

Attitudes about Genetically Modified Foods among Korean and American College Students

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A recent survey of American and Korean undergraduate students yielded some notable differences in attitudes toward genetically modified (GM) foods. Although the majority of both groups were concerned about health risks from GM foods, the proportion of Korean students (87%) was much higher than American students (58%). Women and students who were more likely to invest in health through nutrition and exercise were also more likely to be concerned about GM foods. The differences in attitudes may be partially attributable to recent negative media exposure in Korea toward GMOs.

Key words: consumer attitudes, consumer demand, food consumption, genetically modified organisms.

In 2001, South Korea mandated labeling of foods containing genetically modified (GM) ingredients. The issue of labeling in the United States remains largely contentious due to uncertainty regarding consumer response to GM food content information. It is possible that information provided through labeling and recent negative press in Korea may have reduced acceptance of GM foods among Korean consumers. This study compares attitudes among college students in a Korean and American university to assess differences in acceptance and to provide some insight into the characteristics of students who are more or less willing to accept genetic modification.

Among food safety issues, South Koreans rank biotechnology last among sources of risk, including pesticides, mishandling, artificial additives, and microbial contamination (Kim, Jung, Park, Kim, & Kyung, 2001). This despite a media furor over the discovery of genetically modified soybeans in tofu in 1999 (Yoo, 1999; Yun, 1999), which spurred a response by the Korea Consumer Protection Board and ultimately led to labeling of foods containing genetically modified soybeans and corn. Korean tofu is currently differentiated between domestic and internationally grown soybeans (which presumably contain genetically modified beans), allowing consumers to choose between lower-priced genetically modified and higher-priced non-GM foods.

Consumer attitudes about GM foods are very important, because GM foods are artificial, unfamiliar products (even though biotechnology is widely adapted in food production) and GM foods may be related to future health risk. When consumers are unable to adequately assess subjective health risks due to unfamiliarity, acceptance of these foods may be reduced by labeling and among consumers who care most about health. In

fact, mandatory GMO labeling in Korea has led many producers to use only non-GM sources in response to negative consumer attitudes toward GMOs among Korean consumers following the highly publicized GM tofu scare.

Previous comparisons of consumer attitudes toward GM foods among Asian and US consumers have yielded mixed results. Consumers in the United States seem the least concerned about negative health effects from GM foods, whereas consumers in Europe and Asia appear more concerned (Chern, Rickertsen, Tsuboi, & Fu, 2002). Chinese consumers, on the other hand, seem completely indifferent to or even positive toward GM content (Li, Curtis, McCluskey, & Wahl, 2002), and Japanese consumers also are relatively willing to accept food produced through biotechnology (Hoban, 1996). There is also little consensus regarding the relationship between health concern in general and attitudes toward GM foods.

Concern over GM content arises from a consumer's assessment of potential risk to future health. This makes genetic modification a somewhat unique food safety issue, because many traditional food safety issues (e.g., microbial illnesses) involve more immediate risk to health. In addition, the complexity of genetic modification may lead to a wide potential difference between subjective and objective risk assessment—consumers who are perhaps not as sophisticated may react strongly to a relatively minor health risk. Past studies of opinions related to recombinant bovine growth hormone (Grobe, Douthitt, & Zepeda, 1999) have found that younger, less educated consumers tended to perceive more risk from milk from rBGH-treated cows—milk which is scientifically indistinguishable from untreated cow milk. However, those who are most likely to misperceive

technically complex risks may also be least likely to care about risks that impact future health (Huston & Finke, 2003).

This study compares attitudes toward genetically modified foods among Korean and American college students and further compares attitudes among students who are more future- and more present-oriented regarding health. These data are of particular interest, given that Korean students were exposed to GM labeling and to a broader media controversy regarding unlabeled foods in 1999 (Gwak, 1999), whereas American students may have been exposed to more limited specific information on GM food content. These data will also reveal the extent to which exposure to this information may have disparate affects among students who are more and less concerned about future health risks.

Data and Analysis

Data was collected from samples of 257 American students from an undergraduate psychology course at a large Midwestern university and 319 Korean college students in an introductory human environmental science class, yielding a sample that consists primarily of undergraduates of roughly equal proportion of men and women and heterogeneous in terms of anticipated major (Table 1). Although not representative of the general population in both countries, a survey of college students offers some insight into attitudes and concerns among younger, more educated consumers who may have a greater awareness of the issues related to genetic modification than the general population. Thus, this sample presents a convenient and appropriate means of comparing differences in attitudes between consumers who may have been exposed to different types of GMO information. The Korean sample was slightly older, as military service is mandatory among males prior to entering college. The Korean survey was translated from English and is identical to the American survey.

The survey included a number of questions related to health, including the following question about genetically modified foods: "How concerned are you about health risks from genetically modified foods? (a) very concerned, (b) somewhat concerned, (c) a little concerned, (d) not concerned at all."

A relatively low proportion of the combined sample (6.9%) was very concerned about the health risks from GMOs, while 30.2% were somewhat concerned, 36.5% were a little concerned, and 26.4% were not concerned at all (Table 2). However, 13.5% of the Korean sample was not concerned at all about GMOs compared to

Table 1. Descriptive statistics for the sample (N = 576).

Categorical variables	Frequency (%) ^a
Gender	
Male	248 (43.1)
Female	328 (56.9)
Urbanization	
Urban	216 (37.6)
Suburban	182 (31.7)
Small town/rural	176 (30.7)
Watch diet to prevent disease	
Strongly agree	23 (4.0)
Agree	218 (38.0)
Disagree	279 (48.6)
Strongly disagree	54 (9.4)
Nationality	
American	257 (44.6)
Korean	319 (55.4)
Reason for exercise	
Health	198 (36.6)
Others	343 (63.4)
Health risk concern about GMO	
Very concerned	40 (6.9)
Somewhat concerned	174 (30.2)
A little concerned	210 (36.5)
Not concerned at all	152 (26.4)

^a Frequency may differ due to no response.

42.4% of students from the American sample. A much larger proportion of Korean students (46.1%) were either very or somewhat concerned about GMOs, compared to only 26.1% of American students.

In order to better understand the nature of concern about GMOs, responses to two other questions directly relate to a desire to improve future health and are included in this analysis. The questions were: "How often do you exercise for at least thirty minutes in an average week? (a) 3–5, (b) 1–2, (c) never;" followed by: "The most important reason I exercise is (a) appearance, (b) health, (c) socializing, (d) other." Respondents who exercised 3–5 times per week for health were then grouped together as a dichotomous interaction variable. Just over a third (36.6%) of the respondents in the combined sample exercised 3–5 times a week for health.

The second question in the survey specifically related to concern about future health was: "I watch what I eat to reduce the chance that I will get cancer, have a heart attack, or suffer another diet-related disease when I get older: (a) strongly agree, (b) agree, (c) disagree, (d) strongly disagree."

Table 2. Association between demographic variables, attitudes about health, and GMOs.

		How concerned are you about health risks from genetically modified foods?			χ^2
		Concerned	Not concerned at all	Total	
Gender	Male	164 (66.1)	84 (33.9)	248	12.551** (df = 1)
	Female	260 (79.3)	68 (20.7)	328	
	Total	424 (73.6)	152 (26.4)	576	
Nationality	American	148 (57.6)	109 (42.4)	257	61.336*** (df = 1)
	Korean	276 (86.5)	43 (13.5)	319	
	Total	424 (73.6)	152 (26.4)	576	
Urbanization	Urban	173 (80.1)	43 (19.9)	216	10.991** (df = 2)
	Suburban	119 (65.4)	63 (34.6)	182	
	Small town/rural	130 (73.9)	46 (26.1)	176	
	Total	422 (73.5)	152 (26.5)	574	
Reason for exercise	Health	157 (79.3)	41 (20.7)	198	6.949** (df = 1)
	Others	236 (68.8)	107 (31.2)	343	
	Total	393 (72.6)	148 (27.4)	541	
Watch diet to prevent disease	Strongly agree	16 (69.6)	7 (30.4)	23	30.426** (df = 3)
	Agree	169 (77.5)	49 (22.5)	218	
	Disagree	215 (77.1)	64 (22.9)	279	
	Strongly disagree	23 (42.6)	31 (57.4)	54	
	Total	423 (73.7)	151 (26.3)	574	

* $p < .10$; ** $p < .05$; *** $p < .01$.

Only 4% of respondents strongly agreed that they watched what they eat to reduce probability of diet-related diseases, while 38% agreed, 48.6% disagreed, and 9.4% strongly disagreed. The relatively low concern about diet-related disease may be a function of the age of the sample.

It is hypothesized that there is a difference in concern about GMOs among Korean and American students, and that in general those who are more concerned about future health risks from foods and those who engage in exercise to improve future health will be more likely to be concerned about health risks from genetically modified foods. It is further hypothesized that students from smaller towns or rural areas will be less concerned about genetically modified foods. Gender is also included to account for possible a possible difference in concern between men and women.

Results

According to the cross tabulation analysis results, concern about health risks from genetically modified foods differs by gender, race, urbanization, exercise frequency, and those who watch what they eat to prevent future disease. Females are more concerned about health risks from GMOs than males. Koreans are more concerned

about health risks from GMOs than Americans. Suburban residents are less concerned about health risk from GMOs than those who live urban and small town/rural areas. Students who exercise to maintain or improve their health are more concerned about health risks from GMO than others, and those who do not watch their diet to prevent future disease are less concerned about health risks from GMOs than others.

With this result, we can expect an American male who lives in a suburban area, does not watch his diet to prevent future disease, and exercises for reasons other than health (or does not exercise frequently) to be less concerned about health risks from GMO, whereas a Korean female who lives in either urban or small town/rural areas, exercises for health, and watches her diet to prevent future disease will be more concerned about health risks from GMOs.

Overall, gender and race are strongly associated with concern over health risks from GMOs. To look at the pure effect of gender and race, another cross tabulation analysis was conducted controlling for gender and race. Although a large and statistically significant gender difference exists among American students' concern about genetically modified foods, there appears to be no difference between Korean men and women. More than

Table 3. Association between gender and health risk concern for GMO, controlling for nationality.

Gender		How concerned are you about health risks from genetically modified foods?			χ^2
		Concerned	Not concerned at all	Total	
American	Male	63 (48.1)	68 (51.9)	131	9.865*** (df = 1)
	Female	85 (67.5)	41 (32.5)	126	
	Total	148 (57.6)	109 (42.4)	257	
Korean	Male	101 (86.3)	16 (13.7)	117	0.006 (df = 1)
	Female	175 (86.6)	27 (13.4)	202	
	Total	276 (86.5)	43 (13.5)	319	

* $p < .10$; ** $p < .05$; *** $p < .01$.

Table 4. Association between watching one's diet to reduce health risks and concern for GMO, controlling for nationality.

Watch diet to reduce health risks		How concerned are you about health risks from genetically modified foods?			χ^2
		Concerned	Not concerned at all	Total	
American	Strongly agree	13 (72.2)	5 (27.8)	18	10.353* (df = 1)
	Agree	63 (61.2)	40 (38.8)	103	
	Disagree	62 (59.0)	43 (41.0)	105	
	Strongly disagree	10 (32.3)	21 (67.7)	31	
	Total	148 (57.6)	109 (42.4)	257	
Korean	Strongly agree	3 (60.0)	2 (40.0)	5	24.552*** (df = 3)
	Agree	106 (92.2)	9 (7.8)	115	
	Disagree	153 (87.9)	21 (12.1)	174	
	Strongly disagree	13 (56.5)	10 (43.5)	23	
	Total	275 (86.8)	42 (13.2)	317	

* $p < .10$; ** $p < .05$; *** $p < .01$.

half of American males surveyed were unconcerned about GMOs, while less than a third of American women were not concerned (Table 3). A much smaller proportion of Koreans (roughly one seventh) were not concerned about GMOs, and there was no statistical difference between men and women. There appears to be a clear difference in concern about GM foods between American male and female students.

Although a much larger proportion of American students are not concerned about the health risks from genetically modified foods, in general a greater proportion of both Korean and US students who watch what they eat to reduce risks to future health were concerned about GMOs (Table 4). The majority of Korean students (91%) did not choose either of the more emphatic responses (strongly agree or disagree) related to watching their diet to reduce health risks, compared to 81% of American students, and in general students from both countries who were not at all concerned about the healthfulness of their diet were also the least concerned about risks from GMOs. The proportion of American students who agreed that they watched their diet due to future health risks who were concerned about health

risks was greater (61.2% vs. 59.0%) than students who disagreed; similarly, the proportion of Korean students who watch what they eat (92.2% vs. 87.9%) were more concerned about GMOs.

The relationship between concern for long-term health and acceptance of GM foods was mirrored in the descriptive comparison (Table 5) of those who exercise frequently for health reasons and those who either exercise for other reasons or do not exercise frequently. Among American students, roughly half of those who did not exercise for health (51.8%) were concerned about risks from GM foods. However, over two thirds (67.0%) of those who exercise frequently for health were concerned about risks from genetically modified foods. Among Korean students, 89.1% who exercise for health were concerned about risks from genetically modified foods, whereas 84.4% of those who did not exercise for health were concerned about GM foods. The difference in concern over risks from GMOs between those who did and did not exercise for health was statistically significant for American students, but not quite significant for Korean students.

Table 5. Association between reason for exercise and health risk concern for GMOs, controlling for nationality.

How concerned are you about health risks from genetically modified foods?					
Reason for exercise		Concerned	Not concerned at all	Total	χ^2
American	Health	59 (67.0)	29 (33.0)	88	5.414* (df = 1)
	Others	85 (51.8)	79 (48.2)	164	
	Total	144 (57.1)	108 (42.9)	252	
Korean	Health	98 (89.1)	12 (10.9)	110	1.28 (df = 1)
	Others	151 (84.4)	28 (15.6)	179	
	Total	249 (86.2)	40 (13.8)	289	

* $p < .10$; ** $p < .05$; *** $p < .01$.

Table 6. Multinomial logistic regression results for health risk concern about GMOs.

Effect	-2 Log likelihood of reduced model	χ^2	df	Sig.
Intercept	190.291 ^a	0.000	0	
Gender	197.169	6.877	1	.009
Nationality	229.364	39.073	1	.000
Watch diet to prevent disease	208.410	18.119	3	.000
Reason for exercise	198.047	7.756	1	.005
Urbanization	190.434	0.143	2	.931

Model fitting information -2 log (L) intercept only model = 281.612; final model = 190.291; $\chi^2 = 91.321$, $df = 9$, $p = .000$; Nagelkerke $R^2 = 0.177$.

Classification		Predicted				
		Concerned	Not concerned at all	Percent correct		
Observed	Concerned	356	34	91.3%		
	Not concerned at all	98	50	33.8%		
	Overall percentage	84.4%	15.6%	75.5%		
Concerned vs. others ^a		B	SE B	Wald	df	Exp(B)
Intercept		0.677	0.398	2.894	1	
Gender	Male	-0.582**	0.222	6.835	1	0.559
Nationality	American	-1.477***	0.246	36.049	1	0.228
Watch diet to prevent disease	Strongly agree	1.517*	0.599	6.408	1	4.560
	Agree	1.429***	0.358	15.980	1	4.176
	Disagree	1.344***	0.347	15.001	1	3.834
Reason for exercise	Health	0.643**	0.235	7.478	1	1.903
Urbanization	Urban	-0.086	0.281	0.093	1	0.918
	Suburban	-0.088	0.262	0.112	1	0.916

^a The reference category is not concerned at all.

* $p < .10$; ** $p < .05$; *** $p < .01$.

Table 6 presents results of a logistic regression analysis, using concern over GM foods as a dichotomous dependent variable coded as one if the respondent has some concern over risks from GMOs (84.4% of combined sample) or zero if the respondent has no concern at all (15.6% of combined sample). Factors hypothe-

sized to contribute to acceptance of GM foods were gender, nationality, general concern for health (through watching one's diet or exercising for health), and urbanization. As expected, American students were significantly less likely to express concern about the negative health effects of GM foods. There was also a significant

association between concern for health in general and concern for the health effects of GM foods. Compared to those who strongly disagreed, those who watched their diet to prevent diet-related disease were more likely to be concerned about GMOs. Respondents who exercised for health were also more likely than those who did not exercise for health to be concerned about GMOs. Surprisingly, students who grew up in urban or suburban areas were not significantly more or less concerned about GMOs than those who grew up in rural areas.

Conclusion

Korean students, who may have received more information regarding GMOs both in the popular press and through product labeling, clearly were more concerned about the health risks than American students. Much of this information, particularly in the popular press, has focused on the possible negative consequences of GM foods. Korean farmers have benefited from labeling as a means of differentiating domestic products as GMO free, which may reduce the incentive of organized agriculture and the food industry to portray genetic modification in a positive light. Because much of the media coverage on GMOs has been negative (e.g., portraying genetically modified tofu as a public health threat), it may be concluded that mass media does play an important role in consumer attitudes toward GMOs.

Among both American and Korean student respondents, both a greater expressed willingness to watch one's diet to improve long-term health and active investment in health through exercise were associated with increased concern about the negative consequences of GM foods. The effect appears to be stronger among American students than among Korean students based on descriptive results. Although more scientific study is necessary, this result may distinguish genetic modification as a unique food safety issue. Because genetic modification is perceived as a possible long-term health risk, those consumers who are more forward thinking and willing to engage in preventive health behaviors may be more likely to avoid GM foods in a supermarket. Unlike those consumers who were most likely to respond negatively to the Alar scare or rBGH-treated milk (Grobe et al., 1999), those concerned about genetic modification may be demographically similar to those who traditionally invest in health capital—higher income, female, and more educated. Although level of education and income are essentially held constant in a survey of college students, the positive relationship

between a concern for future health and concern for genetically modified foods would suggest that GMOs are seen as a possible risk to future health among this group of young consumers. Further research is needed into the demographic characteristics of consumers most likely to avoid GMOs.

The response of US consumers to GM labeling is uncertain; however, it will likely depend on the portrayal of biotechnology by the media and through the food industry. Because the US food industry has a greater incentive to promote the positive aspects of biotechnology, it is possible that American consumers will not be as concerned about GM foods as Koreans. Proactive educational efforts and a partnership between the biotechnology industry, government agencies, universities, and independent groups that visibly support the use of biotechnology could influence consumer acceptance of biotechnology in the United States (Hoban, 1997). It is possible that without these efforts, the ability to consumers to make rational food choices (particularly among those consumers who care the most about health) may be compromised by the uncertain and technically complex nature of the perceived risk.

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