
# Consumer Acceptance of Genetically Modified Foods in Korea: Factor and Cluster Analysis

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**Selected Paper**
***Joint 2004 Northeast Agricultural and Resource Economics Association and Canadian Agricultural Economics Society Annual Meeting***
***Halifax, Nova Scotia, Canada***
***June 20-23, 2004***

**This is Food Policy Institute Working Paper No. WP1104-015**

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# Consumer Acceptance of Genetically Modified Foods In Korea: Factor and Cluster Analysis


## Abstract:

The study applies multivariate statistical and econometric tools to estimate the importance of the various factors driving Korean consumer acceptance of GM food products. The evidence thus far on biotechnology is decidedly mixed: public perceptions of food biotechnology are characterized by ongoing tension between opposing forces. The south Korean perceptions about food in general and ranges from excitement about the promise of environmental and economic benefits from GM products to fear and distrust of the technology for unknown risks. This highlights the importance of credibility of private and public institutions responsible for certifying the safety of GM foods and implementing necessary regulatory controls on GM processes and products. In between, many people are undecided, trying to learn more about the issues and reach a definitive position. Encouraging though is that some people are eager to try new foods. Koreans strongly favors food naturalness, familiarity, and access just as the west countries.

Results suggest that the South Korean Consumer priorities with respect to various biotechnology and general food issues are related to their socioeconomic and value attributes. This implies that, at least in the near term, there will be considerable divergence within the society in terms of acceptance of food biotechnology. The finding that large segments of the Korean society are either not fully informed or interested in learning more about biotechnology calls for a public education program. A program that may play a constructive role in not only informing consumers but help them in arriving at a socially optimal collective decisions on the wisdom and desirability of food biotechnology

## Introduction

Consumer acceptance of genetically modified (GM) [1] food products remains a critical factor that will affect the future growth of agricultural biotechnology. The raging debate in the U.S and Europe revolves around risks and benefits of biotechnology in the production of food and feed (Isserman, 2001). The debate has split the public into two, with proponents of biotechnology emphasizing benefits to mankind in the form of improved supply of food and medicine and opponents who view biotechnology as an interference with nature that has unknown and potentially disastrous outcomes (Nelson, 2001).

Not withstanding the European and American controversies, it is increasingly becoming clear that acceptance of GM foods must be addressed now to open potential of tapping into larger Asian markets. From the U.S and Canadian biotech firms' perspectives, there is urgency for information pertaining to the larger Asian sub-continent; a region traditionally importing large amounts of conventional agricultural food products. Recent statistics for example show that GM commodities marketed in Korea comes mainly from U.S. Most studies on acceptance of GM foods have focused on U.S. and the E.U. with a few exceptions. For example, the Asian Food Information Center's 2002 and 2003 studies indicate that Asian consumers have a positive attitude towards GM foods though they demonstrate little knowledge on the broader GM issues. As the wider global society struggles to come to terms with the benefits and (unknown) risks of the biotechnology, better understanding of consumer interests and concerns is needed to formulate and implement effective private and public policies. There is no doubt that cultural and institutional differences influence opinions about GM Foods. Additionally, multiple dimensions stemming from various forces, preferences, and events will also influence such perceptions. For

instance, positive benefits (e.g., health and environmental benefits) are likely to have positive effects while unknown risks are likely to have negative effects on consumer acceptance of GM food products. Other factors such as public trust and confidence in government (i.e., government's ability to protect consumer interests), scientific community, biotechnology companies are also likely to influence public perception of GM Foods. Similarly, social, political, religious and moral/ethical views of the public are also likely to affect their perception and acceptance of GM products.

Given the significance of the subject, full understanding of public interests and concerns is needed to reach sound private and public decisions about biotechnology. However, very few studies have systematically explored the underlying factors influencing public opinions about biotechnology and more so little is known outside EU and U.S. In a recent study, Moon and Balasubramanian (2001) found that consumer acceptance of biotechnology was significantly related to their perceptions of risks and benefits of GM products, as well as their moral and ethical views. Further, public views about corporations, trust in government, and knowledge of science and technology also influenced their attitudes towards biotechnology. Baker and Burnham (2001) found that consumers' cognitive variables (e.g., degree of risk aversion, opinions about GM foods) influenced their acceptance of GM products, whereas their socioeconomic attributes did not have significant effects.

This paper contributes to the broad biotechnology discourse by analyzing the Korean consumer perceptions and attitudes towards GM food products. The objectives of the study are: (i) to identify and estimate the importance of the various factors driving consumer perception of biotechnology and acceptance of GM food products; (ii) to identify and characterize distinct

[1] Throughout this paper, the terms biotechnology, food biotechnology, agricultural biotechnology and

consumer segments in terms of their acceptance of GM food products; (iii) to examine the relation between product attributes (e.g., plant or animal products, products with and without distinct benefits) and consumer acceptance of GM foods; and (iv) analyze how consumers' socioeconomic and value characteristics are related to the principal factors affecting their acceptance of GM foods.

The study is based on 2003 Korean survey which collected information on consumers' knowledge of biotechnology, their perception and attitude towards acceptance of GM food products, and general food, health, safety and environmental concerns relating to GM foods. Additional information on socio-demographic characteristics and social, political, moral, religious views of the respondents was also collected. The survey also elicited respondent's views about their trust in scientists, farmers, environmentalists, media, medical professionals, industry, and government institutions associated with biotechnology in their various roles as information sources, their expertise, telling truth about biotechnology and protecting society in general. The study uses multivariate statistical and econometric tools are utilized to attain the research objectives.

## Data and Methodology

The data set used in this study was collected during a survey that was carried out in South Korea April 10, 2003 to May 9, 2003. The Food Policy Institute at Rutgers University developed the survey questionnaires originally used in South Korea. The Korean survey had in many instances identical questions similar to those for the U.S. survey on the same subject carried out in February to April 1, 2003. Most of the questions in the two surveys were similar with modifications made in considering cultural differences. The Korean Biosafety Clearing House

genetic modification are used interchangeably.

(KBCH) commissioned Gallup Korea to conduct nationally based face-to-face interviews. A target sample was obtained through proportionate random sampling based on population by region. The survey group included adults from across South Korea ranging in age from 20 to 59 years. The sampling error was ± 3.1 percent with a statistical significance level of 95 percent.

Interviewers attended an orientation covering the survey method, contents, and exercise in an effort to minimize non-sampling error. Control over the interviewers was exercised by distributing and collecting questionnaires each day. Interviewers approached subjects, briefly describing the study, and asked them to participate. The data was weighted using demographic variables just as the U. S data set, with exception of race/ethnicity using Korean National Census. Respondents were given a pen (worth 2 U.S Dollars) for answering the questionnaire. The cooperation rate from initially selected interviewees was 40 percent. In total, 1054 complete surveys were collected.

A list of 18 questions relating to public perceptions of food and biotechnology was selected for analysis. These questions explored how people viewed the benefits that biotechnology could bring to society, general views about the foods they eat, their perceptions of risks from plant and animal genetics, as well as their views on various institutions associated with biotechnology development. Respondents were presented with various issues on general food genetically modified foods in particular, and were asked to rate their agreement or disagreement on a scale. Respondents were also asked to rate the importance of certain aspects of the foods they eat. These responses were analyzed to identify the factors underlying public attitudes towards food in general and biotechnology in particular.

Empirical analysis was conducted in multiple phases. First, the principal components factor analysis (PCA) was used to reduce 18 questions exploring public views on the subject to a

smaller and more focused set of dimensions. Initially, using a standard latent root equals one and Scree test to guide the first rotation, a number of trial rotations was obtained to compare factor interpretability. Following this, a confirmatory analysis to ensure factor stability. Finally, 6 factors underlying public views about biotechnology were identified.

In the second stage, standardized factor scores (identified in stage one) were subjected to a two-stage cluster analysis (Punj and Stewart, 1983) to identify clusters of respondents with similar views on food in general and specifically on biotechnology. First, a Ward's minimum variance algorithm using squared Euclidean measure of inter-object similarity was used to determine the initial clustering solution, the number of clusters and cluster cetroids. Individual cases were then subjected to non-hierarchical clustering algorithm (Hair et al., 1992) to obtain the final clusters. Using criteria of increases in cluster coefficients as clusters merge, interpretability and external validity, five consumer clusters were identified based on the importance they placed on the factors underlying their views about biotechnology.

Once the clusters were chosen, ANOVA and Chi-square test of independence were used to test for inter-cluster heterogeneity in the socioeconomic attributes of the respondents. Finally, standard multivariate regression analysis was used to explore the relationship between the dimensions of public perceptions of biotechnology and the socioeconomic and value attributes of the consumers.

# Empirical Results

### *Dimensions of Public Perceptions of Food Biotechnology*

The factor loadings from the principal component factor analysis obtained after a Varimax rotation of consumer responses to the 18 questions exploring their perceptions of food and biotechnology are presented in table 2. Factors are ranked in order according to the

proportion of variance explained and are named to reflect the latent stimuli underlying public perceptions of biotechnology. The analysis identified 6 core factors influencing public opinions about the subject. Together, the factors accounted for about 60 percent of the error variance as summarized below.

***Benefits Dimension:(Environmental, Taste and Price Benefits)*** (factor 1): This factor reflects public recognition of the potential of biotechnology to bring tangible benefits to society for example environmentally friendly agricultural practices that only cut down pesticide use but also helps the farmer in production cost production. This is reflected by the high factor loadings associated with consumer willingness to buy GM foods if they delivered products which use less pesticide, have a better taste and produced in environmentally friendly ways with the additional incentive of a lower price than the conventional product. This is the most important factor in this analysis accounting 18 percent of the error variance.

***Food Naturalness*** (factor 2): This factor captures the conservative dimension that indicates the importance the Korean consumers place in unadulterated foods containing neither preservatives nor artificial colorings. Additionally, the consumers felt strongly that the food they eat should preferably be local and organically produced. This dimension may reflect a group of consumers who may not be open to any new ideas about other foods, including genetically modified foods. If this is the case this may imply a food cultural manifestation, which may be difficult to break. Given the understanding that such cultural knowledge is merely passed down over generations without any scientific scrutiny. This factor accounts for about 15 percent of the error variance.

***Convenience /familiarity*** (factor 3): This factor reflects food products budget prioritization. Additional higher loadings were that the product must be easily available, familiar brands, and have no allergic causing ingredients and be a typical food (e.g., Kimchi). This may reflect habit

formation, which may be hard to break. About 8 percent of the error variance was explained by this factor.

***Opposition/skeptic to Biotechnology*** (factor 4): this factor reflects the public concern about the (unknown) risks associated biotechnology raising a flag on the motives of biotechnology as such. The perception of risks (from GM) to humans and the environment is at the heart of public opposition to biotechnology. As evidenced by the high factor loadings where respondents felt that serious accidents are bound to happen, Biotechnology threatens the natural order of things. The opposition is also reflected by the willingness of the respondents to pay a little more to avoid GM food products. This factor accounts for about 7 percent of the error variance.

***Open-Mindedness about Biotechnology*** (factor 5): This factor reflects open mindedness among some Korean consumers on various biotechnology issues. The high loadings associated with information gathering activities (e.g., willingness to engage in public debates, reading and watching television programs on biotechnology) indicate that many consumers are unsure about their positions on biotechnology. These consumers are seeking more information on various GM issues to arrive at a firm position. This factor accounts for 6 percent of the error variance.

***Discovering /Optimistic about new Foods*** (factor 6): This factor reflects a positive attitude among the respondents in their willingness to try new foods. Though the smallest factor, this dimension may represent an anchor of hope in face of introducing new foods including genetically modified foods. This factor accounts for about 6 percent of the error variance.

## Cluster Analysis

Applying a non-hierarchical cluster analysis to the standardized factor scores (obtained from factor analysis), 3 consumer groups (clusters) were identified based on similarity of their views on factors driving public attitudes toward biotechnology (described above). The mean and

standard deviation of the standardized factor scores and the number of respondents in each cluster are reported in table 3. The F-statistics from the ANOVA analysis (table 2) suggest significant inter-group variations in the importance placed on the 6 factors underlying attitudes towards biotechnology. The three consumer clusters are described below and so named to reflect the dominant GM issue for that group (reflected by mean factor scores).

**Biotechnology Opponents**: These consumers are opposed to the use of biotechnology in food production (note the high mean score for factor 4). Individuals in this group view GM as precursor to serious disasters due biotechnology experiments and therefore tampering with the natural order of things. It is reflects consumer apprehensiveness to biotechnology that predisposes many of them to be most likely risk averse. Such consumers do not place importance on benefits that biotechnology could deliver, they prefer natural foods and have closed their minds to trying new foods and are not ready to participate in biotechnology debates leave alone watching TV and news on biotechnology advances. With only 27 percent of the respondents, this is the smallest of 3 groups identified under cluster analysis.

**Open Minded**: This group is so named because of the high factor score associated with optimism about biotechnology (factor5) among these consumers. About a third (29 %) of the respondents belong to this group. Individuals in this group although opposed to biotechnology as such they place little importance in food convenience or familiarity as shown by large negative coefficient associated with factor 3. This group puts little emphasis on benefits accruing from GM foods, they prefer that their food be natural. This outcome partially is explained as a consequence of negative GM foods and technology coverage in Korea (Thomson and Dininni, 2003). The consumer in this group curiously follows GM debates on the disadvantages and advantages, and has a strong desire to read more about the subject. This is the group offering

promise to new foods including those delivered by biotechnology, as evidenced by their willingness to try new foods outside their tradition or environment.

**Convenience / Familiarity Seekers:** This is the largest group taking about half of the respondents (47%) named after the strong association with factor 3: The group may be described as conservative preferring the status quo. The cluster manifests the strong cultural attachment to Korean foods. The group however positively identify with biotechnology delivered benefits. Their attitude toward Korean food may reflect demand inertia (taste inflexibility) that requires time before persistent habits change. The group is willing to try new foods, but prefer that their food be natural. However this group is opposed to biotechnology and has generally closed their minds to GM debates.

Table 4 shows how the 3 consumer clusters differ in terms of their socioeconomic attributes. Formal Chi-square test rejects the null hypothesis of no association between each of the socioeconomic variables and cluster membership except for gender, religion and income. This implies that most of the socioeconomic attributes of the population influence public views about general in general and biotechnology food in particular[2].

Table 3 shows that people in the age range 30-39 years (31 %) are more opposed to biotechnology compared to those in the 50-59 years range. Whereas those in the 20-29-age category (33 %) were more open minded, with about two thirds of the respondents (65 %) of those in the 30-49 years range fall into the convenience category. Across the board people with high school education are opposed to biotechnology, and prefer convenience. People in the 50-59-age range (32 %) place a premium on deciding which food to consume.

[2] Chi-square test could not reject the null hypothesis of no association between income, gender and religion and cluster membership. Hence, income was excluded from subsequent analysis.

People with average knowledge on food production consider biotechnology suspect, a similar group happen also to be open-minded group. Those people with above average knowledge fall more into the convenience-seeking cluster. Families with children under 17 years preferred convenience foods and were opposed to biotechnology. On the other hand, those families who did not have children were more open-minded.

People living in the medium sized city and rural are less opposed to biotechnology, on the other hand large city dwellers happen to be opposed to biotechnology are more open minded and prefer convenience foods. Those who support labeling of GM foods are less opposed to biotechnology preferring more convenience/ familiar foods. With those not supporting labeling being more open minded.

### *Explaining Factors Underlying Public Perceptions of Biotechnology*

The relationship between the factors underlying public perceptions of general food and biotechnology, and the personal attributes of the respondents is explored using standard regression analysis. The dependent variables are the standardized factor scores obtained from the principal component analysis. Table 1 presents the descriptive statistics of the explanatory variables used in these regressions which include consumers' socioeconomic and value attributes. Table 5, presents the regression results on the factors underlying public attitudes towards biotechnology and food in general. The important findings of this analysis are summarized below.

**Age**: Compared to younger respondents (20-29 years old), mature (50-59) and mid age (30-49) tend to favor biotechnology for the benefits it delivers; prefer their food to be natural. On the other hand the results show it is the young people (20-29 years) who are more open-minded.

However, age was not an important factor in determining people's negative opinion about biotechnology and discovery/curiosity.

**Gender**: Compared to the males the females were less enthusiastic in discovering new foods, but place importance in their foods being natural (no artificial al flavors nor colorings, must be organically produced and sourced in Korea.

**Residence**: The rural folks compared to their city counter parts were more likely to prefer their food to be natural.

**Education**: Respondents who had attained some college education compared to those with less that high school education were more opposed to the biotechnology, while those with graduate education compared to those with less than high school education were less opposed to biotechnology.

**Employment and political affiliation**: compared to those unemployed people, those employed positively related to the benefits accruing to biotechnology, a similar reaction came from the conservative party adherents compared to those with centrist political leanings.

I**ncome**: Those respondents whose income was between 20-40 million Won compared to those whose incomes were less than 20 million Won did not place much importance in food being natural, had a negative attitude to biotechnology, but were keen to try new foods (discoverers). Respondents with incomes above 40 Million Won compared to those with less than 20 million Won, less favored the benefits brought about by technology, did not border about convenience or familiarity in the food s they ate, were less open minded and less keen to try new foods.

**Awareness of GM foods being in the Market and Heard about GM before Interview**: Compared to those not aware that GM foods are already in the market, those aware were less concerned about eating familiar foods, were more opposed to biotechnology, and also were less

open minded about debates on advantages and disadvantages about biotechnology. Results show that those who had about GM before being interviewed were more opposed to GM given the risks that are yet to be proved but at the same were more willing to try new foods (discoverers).

**Eat to stay Health and Vegetarians**: Compared to those who cared less about eating primary to stay health, considered food naturalness and convenience to be important. A similar result was obtained for the vegetarians who place a premium on food convenience and naturalness, but were less willing to be discoverers of new foods.

**Labeling:** Respondents who preferred food to be labeled as such placed importance on their food being natural and were opposed to biotechnology. In late 2001, Korean government imposed a new protocol requiring labeling of GM imports, i.e. all food product above the 3% threshold must be labeled as such. Korean consumers are apprehensive toward GM food, and consequently the Korean food processing industry is reluctant to manufacture products that will require a GM label. Soh Ji-Young (2002) argues that by doing so one will be protecting the interests of the consumers.

**Knowledge of science**: Compared to those who had above average understanding of science and technology place more importance on their food being natural and were more opposed to biocenology.

## Conclusions

Public acceptance of genetically modified products is critically important for the future of food biotechnology. Opinions about food in general and particularly willingness to try new foods will pave way to acceptance of foods that are genetically engineered. The evidence thus far on biotechnology is decidedly mixed: public perceptions of food biotechnology are characterized by

ongoing tension between opposing forces. On the one hand, the public remains optimistic about the prospect of new and improved products that will bring a wide range of health and economic benefits. On the other hand, they are concerned about the potential health, safety and environmental risks from the use of this technology. Underlying public perceptions of food in general and biotechnology specifically are 6 core factors that range from excitement about the promise of environmental and economic benefits from GM products to fear and distrust of the technology for unknown risks. In between, many people are undecided, trying to learn more about the issues and reach a definitive position. Encouraging though is that some people are eager to try new foods. There are strong views expressed for food to be natural, and be familiar but at the same time need for the food to be easily available a characteristic of the west countries catching up with the Asian subcontinent.

There is abundant support for GM foods from the specific benefits point of view, with opposition resting in the unknown risks about the biotechnology. In case of foods in general the good news is the willingness to try new foods and openness about the biotechnology debate. This could be seen as open up for other food products GM included. Additionally people will be more informed about the foods thus make decisions on firmer grounds. The attributes of convenience and naturalness can be exploited by the biotechnology industry i.e. preserve those traits that will appeal to the consumer. We find that there is considerable anxiety among consumers about the safety of biotechnology, which is a major obstacle to its widespread acceptance. This highlights the importance of credibility of private and public institutions responsible for certifying the safety of GM foods and implementing necessary regulatory controls on GM processes and products.

Overall, public attitudes towards food and biotechnology are influenced by multiple factors that are of varying importance to different consumer groups. Consumer priorities with respect to various biotechnology and general food issues are related to their socioeconomic and value attributes. This suggests that, at least in the near term, there will be considerable divergence within the society in terms of acceptance of food biotechnology. Also, we find that large segments of the society are either not fully informed or interested in learning more about biotechnology issues to reach a positive decision on the subject. Public education can play a constructive role in informing consumers so that they can arrive at a socially optimal collective decision on the wisdom and desirability of food biotechnology.

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**Table 1. Descriptive Statistics of Variables**

| Variable | Description | Mean | Std. Dev. |
|---|---|---|---|
| LARGE CITY* | 1=if respondent resides in large city;0=otherwise | 0.48 | 0.50 |
| MED_CITY | 1=if respondent resides in Medium city;0=otherwise | 0.40 | 0.49 |
| RURAL | 1=if respondent resides in rural area;0=otherwise | 0.12 | 0.32 |
| FEMALE | 1=if respondent is female;0=otherwise | 0.50 | 0.50 |
| YOUNG* | 1=if respondent age is between 20-29 years;0 otherwise | 0.22 | 0.42 |
| MIDAGE | 1=if respondent age is between 20-49 years;0 otherwise | 0.63 | 0.48 |
| MATAGE | 1=if respondent age is between 50-59 years;0 otherwise | 0.15 | 0.35 |
| KNOWSCTEC | 1=if responded rates his/her understanding of science and technology to be poor ;0 otherwise | 0.49 | 0.50 |
| EAT_HEALTHY | 1=if respondent answered he eats to primarily to stay healthy;0=otherwise | 0.71 | 0.45 |
| VEGETARIAN | 1=respondent characterized himself as is vegetatian;0 otherwise | 0.52 | 0.50 |
| GM_NOWMA | 1=if respondent is aware that GM food is now in supermarkets;0=otherwise | 0.51 | 0.50 |
| LABEL_GM | 1=if respondent will prefer GM food to labeled as such;0=otherwise | 0.96 | 0.20 |
| LTHIGHSC* | 1=if respondent education is below highschool;0=otherwise | 0.11 | 0.32 |
| HIGH_COL | 1=if respondent level of education is high school and college;0 =otherwise | 0.58 | 0.49 |
| GRAD_COL | 1=if respondent level of education is college degree and above;0 =otherwise | 0.31 | 0.46 |
| EMPLOY | 1=if full time employed;0=otherwise | 0.58 | 0.49 |
| LIBERAL | 1=identifies himself as liberal;0=otherwise | 0.22 | 0.42 |
| CONSERV | 1=identifies himself asconservative;0=otherwise | 0.30 | 0.46 |
| CENTRIST* | 1=identifies himself as in-between liberal and conservativel;0=otherwise | 0.41 | 0.49 |
| INCLT_20* | 1=income range les than 20 million won;0=otherwise | 0.22 | 0.41 |
| INC20_40 | 1=Income range 20-40 million won;0=otherwise | 0.56 | 0.50 |
| INCAB_40 | 1=is in income range above 40 million won;0=otherwise | 0.22 | 0.42 |
| Note: Asterisk implies that the variable was dropped during estimation to avoid dummy variable trap. | | | |

**Table 2: Varimax Rotated Factor Loadings about Korean Attitudes and Perceptions to GM and General Foods**

| | Mean | SD | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | |
|---|---|---|---|---|---|---|---|---|---|
| **Factor 1: Environmental, taste and price Benefits: Buy GM foods if?** | | | | | | | | | |
| I would buy genetically modified food if it contained less pesticide residues than ordinary food | 1.54 | 0.46 | 0.796 | | | | | | |
| I would buy genetically modified foods if it tasted better than ordinary food | 1.67 | 0.44 | 0.790 | | | | | | |
| I would buy genetically modified food if it were grown in a more environmentally friendly way than ordinary food | 1.50 | 0.46 | 0.790 | | | | | | |
| I would buy genetically modified food if it were cheaper than ordinary food. | 1.74 | 0.41 | 0.733 | | | | | | |
| **Factor 2: Food Naturalness: (Conservatism: Importance of General Food Characteristics** | | | | | | | | | |
| It doesn't contain artificial colors. | 1.81 | 0.39 | | 0.859 | | | | | |
| It doesn't contain artificial flavors | 1.78 | 0.41 | | 0.857 | | | | | |
| It's produced organically. | 1.74 | 0.44 | | 0.639 | | | | | |
| It's grown in Korea. | 1.85 | 0.36 | | 0.505 | | | | | |
| **Factor 3: Convenience (Familiarity) Food** | | | | | | | | | |
| It doesn't contain any ingredients you're allergic to. | 1.54 | 0.50 | | | 0.747 | | | | |
| It's easy to get. | 1.70 | 0.46 | | | 0.724 | | | | |
| It's a food you've had before. | 1.68 | 0.47 | | | 0.519 | | | | |
| It's a familiar brand | 1.71 | 0.45 | | | 0.377 | | | | |
| **Factor 4: Opposition to Biotechnology** | | | | | | | | | |
| Serious accidents involving genetically modified foods are bound to happen | 1.34 | 0.39 | | | | 0.731 | | | |
| Genetically modified food threatens the natural order of things | 1.20 | 0.38 | | | | 0.709 | | | |
| I would pay more for non-genetically modified food | 1.38 | 0.45 | | | | 0.591 | | | |
| **Factor 5: Openness to food and biotechnology** | | | | | | | | | |
| I would be prepared to take part in public discussions or hearings about biotechnology | 1.61 | 0.44 | | | | | 0.803 | | |
| I would take time to read articles or watch TV programs on the advantages and disadvantages of biotechnology | 1.25 | 0.40 | | | | | 0.773 | | |
| **Factor 6: Discoverers** | | | | | | | | | |
| I am usually willing to try new foods. | 1.61 | 0.47 | | | | | | 0.942 | |
| **Percent of total Variance explained** | | | **18.07** | **14.46** | **8.04** | **6.87** | **5.92** | **5.60** | **58.95** |

***Table 3: Characteristics of the Consumer Groupings Identified through Cluster Analysis***

| | N=252(24%) | N=305(29%) | N=497(47%) | |
|---|---|---|---|---|
| Dimension of attitude/perception | **Opposition to Biotechnology** | **Open-mindedness** | **Convenience /Familiarity Seekers** | **F-statistic** |
| Factor 1:Benefit Seeking | -0.427 | -0.371 | 0.444 | 112.81* |
| | 1.070 | 0.976 | 0.764 | |
| Factor 2: Naturalness/ Freshness seekers | 0.091 | -0.116 | 0.025 | 3.28* |
| | *1.025* | *1.103* | *0.913* | |
| Factor 3: Food convenience /familiarity Attitude | -0.047 | -0.758 | **0.489** | 203.88* |
| | *0.930* | *0.940* | *0.742* | |
| Factor 4: Opposition to Biotechnology | **1.389** | -0.504 | -0.395 | 819.02* |
| | *0.738* | *0.652* | *0.542* | |
| Factor 5: open-minded attitude | -0.143 | **0.642** | -0.321 | 109.90* |
| | *0.999* | *0.917* | *0.858* | |
| Factor 6: Discovering/curiosity Attitude | -0.013 | -0.128 | 0.085 | 4.32* |
| | *1.023* | *1.019* | *0.970* | |

Note: values are mean of standardized factor scores with standardized deviation in italics. F-statistics is from ANOVA of inter-cluster differences. Asterisk denotes the statistic is significant at 1 % level.

**Table 4: Socioeconomic Characteristics and Distribution of Respondents Across Clusters**

| | **Opposition to Biotechnology** | **Open-mindedness** | **Convenience /familiarity Seekers** |
|---|---|---|---|
| | % | % | % |
| **Gender** | | **Chi Square=0.34** | |
| Male | 50.40 | 50.16 | 48.49 |
| Female | 49.60 | 49.84 | 51.51 |
| **Residence** | | **Chi Square=4.73*** | |
| Large City | 45.63 | 53.44 | 46.48 |
| Small City | 42.86 | 36.07 | 42.25 |
| Rural | 11.51 | 10.49 | 11.27 |
| **Age** | | **Chi Square=33.17*** | |
| 20-29 Years | 29.76 | 32.79 | 16.70 |
| 30-39 Years | 30.95 | 28.85 | 36.62 |
| 40-49Years | 25.40 | 23.93 | 32.19 |
| 50-59 Years | 13.89 | 14.43 | 14.49 |
| **Labeling GM** | | **Chi Square=8.80*** | |
| *YES* | 93.7 | 94.8 | 97.8 |
| *NO* | 6.3 | 5.2 | 2.2 |
| **Basic Food Production Knowledge** | | **Chi Square=30.68*** | |
| Poor | 1.98 | 5.57 | 0.80 |
| Fair | 13.10 | 17.05 | 12.07 |
| Good | 27.38 | 22.95 | 20.93 |
| Very good | 31.75 | 30.49 | 33.60 |
| Excellent | 25.79 | 23.93 | 32.60 |
| **Education** | | **Chi Square=15.08*** | |
| No formal schooling, elementary, middle school | 9.13 | 11.80 | 13.51 |
| High school | 48.41 | 46.56 | 46.77 |
| Attending college | 12.70 | 15.41 | 7.86 |
| College grad and above | 29.76 | 26.23 | 31.85 |
| **Children <17 Years** | | **Chi Square=9.58*** | |
| Yes | 52.38 | 48.52 | 59.36 |
| No | 47.62 | 51.48 | 40.64 |
| **Religion** | | **Chi Square=1.65** | |
| Buddhism | 46.54 | 51.45 | 49.28 |
| Christianity | 39.62 | 34.10 | 38.49 |

| | | | |
|---|---|---|---|
| Other | 13.84 | 14.45 | 12.23 |
| **Political Affiliation** | | **Chi Square=10.30*** | |
| Liberal | 23.81 | 21.31 | 21.33 |
| Conservative | 24.60 | 29.18 | 31.79 |
| Centrist | 44.05 | 38.03 | 40.24 |
| Don't know | 7.54 | 11.48 | 6.64 |
| **Income** | | **Chi Square=2.27** | |
| Below 20 Million Won | 21.46 | 20.00 | 23.00 |
| 20-30 Million Won | 25.32 | 28.52 | 28.27 |
| 30-40 Million Won | 30.47 | 27.41 | 27.64 |
| Over 40 Million Won | 22.75 | 24.07 | 21.10 |
| **Knowledge of Science and Technology** | | **Chi Square=13.65*** | |
| Poor | 7.54 | 14.75 | 10.46 |
| Fair | 38.49 | 43.28 | 38.83 |
| Good | 31.75 | 25.90 | 31.79 |
| Very Good | 21.43 | 15.41 | 18.51 |
| Excellent | 0.79 | 0.66 | 0.40 |

**Table 5: Socioeconomic Variables and Factors Affecting Korean Public Perceptions to Food in General and Biotechnology**

| | Factors Affecting Public Perception of Biotechnology | | | | | |
|---|---|---|---|---|---|---|
| **Variable Description** | **Benefit Seeking** | **Naturalness/ Conservatism** | **Convenience / Familiarity** | **GM Opposition** | **Open mindedness** | **Discovering/ Curiosity** |
| Constant | -0.530 | -1.263 | -0.546 | 0.654 | 0.864 | 0.058 |
| | (-2.66) | (-6.67) | (-2.88) | (3.27) | (4.42) | (0.29) |
| Small City residence (vs. large city) | 0.098 | 0.054 | -0.051 | 0.076 | -0.020 | 0.087 |
| | (1.43) | (0.82) | (-0.78) | (1.10) | (-0.29) | (1.26) |
| Rural Residence (vs. large city) | -0.076 | 0.207** | -0.038 | -0.090 | 0.037 | -0.006 |
| | (-0.69) | (1.98) | (-0.37) | (-0.82) | (0.34) | (-0.05) |
| Female (Vs. Male) | 0.085 | 0.116** | 0.061 | -0.063 | -0.051 | -0.154* |
| | (1.11) | (1.60) | (0.83) | (-0.82) | (-0.68) | (-2.00) |
| Mid age 30-49 years (Vs. Young 20-29 years) | 0.258* | 0.140** | -0.047 | -0.084 | -0.262 | 0.085 |
| | (3.03) | (1.74) | (-0.58) | (-0.99) | (-3.15) | (0.99) |
| Mature age 50-59 years (Vs. Young 20-29 years) | 0.220** | 0.352* | -0.044 | -0.004 | -0.113 | 0.165 |
| | (1.88) | (3.17) | (-0.39) | (-0.03) | (-0.98) | (1.40) |
| Some college education (vs. less than high school) | -0.040 | -0.073 | 0.060 | 0.031 | 0.098** | 0.068 |
| | (-0.71) | (-1.37) | (1.12) | (0.56) | (1.79) | (1.22) |
| Graduate education (less than high school) | 0.039 | 0.073 | -0.059 | -0.031 | -0.097** | -0.069 |
| | (0.70) | (1.37) | (-1.11) | (-0.55) | (-1.77) | (-1.23) |
| Full time Employed (vs. not employed) | 0.231* | 0.042 | -0.009 | -0.032 | 0.028 | -0.084 |
| | (2.95) | (0.56) | (-0.12) | (-0.40) | (0.36) | (-1.07) |
| Liberal (vs. centrist) | -0.087 | -0.013 | 0.099 | 0.033 | 0.003 | -0.178 |
| | (-1.05) | (-0.17) | (1.27) | (0.40) | (0.04) | (-2.16) |
| Conservative (vs. centrist) | 0.223* | 0.067 | 0.042 | -0.080 | 0.075 | -0.055 |
| | (2.94) | (0.93) | (0.58) | (-1.05) | (1.01) | (-0.72) |
| Income between 20 –40 thousand Won (vs. income less 20 thousand Won) | -0.044 | -0.183* | 0.033 | -0.176* | -0.085 | 0.175* |
| | (-0.51) | (-2.21) | (0.39) | (-2.01) | (-0.99) | (2.00) |
| Income above 40 thousand Won (vs. income less 20 thousand Won) | -0.199* | 0.064 | -0.161* | -0.074 | -0.219* | -0.125 |
| | (-2.48) | (0.84) | (-2.11) | (-0.91) | (-2.78) | (-1.55) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Aware about GM products being in the supermarket (vs. not aware that GM food is in supermarkets) | 0.095 | 0.060 | -0.223* | -0.217* | -0.126** | 0.000 |
| | (1.44) | (0.95) | (-3.55) | (-3.27) | (-1.94) | (0.01) |
| Eat primarily to stay healthy (not eating primarily to keep healthy) | -0.044 | 0.230* | 0.121** | -0.019 | -0.008 | 0.009 |
| | (-0.59) | (3.25) | (1.71) | (-0.25) | (-0.11) | (0.12) |
| Vegetarians (vs. not vegetarian) | 0.021 | 0.345* | 0.546* | -0.087 | -0.025 | -0.182* |
| | (0.31) | (5.48) | (8.67) | (-1.30) | (-0.39) | (-2.73) |
| Label GM products (vs. not) | 0.114 | 0.515* | 0.246 | -0.313** | -0.218 | -0.009 |
| | (0.70) | (3.33) | (1.59) | (-1.92) | (-1.36) | -0.05 |
| Knowledge of science | 0.013 | 0.039 | 0.143* | 0.023 | -0.277 | -0.085 |
| | (0.19) | (0.60) | (2.22) | (0.34) | (-4.18) | (-1.25) |
| Heard about Gm Before interview (Vs. not) | -0.016 | 0.144 | 0.055 | -0.056 | -0.247* | 0.181* |
| | (-0.18) | (1.70) | 0.65 | (-0.63) | (-2.82) | (2.02) |
| Adjusted $R^2$ | 0.04 | 0.09 | 0.1 | 0.02 | 0.06 | 0.02 |
| Model F-statistics | 3.06 | 6.47 | 7.36 | 1.83 | 4.59 | 2.24 |

Note Figures in Parentheses denote the t-ratios. Single asterisk denotes variable is significant at .05 level and double asterisk denotes variable is significant at .10. The variable categories in parenthesis are excluded to avoid dummy variable trap.

**Figure 1: Cluster Proportion of Respondents**