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NORTH DAKOTA SHOPPER PERCEPTIONS OF GENETICALLY MODIFIED ORGANISMS AND FOOD: RESULTS OF A WINTER 2003 SURVEY

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ABSTRACT

Primary information about awareness and attitudes of North Dakota shoppers toward foods containing ingredients produced from genetically modified (GM) varieties was elicited. A telephone survey resulted in 407 completed questionnaires. Level of awareness of biotechnology was very low, few could define GM, and considerable misattribution was encountered among respondents about the availability of GM foods. Shoppers reported a preference for information about GM content on food labels and also favored disclosures that foods would be GM-free. Level of interest among shoppers for two GM products depended on the product attribute that was emphasized, with the highest propensity to purchase a GM product when it had a health trait not offered by the non-GM product. Shoppers were more accepting of plant-based GM products than those that are animal-based. Degree of shopper approval for GM applications varied. Several applications involving an altruistic element received the strongest support. GM modifications involving cost reductions for fruits/vegetables, or affecting taste or shelf life, averaged approval in the range of 50% of shoppers. GM applications to animals were viewed with substantially more disapproval than those involving plants. Overall, the results compare with those found on a national level, excepting the higher proportion of approval locally evidenced for plants.

KEY WORDS: Biotechnology, Genetic Modification, Consumer Preferences

EXECUTIVE SUMMARY

Primary information on the level of awareness, knowledge, and potential behaviors, of North Dakota shoppers toward foods containing ingredients produced from genetically modified (GM) varieties was sought. Specific goals were to:

- Determine level of awareness and accuracy of GM attributions about GM among shoppers;
- Ascertain shoppers' perceived knowledge of the availability or prevalence of GM-based foods in grocery stores;
- Test shopper acceptance of two hypothetical food products which contained GM ingredients;
- Ascertain general attitudes toward GM processes; and
- Compare North Dakota shopper opinions with those from a national study.

A telephone survey was used. The original questionnaire was subjected to a pilot study of 25 shoppers and subsequently modified. The final questionnaire was administered between November 20 and December 8, 2003. Overall response rate for the statistically representative sample of North Dakota households was 67%. Final sample size was 407, offering a margin of error of +/- 4.9%. The average interview was approximately 16.5 minutes in length.

Adult shoppers of at least age 18 were included in the sampling frame. Participants were predominantly female (67%) and Caucasian (89%). Sixty-two percent were married. Roughly equal numbers reported that their annual household income was below or above $40,000. Forty-one percent reported children in the household under age 18, and the average age of interviewees was 50. Approximately one-half of the respondents in this decidedly agricultural state had grown up on a farm. More than one in ten was an active farmer.

Respondents were queried regarding their awareness of genetically modified organisms (GMO), knowledge of GM-food availability, and about product labeling. Results include:

- *Awareness.* Level of awareness of GMOs assessed through unaided recall was very low. Few could define GM although, when offered a definition, roughly two-thirds properly reported its absence on Nutrifacts labels.
- *Knowledge and Labeling Preference.* Considerable misattribution was encountered among respondents about the availability of GM foods. Thirty-seven percent of shoppers correctly reported the presence of GM-based foods in grocery stores; roughly four in ten were not sure. Shoppers reported a preference for information about GM content on food labels and also favored disclosures that foods would be GM-free.
- *Consideration of Hypothetical GM Improvements*. Level of interest among shoppers for GM pasta and hamburger depended upon the product attribute that was emphasized with the highest propensity to purchase the GM product when it had a health trait not offered by the

non-GM product. Shoppers were more accepting of GM pasta than GM hamburger when the benefit provided by the GM product was the same. This is consistent with the relatively higher level of acceptability of biotechnology in plants than in animals among these shoppers.

- *Attitudes toward GM Processes.* Degree of shopper approval for GM applications varied. Several applications involving an altruistic element (e.g., food for the poor) received the strongest support. GM modifications involving cost reductions for fruits/vegetables or affecting taste or shelf life averaged approval in the range of 50% of shoppers. GM applications to animals were viewed with substantially more disapproval than those involving plants. A strong majority approved of GM applications to plants, but an even larger percentage expressed disapproval of GM applications for animals. These results compare with those found on a national level, except for the higher proportion of approval for plants locally evidenced.

Shoppers responded to a series of more general GM-opinion items relating to knowledge, risk, regulations, and benefits. Most disagreed that they were adequately informed, and concerns about the interplay of science and the regulatory environment were more common than not. This "uncertainty" appeared to be reflected in shopper assessments of GM-associated risks. They were numerically split in their assertions that risks were "acceptable," or "neutrally" disposed, as contrasted with those in "disagreement." The pattern of findings suggests that follow-up studies with these and other data may well reveal segments of more homogeneous shoppers that are comfortable with the degree of perceived risk, and those who are not.

The technical nature of the topic may have played an influential role in where consumers would attribute the highest quality of information about this topic. The USDA and (generally) university scientists received highest "trustworthiness" consideration in the aided listing of a group of institutions and professions. Food manufacturers and public interest groups, as well as the clergy and grocery stores did not emerge as credible sources of information for GM.

NORTH DAKOTA SHOPPER PERCEPTIONS OF GENETICALLY MODIFIED ORGANISMS AND FOOD: RESULTS OF A WINTER 2003 SURVEY

Cheryl J. Wachenheim[1] **and William C. Lesch**[2]

INTRODUCTION

Crop varieties produced using genetic modification were first commercially available in 1996. In 2003, estimated worldwide plantings of crop varieties developed with biotechnology increased at a double-digit pace for the seventh consecutive year (James 2003). Worldwide plantings have also broadened with six principal countries producing 99% of plantings in 2003, as compared to only four such nations in 2002.[3] In 2003, farmers in the United States alone grew 105.7 million acres of biotech soybeans, corn, and cotton.[4]

Farmers continue to rapidly adopt biotech crops because of agronomic, economic, and environmental advantages and as new varieties are developed and become commercialized. As the application of genetic modification in crop varieties grows and expands in scope, participants throughout the marketing channel face new opportunities and challenges associated with development and use of the resulting products. They must evaluate the potential benefits, costs, and associated risks as part of their strategic decision making process. Growers are faced with decisions about whether to grow genetically modified (GM) crops. Biotechnology companies must make investment decisions regarding the research and development of GM technologies, organisms, and products. Commodity distributors must develop or adapt methods of handling to address issues of identity preservation or testing. Food manufacturers must consider use of commodities produced with biotechnology in light of consumer desires and determine labeling and promotion strategies for resultant food products. Consumers have new choices associated with food and other products produced with biotechnology. Participants and stakeholders throughout the food system will benefit from information about consumer knowledge and attitudes about, and acceptance of, biotechnology. Certainly, the free-flow of this information will facilitate decision making and reduce risks associated with the adoption of new biotechnologies.

Acceptance and adoption by users and participants at each step in the marketing channel is paramount to the commercial success of products including GM ingredients or those developed using biotechnology. However, there is little information available specifically about the willingness of consumers to purchase GM food products (Lusk et al. 2001). In part, this is because consumers are not well-informed about biotechnology (Rousu et al. 2002; Roper Starch Worldwide, Inc. 2000), and in part because available market research is limited. Hallman et al.

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[2] Professor of Marketing, University of North Dakota, Grand Forks, (701) 777-2526, william.lesch@und.nodak.edu.
[3] China and South Africa joined the United States, Argentina, and Canada.
[4] Throughout this report the terms biotechnology and genetic modification (GM) are used interchangeably.

(2002) surveyed 1,203 U.S. residents in the spring of 2001, finding Americans to be not well-informed about technologies used in agriculture and the food industry, including biotechnology. Nearly 60% either did not believe or were not sure whether GM products were available in grocery stores. Perhaps in part a result, they did not tend to hold strong beliefs regarding the role of biotechnology in food production. Approximately 60% approved of the use of GM to create new plants and believed biotechnology will improve the quality of their lives and those of others and that unjustified fears about biotechnology have hindered development of beneficial foods. Support of the use of biotechnology among respondents rose considerably when specific products and benefits were mentioned.

A follow-up study was conducted in early 2003 (Hallman et al. 2003). Fifty-two percent of those polled were aware GM food products were available in grocery stores (48% either did not believe or were not sure). This represented an increase in awareness since 2001 when only 41% were aware GM foods were so available. The portion of Americans approving of plant-based GM foods was only 49%, down considerably from the earlier study. The percentage that approved of animal-based GM foods was 27%, essentially unchanged over the two periods.

In the present case, a comparative study was conducted in North Dakota to examine regional (state-wide) shoppers' awareness and knowledge of, and attitudes about, foods containing GM ingredients. This was accomplished through the use of a telephone survey of a statistically representative sample of North Dakota shoppers during late 2003.

The remainder of this report is organized into four basic parts. First, the objectives of the project are presented and then the methods used in the study are outlined. These are followed by overall results and general conclusions.

OBJECTIVES OF THE STUDY

The Young Farmers and Ranchers Committee of the North Dakota Farm Bureau commissioned the project. The purpose was to obtain primary information on the level of awareness, knowledge about, and attitudes and potential behaviors toward, foods containing ingredients produced from GM varieties. Specific goals of the project were to:

- Determine the level of awareness and accuracy of GM attributions about GM among shoppers;
- Ascertain shoppers' perceived knowledge of the availability or prevalence of GM-based foods in grocery stores;
- Test shopper acceptance of two hypothetical food products which contained GM ingredients;
- Ascertain general attitudes toward GM processes; and
- Compare North Dakota shopper opinions with those from a recent national study of a similar nature (adults).

METHODS

Formulation of Research Questions. A literature review focusing on consumer knowledge of, and attitudes about, GM foods was undertaken to identify constructs useful to the study. The aforementioned earlier study by Hallman et al. (2002) proved useful to framing the overall study, offering a comparative sample as well as items with strong face validity. Several draft instruments were prepared and discussed with the sponsor[5] in order to maximize the "fit" between sponsor goals and the information to be gathered. The questionnaire content and initial layout were finalized in early November 2003.

Data Collection Methods. A range of research methods was considered for the project (including in-depth interviews, mall intercepts, focus groups, mail and telephone surveys) before deciding upon the use of a telephone survey. The advantages to gathering information in this manner were clear in that it offers a generally high response rate at low-to-modest cost, while providing for generalization of findings to the overall target group of interest. It also offers the opportunity for flexibility in responses that are not found in mail surveys and is an expeditious data collection technique when comparatively large numbers of consumers are involved.

The questionnaire was reviewed by the Director and staff of the Social Science Research Institute (SSRI) at the University of North Dakota, and minor changes were made to improve wording and respondent flow from item-to-item. The instrument was then subjected to a pilot study of approximately 25 shoppers in order to detect any final problems before going into full data collection effort. Data for the main design were collected between November 20 and December 8, 2003. Overall response rate for the statistically representative sample of North Dakota households was approximately 67%, most acceptable for a study of this type. Final sample size was 407, offering a margin of error of approximately +/- 4.9%. Appendix A contains the final instrument used in the study, and Appendix B contains the technical report on sampling methods. The average telephone interview was approximately sixteen and one-half minutes and no unusual interviewer problems were reported.[6]

Respondent Profile. Adult shoppers of at least age 18 were included in the sampling frame. The final pool of respondents was predominantly female (67%) and mostly Caucasian (89%). Most persons were married (62%), with roughly equal numbers reporting that their annual household income was below (47%) or above $40,000, although 27.5% reported an income of $20,000 or less. Forty-one percent reported children in the household under age 18, and the average age of interviewees was 50.

North Dakota is a decidedly agricultural state. It was not surprising that roughly one-half of those participating in the survey had grown up on a farm and that more than one in ten were active farmers. Approximately one-in-five of the shoppers interviewed (n = 73) reported their occupation as "retired." Additional occupations included teacher (24), housewife (21), student (16), nurse (14), salesperson (12), secretary (11), accountant (9), and cook (7) among others.

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[5] Mr. Jeff Missling of the North Dakota Farm Bureau.

[6] The authors express their appreciation to Mr. Cordell Fontaine, Director, Social Science Research Institute, and staff, for carrying out the data collection.

RESULTS

This section reports the major findings from the study in order of the objectives listed above.

Objective 1: Determine the level of awareness of GM foods and its accuracy among shoppers

The study commenced with the assumption that few shoppers would be very knowledgeable about the nature of GMOs, an outcome identified in previous research. Accordingly, two approaches were used to examine the level of shopper awareness concerning food products containing GM ingredients. First, an "unaided" query was employed to ascertain level of awareness through product labeling. Subsequently, shoppers were asked to define a GMO. Only after existing knowledge levels had been assessed was a working definition of GM offered. This two-step approach allowed the researchers to assess top-of-mind awareness and initial understanding and then obtain responses using a frame of reference that was common to all, since it was imposed by the researchers. [See Appendix A to follow question flow.]

The unaided inquiry asked shoppers whether or not GMOs could be found on the Nutrifacts label required on packaged goods. As shown in Table 1, nearly all respondents could properly assert the presence of information on sodium and fat and, to a much lesser extent, cholesterol and iron. When asked whether GM ingredients were listed on the food product label, 64% indicated they did not know what GMOs were. Of the remaining respondents (36%), 7% reported that GMO content could be found on a label, 19% reported it was not on the label (correctly so), and about 10% were not sure.

Subsequent probes among those 20 persons who *asserted a working knowledge of GMOs* revealed that 17 could provide a reasonable definition of the acronym. Those definitions included no negative connotations, and many referenced the process as involving changes, modifications, or alterations. These findings support the general hypothesis of the researchers that few shoppers are generally aware of, or knowledgeable about, the meaning of GMO.

It is important to point out that previous research suggests that impressions differ depending on the word(s) used to describe the technology. For example, Hallman et al. (2003) found that the term genetic modification evoked the largest percentage of negative top-of-mind thoughts among Americans. Biotechnology evoked more thoughts related to science and also the most positive images. Finally, they found that the term genetic engineering was most often associated with cloning.

Table 1. Shopper Response to Question: Is Ingredient Listed on Food Product Label?

Ingredient	Yes	No	Unsure
Sodium	90.9	2.0	7.1
Fat	92.6	1.2	6.1
Cholesterol	63.1	20.1	16.7
Iron	57.9	20.6	22.1
GMO*	6.9	19.0	9.9

*When asked if GMOs were listed on food product labels, 64% said they did not know what GMOs are.

Following this process, a definition of GMO was read to all respondents, as below:

"GMO stands for genetically modified organism. It 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 similar, and it takes time. The genetic modification process moves genetic material from one organism to another such as from bacteria to plants or between dissimilar plants or animals. It produces plants or animals with desired characteristics faster than traditional cross breeding."[7]

Having aided the respondents by providing the definition, the interviewer asked again if GMOs were to be found on food labels. Approximately 14% of respondents now indicated that GMO content was on a label (roughly twice the unaided number), while the number responding that such content was not on a label grew three-fold, to 61%. The percentage of persons indicating uncertainty declined to one-quarter of those polled.

[7] This definition was developed after query of a number of North Dakota State University researchers. It was surprising to find that there was not widespread agreement among even scientists about the appropriate definition. Hallman et al. (2003) offered the following definition: "Genetic modification involves new methods that make it possible for scientists to create new plants and animals by taking parts of the genes of one plant or animal and inserting them into the cells of another plant or animal. This is sometimes called genetic engineering or biotechnology." Those researchers offered the definition **prior** to asking participants how much they knew about GM and their attitudes of such. See http://scope.educ.washington.edu/gmfood/position/ (accessed 12 March 2004), for a number of definitions offered by scientists and others from throughout the world.

Summary of Shopper Awareness of GMOs. These results suggest that the level of awareness of GMOs assessed through unaided recall is very low. And, accurate respondent attribution of GM was almost non-existent among shoppers in this sample. However, when offered a definition of GMO, 61% properly reported their absence on Nutrifacts labels, while one quarter were not sure. Yet, 14% of shoppers still inaccurately reported that GMO content could be found on a food label. In stark comparison, the majority of consumers accurately reported on label content for other nutrients including sodium, fat, cholesterol, and iron. Thus, on both an absolute and comparative basis, awareness of GMOs was very low.

Objective 2: Ascertain shoppers' perceived knowledge of the availability or prevalence of GM-based foods in grocery stores

Respondents were asked a series of questions to obtain both closed- and open-ended responses regarding knowledge of the availability of foods with GM ingredients in everyday groceries and ascertain their thoughts about product labeling.

As a screener question, shoppers were asked whether GM food products were available in grocery stores. Thirty-seven percent responded affirmatively, 22% responded that they were not, and 41% were unsure. North Dakota shoppers are less aware of the prevalence of GM foods than their national counterparts. Hallman et al. (2003) reported that 52% of adults nationwide reported that such foods could be obtained in grocery stores. Nationwide, a lower percentage of respondents were unsure (23%).

If the respondent indicated that GMO foods **were available**, (s)he was asked (without assistance or prompting from the interviewer), to reveal which daily food products, if any, had been genetically modified. Nearly one-quarter (n = 92) of respondents were so inclined and their responses were categorized by the researchers into general groups (most frequent mentions). Meat received the most number of references (nearly four in ten), followed by various vegetables and corn (Table 2). Wheat and various wheat products were mentioned by 21% of respondents, similar to other grains but more often than fruits, and certainly more often than soy. It is interesting to note that soybeans, the commodity for which GM varieties comprise the largest percentage of all plantings in the United States, was among the least-mentioned by consumers in this unaided exercise.

Subsequently, this same group of shoppers was asked their opinions concerning *specific* grocery store items in an aided format. Table 3 contains the overall results from these shoppers.

These data suggest that goods which *are not likely* to contain a GM process (hamburger, potatoes, sugar, and edible beans) may not be perceived dramatically different from those which *are likely* to be so comprised. Corn oil is likely to be derived in part from corn that includes GM processes (e.g., Bt corn). While the greatest percentage of respondents correctly asserted corn oil is likely to be GM-based, very large numbers also attributed GM processes to those which are decidedly GM-free. This lack of differentiation in consumer thinking should not be surprising given the relatively low levels of awareness for the GM concept, but represents consumer assertions that at this time are simply incorrect.

Table 2. Top Responses to Query "Of the Many Different Food Products You Eat Daily, Which, if Any, May Have Been GM or Contain GM Ingredients?" (n = 92)

Product Category	Percentage (number of responses)*
Meat (beef)	38% (35)
Vegetables	27% (25)
Corn	25% (23)
Wheat, wheat products	21% (19)
Grains	17% (16)
Fruit	15% (14)
Soy, soy products	6% (6)

*Sum of percentages exceeds 100 because multiple responses were allowed (and encouraged by question wording).

Table 3. Shopper Response to Aided Query "Which are GM or Contain GMOs?"

Product	Yes	No	Unsure
Corn Oil	62.8	15.5	21.6
Bread	58.1	23.0	18.9
Hamburger	56.8	20.9	22.3
Beans	50.0	25.7	24.3
Potatoes	41.9	33.8	24.3
Sugar	31.8	42.6	25.7

Similar results to those presented in Table 2 were obtained when respondents were further asked to reveal which food products they thought to be *most likely* to contain GMOs, if any. The same overall ranking (as above) is preserved, as was the rough proportionality of mention (Figure 1). One hundred sixty-nine shoppers responded.

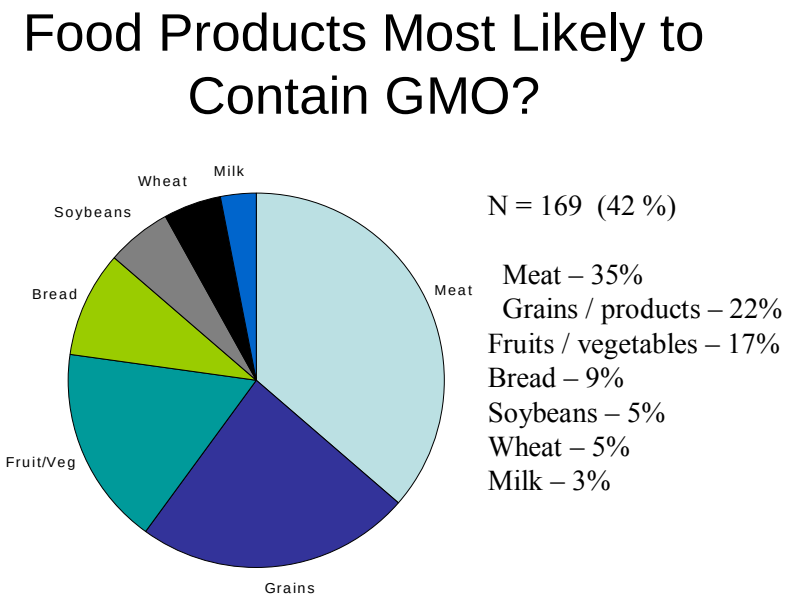

Figure 1. Food Products Considered Most Likely to Contain GM Ingredients

Continuing this line of inquiry, food products reportedly least likely to include GM ingredients were also explored. While the same basic food entries are noted, fruits and vegetables led the list (Figure 2).

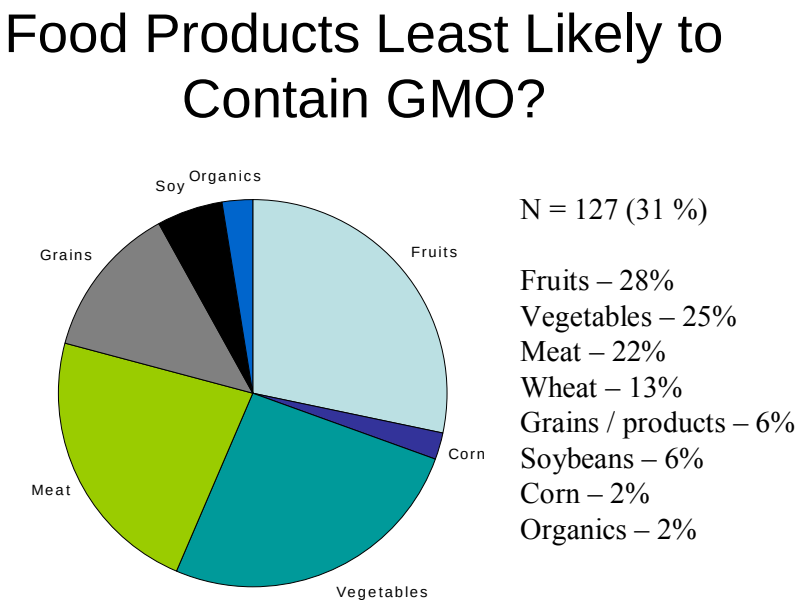

Figure 2. Food Products Considered Least Likely to Contain GM Ingredients

Labeling. Shoppers were also queried about their thoughts on product labeling. They were asked whether labels should include information about product contents if they include GM ingredients. More than eight-in-ten of those shoppers polled (83%) responded affirmatively, while only 7% answered "no"; the remainder expressed "no opinion." These findings are similar to those of Hallman, et al. (2002) wherein 90% responded yes (94% in 2003) and 9% responded no. Although most shoppers in the present and other studies indicate a preference for labeling of GM food ingredients, this information would not necessarily be used or affect the purchasing decision. For example, Hallman, et al. (2003) reported that 30% of respondents reported reading food labels only "sometimes" and 17% of those in their sample indicated doing so "rarely" or "never." Furthermore, when Hallman and colleagues asked how the GM food label would affect their food purchase decisions, 38% said it would make no difference. More than one-half (52%) indicated that it would make them less willing to purchase the product. Readers should recognize that there is often a "gap" between consumers' intended or reported behavior, and how they actually behave.

In the current survey, the investigators also asked North Dakota shoppers whether labels should indicate if the ingredients are GM-free. Three-quarters (74%) responded yes, 15% said no, and the remainder had no opinion.

Summary of Shoppers' Knowledge of GM-Food Availability and Product Labeling. When asked generally about the prevalence of GM-based foods in grocery stores, about one-third of shoppers report their presence and roughly four-in-ten are not sure. Considerable misattribution was encountered among respondents believing in the availability of GM foods. When asked about specific foods, a strong plurality of this sample subset expressed the belief that commonly used foods contained GM elements; when in fact, they likely did not. Approximately two-thirds of those in this group did properly attribute corn oil to involve GM processes. Between approximately one-fifth and one-quarter of respondents expressed uncertainty as to whether reference goods involved a GM ingredient.

Clearly, shoppers in North Dakota do not have a complete understanding of the prevalence of GM-based foods, and a large number may be relying upon beliefs which are not consistent with existing market practices.

Shoppers reported a preference for information about GM content on food labels and also favored disclosures that foods would be GM-free. The comparatively low-level of understanding of GM processes among shoppers may or may not contribute to their preference for GM labeling.

Objective 3: Test shopper acceptance of two hypothetical food products which contained GM commodities

An additional theme investigated in this study included the level of consumer acceptance of either of two hypothetical food products. At this stage in the interview, all shoppers were randomly exposed to one of two hypothetical food products for consideration of purchase, as compared with a current standard. The hypothetical good was described as having been genetically modified to offer additional benefits beyond those found in the normal product. Consumers were asked to consider each GM-induced benefit individually, not as an overall

package. This portion of the study affords an initial opportunity to investigate potential behavior of the shoppers were these products to be introduced. It should again be emphasized, however, that what shoppers say they will do, and what they indeed do, are often at odds.

Table 4 contains summary results of shopper reactions to hypothetically available, GM-based ground beef. A variety of product qualities were examined, including texture, color, flavor, protein level, omega compounds, shelf life, and improvements to vitamin and mineral levels. The average scores (means) are presented, along with insights into the overall distribution of responses. The latter are presented as the percentage of respondents who could be described as "more willing," "neutral," and "less willing."

Table 4. Willingness to Purchase Hypothetical GM Hamburger with Particular Attributes

Attribute	Average*	More Willing	Neutral	Less Willing
Additional omega compounds	2.48	65.7	6.1	28.2
Added vitamins and minerals	2.73	55.5	12.1	32.4
Higher protein level	2.75	57.4	8.3	34.2
Better flavor	2.95	50.8	8.7	40.5
Extended shelf life	3.28	30.0	21.3	48.6
Improved texture	3.40	23.7	23.7	52.6
More attractive color	3.46	24.8	21.5	53.7

* 1=much more willing, 2=more willing, 3=indifferent, 4=less willing, 5=much less willing

Ground beef attributes that were more favorably considered in the hypothetical GM case included additional omega compounds, added vitamins and minerals, and higher protein level. A majority of shoppers were more willing to purchase GM hamburger with these individual attributes at the same cost as conventional hamburger, the latter not containing the attributes.

Improvements to flavor, extended shelf life, improved texture, and more attractive color met with somewhat to considerably less interest by this group of shoppers. Of the latter group, only flavor improvements elicited a greater willingness to purchase by a majority of shoppers. Conversely, texture and color enhancements would reportedly result in a comparatively lower willingness to purchase by a majority of respondents. This scenario seems to support investigation of health benefits in GM-based improvements to ground beef and the comparatively stronger promotional value of certain attributes.

Shown in Table 5 are respondent reactions to the hypothetical GM-based pasta product. On an absolute basis, improving levels of vitamins and minerals was clearly desirable in this good. Seventy-eight percent of shoppers were willing to pay more for GM pasta with added vitamins and minerals. Flavor improvements, and to a lesser extent the inclusion of zinc, also scored strongly, viewed as positive considerations for purchase by more than half of shoppers. Conversely, extended shelf life, improved texture, and more attractive color were not so highly sought. Notably, only for the attribute more attractive color, would one-half of respondents be less willing to purchase the pasta that included GM ingredients.

Table 5. Willingness to Purchase Hypothetical GM Pasta Noodles with Particular Attributes

Attribute	Average*	More Willing	Neutral	Less Willing
Added vitamins & minerals	2.16	78.0	6.9	15.2
Better flavor	2.57	59.0	14.6	26.4
Zinc to prevent colds	2.79	52.6	11.1	26.2
Extended shelf life	2.96	41.4	22.2	36.4
Improved texture	3.20	32.1	23.3	44.6
More attractive color	3.41	19.4	29.9	50.7

*1=much more willing, 2=more willing, 3=indifferent, 4=less willing, 5=much less willing

Summary of Hypothetical GM Improvements to Ground Beef and Pasta. Health qualities appear to offer some degree of leverage in the introduction of both of these hypothetical GM products. A majority of consumers would be more willing to purchase the GM product as compared with the standard whether it is hamburger or pasta. This was particularly true for the pasta product with added vitamins and minerals. Shoppers were apparently more accepting of GM pasta (including plant ingredients) than GM hamburger (an animal product) on a comparable basis (e.g., added vitamins and minerals). (This is also consistent with later-reported findings about the relative acceptability of biotechnology in plants and animals among these shoppers.) Differences observed in shoppers' willingness to buy a GM product that is plant- versus animal-based underscore the importance of scrutinizing the consumer decision process and how it can differ from product to product. If GM-based varietals are considered, these data underscore the necessity of carefully planned and executed consumer research.

Considerable interest in GM products, as measured by relative willingness to purchase, was evidenced among the North Dakota shopper sample. The level of interest depended upon the product attribute that was emphasized, however, with the highest propensity to purchase associated with health traits. The responses also suggest that consumers seek different benefits from the two products and are more accepting of biotechnology-based improvements in a plant-

based product. Overall, these data suggest that, at least in this test setting, consumer interest for select GM traits in these foods was moderate to strong.

Objective 4: Ascertain shoppers' general attitudes toward GM processes

General shopper attitudes toward GM procedures and the circumstances involving their use were examined in a series of short-answer questions, responses to which are displayed in Table 6. Shoppers were specifically asked "Based on what you know, do you approve, disapprove, or are you undecided about scientists using genetic modification methods to develop…"

Table 6. Approval of GM Foods

	Percentage Responding		
Attribute	Approve	Disapprove	Undecided
More nutritious grain to help poor countries	72.0	14.1	13.9
Hormones to help diabetics	64.8	17.4	17.9
Wheat with vitamin A to prevent blindness	63.3	17.4	19.4
Less expensive fruits and vegetables	53.6	30.3	16.1
Better tasting fruits and vegetables	50.9	29.8	19.4
Longer shelf life of fruits and vegetables	47.9	35.0	17.1
Hormones for cows to produce low cholesterol beef	44.9	32.5	22.6

In order of approval, those health benefits addressing assistance to "poor countries," diabetics, and the prevention of blindness, ranked most strongly. They were approved by roughly two-thirds or more of respondents. Lower-cost fruits and vegetables, their extended shelf life, and improved taste found approval among approximately half of shoppers in the survey. Least-approved was the use of hormones for cows in the production of low cholesterol beef .

Similarly, approximately one-third of persons in the survey expressed disapproval of the use of GM methods in order to improve the shelf life, reduce the cost, or improve the taste of fruits and vegetables. The number of objections was about the same in the case of the use of hormones to produce low cholesterol beef.

In all cases, the number of shoppers reporting as "undecided" ranged from roughly 15% to 20%.

Approval of GM Processes: Plants and Animals. Two additional questions were used to obtain an overall opinion on the use of GM processes for plants and for animals. As shown in Figure 3, shoppers were considerably more favorably disposed to the use of GM processes involving plants than animals. Two-thirds of those polled "approved" or "strongly approved" of *plants* created using GM; one-third "somewhat" or "strongly disapproved." This compares with 49% (approve or strongly approve) and 39% (somewhat or strongly disapprove) of American adults surveyed by Hallman et al. (2003) (Figure 4).

In the current regional study, only 28% "approved" or "strongly approved" of *animals* created using GM; 72% "disapproved" or "strongly disapproved." This compares respectively with 27% and 66% among adults in the Hallman et al. (2003) study. North Dakota shoppers tended to be more approving than Americans in general regarding GM plants. However, in the case of biotechnological applications to animals, the numbers were similar in both samples. One difference between the studies is that North Dakota shoppers were asked about plants or animals created using GM, while Hallman et al. (2003) used the terms "plant-based GM foods" and "animal-based GM foods."[8]

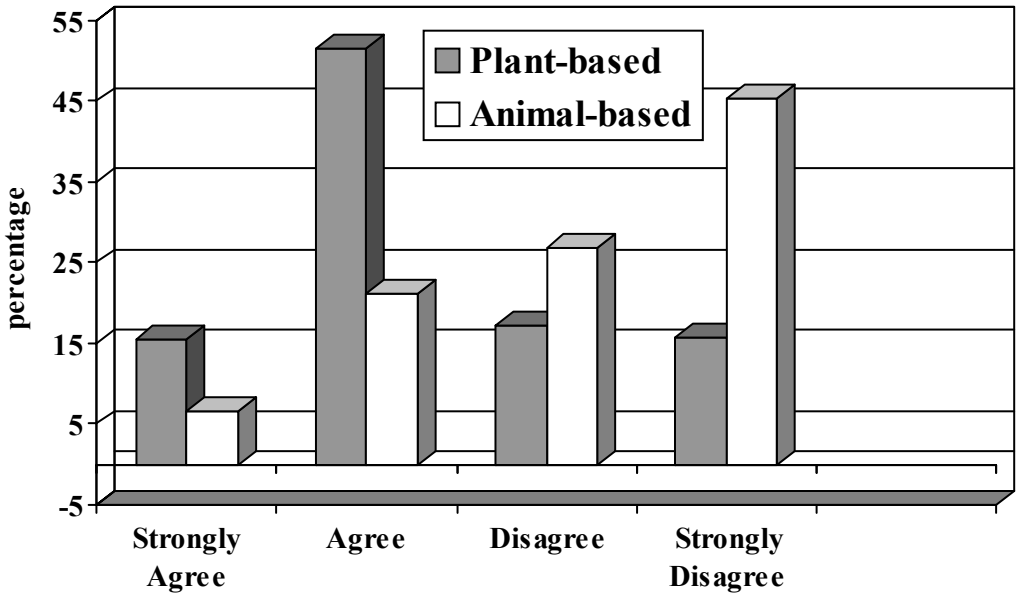

Figure 3. Percentatge Approval of GM Foods (current study)

[8] Sources of differences can arise from any number of factors. For example, recall that the introduction of and specific definitions for GM differed in the two studies. And, while the regional sample included shoppers, the national sample included non-shoppers. These results appear more to converge on the general issue of GM treatment in that the directions and proportion are quite similar.

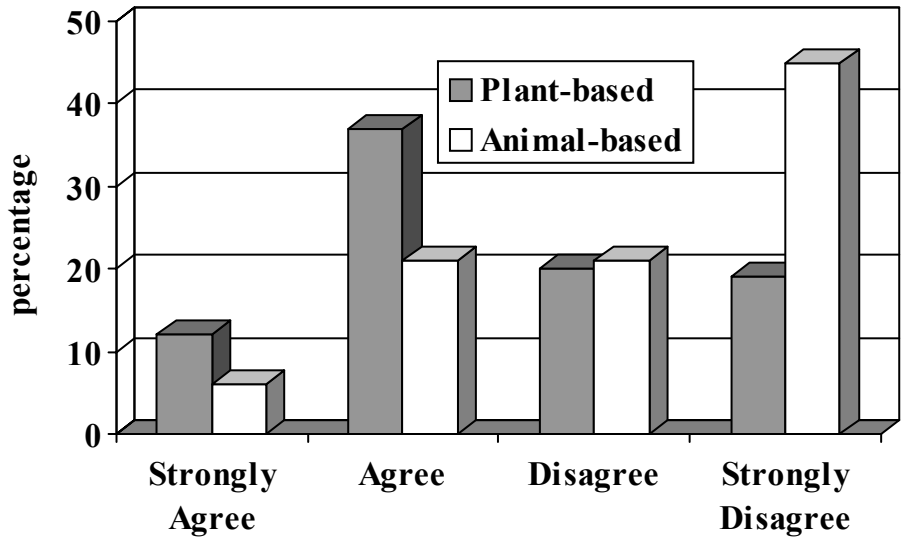

Figure 4. Percentage Approval of GM Foods (Hallman et al. 2003)

Select Opinions on Aspects of GM Processes. This section of the instrument inquired into four aspects of shoppers' opinions about GM processes. These included their perceived adequacy of understanding of biotechnology and dimensions of regulation and the benefits as well as risks to consumers. The summary statistics are found in Table 7.

Shoppers disagreed that they were adequately informed about biotechnology, concurring with Hallman et al. (2002, 2003) In the current study, 63% disagreed they were adequately informed. On the regulatory dimension, shoppers tended to disagree that scientists "know what they are doing so only moderate regulations are necessary," and that "government regulators have the best interest of the public in mind." For the former, 63% disagreed while only 19.5% agreed. For the latter, some 56% disagreed while 27% agreed. Shoppers were more evenly split with respect to the statement asserting that the "government does not have the proper tools to regulate GM foods," although more agreed (46%) than disagreed (33.5%).

Nearly half agreed that "unjustified fears have seriously blocked development of GM foods" (48%) and that "GM foods will benefit many people" (48%). Shoppers also agreed that companies involved in creating GM crops were more concerned about profits than safety (61%).

On the side of risks, 42% of those polled agreed that those (risks) "…associated with GM have been greatly exaggerated." Nearly as many shoppers indicated that they were "willing to serve GM foods to their family" (38%). Twenty-one percent agreed with the assertion that "GM food presents no danger to future generations" and 25% agreed that the "risks involved in GM foods are acceptable."

Table 7. Level of Agreement with Statements

Statement	Average*	Agree	Neutral	Disagree
INFORMED				
I am adequately informed about biotechnology	3.69	22.2	15.0	62.7
REGULATION				
Scientists know what they are doing so only moderate regulations on GM are necessary	3.71	19.5	17.9	62.6
Government regulators have best interests of public in mind	3.52	26.8	17.4	55.7
Government does not have tools to properly regulate GM foods	2.78	45.8	20.8	33.5
BENEFITS				
GM food will benefit many people	2.65	48.4	29.0	22.6
Unjustified fears about GM have seriously blocked development of beneficial foods	2.57	47.6	32.5	19.8
Companies involved in creating GM crops believe profits more important than safety	2.41	61.1	17.5	21.3
RISKS				
GM food presents no danger for future generations	3.51	20.7	28.0	51.2
Risks involved in GM foods are acceptable	3.39	24.7	27.6	47.7
Willing to serve GM foods to my family	3.11	38.2	22.3	39.5
Risks of GM have been greatly exaggerated	2.72	41.9	34.2	23.9

* 1=strongly agree, 2=agree, 3=neutral, 4=somewhat disagree, 5=strongly disagree

Summary of General Attitudes toward GM Processes. The degree of shopper approval for GM applications clearly varied. Several applications involving an altruistic element (food for the poor, medical benefits) received the strongest support. GM modifications involving cost reductions for fruits/vegetables, or affecting taste or shelf life, averaged approval in the range of 50% of shoppers polled. Least desirable from the respondents' point of view was an application involving bovine attributes for production of low cholesterol beef.

In general, this study found that GM applications to animals were viewed with substantially more disapproval than those involving plants. While a strong majority of shoppers in this regional study approved of GM applications to plants, an even greater proportion expressed disapproval of GM applications in the animal environs. These findings are somewhat similar to those found on a national level, except for the higher proportion of approval locally evidenced for plants.

Responding to a series of more general opinion items relating to perceptions of knowledge, concerns regarding risk, regulations, and benefits, provides additional insights into what shoppers "bring" to the discussion of GM. Most disagreed that they were adequately informed, and concerns about the interplay of science and the regulatory environment were more common than not. Perhaps this "uncertainty" is also reflected in the overall assessments of GM-associated risks. Shoppers were numerically split in their assertions that risks were "acceptable," or "neutrally" disposed, as contrasted with those in "disagreement." The pattern of findings suggests that follow-up studies with these and other data may well reveal *segments* of more homogeneous shoppers that are comfortable with the degree of perceived risk and those who are not.

Following the elicitation of general opinions toward GM, respondents were asked to rate the "trustworthiness" of a range of possible sources of information on GM. These data are summarized in Table 8.

The USDA and university scientists ranked highest as overall choices for information, with the former receiving the strongest number of attributions as a "first choice." This should not be surprising given that the subject matter is a technical one by definition. Similarly, non-technical institutions did not emerge as favorably as sources for insight and, in the case of food manufacturers as well as public interest groups, low trustworthiness was reflected in both few "first" or "second" attributions and highest numbers of "least" credible associations.

Table 8. Information Sources Trusted Most, Second Most, and Least in Providing Information about GM Foods

Information Source	Percentage			
	Most	Second Most	First or Second Most	Least
United States Department of Agriculture	43.3	29.1	72.4	15.4
University scientists	24.3	27.1	51.4	4.1
Farmers / ranchers	14.5	16.1	30.6	4.1
Friends or family members	9.2	10.8	20.0	6.2
Public interest groups	3.7	4.4	8.1	21.4
Food manufacturers	1.3	4.7	6.0	23.8
Clergy	2.9	5.3	8.2	12.2
Grocery stores	0.8	2.5	3.3	12.7

The technical nature of the topic may have played an influential role in where consumers would attribute the highest quality of information about this topic. The USDA and (generally) university scientists received highest "trustworthiness" consideration in the aided listing of a group of institutions and professions. Food manufacturers and public interest groups, as well as the clergy and grocery stores, did not emerge as credible sources of information for GM.

GENERAL CONCLUSIONS

The purpose of this study was to examine regional shopper awareness of GM processes, knowledge of the availability of GM foods, acceptability of two new and hypothetical GM products, and ascertain overall attitudes toward GM procedures and outcomes. Findings from this study are now summarized and suggestions for still further inquiry are discussed.

Shopper awareness of GM as evidenced in this study was very low. This is consistent with other national studies of adults. Nearly all shoppers could not properly define GM. However, when respondents were informed of the nature of GM, most could properly attribute their absence as a required feature of Nutrifacts labeling. Similarly, most shoppers in this regional study would prefer labeling of GM content, and a strong majority favored labeling to disclose the absence of GM ingredients.

Respondents in this study were split with respect to knowledge about the availability of GM-related foodstuffs in contemporary grocery items. Less than one-half of the sample reported knowing that foods including GM were available for sale. Among this subset, most respondents improperly attributed the GM-product mix, i.e., GM availability as perceived by shoppers went far beyond the range of goods in which they are actually available, and included both plant- and animal-based foods.

Possible new and improved GM food products were tested in hypothetical scenarios to ascertain shoppers' willingness to buy as compared with today's available, non-GM counterparts. Overall willingness to buy either an enhanced ground beef or pasta product depended upon the individual quality or benefit to be afforded to the customer. And, the importance of the same qualities in both scenarios, differed, by product. Specific product-market consumer research needs to be undertaken to further examine what *mix* of attributes might lead to an optimal GM-product, but these initial data suggest that some consumers would be willing to purchase GM-modified products. Overall interest was higher for the pasta product than for the beef product.

Plant modifications emerged as more acceptable to shoppers than those applied to animals, in specific and overall shopper opinions. Reasons for this were not explored in detail in this study, but the results parallel those on the national level. Similarly, shoppers did not uniformly agree that the scientific or governmental communities had balanced the interests of science with those of regulators. Shopper opinions regarding safety of GM and their willingness to serve GM-based food products also varied. It is likely to be worthwhile to further examine and compare/contrast shoppers inclined to purchase and use GM-based foods with those who would not and develop further understandings of the attitudinal factors that may contribute to their views.

Such studies could inform both promotional campaigns intended to further educate shoppers of the benefits of GM foods and be useful to focusing market development efforts.

LITERATURE CITED

Hallman, W.K., A.O. Adelaja, B.J Schilling, and J.T. Lang. 2002. "Public Perceptions of Genetically Modified Foods: Americans Know Not What They Eat." Food Policy Institute Publication Number PR-0302-001. Rutgers, The State University of New Jersey, New Brunswick, March.

Hallman, W., W. Hebden, H. Aquino, C. Cuite, and J. Lang. 2003. "Public Perceptions of Genetically Modified Foods: A National Study of American Knowledge and Opinion." Food Policy Institute, Rutgers, The State University of New Jersey, New Brunswick, October, 32 pp.

James, Clive. 2003. "Preview: Global Status of Commercialized Transgenic Crops: 2003." International Service for the Acquisition of Agri-biotech Applications, Briefs No. 30. ISAAA: Ithaca, NY.

Lusk, J.L., M.S. Danield, D.R. Mark, and C.L. Lusk. 2001. "Alternative Calibration and Auction Institutions for Predicting Consumer Willingness to Pay for Nongenetically Modified Corn Chips." *Journal of Agricultural and Resource Economics* 26(July):40-57.

Roper Starch Worldwide, Inc. 2000. "Consumer and Farmer Opinions about Food and Agriculture." Philip Morris Management Co., January.

Rousu, M., W.E. Huffman, J.F. Shogren, and A. Tegene. 2002. "The Value of Verifiable Information in a Controversial Market: Evidence from Lab Auctions of Genetically Modified Foods." Staff Working Paper #3, Iowa State University, Department of Economics, Ames, February.

APPENDIX A – SURVEY INSTRUMENT

INTERVIEWER GREETING

1. When you do your grocery shopping, how many people do you shop for?

2. Many of today's foods contain labels indicating their nutrients and ingredients. I am going to read you a list of these and I would like you to tell me which, if any, is shown on the label. If you are not sure about any of these, it's OK to tell me that as well. The first ingredient is _____. Is it listed on food labels?

[sodium, fat, cholesterol, iron, GMOs]

[IF RESPONDENT INQUIRES ABOUT DEFINITION OF GMO, SKIP TO QUESTION 4 BELOW]

3. OK. Among those terms I mentioned was **GMO**. GMO is a three-letter abbreviation for another word. Could you tell me what it stands for? _____.

a. YES (unaided – record open-ended response) _____.

Now, can you please define to the best of your ability what it means for a food product or ingredient to be genetically modified? _____

4. Here is a description used by food scientists. **GMO** stands for *genetically modified organism*. It 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 be similar, and it takes time. The genetic modification process moves genetic material from one organism to another, bacteria to plants or between dissimilar plants or animals. It produces plants with desired characteristics faster than traditional cross breeding.

a. Now after hearing the description of GMOs, can you please tell me whether you think that they are shown on food nutrition labels?

Sometimes the process of genetic modification is called **bio-engineering** or **genetic engineering.**

b. Are either of **those** terms, bio-engineering or genetic engineering, familiar to you?"

5. As far as you know, are there any food products available in grocery stores that are genetically modified or include ingredients produced through genetic modification? [if no or unsure, skip to question 8].

6. Of the many different food products you eat daily, please tell me which, if any, that you think may have been genetically modified, or contain genetically modified food ingredients.

7. I will read you a list of grocery store food products and I'd like you to tell me which, if any, is genetically modified or contain GMOs. Again, tell me yes, no, or, you're just not sure. [Order of offer randomized.]

[hamburger, potatoes, sugar, bread, corn oil, beans]

NOW I HAVE A FEW QUESTIONS ABOUT LABELING AND CONTENT OF FOOD PRODUCTS

8. Do you think that food labels should include information about the contents if they include GMOs?

9. Similarly, if the contents do NOT contain GMOs, should the label say that the contents are GMO-free?

10. Is there a food product that you think is most likely to contain GMOs? What is this product?

11. Is there a food product that you think is least likely to contain GMOs? What is this product?

INTERVIEWER WILL ASK ONLY PART A OR PART B OF QUESTION 12. RANDOMIZE THE STEMS ON EACH OF THE STATEMENTS TO ELIMINATE ORDER EFFECTS. ROTATE THROUGH A, OR B, WITH EACH RESPONDENT. THE BENEFITS ARE READ IN A RANDOMIZED ORDER TO ELIMINATE ORDER EFFECT

12. NOW I'D LIKE TO PRESENT YOU WITH A PURELY HYPOTHETICAL CASE.

PART A. Please compare two packages of pasta noodles made from wheat. One product contains wheat that has been genetically modified to add a benefit not found in the other. Tell me if you would be much more willing, more willing, less willing, or much less willing to buy the product including genetically modified wheat for each of the benefits I list. If you would be indifferent, please indicate that as well. Think about only one benefit at a time. That is, other than the feature mentioned, consider the products identical, including the cost. Ready?

The wheat was genetically modified so the pasta has different characteristics than the regular pasta. How willing would you be to buy this product if it had been modified…..

to improve texture or feel in your mouth; have a more attractive color; have a better flavor; contain added vitamins and minerals for better nutrition; have an extended shelf life; contain added zinc to prevent the common cold

[much more willing, more willing, indifferent, less willing, much less willing]

PART B. Please compare two packages of ground beef found in the grocery refrigerator case. One is regular ground beef, and the other comes from animals that have been genetically modified to produce the benefits listed below. Tell me if you would be much more willing, more willing, less willing, or much less willing to buy the product including genetically modified ground beef for each of the benefits I list. If you would be indifferent, please indicate that as well. Think about only one benefit at a time. That is, other than the feature mentioned, consider the products identical. And, I want you to assume that the cost is the same for both. Ready?

The beef was genetically modified so the beef has different characteristics than regular ground beef. How willing would you be to buy this product if it had been modified….

to improve texture or feel in your mouth; have a more attractive color; have a better flavor; have a higher protein level for nutrition; contain additional omega compounds to lower cholesterol to prevent heart disease; have an extended shelf life; contain added vitamins and minerals for better nutrition.

GREAT. I DO HAVE A FEW ITEMS ON YOUR GENERAL ATTITUDES TOWARD GENETIC MODIFICATION. I'LL FIRST READ A STATEMENT AND THEN GET YOUR LEVEL OF APPROVAL TOWARD IT.

13. In general, how do you feel about **plants** created using genetic modification? Would you say that you… [strongly approve, somewhat approve, somewhat disapprove, strongly disapprove, have no opinion]

14. In general, how do you feel about **animals** created using genetic modification? Would you say that you…

15. I'm going to read you a list of statements. Based on what you know, I'd like you to tell me if you approve, disapprove, or are undecided about scientists using genetic modification methods to develop… [RANDOMIZE ORDER OF APPEARANCE]

better tasting fruits and vegetables; fruits and vegetables with a longer shelf life; fruits and vegetables that are less expensive; hormones like insulin that help people with diabetes; more nutritious grain that could feed people in poor countries; hormones that enable cows to produce beef with less cholesterol; wheat with enhanced vitamin A to prevent blindness

16. OK. I have a list of statements. I will read each and ask you to identify your level of agreement with the statement using a five point scale -- 1 for strongly agree, 2 if you somewhat or slightly agree; use a 3 if you are neutral, while 4 indicates somewhat or slight disagreement. Use a 5 if you strongly disagree. If you feel you don't have enough information to form an opinion, or are unsure, please tell me. [RANDOMIZE ORDER OF APPEARANCE]

a. Most farmers would prefer to farm organically rather than use chemical pesticides and fertilizers.
b. Scientists in this country know what they are doing, so only moderate regulations on genetic modification are probably necessary.
c. The government does not have the tools to properly regulate genetically modified foods.
d. The balance of nature can be easily disrupted by humans.
e. Unjustified fears about genetic modification have seriously blocked the development of beneficial foods.
f. Companies involved in creating genetically modified crops believe profits are more important than safety.
g. Genetically modified food presents no danger for future generations.
h. I feel that I am adequately informed about biotechnology.
i. The risks involved in genetically modified food are acceptable.
j. I would be willing to serve genetically modified foods to my family.
k. Genetically modified food will benefit many people.
l. The risks of genetic modification have been greatly exaggerated.
m. Government regulators have the best interests of the public in mind.

17. Now I am going to read you a list of possible information sources. Please indicate which of these you would trust the most, and which one you would trust the second most, to provide you with information about genetically modified foods. I am also going to ask you which source you trust the least. I will read the list first (read responses). Now can you tell me which you would trust the most? [RANDOMIZE ORDER OF APPEARANCE] Which one would you trust the second most to provide you with information about genetically modified foods?

United States Department of Agriculture; University scientists; Food Manufacturers; Grocery stores; Farmers / Ranchers; Clergy; Friends or family members; Interest groups

18. And, of those sources I just mentioned, which would you trust the least? (INTERVIEWER, BE PREPARED TO RE-READ THE LIST).

FINALLY, I HAVE A FEW QUESTIONS ABOUT YOURSELF FOR CLASSIFICATION PURPOSES.

19. Did you grow up on a farm?

20. Are you an active farmer?

21. What is your occupation?

22. What is the approximate population of the town or city in or near which you grew up?

23. What best describes your marital status?
    Single; Married; Unmarried but living with a partner; Separated; Divorced; Widowed

24. Gender (Record -- do not ask)

25. In what year were you born?

26. Do you have children under the age of 18 living in your household?

27. What is your ethnic background? Is it…..
    Hispanic or Latino; Asian American; Caucasian (non-Hispanic); Native American; African American; Other

28. Is your annual household income more than $20,000? (Check first NO up to $75,000)

29. What is the last year or grade of school you completed?
    Did not complete high school; High school graduate; Some college; Four-year college degree; Post graduate degree (e.g., Masters)

30. Are you a member of or do work for any:
    a. environmental groups or organizations?
    b. scientific groups or organizations?
    c. consumer groups or organizations?

INTERVIEW CLOSE: "THAT IS ALL THE QUESTINS THAT I HAVE FOR YOU. THANK YOU FOR YOUR RESPONSES AND TIME…."

APPENDIX B – REPORT ON DATA COLLECTION

Introduction

The faculty members of North Dakota State University's College of Agriculture, Food Systems, and Natural Resources and the University of North Dakota's College of Business and Public Administration selected the Social Science Research Institute (SSRI) to conduct a statewide survey to measure grocery shoppers' knowledge of food ingredients and nutrition labels. The goal of the study was to provide the "core" data elements in order to correctly identify the average grocery shoppers' knowledge on food ingredients and their labels based on the core factors that affect our shopping habits (e.g., age, region of the country, and gender). The following is a detailed description of SSRI's research methodology utilized in data collection.

Methodology

Target Population and Survey Area. The target population was randomly selected adults in North Dakota (18 years of age or older) who reported they had performed most of the household grocery shopping in the past month.

Sample Size. A random sample of 407 adults statewide yields a margin of error of +/- 4.9% with a confidence interval of 95% in proportion to the North Dakota population age 18 or older.

Field Period. The survey was pre-tested November 17 and the data were collected November 20 through December 8, 2003.

Sample Design. To obtain a representative sample for the survey, a random selection of households was used during the data collection process. The survey of adults (18 or older) performed by SSRI was conducted by telephone. A random sample of 10-digit telephone numbers were generated utilizing Genesys Sampling Systems Random Digit Dialing (RDD) in-house software. The list from which the numbers were drawn included only the North Dakota area code and telephone banks (that is, blocks of 1,000 consecutive numbers) that had been determined to contain a threshold number of active residential numbers.

Overall, SSRI called 2,775 telephone numbers in North Dakota to determine whether it was a working residential number in contrast to a non-working number, a commercial/business line, a cell phone, data or fax line, or a non-primary household telephone. SSRI staff classified 1,179 of these numbers as working residential numbers eligible for interview and successfully interviewed 407 of these households. Table 1 presents the sample dispositions.

TABLE 1. GMO SURVEY SAMPLE DISPOSITIONS

Sample Disposition	Num	Percent
Completed Interviews	407	14.7%
Nonworking Number	1,596	57.5%
Non-primary Household	403	14.5%
Language Barrier	144	5.2%
Refusals	177	6.4%
Terminated Interview	22	0.8%
Contacted Not Interviewed	26	0.9%
Totals	2,775	100.0%

Response Rates. Survey professionals in general have found that response rates for telephone surveys have declined in recent years. These declines are related to the proliferation of fax machines, answering machines, blocking devices and other telecommunications technology that make it more difficult to identify and recruit eligible individuals. These declines are also related to the amount of political polling and market research that is now done by telephone and to the higher likelihood that eligible households will refuse to participate in any surveys. The consequence has been that response rates for telephone surveys are now calculated in several different ways although all of these approaches involve dividing the number of respondents by the number of contacts believed to be eligible. Differences in response rates result from different ways of calculating the denominator, i.e. the number of individuals eligible to respond. The most liberal approach is called the Upper Bound method and takes into account only those individuals who refuse to participate or who terminate an interview. This approach is used by the federal government because of controversies about the eligibility of numbers that could not be reached.

The most conservative approach is the method adopted by the Council of American Survey Research Organizations (CASRO). The CASRO method uses the known status of portions of the sample that are contacted to impute characteristics of portions of the sample that were not reached.

- The Upper Bound method of calculating the response rate for the sample yields a rate of 67%
  (Refusals + Terminate + Completes) = Total
  Completed Interviews / Total = Upper Bound

- The CASRO method of calculating the response rates for the sample yields an average completion rate of 64% if over-quota eligibles are assumed to qualify as "good numbers."
  (Contacted Not Interviewed + Refusals + Terminate + Completes) = Total
  Completed Interviews / Total = CASRO

Interviewing Procedures. Telephone interviews were conducted from SSRI and the Department of Sociology at the University of North Dakota by trained interviewers with supervision and random monitoring for technique and adherence to established procedures. Production interviewing began after a pre-test of the survey in a series of actual telephone interviews. The majority of interviews were conducted on weekday and Sunday evenings. Efforts to complete interviews with selected respondents were extensive. The number of callbacks to complete an interview with an eligible respondent ranged from one to nine.

Computerized Assisted Telephone Interviewing (CATI). To ease telephone interviewing, all telephone interviews were conducted with a computer assisted telephone interview (CATI) system. The SSRI version of CATI is implemented with microcomputers, which display survey questions on interview terminals and collect telephone interview data as the interview is being conducted. For CATI telephone interviews, all coding of numeric and categorical responses is done by microcomputer software, with error checking to catch out-of-range values at the time of the interview.

The use of CATI increases both the speed of data collection and the accuracy of data collected. All CATI questionnaires are tested prior to conducting telephone interviews to ensure accurate encoding of survey responses and accurate branching and skip patterns in the questionnaire. The system prompts interviewers for a valid response to every question in the survey. For numeric questions, legitimate ranges of responses are entered into the computer so that the computer can detect out-of-range values. When these are detected during the interview, the computer warns the interviewer that the entered value is out of range and prompts the interviewer for a legitimate response.

Data validation at the data management step consists of accounting for all cases in the survey, and

ensuring that data record exists for every completed interview in the sample. Data records were passed through a SPSS program to ensure that all data fields are readable, and that all fields are reading the format specified for that variable. The final validation step consists of checking the consistency of respondents' answers to objective and verifiable survey questions.

Random Digit Dialing Sample Design. Since 1995, SSRI has used GENESYS, a stand alone, in-house RDD windows based program through Marketing Systems Group[9] (MSG). After experimenting in the early 1990's with various approaches, SSRI has determined that a list-assisted RDD approach is the most efficient and statistically valid sampling method available. Among commercial survey researchers, the pivotal nature of sampling methodology is often ignored and there remains widespread ignorance of telephone sampling procedures. It is not surprising that the phrase "RDD sampling" covers a lot of territory - it is used to describe a wide range of telephone sampling processes, most of them being less than rigorous. It is the standard "proposed sampling method," yet rarely is it defined or described in detail; and the actual methodology(ies) is typically production-cost driven. GENESYS is recognized as the industry's only source for a single stage *epsem* RDD sampling methodology (for a basic review of the Mitofsky-Waksberg sampling methodology utilized by SSRI please see www.genesys-sampling.com).

The list-assisted Random Digit Dialing (RDD) sample that would be used for this study could best be characterized as a single-stage epsem sample of all residential telephone numbers in North Dakota. This method differs from dialing purely at random. Purely random dialing is not as efficient because most of the randomly generated telephone exchanges will not be in operation, many telephone numbers grouped into what are called 100-blocks will not be in use, and many of the 100-blocks that are in use will contain numbers for businesses only.

Modern sampling techniques take advantage of the fact that residential telephone numbers are likely to be clustered among a small number of 100-blocks[10] in which a large percentage of the possible numbers, more than 40% but often much higher, are in use. Rather than selecting a sample of telephone numbers purely at random, the list assisted approach uses information about which 100-blocks will likely contain residential numbers as a basis for selecting a sample of telephone numbers. This approach makes it faster and less expensive to conduct statistically valid surveys.

The list of working 100-blocks used by SSRI, called the Master Exchange Data Base, is a comprehensive listing of all telephone exchanges currently in use in the United States. It consists of all working exchanges in the country, provided by Bell Communications Research (Bellcore), plus a computerized listing of individual telephone numbers along with the state, county, and ZIP codes. The Bellcore information is used to determine whether there are at least five working telephone numbers in each exchange and two in each 100-block, and the resulting list is used as the basis for developing a survey sample. The Bellcore database (telephone numbers along with the state, county, and ZIP codes listing) was last updated November 15, 2003.

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[9] Marketing Systems Group, GENESYS Sampling Systems, 565 Virginia Drive, Fort Washington, PA, 19034, 1-800-336-7674 www.genesys-sampling.com.

[10] A telephone number is defined as having 10 digits (i.e., the area code [first 3 digits], the exchange [the second 3 digits], plus the last 4 digits). A 100-block is simply a way of grouping telephone numbers that have the same first 8 digits. For example, the telephone number 701-772-5856 consists of the following parts: Area code: 701 - Telephone exchange: 772 - Last 4 digits: 5856 100-block: 701-772-6600 through 701-772-6699

After identifying the working 100-blocks that are in the geographic area to be sampled, a set of telephone numbers to be called is generated by randomly selecting a working 100 block and then randomly adding a value from 01 to 99. This process is repeated as many times as needed to produce the desired sample size, with an allowance for non-responses. [Unlisted- phone numbers are automatically included in these randomly generated telephone numbers.]

At this point, SSRI incorporates GENESYS-ID*plus* enhancements, which are made to increase sampling efficiency. These include:

The Pre-Dialer Phase: The file of generated numbers is passed against the ID database, comprised of the GENESYS-Plus business database and the listed household database. Business numbers are eliminated while listed household numbers are set aside, to be recombined after the active Dialer Phase.

The Dialer Phase: The remaining numbers are then processed using automated dialing equipment – actually a specially configured PROYTY S Telephony system. In this phase, the dialing is 100% attended and the phone is allowed to ring up to two times. Specially trained agents are available to speak to anyone who might answer the phone and the number is dispositioned accordingly. Given this human intervention in evaluating all call results, virtually all remaining businesses and non-working and non-tritone intercepts are eliminated, and there is compensation for differences in non-working intercept behavior. Most importantly, all of this testing takes place during the restricted hours of 9 a.m. – 5 p.m. local time, to further minimize intrusion since fewer people are home during these hours.

The Post-Dialer Phase: The sample is then reconstructed, excluding the non-productive numbers identified in the previous two phases.

Unlike other systems that rely solely on databases of non-working numbers that need constant updates, this methodology provides up-to-the-minute results since the sample is screened just a day or two prior to being utilized by SSRI interviewers.