Worded

STATEMENT

1. The use of organic production practices will forever change our natural environment.
2. Organic will introduce new organisms that may harm our society.
3. I am worried about unknown effects of organic production on our ecosystem.
4. The balance of nature has been upset by the use of organic production.
5. More chemicals are required to raise organic crops.

In general, participants tended to disagree or be neutral that organic food production has negative effects on the environment. For example, 52% disagreed that the balance of nature has been upset by the use of organic practices in the production of food.

Genetically Modified. Figures 7 and 8 show agreement of respondents to positively and negatively worded statements, respectively, about the effect of GM production on the environment. In terms of the environment and GM, 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. The literature in the area of consumer perceptions with regard to the environment and GM food supports the notion that consumers are unaware of the benefits of GM to the environment (e.g., Hoban, 1997; Wachenheim and Lesch, 2004).

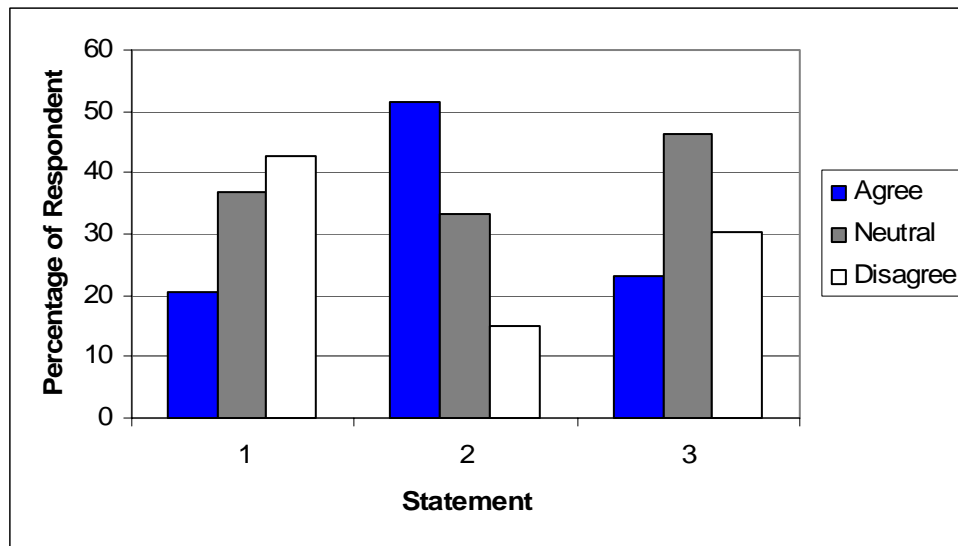


Figure 7. GM Environment Statements Positively Worded

STATEMENT

1. The balance of organisms is better managed by humans using GM techniques.
2. GM crops use lesser amounts of pesticides.
3. Production of GM crops reduces unnecessary erosion of farmland.

In the present study, findings in general neither support nor refute GM production as having an environmentally negative impact in the eyes of student participants. 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 students agreed that they are worried about the unknown effects that GM will have on our ecosystem, only 17% disagreed. To the statement that GM will forever change our natural environment, only 6% disagreed; while 49% agreed. Eighty percent were neutral or disagreed that the balance of organisms is better managed by humans using genetic modification. Thirty-six percent agreed that GM will introduce new organisms that may harm our society (41% were neutral).

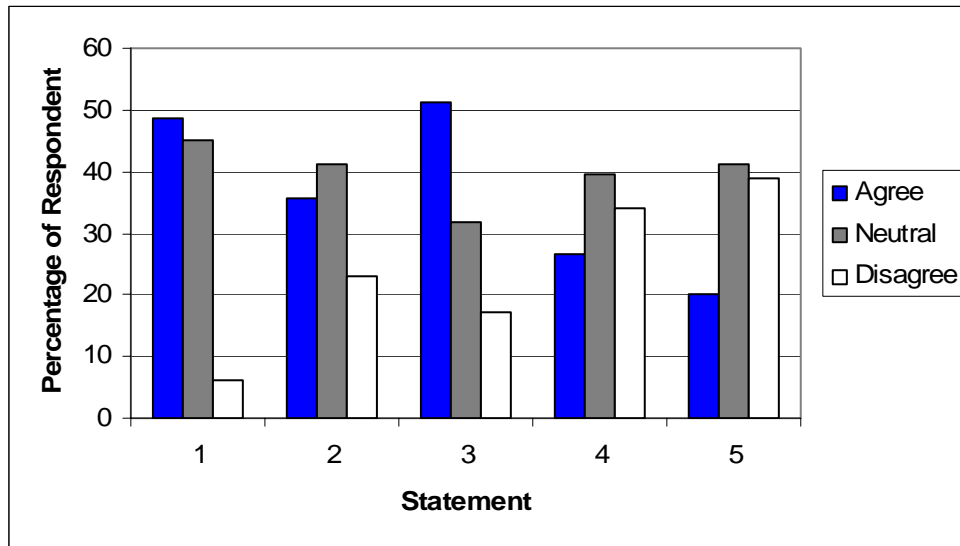


Figure 8. GM Environment Statements Negatively Worded

STATEMENT

1. The use of GM production practices will forever change our natural environment.
2. GM will introduce new organisms that may harm our society.
3. I am worried about unknown effects of GM production on our ecosystem.
4. The balance of nature has been upset by the use of GM production.
5. More chemicals are required to raise GM crops.

Fifty-two percent of participants agreed that production of GM food uses lesser amounts of pesticides, only 15% disagreed. Only 20% agreed that GM food needs more chemicals than traditional food; 39% disagreed.

Comparing Organic and Genetically Modified. Generally, consumers perceive organic food production as environmentally friendly, while production involving GM varieties is perceived as less environmentally friendly than production of traditional food and consumers are unaware of the benefits that GM has to the environment (Sloan 2002). The current findings do not refute this, but the perceptions among the participants were more moderate/neutral than expected. With one exception for which there was no difference, for each positive (negative) statement about the effect of organic production on the environment, level of agreement (disagreement) was stronger for GM (i.e., participants felt that organic food production is more environmentally friendly than its GM counterpart).

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. Men were found to more strongly disagree that GM has negative effects on the environment than women. Men also more strongly agreed that the use of organic production practices will not have a positive impact on the environment. These findings suggest that women would be more inclined to favor organic products for their environmentally friendly attributes and less inclined to use GM products for the negative associations with the environment.

Risk

Risk is inherent in food and today, more than ever, U.S. consumers are exposed to information about those risks. Although there is evidence that, in general, Americans trust regulations in place to protect the safety of their food, consumers' risk perception of different food classes (e.g., organic and GM) may affect consumers' willingness to buy the food classes. Several different levels of risks are considered including general risk, consumption risk, long-term effects of the use of GM/organic on society, and the risk to plants and animals. Average levels of agreement with statements related to risk associated with organic and GM foods and percentages of respondents by strength of agreement are presented in Table 4.

Organic. Figures 9 and 10 show agreement of respondents to positively and negatively worded statements, respectively, about risks associated with organic production and consumption. Between 52% and 56% 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. 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 or 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. For example, one-fourth disagreed that organic foods hold no danger for future generations. Forty-two percent agreed that animals such as organic sheep and cattle may change the overall gene pool. Fifty percent disagreed that raising organic species is dangerous to the gene pools, while only 10% agreed. In general, there is little risk perceived by most associated with the consumption or production of organic foods although there were respondents who did perceive risk, especially longer-term risk.

Table 4. Risk Statements										
Statement	Organic									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
I see no risks in the consumption of Organic foods	69	C13	P	0.000	115	3.44	10	52.2	34.8	13.0
I would be willing to serve Organic foods to my friends	68	C12	P	0.042	116	3.45	9	55.2	30.2	14.7
Organic foods are completely safe to eat	9	C3	P	0.007	117	3.61	7	55.6	24.8	19.7
The risks to people associated with Organic foods outweigh the benefits	65	C11	N	0.001	97	5.90	28	10.3	25.8	63.9
Consumption of regular foods is far more risky	58	C9	P	0.003	107	4.75	17	27.1	37.4	35.5
Raising Organic animals holds no potential danger to other species	55	C8	P	0.000	108	4.40	17	32.4	40.7	26.9
Scientists cannot predict the future outcomes of Organic	18	C5	N	0.007	112	3.96	13	47.3	31.3	21.4
Organic foods present no danger for future generations	77	C14	N	0.000	102	4.18	23	35.3	40.2	24.5
Organic will harm society more than help	5	C1	N	0.001	123	6.01	2	10.6	22.8	66.7
Eating Organic foods will subtract from my quality of life	8	C2	N	0.011	120	6.23	5	11.7	13.3	75.0
It is dangerous to use Organic to alter what we eat	12	C4	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	33	C6	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	45	C7	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	60	C10	N	0.012	106	5.41	18	10.4	39.6	50.0

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. 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 4. (continued)										
Statement	GM									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
I see no risks in the consumption of GM foods	69	C13	P	0.000	16	4.43	16	32.8	37.1	30.2
I would be willing to serve GM foods to my friends	68	C12	P	0.042	13	3.95	13	40.0	40.0	20.0
GM foods are completely safe to eat	9	C3	P	0.007	21	4.30	21	35.4	40.7	23.9
The risks to people associated with GM foods outweigh the benefits	65	C11	N	0.001	35	5.03	35	22.2	36.4	41.4
Consumption of regular foods is far more risky	58	C9	P	0.003	27	5.50	27	13.2	33.0	53.8
Raising GM animals holds no potential danger to other species	55	C8	P	0.000	30	5.04	30	19.2	37.5	43.3
Scientists cannot predict future outcomes of GM	18	C5	N	0.007	17	3.29	17	56.4	30.8	12.8
GM foods present no danger for future generations	77	C14	N	0.000	30	5.08	30	17.5	40.8	41.7
GM will harm society more than help	5	C1	N	0.001	10	5.15	10	21.0	33.9	45.2
Eating GM foods will subtract from my quality of life	8	C2	N	0.011	10	5.62	10	16.1	28.2	55.6
It is dangerous to use GM to alter what we eat	12	C4	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	33	C6	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	45	C7	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	60	C10	N	0.012	22	4.39	22	26.1	48.6	25.2

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. 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.

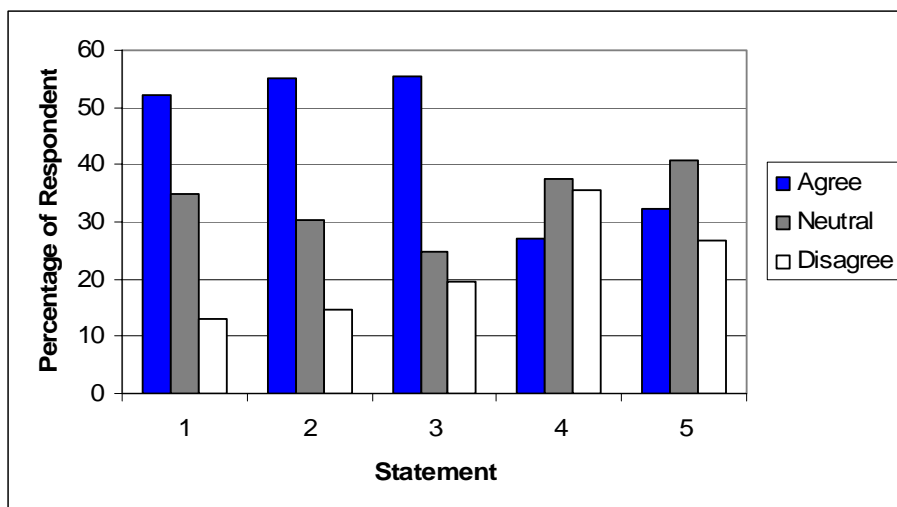


Figure 9. Organic Risk Statements Positively Worded

STATEMENT

1. I see no risks in the consumption of organic foods.
2. I would be willing to serve organic foods to my friends.
3. Organic foods are completely safe to eat.
4. Consumption of regular foods is far more risky.
5. Raising organic animals holds no potential danger to other species.

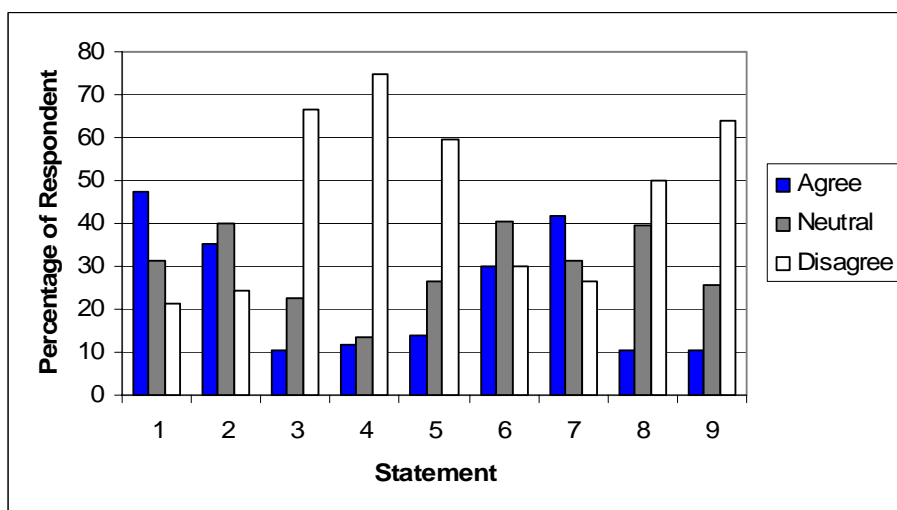


Figure 10. Organic Risk Statements Negatively Worded

STATEMENT

1. Scientists cannot predict future outcomes of organic technologies.
2. Organic foods present no danger for future generations.
3. Organic food will harm society more than help.
4. Eating organic foods will subtract from my quality of life.
5. It is dangerous to use organic techniques to alter what we eat.
6. Production of organic crops could harm other species in ways we do not understand.
7. Animals such as organic sheep and cattle may change the overall gene pool.
8. Raising organic species is dangerous to the gene pools of those species.
9. The risks to people associated with organic foods far outweigh the benefits.

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 and 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 expected given the findings from the literature and the content of popular press stories. Figures 11 and 12 show agreement of respondents to positively and negatively worded statements, respectively, about risks associated with GM production.

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.

When asked how GM will affect themselves and others, some participants perceived risks. Twenty-one percent agreed that GM will harm society more than help it; 45% disagreed. Forty-two percent disagreed that GM holds no danger for future generations, while only 18% agreed. However, only 16% agreed that eating GM foods will subtract from their quality of life; 56% disagreed. 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 eating GM foods will subtract from the quality of their own life).

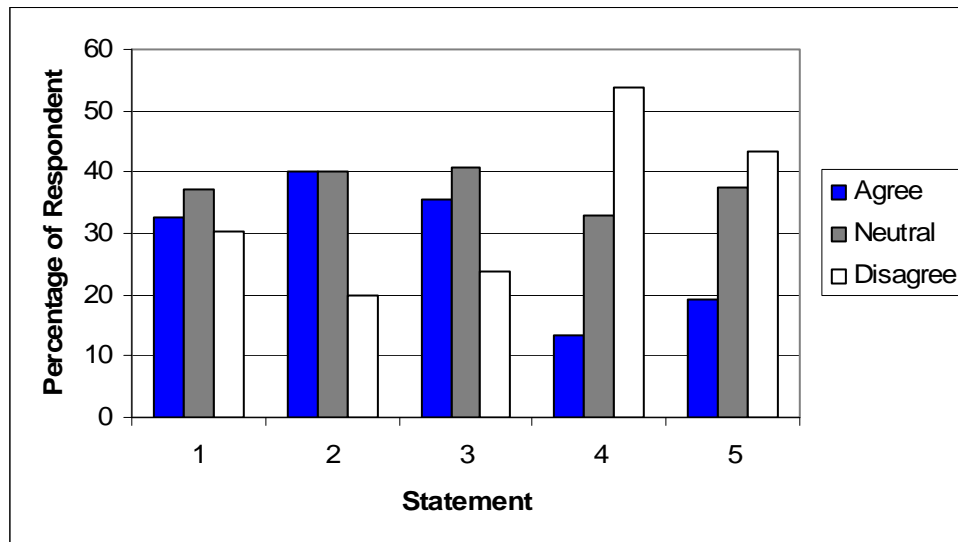


Figure 11. GM Risk Statements Positively Worded

STATEMENT

1. I see no risks in the consumption of GM foods.
2. I would be willing to serve GM foods to my friends.
3. GM foods are completely safe to eat.
4. Consumption of regular foods is far more risky.
5. Raising GM animals holds no potential danger to other species.

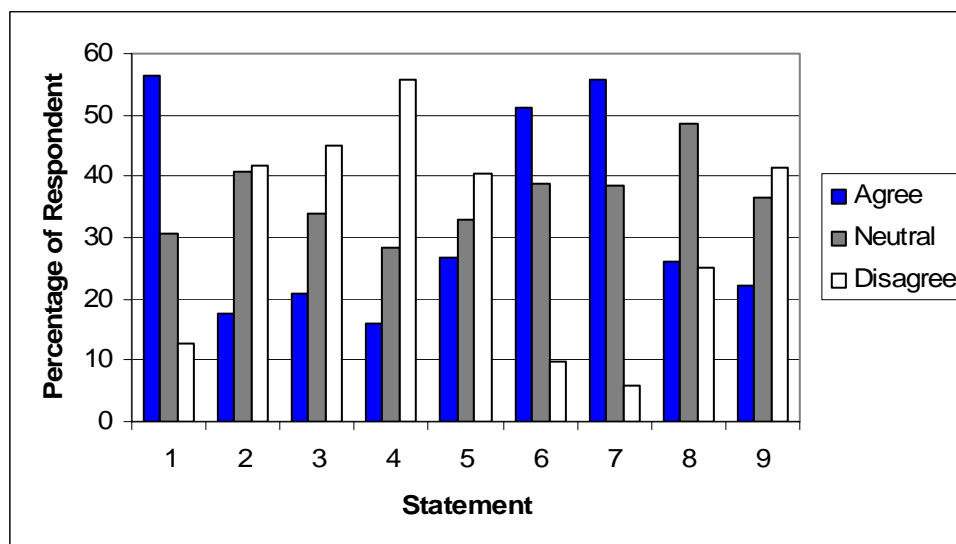


Figure 12. GM Risk Statements Negatively Worded

STATEMENTS

1. Scientists cannot predict future outcomes of GM technologies.
2. GM foods present no danger for future generations.
3. GM food will harm society more than help.
4. Eating GM foods will subtract from my quality of life.
5. It is dangerous to use GM techniques to alter what we eat.
6. Production of GM crops could harm other species in ways we do not understand.
7. Animals such as GM sheep and cattle may change the overall gene pool.
8. Raising GM species is dangerous to the gene pools of those species.
9. The risks to people associated with GM foods far outweigh the benefits.

There is a perception that GM may change nature, but it is not consistent across statements (i.e., it depends on statement wording). Over half agreed that GM crops could harm other species in ways we do 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, wherein only 6% disagreed. Only one-quarter agreed that the use of GM is dangerous to the gene pool but 43% disagreed that GM animals hold no potential danger to other species.

Participants perceived GM 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 effects to the world around them.

Comparing Organic and Genetically Modified. 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.

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 of every question within the risk construct were statistically different for the GM and organic versions. Mean levels of agreement were stronger (weaker) for organic (GM) with positively (negatively) worded statements.

Men had a higher level of disagreement with negatively worded GM statements and a higher level of agreement with positively worded GM statements than women. The conclusion is that men see less risk associated with GM products and processes. Graduate students did not see GM or organic food to be as risky as undergraduate students.

Ethics

Average levels of agreement with statements related to ethics regarding organic and GM foods and food production and percentages of respondents by strength of agreement are presented in Table 5.

Organic. Social acceptability is one motive driving the purchase of organic food. This was examined using the construct area involving ethics. Figures 13 and 14 show level of agreement among respondents to positively and negatively worded statements, respectively, regarding ethical issues associated with organic production. The statements where the term organic or GM was not explicitly included are starred.

Table 5. Ethics Statements										
Statement	Organic									
	A	B	C	D	N	Mean	E	Percent		
								Agree**	Neutral**	Disagree**
Animals have the basic right to exist without the manipulation of their genes*	63	E13	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	67	E14	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	4	E1	P	0.079	113	4.34	12	34.5	38.9	26.5
Scientists are fulfilling moral obligations to society by improving food	27	E6	P	0.002	114	4.15	11	39.5	37.7	22.8
Organic is not morally acceptable	78	E16	N	0.012	118	5.39	7	12.7	41.5	45.8
Changing the makeup of animals is not morally acceptable	61	E12	N	0.202	120	4.95	5	25.8	34.2	40.0
It is inhumane to enhance livestock by Organic means	11	E4	N	0.009	121	5.60	4	14.0	26.4	59.5
It is unethical for scientists to conduct research	32	E8	N	0.024	121	6.01	3	7.4	25.6	66.9
Scientists are playing God when altering the genes of plants*	15	E5	N	0.751	123	4.85	2	33.3	26.8	39.8
Scientists are playing God when altering the genes of animals*	36	E9	N	0.877	118	4.37	7	40.7	28.8	30.5
Plants have the right to exist without manipulation by humans*	7	E3	N	0.850	120	5.03	5	30.0	26.7	43.3
Crops should only be enhanced by natural means*	6	E2	N	0.767	121	4.32	4	41.3	25.6	33.1
Organic foods threaten the natural order of things	49	E10	N	0.000	113	5.48	12	13.3	38.1	48.7
Organic will harm future generations	53	E11	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*	73	E15	N	0.650	117	4.45	7	26.5	45.3	28.2

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. Number answered "Don't Know" or "No Opinion."

* Statement does not explicitly mention organic or GM.

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

Table 5. (continued)										
Statement	GM									
	A	B	C	D	N	Mean	E	Percent		
								Agree**	Neutral**	Disagree**
Animals have the basic right to exist without the manipulation of their genes*	63	E13	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	67	E14	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	4	E1	P	0.079	117	4.76	16	28.2	35.9	35.9
Scientists are fulfilling moral obligations to society by improving food	27	E6	P	0.002	121	4.85	12	21.5	40.5	38.0
GM is not morally acceptable	78	E16	N	0.012	118	4.75	15	27.1	37.3	35.6
Changing the makeup of animals is not morally acceptable	61	E12	N	0.202	122	4.61	12	31.1	36.9	32.0
It is inhumane to enhance livestock by GM means	11	E4	N	0.009	126	4.95	8	23.0	33.3	43.7
It is unethical for scientists to conduct research	32	E8	N	0.024	131	5.50	3	13.7	33.6	52.7
Scientists are playing God when altering the genes of plants*	15	E5	N	0.751	130	4.77	4	29.2	30.8	40.0
Scientists are playing God when altering the genes of animals*	36	E9	N	0.877	127	4.33	7	33.9	34.6	31.5
Plants have the right to exist without manipulation by humans*	7	E3	N	0.850	128	4.98	6	32.0	24.2	43.8
Crops should only be enhanced by natural means*	6	E2	N	0.767	131	4.40	3	40.5	23.7	35.9
GM foods threaten the natural order of things	49	E10	N	0.000	118	4.29	16	29.7	44.9	25.4
GM will harm future generations	53	E11	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*	73	E15	N	0.650	123	4.56	10	30.1	39.8	30.1

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. Number answered "Don't Know" or "No Opinion."

* Statement does not explicitly mention organic or GM.

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

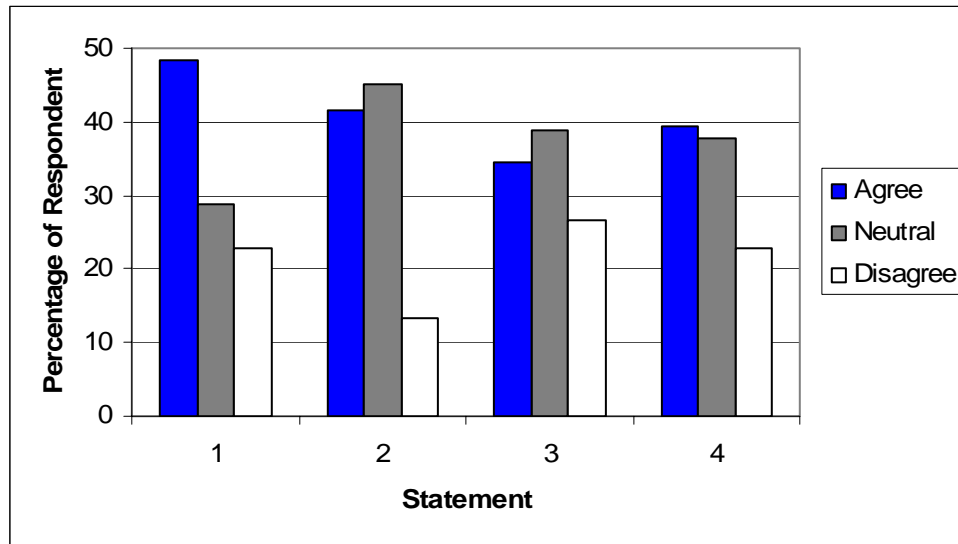


Figure 13. Organic Ethics Statements Positively Worded

STATEMENT

1. Animals have the basic right to exist without the manipulation of their genes.*
2. Improving crop production by using organic methods is the right thing to do.
3. Breeding animals using organic methods to introduce better genes will improve the quality of life of animals.
4. Scientists are fulfilling moral obligations to society by improving food using organic means.

* Statement does not explicitly mention organic or GM.

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. Fifty-seven percent disagreed that organic food will harm future generations, while only 13% agreed. Only 13% agreed that organic production was not morally acceptable. Only 7% of participants agreed that it was unethical to use organic methods to conduct research; 67% disagreed. The strongest level of agreement with negatively worded statements are for the five that do not explicitly mention the term organic. For these and for the positively worded statement also not mentioning organic, the average level of agreement does not differ between respondents to the organic and the GM surveys.

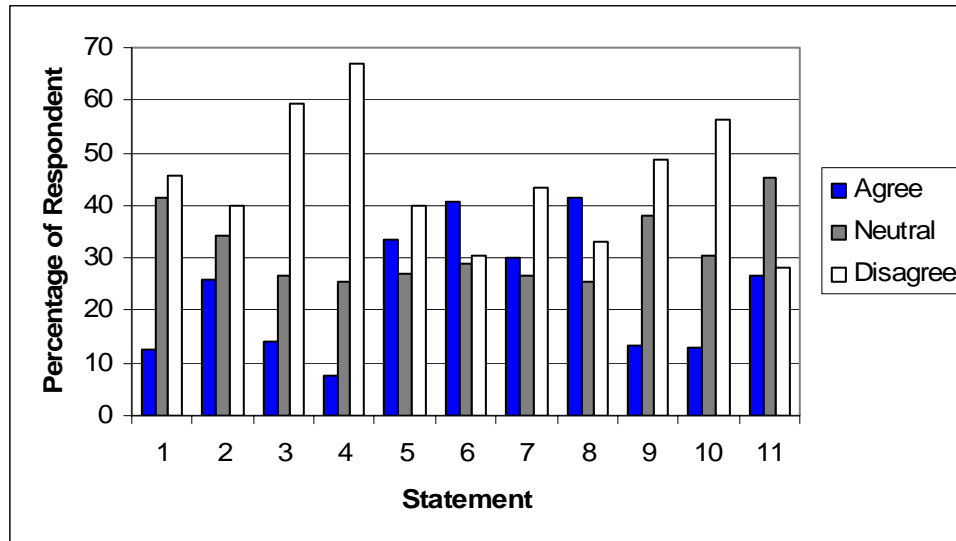


Figure 14. Organic Ethics Statements Negatively Worded

STATEMENT

1. Changing the makeup of plants by using organic means is not morally acceptable.
2. Changing the makeup of animals by using organic techniques is not morally acceptable.
3. It is inhumane to enhance livestock by organic means.
4. It is unethical for scientists to conduct research involving organic means.
5. Scientists are playing God when altering the genes of plants.*
6. Scientists are playing God when they alter the gene pools of animals.*
7. Plants have the right to exist without manipulation of their genes by humans.*
8. Crops should only be enhanced by natural means.*
9. Organic foods threaten the natural order of things.
10. Organic production will harm future generations.
11. Humans should not meddle with the natural order of plants and animals.*

* Statement does not explicitly mention organic or GM.

Genetically Modified. Respondents did not have major ethical objections to GM food. Figures 15 and 16 show the level of agreement among respondents to positively and negatively worded statements, respectively, regarding ethical issues associated with organic production. The statements wherein the term GM was not explicitly noted are starred.

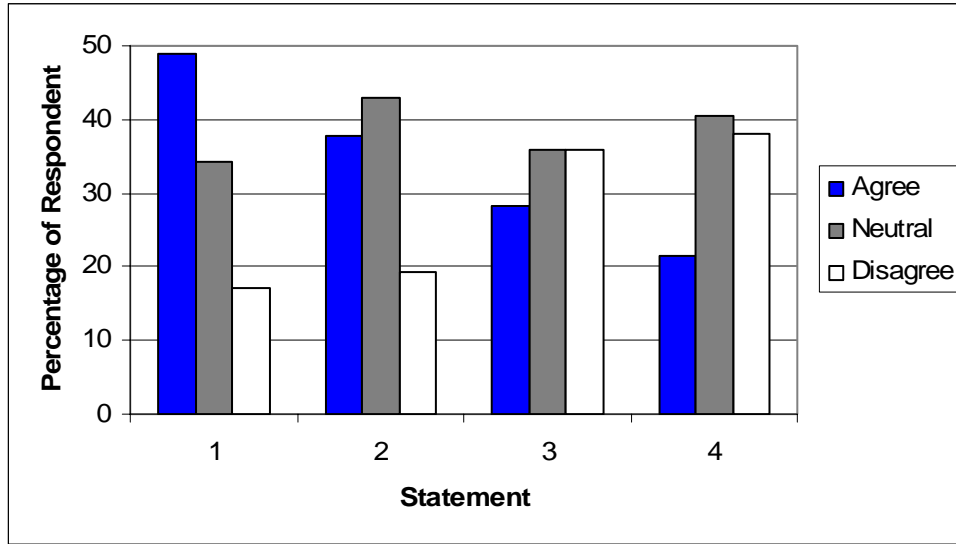


Figure 15. GM Ethics Statements Positively Worded

STATEMENT

1. Animals have the basic right to exist without the manipulation of their genes.*
2. Improving crop production by using GM methods is the right thing to do.
3. Breeding animals using GM methods to introduce better genes will improve the quality of life of animals.
4. Scientists are fulfilling moral obligations to society by improving food using GM means.

* Statement does not explicitly mention organic or GM.

There was not strong opposition to the use of GM to enhance production. Thirty-eight percent agreed that improving crop production by using GM is the right thing to do, while only 19% disagreed. However, fewer (22%) agreed scientists are fulfilling moral obligations to society by improving foods. As found in the literature, participants perceived the use of GM in plants as more acceptable than use in animals. However, perceptions about the ethical appropriateness of the use of GM in animals varied depending on the specific statement. Twenty-nine percent agreed that introducing GM into livestock gene pools will improve the quality of life of animals. Thirty-two and 44% disagreed with the negatively worded statement that changing the makeup of animals is not morally acceptable and it is inhumane to enhance livestock using GM, respectively.

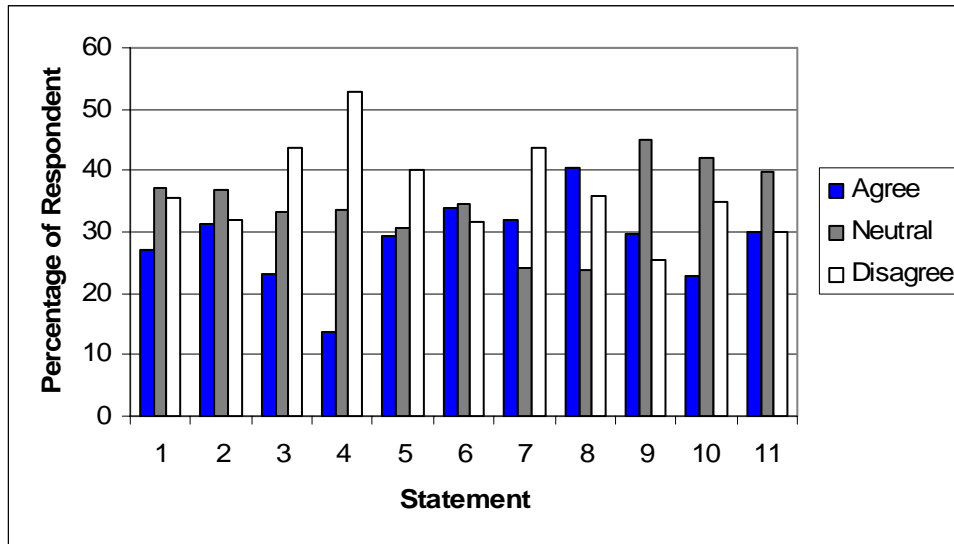


Figure 16. GM Ethics Statements Negatively Worded

STATEMENT

1. Changing the makeup of plants using GM means is not morally acceptable.
2. Changing the makeup of animals using GM techniques is not morally acceptable.
3. It is inhumane to enhance livestock by GM means.
4. It is unethical for scientists to conduct research involving GM means.
5. Scientists are playing God when altering the genes of plants.*
6. Scientists are playing God when they alter the gene pools of animals.*
7. Plants have the right to exist without manipulation by humans.*
8. Crops should only be enhanced by natural means.*
9. GM foods threaten the natural order of things.
10. GM production will harm future generations.
11. Humans should not meddle with the natural order of plants and animals.*

* Statement does not explicitly mention organic or GM.

Comparing Organic and Genetically Modified. Participants had fewer ethical objections with organic processes than GM processes. However, consumers seem 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 fifteen statements' means regarding ethics were found to be different. Higher levels of agreement for the positively worded questions were present for organic food than that of GM food, and higher levels of disagreement for the negatively worded questions were found for organic food than GM food. However, again, there were no major ethical objections for either class of food.

There was no difference in average level of agreement between the organic and GM survey respondents for any of the statements that did not explicitly mention organic or GM. Each dealt with the rights of animals or plants (specified). Forty-eight and 49% agreed that

animals have the right to exist without manipulation of their genes, 41% and 34% agreed that scientists are playing God when altering animals, and 41% and 41% agreed that crops should only be enhanced by natural means in the organic and GM surveys, respectively. Lesser percentages of 33% and 29% agreed scientists are playing God when altering plant genes and of 30% and 32% agreed plants have the right to exist without manipulation by humans.

Men were found to have an average lower level of agreement to the ethical dilemmas of GM food than women. Men also had fewer ethical objections to the use of organic methods than women. Graduate students were less inclined to believe that both GM and organic foods had ethical issues associated with them than undergraduate students.

Other Benefits

Some statements did not seemingly fit into any construct area. 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 level of agreement was found. Thirty-three percent of participants agreed that organic processes can benefit animals while 31% agreed that GM processes will benefit animals.

When asked if the tools of GM/organic production will prompt breakthroughs in the understanding of life processes, 64% agreed for GM while only 6% disagreed; 40% agreed with regard to organic while 19% disagreed. Surprisingly only 23% agreed that GM processes only speed up the process of change (nearly an equal percentage for organic) while 39% disagreed with that statement (33% for organic).

Participants were also queried about the perceived benefits of GM or organic foods. The use of GM or organic technologies 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), while only 11% disagreed (also 11% for organic). Fifty-two percent agreed that GM can improve the quality of life (50% for organic) while only 10% disagreed (15% for organic). When asked if it is OK to use GM/organic to lower the cost of foods, 32% agreed with GM and 30% disagreed, while 39% agreed with the same for organic and 25% disagreed.

Regulation

Average levels of agreement with statements related to the regulation construct and percentages of respondents by strength of agreement are presented in Table 6.

Organic. The purpose of regulation is to mitigate risks for consumers as well as for society. Organic food regulation focuses on qualification as organic and associated labeling issues. The question of whether or not the consumer feels that adequate regulation exists still lingers. Figures 17 and 18 show the level of agreement among respondents to positively and negatively worded statements, respectively, about regulation of organic production.

Table 6. Regulation Statements										
Statement	Organic									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
Government has effective enforcement	29	R3	P	0.894	92	4.54	33	28.3	45.7	26.1
Being monitored effectively by government	44	R6	P	0.733	81	4.27	43	32.1	45.7	22.2
Government adequately polices the food industry with regard to Organic	54	R7	P	0.946	84	4.29	41	33.3	40.5	26.2
Regulations should be done by corporate associations	70	R8	P	0.493	104	5.27	21	18.3	35.6	46.2
Existing regulations on foods are an unnecessary burden on business	39	R5	N	0.466	101	5.39	23	15.8	33.7	50.5
Government has no tools to regulate	1	R1	N	0.251	99	5.21	26	22.2	27.3	50.5
Government spends too much money regulating	72	R9	N	0.136	80	5.19	45	18.8	38.8	42.5
Government has failed to regulate	31	R4	N	0.527	88	4.84	37	21.6	40.9	37.5
Government does not adequately regulate the private sector	13	R2	N	0.533	89	4.46	35	29.2	42.7	28.1
Government has too little regulation	74	R10	N	0.851	84	4.38	40	26.2	47.6	26.2
Statement	GM									
	A	B	C	D	N	Mean	E	Percent		
								Agree*	Neutral*	Disagree*
Government has effective enforcement	29	R3	P	0.894	88	4.58	45	28.7	42.5	28.7
Being monitored effectively by government	44	R6	P	0.733	88	4.36	46	33.0	43.2	23.9
Government adequately polices the food industry with regard to GM	54	R7	P	0.946	86	4.3	47	32.6	45.3	22.1
Regulations should be done by corporate associations	70	R8	P	0.493	108	5.45	24	14.8	37.0	48.1
Existing regulations on foods are an unnecessary burden on business	39	R5	N	0.466	108	5.57	26	13.0	36.1	50.9
Government has no tools to regulate	1	R1	N	0.251	103	4.9	31	25.2	32.0	42.7
Government spends too much money regulating	72	R9	N	0.136	97	5.56	36	10.3	38.1	51.5
Government has failed to regulate	31	R4	N	0.527	97	5.00	36	16.5	46.4	37.1
Government does not adequately regulate the private sector	13	R2	N	0.533	96	4.29	38	32.3	41.7	26.0
Government has too little regulation	74	R10	N	0.851	86	4.43	47	26.7	47.7	25.6

A. Number of Statement on Survey.

B. Reliability Analysis Code.

C. P = positively worded statement and N = negatively worded statement.

D. Significance is based on parametric f-test (2 tailed).

E. 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.

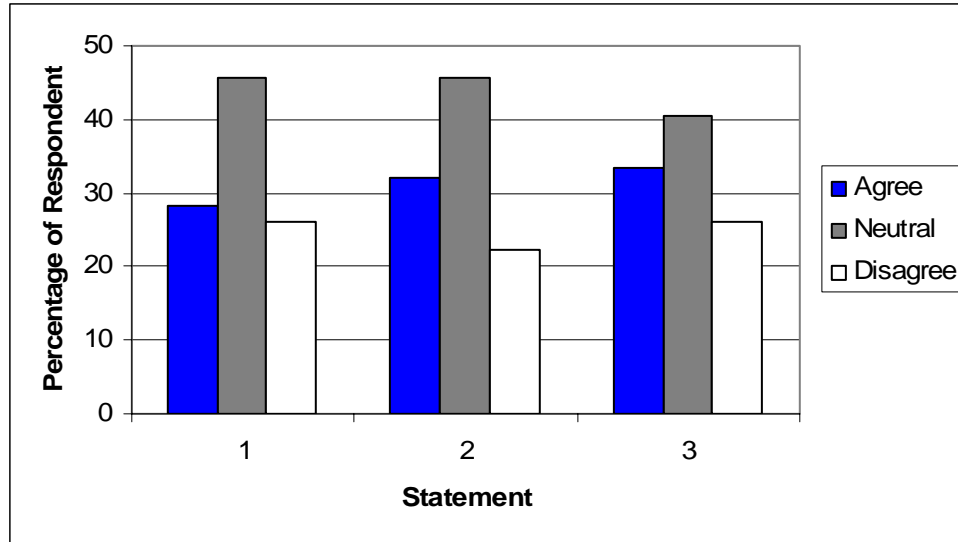


Figure 17. Organic Regulation Statements Positively Worded

STATEMENTS

1. Government has effective enforcement of organic food.
2. Organic food production is being monitored effectively by the government.
3. The government adequately polices the food industry with regard to organic food.

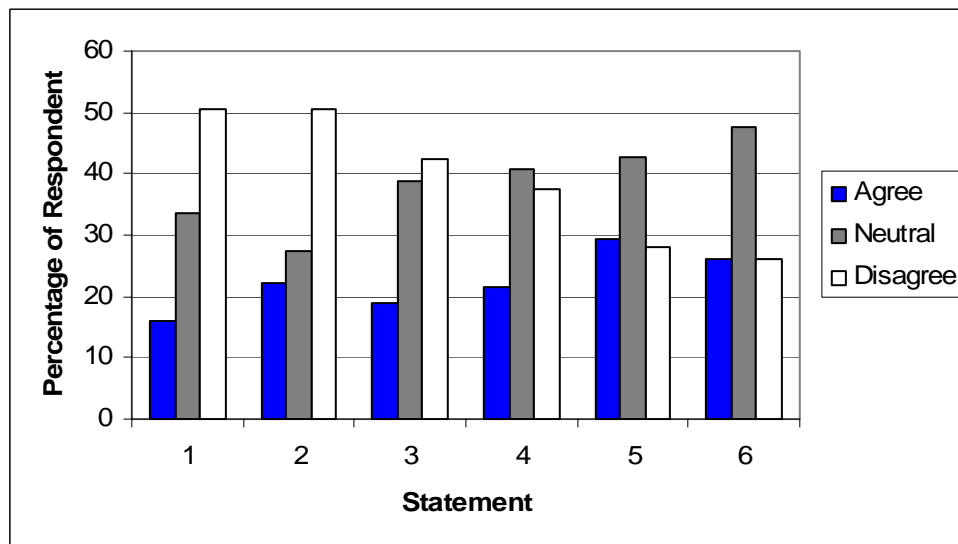


Figure 18. Organic Regulation Statements Negatively Worded

STATEMENT

1. Existing regulations of organic foods are an unnecessary burden on business.
2. Government has no tools to regulate organic foods.
3. Government spends too much money regulating organic foods.
4. Government has failed to regulate organic foods.
5. Government does not adequately regulate the private sector when it comes to the production of organic foods.
6. Government has too little regulation when it comes to organic production.

Participants generally did not have strong feelings towards the regulation of organic foods. The strongest feelings appeared in the area of whom should do the regulating and the effects of regulation. Forty-six percent disagreed that regulation should be conducted by corporate associations, while only 18% agreed. One-half of consumers disagreed that regulation poses an unnecessary burden on business; only 13% agreed.

There is some support for the general perception that the government is an effective regulator, but some participants disagreed. Nearly one out of three participants think the government has effective enforcement and that organic production is being monitored effectively by the government. Also, only one-third agreed that the government has adequately policed the food industry with regard to organic. Twenty-two percent agreed that the government has failed to regulate the organic food industry and 29% agreed the government does not adequately regulate the private sector.

A relatively high level of uncertainty in terms of regulation was evident among the population of participants. Between 17% and 35% of participants responded “don’t know” in this aided survey construct area depending on the statement. This suggests that many consumers do not well understand the regulation with regard to the organic food industry. Participants in this survey also felt that adequate resources should be appropriated to the regulating of organic foods.

Genetically Modified. Currently, there are no labeling guidelines defined by any agency for the labeling of food containing GM ingredients. However, the world of biotechnology has a very strong regulatory environment. Figures 19 and 20 show the level of agreement among respondents to positively and negatively worded statements, respectively, about regulation of GM production.

As is the case for organic food, there were a large number of “not sure” responses (range from 18% to 35%). In general, the government was seen as the logical regulator of business. Forty-eight percent disagreed that regulation should be the responsibility of corporate associations. Fifty-one percent disagreed that current regulations pose an unnecessary burden to business. Forty-three percent of respondents agreed that government had the tools to adequately regulate the GM food industry.

As with organic, participants did not have very strong feelings regarding the regulation of GM foods. When asked if the government adequately polices the GM food industry, 33% agreed, 22% disagreed, and 45% were neutral.

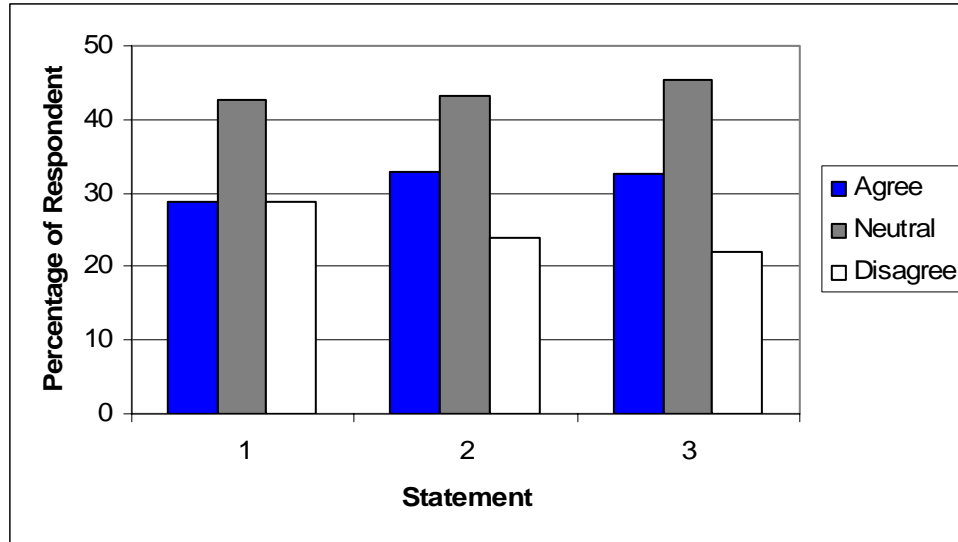


Figure 19. GM Regulation Statements Positively Worded

STATEMENT

1. Government has effective enforcement of GM food.
2. GM food production is being monitored effectively by the government.
3. Government adequately polices the food industry with regard to GM food.

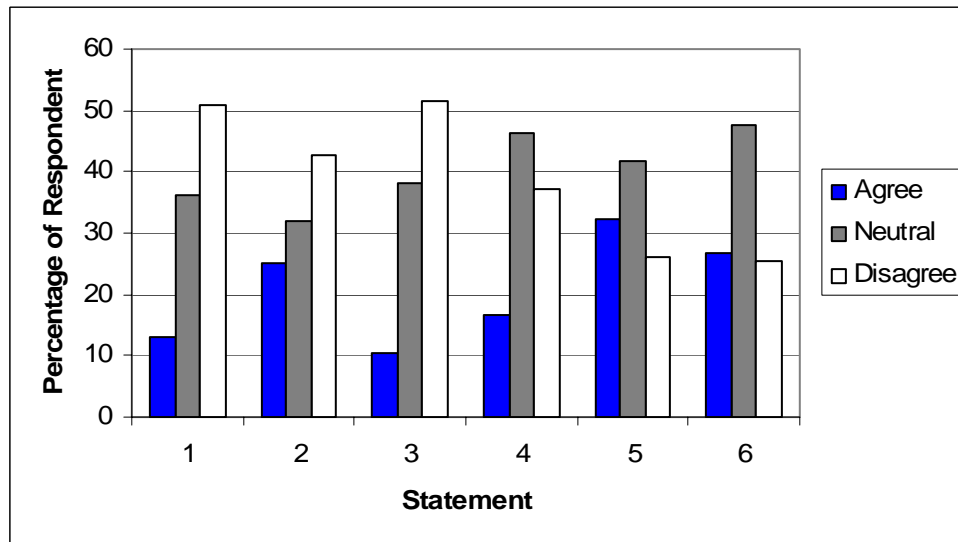


Figure 20. GM Regulation Statements Negatively Worded

STATEMENT

1. Existing regulations of GM foods are an unnecessary burden on business
2. Government has no tools to regulate GM foods.
3. Government spends too much money regulating GM foods.
4. Government has failed to regulate GM foods.
5. Government does not adequately regulate private sector when it comes to the production of GM foods.
6. Government has too little regulation when it comes to GM production.

Comparing Organic and Genetically Modified. There was a higher average level of perceived risk associated with GM versus organic foods and processes among respondents. One would, therefore, expect the regulation of genetically modified food to be more important compared to organic food. However, in both classes of food, participants seemed rather indifferent about regulation. Participants' perceptions toward regulation were, in fact, very similar between organic and GM foods, and there was a relatively high degree of self-reported ignorance about regulation for each category. There were no statistical differences between organic and GM means among the regulation construct.

Men had a higher level of agreement that regulation is an unnecessary burden on business than women; however, they had a lower level of agreement that regulation should be the responsibility of corporate associations. In the area of organic food, men more strongly agreed that the organic food industry is properly regulated than women. No significant difference was found between undergraduate and graduate students.

RELIABILITY ANALYSIS

Cronbach's alpha was used as a reliability measurement for the different statements within each construct area (e.g., health, environment, regulation, risk, and ethics). Cronbach's alpha represents how well a set of statements reflect on a single idea or construct area. It is defined as

$$\alpha = \frac{N \cdot \bar{r}}{1 + (N - 1) \cdot \bar{r}},$$

where N is the number of statements, and r-bar is the average inter-item correlation among statements. Wording of statements can (sometimes strongly) influence level of agreement (e.g., see Hallman et al. 2003). A Cronbach's alpha closer to one indicates that the statements included in its calculation are measuring the same thing (i.e., are reliable). Measuring reliability will be useful for future work based on the statements and constructs included in this instrument.

Every statement within each construct area was first tested and included. Statements were eliminated that caused Cronbach's alpha to be lower if doing so maintained face validity (e.g., only those statements supported by the literature and/or those intuitively less well aligned with other statements were eliminated; others were retained). Analysis of only GM and then only organic surveys were conducted using the same process to find if any striking differences exist between the two food classes.

Health

Within the construct area of health there were 14 statements included in the survey. Including all statements resulted in 95 cases and produced a Cronbach's alpha of 0.6626. The alpha increased by dropping some statements, but not substantially, and there was no apparent justification for removing any one statement.

GM and organic analysis produced very similar results. With all 14 statements there were 44 cases for GM which produced an alpha of 0.5605. Again, there was no reason to

remove any of the statements since the alpha was within the acceptable range. The organic surveys had a higher alpha. With all statements the organic surveys produced an alpha of 0.7302. This was not surprising considering that health benefits are key motivators for the purchasing of organic food. Health benefits were more consistently noted as a perceived benefit of organic foods than GM foods.

Environment

In terms of the construct of the environment, there were originally 8 statements with 121 cases that produced a Cronbach's alpha of 0.5338. Analysis suggested that we remove 2 statements that were production specific (V2 and V7, dealing with pesticides and erosion, respectively). The third statement removed dealt with the environment being managed by humans (V3). After the removal of these three items the alpha rose to 0.8243.

Within the construct of the environment there seemed to be some logical subsets. We looked at general environment impact statements only and the case number rose to 156, which demonstrates that participants do not have an opinion about or knowledge of the effects of specific agronomic practices on the environment, particularly for GM. This lack of knowledge may be what led to the inconsistent responses (increase of alpha with the removal of statements). There was one interesting situation. The removal of V6, which dealt with chemical use, did not change alpha. This suggests that the tone and wording is important to the statements. The statement regarding chemicals, but not that regarding pesticides was retained. The highest alpha set was V4, V5, V8, and V9 which had an alpha of 0.8423. Overall GM analysis produced very similar results. The only difference was that V6 (dealing with chemical use) was also removed. This produced a Cronbach's alpha of 0.8269. The removal of V6 is logical since there is not general acceptance of whether GM production increases or decreases chemical use. In terms of general environment impact statements, GM had an alpha of 0.7827 using the same statements as for the overall surveys but with somewhat lower reliability.

In the organic analysis, all statements included produced an alpha of 0.6016. The best case scenario was the same as when all surveys were considered. Six statements were included, producing an alpha of 0.8311. This included only general environment impact statements.

Risk

Within the risk construct there were 14 statements with 128 cases (participants) providing a response for each. The resulting Cronbach's alpha was .4244. The highest Cronbach's alpha that maintained face validity included 7 statements and 158 cases ($\alpha=.8670$). The statements removed were extremely worded statements like those including phrases such as "no risk" and "completely safe to eat." Statements included in the resulting best set are C1, C2, C4, C6, C7, C10, and C11 (see Table 3).

Analysis of GM and organic surveys produced nearly the same results. The same 7 statements for only the GM surveys resulted in a Cronbach's alpha of 0.8799. The best organic set required also dropping C7, a statement regarding changes in the gene pool. The six items remaining resulted in a Cronbach's alpha of 0.8592.

Since risk is so broadly described in the original 14 statements and consumers pay special attention to consumption risk, we looked only at those statements associated with consumption risk and conducted a complete analysis for all, GM and organic surveys. In all of these cases, the best set included the statements C12 and C13 with strong reliability as measured by Cronbach's alpha.

Ethics

Within the construct of ethics, fifteen statements were in the original survey dealing both with plants and animals. The base case of fifteen statements had 163 cases and produced a Cronbach's alpha of 0.8290. The literature demonstrates that there is more acceptance of GM in plants than in animals and there is also no clear consensus on what a GM or organic animal actually is (Wachenheim and Lesch, 2004; Hallman et al., 2003). Therefore, we also examined two subsets (plants and animals) within this construct.

The statements that involved animals had an original alpha of 0.5449. The alpha increased to 0.7549 when a statement that involved the "quality of life" (E1) was removed (versus the remaining normative statements). Statements involving plants had an alpha of 0.5875. No statements were removed so as to maintain face validity since the resulting Cronbach's alpha was within the appropriate range for a pilot study of this nature.

Similarly, when only GM surveys were considered, there was strong reliability. With all statements, the alpha for GM surveys was 0.8386 which increased to 0.9345 when E1, E6, and E14 were removed. These were the same statements that came up for removal previously. In terms of plants and animals, the statements regarding livestock produced an alpha of 0.8241 without E1 (again, as with all surveys). Plants had an alpha of 0.7787 when the statements E2, E3, and E5 were removed (similar to overall surveys).

Organic only surveys also were very similar to the other groups compared. The base case scenario of all 15 items produced an alpha of 0.8243 which increased to 0.8458 when statements E1 and E14 were removed. Livestock statements had an alpha of 0.6755 and plants had an alpha of 0.7624.

Regulation

Within the construct area of regulation there were originally 10 statements and 112 cases. A high number of "no opinion" responses was seen in this construct area. Given this base case scenario, Cronbach's alpha was 0.3713. Analysis dictated that 6 statements and 125 cases should remain to maximize Cronbach's alpha at 0.7436. However to maintain face validity, removal of statements was limited to R1 and R2. The remaining 8 statements resulted in a Cronbach's alpha of 0.5738 which is still adequate for a pilot study of this nature.

GM and organic analysis produced very similar results. In the area of GM, we started with all 10 statements and 56 cases resulting in an alpha of 0.2503. Maintaining face validity, statements R1, R2, and R10 were removed resulting in an alpha of 0.6164. The reliability of organic survey statements were once again found to be similar. In the base case of 10

statements, Cronbach's alpha was 0.4418. Removal of items R1, R2, and R10 resulted in 7 statements remaining, 60 cases, and an alpha of 0.6820. Organic statement sets were more reliable than their GM counterpart in the regulation construct. Perception of regulation of "organic" is relatively more consistent (regardless of how it is stated) than for GM. In other words, the wording for statements regarding regulation is more important for GM than organic. Once again, the removal of the same statements improved reliability overall and when considering only GM or organic surveys.

DISCUSSION AND IMPLICATIONS

GENERAL ATTITUDES TOWARDS GM AND ORGANIC FOOD PRODUCTS

Organic food is perceived by the student population surveyed to be, in general, a healthier alternative to "regular food," including its effect on appearance and its higher nutrient levels. This supports one of the primary marketing foci used by the organic industry, the purported health benefits associated with organic food. Students surveyed were found to be less critical of GM food than was expected. In general, it is perceived that GM food is less healthy than traditional food. However, the sample population used in this study was generally neutral to the perception of GM food in regard to its effect on health.

Organic food was perceived as environmentally appropriate. For example, organic food production was perceived as reducing pesticide use. Alternatively, some students 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 unexpected and large percentage of students 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 in this study. While students associated a higher level of risk with GM foods than traditional foods, this risk did not appear to affect their personal behavior. Specifically, respondents tended to agree that there were unknowns involved in the GM process which elevate the risk associated with the food. However, given the possibilities (some of which may be altruistic) of GM's potential, students 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 not to the individual), but did not feel personally at risk. Finally, even though perception of risk associated with the two classes of food differed, the differences did not seem to affect respondent beliefs about or perceptions of regulation.

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, Bacon, and Toensmeyer, 1994; Goldman and Clancy, 1991). On the other side of the spectrum is GM food. Few college students in this study 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, supporting existing literature (Wachenheim and Lesch, 2004; Hallman et al., 2003). However, students did not appear to have strong feelings against the use of biotechnology and once again believed that it could be used effectively.

IMPLICATIONS TO STAKEHOLDERS

Many within the food industry marketing channel have an interest in the perceptions of consumers with regard to GM and organic foods. The population 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 overly concerned by changing their present behavior. Long-term effects need to be researched more thoroughly to address these concerns; this will come from additional research. The management of this information to influence consumer perceptions and behaviors will be important for stakeholders from throughout the marketing channel. For example, benefits to consumers should be identified, addressed, and “sold.” In short, consumers’ minds are not made up yet; those who are interested in the future of GM would benefit from giving consumers a favorable reason to accept the technology; whether such is in actual product attributes or simply a result of a well planned and executed marketing strategy.

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 environmentally 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. The industry can also benefit from more effectively utilizing the current health food distribution channel. Consumers are concerned about their health and this study demonstrates that organic food is perceived as a healthy alternative. The current distribution channel can be more effectively used and perhaps expanded.

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 (Land, 1998; Wier and Andersen, 2003; Makatouni, 2002; Huang, 1996; Jolly, 1991; Byrne, Bacon, and

Toensmeyer, 1994; Baker and Crosbie, 1993; Swanson and Lewis, 1993; Sloan 2002). Therefore, GM stakeholders need to stress that GM food uses fewer chemicals 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 is.

Economics and science may not play as key of a role in this debate as would be expected (i.e., we might expect legislation to affect market offerings in addition to economics driven by consumer sovereignty). The high political ramifications will both be a challenge and opportunity for stakeholders. Resources should be extended to increase awareness and provide political education regarding biotechnology. Once again, consumers' minds are far from being made up. Consumer-level benefits should be identified and highlighted throughout all distribution channels.

AREAS FOR FURTHER STUDY

In the present study, there was never any mention of price. The substantial price premium of organic foods is often a main deterrent to consumption. It would certainly be prudent to determine willingness to pay after highlighting the various attributes of organic food. The effectiveness of a dynamic marketing plan on willingness to pay is another fruitful area of research for the industry.

The level of agrarian knowledge of the participants of this study was estimated to be quite high. Even though classes were selected to reflect the diversity of students in the universities, this sample set had higher farm knowledge than the national average. It would be interesting to compare this study with findings from another university either domestically or abroad to see how political or cultural values change perceptions.

The tone and way researchers word statements in this area is critical. The current study was found to contain very reliable constructs. The statements used, therefore, would be a logical cornerstone for further research. A larger sample would provide the ability to predict purchasing and other behaviors from perceptions. For example, willingness to pay and voting intentions could be predicted based on perceptions. The effect of various marketing strategies on perceptions would also provide marketers more direction in their marketing and strategic decision making with regard to organic and GM foods.

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