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

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This study extends biotechnology discourse to cover South Korea in the Asian sub-continent showing a marked difference in perceptions between traditional and GM foods. Factor analysis suggests South Koreans may treat foods that are locally produced and those with no artificial flavors or colorings preferentially to GM foods. Additionally, South Koreans have concerns about perceived risks related to biotechnology, and, given a choice, they may pay more to avoid GM foods. Cluster analysis results yielded four consumer segments: (*a*) ardent supporters of the attribute of "naturalness" in foods, (*b*) those apprehensive about biotechnology, (*c*) the food adventurous, and (*d*) information seekers about biotechnology.

Key Words: consumer perceptions, factor and cluster analysis, food attributes, genetic modification

Consumer acceptance of genetically modified (GM)[1] food products remains a critical factor in the potential growth of agricultural biotechnology. The current debate in the United States and Europe revolves around risks and benefits of biotechnology in the production of food and feed (Isserman, 2001). In this debate in developed Western countries, the proponents of biotechnology typically emphasize its ability to deliver an improved supply of food and medicine, while opponents argue biotechnology is an interference with nature that has unknown and potentially disastrous effects on health and the environment (Nelson, 2001).

However, American and European consumers are not the only players who matter in these controversies. For example, the Asian sub-continent is a region that has

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[1] Throughout this paper, the terms biotechnology, food biotechnology, agricultural biotechnology, and genetic modification are used interchangeably.

traditionally imported large quantities of conventional agricultural food products. Yet, Asian policies toward GM food are quite diverse. They range from fairly pro-GM stances held by China, which is one of the world's top producers of GM food, to those clearly opposed to it—for example, Japan, which would prefer not to important GM products (Teisl et al., 2003; Feffer, 2004).

South Korea stands somewhere in the middle regarding this debate. Recent statistics show that GM commodities marketed in South Korea come mainly from the United States [U.S. Department of Agriculture/Economic Research Service (USDA/ERS), 2004]. Yet, in 2001, due to pressures of consumer groups and the media, the South Korean government added a labeling protocol on its biosafety act, requiring any food product containing over 3% GM to be labeled. The exception is those finely processed foods where no trace of GM DNA exists (such as canola or corn oil). Ji-Young (2002) argues that by requiring such labels, consumers' interests are protected. Nevertheless, because of their concerns about consumers' reactions to biotechnology, food producers have felt compelled not to use GM in their products. Consequently, there are no products currently labeled as containing GM food in South Korea because of fears no consumers will buy them.

Whether these fears are founded is open to question. Very little is known about how South Korean consumers feel about GM foods. Only a few studies of acceptance of GM foods have explored the opinions of Asian consumers. For example, the Asian Food Information Center's 2002 and 2003 studies indicate consumers in the region generally have a positive attitude toward GM foods, though they demonstrate little knowledge on the broader GM issues. In contrast, in a study conducted through the South Korea Health Industry Development Institute, Kim et al. (2003) report dramatically negative attitudes of South Korean consumers due to doubts about safety of GM foods.

Public perceptions of GM foods and food in general are multidimensional and are shaped by various forces, preferences, and events. For instance, GM's product benefits (e.g., health and environmental benefits) are likely to have positive effects on attitudes, while perceived risks associated with GM foods are likely to have negative effects on consumer acceptance. Similarly, public trust and confidence in government (i.e., government's ability to protect consumer interests), the scientific community, and biotechnology companies are also likely to influence public perception of GM foods. Additionally, cultural expectations and institutions may influence opinions about GM foods. Other factors such as social, political, religious, and moral/ethical views of the public are also likely to affect consumers' perceptions and acceptance of GM products.

General findings from studies on public perceptions of biotechnology underscore the importance of relationships between perceived existing or potential risks/benefits and acceptance. A recent study by Moon and Balasubramanian (2001) suggests public acceptance of biotechnology is significantly related to consumers' perceptions of the risks and benefits derived from GM products, as well as their moral and ethical views. The findings also reveal that public views about corporations, trust in government, and knowledge of science and technology influence consumer attitudes

toward biotechnology. Moreover, findings reported by Baker and Burnham (2001) indicate consumers' cognitive variables (e.g., degree of risk aversion, opinions about GM foods) are linked to their acceptance of GM products.

Given the significance of this subject, a better understanding of public interests and concerns is desirable for sound private and public decisions relating to biotechnology and food in general. This analysis widens the scope of the biotechnology debate to include South Korean consumers' perceptions and attitudes toward GM and other food products. The primary objectives of the study are: (*a*) to identify and estimate the importance of the various factors driving consumer perception and acceptance of GM and other food products, (*b*) to identify and characterize distinct consumer segments in terms of their acceptance of GM and other food products, and (*c*) to analyze how consumers' socioeconomic and value characteristics are related to the principal factors affecting their acceptance of GM and other foods.

The remainder of this article proceeds with the following section on data and analytical methods, followed by the results from factor, cluster, and regression analyses. The final section offers concluding remarks.

Data and Analytical Methods

Data used in this study were collected using a personal interview survey administered in South Korea between April 10, 2003 and May 9, 2003. The Food Policy Institute at Rutgers University developed the survey questionnaires originally used in the United States. The South Korean survey included many of the same questions used in the U.S. survey on the same subject conducted in February and April 2003 by Hallman et al. (2003). Most of the questions in the two surveys were similar, with modifications to account for cultural differences and language.

The survey collected information concerning consumers' opinions about, knowledge of, and awareness of biotechnology and other food products. Also collected were data on consumers' attitudes toward personal health and safety in combination with their environmental concerns relating to GM foods. The survey elicited additional information relative to respondents' socioeconomic characteristics, political, moral, and religious views, as well as respondents' views on trust of scientists, farmers, environmentalists, media, medical professionals, industry, and government relating to biotechnology in their roles as information sources, expertise, telling the truth, and protecting society in general.

The South Korean Biosafety Clearing House (KBCH) commissioned Gallup South Korea to conduct the interviews. The survey sample included adults from across South Korea ranging in age from 20 to 59 years.[2] Interviewees were randomly drawn from seven regional large cities (e.g., Seoul), nine small cities (e.g., Kyounggi), and nine rural areas (e.g., Jeju). A stratified sample of interviewees was

[2] Note that 59 years of age is not an intentional cutoff point. It is simply the age of the oldest survey participants in our sample (i.e., the interviewers who conducted the interviews in person did not intentionally exclude, nor were they instructed to exclude, persons above the age of 59).

selected systematically based on the size of households. In cases where the preselected interviewee could not be interviewed, a replacement was picked from the same region based on sex and age characteristics. In executing the survey, interviewers briefly described the study, and then asked the interviewee to participate. Interviewees were given a pen (valued at $2 U.S.) for responding to the questionnaire. To minimize bias in data collection, interviewers attended an orientation session covering the survey method and content. Control over the interviewers was exercised by distributing and collecting questionnaires each day. The data were weighted according to age, gender, and education using data from the South Korean National Census. A total of 1,054 completed surveys were collected, representing a cooperation rate of 40% from selected interviewees with a sampling error of ±3.1% at the 95% significance level.

This analysis is based on responses to 18 questions relating to South Koreans' attitudes toward GM and other foods. In one set of the questions, respondents were asked to state whether they were in agreement or disagreement with a statement. In the other set, they were asked to rate the importance of certain attributes or characteristics of foods they eat.

In the case of the "agree/disagree" set of questions, a respondent's view on biotechnology was captured via the following question: "*Please tell me whether you tend to agree or disagree with the following statement about genetically modified food.*" [For example,] "*Serious accidents involving genetically modified foods are bound to happen.*" Possible responses were dichotomous, i.e., agree or disagree.[3] As scale measures for purposes of this analysis, the responses were coded as 1 for those disagreeing and 2 for those agreeing. A similar approach was adopted for responses to the statement "*I am usually willing to try new foods.*"

The question on rating importance of attributes or characteristics of food read as follows: "*Now I'd like to ask you about the kinds of things you consider important when deciding what to eat. For each of the following, please tell me what is important to you when deciding to eat. On a scale of 1 to 10, where 1 = not at all important, and 10 = extremely important, how important is it that* [insert food attribute/characteristic statement] *in deciding what to eat?*" Among the statements analyzed were: "*it is a food you've had before*," "*it is grown in South Korea*," "*it is a familiar brand*," etc. No rescaling was done on the questions relating to the respondent's view on importance of a food attribute. Raw coding on a scale of 1 to 10 was retained without undermining the metric scaling.

Principal components factor analysis (PCA) was used to reduce the 18 questions exploring public views on the subject to a smaller set of dimensions (factors). A standard latent root equal to one and a scree test were used to establish the number of factors to retain, followed by a confirmatory analysis to ensure internal reliability of the factors. Next, a two-stage cluster analysis (Punj and Stewart, 1993; Hair et al., 1992) was employed to identify clusters of respondents with similar views on GM

[3] Use of dichotomous data is allowable if the underlying metric correlations between the variables are moderate (0.7) or lower.

and others foods. ANOVA tests were applied to examine inter-cluster heterogeneity. Finally, a regression analysis was applied on the standardized factor scores obtained from principal component analysis to explore the relationship between the identified dimensions and the socioeconomic attributes of the consumers.

Empirical Results

Dimensions of Public Perceptions of GM and Other Foods

Table 1 presents the mean, standard deviation, and factor loadings[4] from the principal component factor analysis obtained after a Varimax rotation of consumer responses to the 18 questions exploring public perceptions on GM and other foods. Factors are ranked in order of the proportion of variance explained, and are labeled to reflect the latent stimuli underlying public perceptions on food. The estimated means of >6 and >1.2 on questions relating to the importance of food attributes and views on biotechnology, respectively, suggest relevance of the variables in defining the latent dimensions on the food issues explored. As reported in table 1, the analysis identified six core factors influencing public opinions on GM and other foods. Together, these factors accounted for 61% of the variance, and are summarized in the discussion below.

- FACTOR 1: *Importance of Naturalness in Food* (scale of 1–10, where 1 = not at all important and 10 = extremely important). This factor captures the importance South Korean consumers place on the naturalness attribute in food eaten—the foods containing neither preservatives nor artificial colorings. Additionally, this dimension suggests that some South Korean consumers place a premium on locally and organically grown food on eating decisions. To a lesser degree, this factor may be seen as reflecting a sense of attachment to locally (South Korean) produced foods. The mean scores of all the variables under this dimension averaged about 8, highlighting the strength of the latent stimuli, i.e., food naturalness and the characterizing variables. This is the most important of the six factors, accounting for approximately 21% of the variance.

- FACTOR 2: *Purchasing Incentives:* "*I will buy GM food if* ..." (1 = disagree, 2 = agree). This factor underscores the importance of incentives in influencing a consumer's purchasing decision. Although the purchasing incentives are specific to GM foods, they can equally apply to any commodity (i.e., the consumer will buy those items that will maximize utility). In this case, a consumer faced with a purchasing decision will basically consider whether the food is reasonably priced compared to other foods. Once the basic criterion is met, other secondary considerations based on preferences such as taste, food quality, or health will be subsequently factored in.

[4] Factor loadings represent both how the variables are weighted for each factor and the correlation between the variables and the factor.

Table 1. Varimax Rotated Factor Loadings: South Korean Consumer Attitudes Toward and Perceptions of GM and General Foods

Description	Mean (Std. Dev.)	Factors 1	2	3	4	5	6
FACTOR 1. Importance of Naturalness in Food (1 = not at all important, 10 = extremely important)							
< It doesn't contain artificial colors.	7.91 (2.20)	0.859					
< It doesn't contain artificial flavors.	7.70 (2.25)	0.843					
< It's produced organically.	7.59 (2.25)	0.757					
< It's grown in South Korea.	8.17 (2.04)	0.666					
FACTOR 2. Purchasing Incentives: "*I will buy GM food if ...*" (1 = disagree, 2 = agree)							
< I would buy GM food if it contained less pesticide residues than ordinary food.	1.54 (0.46)		0.803				
< I would buy GM food if it were grown in a more environmentally friendly way than ordinary food.	1.50 (0.46)		0.796				
< I would buy GM food if it tasted better than ordinary food.	1.67 (0.44)		0.787				
< I would buy GM food if it were cheaper than ordinary food.	1.74 (0.41)		0.727				
FACTOR 3. Importance of Convenience/Comfort in Food (1 = not at all important, 10 = extremely important)							
< It's easy to get.	7.12 (2.17)			0.758			
< It doesn't contain any ingredients you're allergic to.	6.33 (2.67)			0.664			
< It's a familiar brand.	7.11 (2.15)			0.558			
< It's a food you've had before.	7.04 (2.24)			0.550			
FACTOR 4. Fears About Biotechnology: Perceived Risks (1 = disagree, 2 = agree)							
< Serious accidents involving GM foods are bound to happen.	1.34 (0.39)				0.722		
< GM food threatens the natural order of things.	1.20 (0.38)				0.707		
< I would pay more for non-GM food.	1.38 (0.45)				0.618		

(continued . . .)

Table 1. Continued

Description	Mean (Std. Dev.)	Factors 1	2	3	4	5	6
FACTOR 5. Information Seeking About Biotechnology (1 = disagree, 2 = agree)							
< I would be prepared to take part in public discussions or hearings about biotechnology.	1.61 (0.44)					0.814	
< I would take time to read articles or watch TV programs on the advantages and disadvantages of biotechnology.	1.25 (0.40)					0.779	
FACTOR 6. New Foods Adventurism (1 = disagree, 2 = agree)							
< I am usually willing to try new foods.	1.61 (0.47)						0.964
Percent of total variance explained:		**20.6%**	**14.67%**	**7.87%**	**6.73%**	**5.87%**	**5.6%**
[Total Variance Explained by Factors 1–6 = 61.34%]							

For example, in addition to the initial criterion, consumers conscious of environmental and health-related issues would factor in relevant criteria pertaining to personal health and the environment. The high factor loadings [i.e., correlation coefficient between the variable(s) and the dimension] to buy GM foods are strongly associated with consumer purchasing incentives. Thus, a consumer is willing to buy a GM food if it has a better price, contains fewer pesticides, tastes better, and is produced in an environmentally friendly manner compared to the non-GM alternative. The mean of 1.74 on price reflects a strong consensus among the consumers that price is the first consideration in a purchasing decision. This is followed by food taste (mean = 1.67) and health (mean = 1.54), with the farming method consideration ("environmentally friendly," mean = 1.50) coming last. This factor is the second most important in our analysis, accounting for nearly 15% of the variance.

- FACTOR 3: *Importance of Convenience/Comfort in Food* (scale of 1–10, where 1 = not at all important and 10 = extremely important). Although explaining only about 8% of the variance, this factor captures the South Korean consumers' thought process about the foods they choose to eat. This dimension reflects the role of convenience and comfort aspects of food in eating decisions. The foods chosen must not only provide convenience to the consumer in terms of its availability or recognition (i.e., "familiar brand"), but at the same time must provide comfort in terms of being the typical food ("it is a food you've had before"), and have no allergy-causing ingredients. The fact that all the variables in this dimension loaded highly and had above-average mean scores (ranging from 6.33 to 7.12) emphasizes the importance of this factor for South Koreans when deciding what foods to eat.

- FACTOR 4: *Fears About Biotechnology: Perceived Risks* (1 = disagree, 2 = agree). This factor reflects South Korean public concerns about (unknown) risks associated with biotechnology. The dimension captures those issues that touch on public awareness about the motives of biotechnology. The perception of risks (from GM) to humans and the environment is at the heart of a negative public image about biotechnology (Nelson, 2001). If people are not well-informed, they may be likely to view the technology negatively, thus predisposing them to concerns about GM foods (Hallman et al., 2003, 2004). In the case of South Korean consumers, fears about risks associated with biotechnology are evidenced by the high factor loadings in situations where respondents felt "serious accidents are bound to happen," and their view that biotechnology may probably "threaten the natural order of things." The intensity of respondents' fears about biotechnology is further reflected by their willingness to pay more to avoid GM food products (mean = 1.38). In terms of overall perceptions about foods, this dimension may be comparatively less critical, as evidenced by the scores averaging < 1.5. This factor accounts for approximately 7% of the error variance.

- FACTOR 5: *Information Seeking About Biotechnology* (1 = disagree, 2 = agree). This factor highlights the quest for information on various biotechnology issues by the South Korean public. Consumers require information to make informed decisions; thus the high loadings associated with information-related activities (i.e., willingness to engage in public debates, reading and watching television programs on biotechnology) reveal that many consumers are unsure about their positions on biotechnology, and would like to be better informed. The survey responses suggest these consumers are seeking more information on various GM issues to arrive at well-thought-out and grounded positions. However, it is not necessarily true that those seeking information will be proponents of biotechnology. In fact, some may seek more information to lend support to a stance in opposition to biotechnology. On the other hand, there may be those genuinely seeking information to mitigate their fears about biotechnology due to many of the unknowns yet to be answered. This factor accounts for approximately 6% of the variance.

- FACTOR 6: *New Foods Adventurism* (1 = disagree, 2 = agree). This factor reflects enthusiasm among the respondents as expressed by their willingness to try new foods. Though the smallest of the six factors, this dimension may represent a segment of people within the South Korean public with a propensity to try new foods. Such information is likely to be useful for marketers introducing new products. This dimension does not imply that those consumers willing to try new foods are in favor of biotechnology (or any other food in particular). It only indicates this is a group willing to try new foods regardless of whether the food is genetically modified or otherwise. This factor accounts for about 6% of the variance.

Table 2. Characteristics of the Consumer Groupings Identified Through Cluster Analysis (means and standard deviations)

Dimensions/Factors: Food and Biotech Perceptions	Consumer Clusters: Biotechnology Apprehensives *N* = 203 (19%)	Food Naturalness Seekers *N* = 299 (28%)	Biotechnology Information Seekers *N* = 322 (31%)	Food Adventurers *N* = 230 (22%)	*F*-Statistic
FACTOR 1. Importance of Naturalness in Food	0.233 (0.821)	0.559 (0.617)	0.318 (0.607)	!1.378 (0.697)	418.84*
FACTOR 2. Purchasing Incentives: "*I will buy GM foods if ...*"	!0.343 (1.102)	0.379 (0.783)	0.046 (0.985)	!0.253 (1.005)	29.65*
FACTOR 3. Importance of Convenience/Comfort in Food	!0.178 (0.980)	!0.342 (0.993)	0.425 (0.870)	0.007 (0.986)	36.51*
FACTOR 4. Fears About Biotechnology: Perceived Risks	1.549 (0.694)	!0.441 (0.526)	!0.442 (0.618)	!0.175 (0.771)	491.57*
FACTOR 5. Information Seeking About Biotechnology	0.072 (1.014)	!0.769 (0.572)	0.818 (0.723)	!0.209 (0.878)	217.53*
FACTOR 6. New Foods Adventurism	!0.164 (1.033)	!0.045 (0.980)	0.014 (1.005)	0.183 (0.966)	4.65*

Notes: Values in the table are means of standardized factor scores, with standard deviations in parentheses. *F*-statistics are from ANOVA of inter-cluster differences, where an asterisk (*) denotes significance at the 5% level or better.

Cluster Analysis

The means and standard deviations of the standardized factor scores and the number of respondents in each cluster are reported in table 2. The analysis identified four clusters on the basis of importance placed by respondents on the factors identified in the principal component factor analysis. The results were obtained by subjecting individual cases to non-hierarchical clustering. The number of clusters was determined on the basis of interpretability and external validity using the criteria of increases in cluster coefficients as clusters merge. The ANOVA tests suggest significant inter-group heterogeneity on the importance South Korean consumers placed on each of the six factors. The four consumer groupings are identified below and are named to describe the dominant issue characterizing each group (reflected by mean factor scores). For example, respondents in cluster one, Biotechnology Information Seekers, are significantly different from the other clusters in that they were more likely to seek out information on various biotechnology issues ($F[3, 1{,}050] = 217.53$, $p < 0.05$), as shown by a relatively higher mean score (0.818) on information seeking compared to the other clusters.

- *Biotechnology Information Seekers.* This group is comprised of respondents eager to learn more about biotechnology (note the high mean score of 0.818 for factor 5).

Close to a third (31%) of the respondents belong to this group, making it the largest of the four consumer clusters. The result is important as it brings into focus the overall public awareness about biotechnology. A consumer may be seeking more information on biotechnology to firm his or her opinions about the technology. The data suggest that South Koreans keen to obtain more information to enhance their understanding of the subject are less likely to be fearful about biotechnology. Seeking information about biotechnology does not deter individuals in this group from trying new foods, nor does it make them less conscientious in their purchasing decisions. On the other hand, food naturalness and comfort aspects are critical considerations in the eating decisions for this group.

▪ *Food Naturalness Seekers.* This is the second largest consumer group, comprising 28% of the respondents. The group may be described as conservative, preferring naturalness attributes in the foods they eat. Food Naturalness Seekers attach strong feelings to South Korean produced foods, preferably locally and organically produced. Also, this group is cognizant of product incentives—a basic consumer purchasing behavior. In their decisions on what foods to eat, members of this group do not place much importance on comfort. Moreover, they are less curious about new foods and are less inclined to seek information about biotechnology.

▪ *Food Adventurers.* As the third largest group, Food Adventurers comprise 22% of the respondents. For this group, concerns about biotechnology and a lack of interest in more information about the technology does not diminish their desire to try new foods. In fact, the defining characteristic of this group of consumers is simply their curiosity in trying new foods, irrespective of whether the food is GM or otherwise. It makes sense for Food Adventurers to underplay the importance of the food naturalness aspect as a factor in trying a new food. The quest to try new foods also minimizes the impact of purchasing incentives (for example, the cost of the food is not a deterrent) for a food adventurous person. The motivation to try such new foods will be enhanced if such foods have a convenience characteristic, such as being easily available or having no allergy-causing ingredients.

▪ *Biotechnology Apprehensives.* This is the smallest consumer group, with only 19% of the respondents. Individuals in this group view biotechnology experiments as a precursor to serious disasters; moreover, they interpret biotechnology as an interference with the natural order of things. The group may represent those consumers predisposed to risk aversion due to unproven risks associated with biotechnology. Such consumers may be opposed to biotechnology-derived foods, even though such foods may have potential superior benefits compared to alternatives (Hossain et al., 2003). Given a choice, those in this group would prefer that the foods they eat be grown and produced in South Korea, and these individuals will not try new foods. However, consumers in this group are keenly seeking information about biotechnology. Furthermore, the results show that consumers with fears about biotechnology tend to downplay the comfort food aspect, and basic purchasing

behavior considerations relating to GM foods. The fears about biotechnology may be somewhat compounded as a result of the media coverage in South Korea (which has depicted GM foods and the technology negatively) and by doubts about the safety of genetically modified foods (Thomson and Dininni, 2003; Kim et al., 2003).

Explaining Factors Underlying Public Perceptions of GM and Other Foods

Multiple regressions were carried out on the six factors identified in the principal factor analysis. The regression analysis identifies and estimates the relationships between the respondents' perceptions about foods and biotechnology, their socioeconomic attributes, and value characteristics. In addition to profiling the respondents in terms of their perceptions toward food and biotechnology, the regression results may assist policy makers, food marketers, and food manufacturers with segmentation information in the development of risk communication strategies and general education about food biotechnology. Table 3 presents the socioeconomic variables used in the regression analysis and their relevant statistics. The dependent variables in the regression analysis are the standardized factor scores that were obtained from the principal component analysis. As observed from the regression results reported in table 4, the adjusted R^2 ranged between 0.02 and 0.11, with the F-statistic for model performance being significant across all the models. Results on significant factors influencing the six dimensions about consumers' views on GM and other foods are summarized below.

Importance of Food Naturalness

Importance of food naturalness stands out as the most important factor associated with South Koreans' perceptions on food relating to their eating decisions. The results indicate that the variables associated with age groups 30–49 years and 50–59 years, high school and college education, food production knowledge, awareness of the presence of GM food in supermarkets, healthy eating, vegetarianism, organic food buying, and support of GM food labeling, had a positive effect on the food naturalness attribute, all with significance at the 5% level.

The age effect on this factor was in line with a prior expectation that older consumers (30–59 years) compared to young consumers (20–29 years) would be more likely to consider food naturalness as an important factor in their eating decisions. However, the results related to education were mixed, with respondents who had graduated high school placing less importance on food naturalness, while college graduates considered this aspect important. At a 10% level of significance, the results show that rural residents compared to those in large cities considered the food naturalness attribute important in their eating decisions. These findings may imply that when introducing products with naturalness attributes into the South Korean market, the target population should include young individuals aged 20–29, high school graduates, and medium/large city residents.

Table 3. Definitions and Descriptive Statistics of Socioeconomic Variables

Variable	Definition	Mean	Std. Dev.
FEMALE	=1 if respondent is female; 0 otherwise	0.50	0.50
YOUNG [a]	=1 if respondent is 20–29 years of age; 0 otherwise	0.22	0.42
MIDAGE	=1 if respondent is 30–49 years of age; 0 otherwise	0.63	0.48
MATAGE	=1 if respondent is 50–59 years of age; 0 otherwise	0.15	0.35
LTHIGHSC [a]	=1 if respondent's level of education is below high school; 0 otherwise	0.59	0.49
HIGH$COL	=1 if respondent is a high school graduate and has some college education; 0 otherwise	0.11	0.31
GRAD$COL	=1 if respondent is a college graduate or above; 0 otherwise	0.30	0.46
INCLT$20 [a]	=1 if respondent is in low-income group (less than 20 million Won); 0 otherwise	0.22	0.41
INC20$40	=1 if respondent is in middle-income group (20–40 million Won); 0 otherwise	0.56	0.50
INCAB$40	=1 if respondent is in high-income group (above 40 million Won); 0 otherwise	0.22	0.42
KNW$FPRD	=1 if respondent rates self-understanding of how food is produced and grown to be very good to excellent; 0 otherwise	0.62	0.49
KNOWSCTEC	=1 if respondent rates self-understanding of science and technology to be very good to excellent; 0 otherwise	0.19	0.39
GM$NOWMA	=1 if respondent is aware that food containing GM ingredients is now in supermarkets; 0 otherwise	0.51	0.50
EAT$HEALTHY	=1 if respondent eats to primarily stay healthy; 0 otherwise	0.71	0.45
VEGETARIAN	=1 if respondent is a vegetarian; 0 otherwise	0.52	0.50
LABEL$GM	=1 if respondent prefers GM foods to be labeled; 0 otherwise	0.96	0.20
ORGA$BUY	=1 if respondent buys organic labeled foods frequently; 0 otherwise	0.12	0.32
LARGE$CITY [a]	=1 if respondent resides in large city; 0 otherwise	0.48	0.50
MED$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
LIBERAL	=1 if respondent self-identifies as liberal; 0 otherwise	0.22	0.42
CONSERV	=1 if respondent self-identifies as conservative; 0 otherwise	0.30	0.46
CENTRIST [a]	=1 if respondent self-identifies as in-between liberal and conservative; 0 otherwise	0.41	0.49

[a] These variables were dropped during estimation to avoid the dummy variable trap.

Purchasing Incentives: "I Will Buy GM Food if ..."

Age and political party affiliation emerged as the important factors positively influencing decisions on whether to buy GM foods, at the 5% and 10% significance levels, respectively. People in the age groups of 30–49 years and 50–59 years had a positive impact on this factor compared to those in the 20–29 year age group. Similarly, the results also indicate that the conservatives impacted positively the factor on purchasing incentives for GM products compared to centralists. Based on these findings, the needs and characteristics of younger age group consumers and centralists should be considered when providing purchasing incentives for GM products.

Importance of Convenience/Comfort in Food

As can be seen from table 4, variables associated with healthy eating, vegetarianism, and organic purchasing frequency positively impacted the convenience food aspect consideration by South Koreans at the 5% level of significance. In contrast, this factor was negatively influenced by income and awareness of the presence of GM food products in the supermarket, again at the 5% level. The influence of education on this factor was mixed. High school graduates placed importance on the food convenience aspect, but college graduates did not. The latter outcome was unexpected, based on the general behavior of the majority of those with high incomes. For such individuals, time is a valuable resource; often, people with high incomes spend little or no time in food preparation and eat out more often, thus making food convenience a factor in their eating decisions (Stewart et al., 2004).

Fears About Biotechnology: Perceived Risks

Compared to those in the low-income group (< 20 million Won), survey respondents in the middle-income group (20–40 million Won) are fearful about biotechnology (at the 5% significance level). On the other hand, consumers not fearful about biotechnology were those aware of the presence of GM foods in supermarkets and those supporting GM food labeling, versus those who are not aware and those not supporting GM food labeling (at the 5% significance level). These findings would be helpful to policy makers in designing risk communication strategies associated with GM foods and targeting consumer segments for biotechnology education.

Information Seeking About Biotechnology

Survey results indicate that those with high incomes did not seek information about biotechnology compared to those with low incomes (at the 10% level of significance). Similarly, those with excellent knowledge about science and technology, those who are aware of the presence of GM foods in supermarkets, and those who

Table 4. Regression Results: Socioeconomic Variables and Factors Affecting South Korean Consumer Perceptions of Food in General and Biotechnology

	Food and Biotechnology Dimensions (Factors)		
Variable Description	1. Food Naturalness	2. Purchasing Incentives	3. Food Convenience
Constant	!1.340 (!7.22)	!0.405 (!2.06)	!0.753 (!4.05)
Middle age, 30!49 years [vs. young, 20!29 years]	0.197** (2.43)	0.243** (2.82)	—
Mature age, 50!59 years [vs. young, 20!29 years]	0.346** (3.09)	0.211* (1.77)	—
High school education [vs. less than high school]	!0.135** (!2.59)	—	0.123** (2.36)
College education [vs. less than high school]	0.135** (2.58)	—	!0.122** (!2.34)
Middle income [vs. low income]	—	—	—
High income [vs. low income]	—	—	!0.235** (!2.41)
Food production knowledge	0.161** (2.45)	—	—
Science and technology knowledge	—	—	—
Aware of presence of GM foods in the supermarket [vs. not aware]	0.160** (2.60)	—	!0.185** (!3.01)
Eat primarily to stay healthy [vs. not eating primarily to stay healthy]	0.158** (2.25)	—	0.141** (1.99)
Vegetarian [vs. non-vegetarian]	0.236** (3.73)	—	0.476** (7.53)
Organic foods purchasing [vs. not]	0.527** (3.45)	—	0.529** (3.45)
Label GM products [vs. not]	0.324** (3.43)	—	—
Small city residence [vs. large city]	—	—	—
Rural residence [vs. large city]	0.195* (1.88)	—	—
Liberal [vs. Centrist]	—	—	—
Conservative [vs. Centrist]	—	0.227** (2.97)	—
Adjusted R^2	0.10	0.03	0.11
Model F-Statistic	7.34	2.45	7.57

Notes: Single and double asterisks (*) denote significance at the .10 and .05 levels, respectively. The values in parentheses are t-ratios. The variable categories in brackets are excluded to avoid the dummy variable trap.

Table 4. Extended

	Food and Biotechnology Dimensions (Factors)		
Variable Description	4. Fears About GM Foods	5. Information Seeking About Biotechnology	6. New Foods Adventurism
Constant	0.368 (1.88)	0.535 (2.77)	0.244 (1.24)
Middle age, 30!49 years [vs. young, 20!29 years]	—	—	—
Mature age, 50!59 years [vs. young, 20!29 years]	—	—	—
High school education [vs. less than high school]	—	—	—
College education [vs. less than high school]	—	—	—
Middle income [vs. low income]	0.189** (2.18)	—	!0.169* (!1.93)
High income [vs. low income]	—	!0.198* (!1.95)	!0.296** (!2.86)
Food production knowledge	—	—	—
Science and technology knowledge	—	!0.199** (!2.43)	—
Aware of presence of GM foods in the supermarket [vs. not aware]	!0.216** (!3.32)	!0.150** (!2.34)	—
Eat primarily to stay healthy [vs. not eating primarily to stay healthy]	—	—	—
Vegetarian [vs. non-vegetarian]	—	—	!0.141** (!2.10)
Organic foods purchasing [vs. not]	—	—	—
Label GM products [vs. not]	!0.185* (!1.85)	!0.363** (!3.68)	!0.190* (!1.89)
Small city residence [vs. large city]	—	—	0.131* (1.90)
Rural residence [vs. large city]	—	—	0.013 (0.12)
Liberal [vs. Centrist]	—	—	!0.192** (!2.32)
Conservative [vs. Centrist]	—	—	—
Adjusted R^2	0.02	0.05	0.02
Model F-Statistic	2.17	3.77	2.17

support GM food labeling did not seek information about biotechnology. Based on these findings, consumers lacking information on biotechnology, or with a low level of scientific knowledge, may be more interested in acquiring additional information about biotechnology.

New Foods Adventurism

Those survey respondents residing in small cities expressed a greater willingness to try new foods compared to large city dwellers (at the 10% level of significance). Individuals in the middle- and high-income groups, as well as vegetarians and those supporting labeling of GM foods, are not willing to try new foods (at the 5% significance level). Also, liberals compared to centrists were not willing to try new foods (at the 5% significance level). These results imply that the new food marketers should focus on those consumers with low incomes, non-vegetarians, and large city dwellers.

Concluding Remarks

Although biotechnology has revolutionalized agricultural production, it still remains a controversial subject globally. Biotechnology proponents (primarily industry) have maintained that GM food is substantially equivalent to conventional food. However, the results from this study suggest that many South Koreans perceive a marked difference between traditional and GM foods. Based on our factor analysis results, South Korean consumers may treat foods that are locally produced and those without artificial flavors or colorings preferentially to GM foods. Moreover, many South Koreans have expressed concerns about the risks of biotechnology and, given a choice, they may pay more to avoid genetically modified foods.

Cluster analysis results suggest that South Korean public opinions about GM and other foods may be broken down into four consumer segments: (*a*) consumers who are ardent supporters of the naturalness attribute of foods, (*b*) consumers who are apprehensive about biotechnology, (*c*) those who are food adventurous (willing to try new foods), and (*d*) consumers seeking more information on biotechnology. Such consumer segmentation may be useful in designing marketing strategies. Regression results show that consumer socioeconomic and value attributes influence perceptions about GM and other foods.

Overall, the results of this study indicate, at least in the short run, there will be considerable divergence of opinion within the South Korean public in terms of how GM foods are viewed relative to other foods. Findings also show that large segments of South Koreans know little about biotechnology issues. In this regard, public education could play a constructive role in providing information to help consumers make decisions about the desirability of GM foods.

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