CONSUMER PERCEPTION ON GENETICALLY MODIFIED SALMON: THE CASE OF SOUTHEASTERN NORTH CAROLINA

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ABSTRACT

Consumer Perception of Genetically Modified Salmon:

The Case of Southeastern North Carolina

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The purpose of this study was to determine consumers' perception on genetically modified (GM) salmon. An anonymous survey was conducted on a college campus, regarding views on different aspects of genetic modification: ethics, health, risks (personal and environmental), and price and labeling activities. The focus of the research was GM salmon because not only is it the largest farmed species of fish, it could potentially be the first of many GM animals to be sold commercially in supermarkets. The data gathered from the survey was analyzed using SPSS, Microsoft Excel, and R documentation, to perform Crosstabs, descriptive statistics, and ANOVA tests respectively. These statistical analyses were used to determine which factors were significant and which were not in determining consumers' willingness to adopt GM products. It was found that there is a need to rectify the lack of knowledge about genetic modification. To successfully market GM salmon, not only should the producers provide information, they would be better off specifying the target market based on the significant demographic variables as identified by the data analysis. One limitation of the study was that a *post hoc* test has not yet been conducted, which would reveal the sources of significance within these demographic variables.

Introduction

The purpose of this study is to determine consumer perception of genetically modified (GM) salmon. This research is designed to identify the differences in how consumers view GM salmon to verify the degree of consumer acceptance of GM products. Although not the primary focus of this study, it will also help in identifying the factors that affect the adoption of GM food products.

Recent years have shown an increase in the use of genetically modified food products. These include GM crops and GM animals. Most American consumers unknowingly consume food products that have been genetically modified in some way; there is no labeling requirement regarding GM products in the U.S. market. Most of these products have GM ingredients, such as corn or soybeans (Ganiere et al., 2006). Numerous studies have shown that GM crops are more widely accepted than GM animals. Animals are considered genetically modified if they are fed with GM feed, given hormones or vaccines, or have undergone genetic alteration.

In a previous study, Curtis et al. (2004) stated that consumer attitudes toward GM food in developed countries are largely negative. People have been found to be skeptical about GM food because of the unknown risks and consequences to their health and environment. It is important to understand what consumers want, and what they want to avoid, from genetically modified products. Linking perceived benefits and risks to the various consumer characteristics is a step forward in addressing concerns such as food

safety, health, environmental risks, and ethics. It may also be used to design marketing campaigns, food safety policies, or educational programs to raise awareness on the various aspects of GM food (Baker and Burnham, 2001).

Given that this controversy over GM products is not new, one may wonder to what extent consumers would embrace or adopt GM salmon – a newly introduced biotech food product. The tenets of this exploratory study are therefore based on the following questions: (1) How do consumers view GM salmon? (2) Are they willing to consume it? (3) Will they prefer it to organically raised salmon if offered at a lower price? This study aims to answer these questions, with the goal of understanding the factors that cause variations in willingness to consume.

According to Kaneko and Chern (2005), most salmon sold in U.S. supermarkets are farmed, and are typically fed soybean based feed. Soybean is one of the largest crops where GM varieties are grown widely in the United States. If farmed salmon are fed a GM variety soybean feed, they are considered GM (specifically GM-fed salmon). Gene-altered salmon have not yet entered the market for consumption.

There is a lot of focus on GM fish because they are the most likely of GM animals to enter the open market (Pew, 2003). In fact, AquaBounty, a biotech company that develops hybrid fish (salmon, trout, and tilapia) that grows faster than non-GM fish, is just waiting for FDA approval to sell in U.S. markets (Peterson, 2010). If the FDA approves AquaBounty's salmon for human consumption, it will possibly be the first of many genetically altered animals to be sold commercially in supermarkets.

Though most of the controversy surrounding GM food revolves around perceived risks and ethical issues, sometimes it simply stems from a lack of information and consumer awareness. The purpose of this study is to provide an assessment of consumer perception of GM food, with a focus on GM salmon, in Southeastern North Carolina. In evaluating willingness to consume GM salmon, the perceived risks and benefits will be considered, as well as factors of consumer preferences. The results could be further used in marketing GM salmon, creating pricing strategies, and in addressing consumers' concerns.

Literature Review

Numerous studies have indicated that American consumers are wary of GM food products. Baker and Burnham (2001) state that GM food products are a source of fear for American and European consumers. Consumer response from around the world has been mostly negative, though most of the studies conducted were set in developed countries. US consumers are more accepting of GM food than consumers from Europe and Japan (Curtis et al., 2004).

It is necessary to understand the nature of consumers' acceptance of GM food. It would be expensive for the stakeholders otherwise (Kaneko and Chern, 2005). Furthermore, understanding would lead to developments in food safety policies, including the issue of labeling (Baker and Burnham, 2001). Grimsud et al. (2002) states that consumer education can increase consumers' willingness to pay for GM food.

The value of more education is clear with the irony that Anderson et al. (2006) pointed out: "growing segments of consumers seemingly want or potentially value a product that does not contain GM ingredients while producers have been producing record volumes of GM commodities." Organic markets are rapidly growing, but are also becoming more expensive. To successfully market GM food, consumers must be reassured of its safety to human health; in other words, their risk perception must be lowered (Kaneko and Chern, 2005). A study in Norway and one in Singapore both found that education may increase willingness to consume GM food (Grimsud et al., 2002;

Subrahmanyan et al. 2000). Furthermore, Ganiere et al. (2006) stated that consumers are more accepting of GM food if there are tangible benefits; people need incentives. Lusk (2003) reported that some are even willing to pay a price premium when there are tangible benefits.

According to Kaneko and Chern (2005), U.S. consumers generally accept GM food if offered at sufficient price discounts. They also found that if consumers approved of the government's food safety regulation, they were more likely to accept GM foods. Their respondents were reassured that they had not become ill due to GM food consumption.

Baker and Burnham (2001) have found that the level of risk aversion is significant in consumers' willingness to accept genetic modification. Strict regulatory processes and government approval may make GM food more acceptable, especially to those who are risk averse. Furthermore, the quality and safety benefits of GM food are important for acceptance too.

Numerous studies have been conducted on acceptance and willingness to pay for non-GM food, but is often too general. There is a growing demand for organic or non-GM food, and one of the reasons may be the absence of GM ingredients. Generally, existing literature has found that Americans have very little knowledge about biotechnology used in food (Anderson et al., 2006). In fact, only one-fourth of American

residents believe that they have consumed food with GM ingredients (Hallman et al., 2003).

There are no labeling requirements in the US to specify if a product has been genetically modified in any way. Typically, unless it has been specified to be organic or non-GM, consumers have no information regarding GM ingredient content.

Anderson et al. (2006) have found that most respondents in a survey disagreed with statements about the potential dangers of GM food, while almost half agreed that genetic modification improves nutritional quality. Overall, the respondents in this study did not perceive GM food to be as healthy as their non-GM counterparts. A little more than half of the respondents agreed that there is little risk in consuming organic food. Biotechnology companies and producers tend to hold to the belief that the use of GM ingredients in food has benefits to the environment, while some environmental groups and consumer advocate groups disagree. The respondents generally viewed risks to impact the aggregate level rather than the individual level, meaning that it has less impact on their personal life than to society in general. The biggest issue was the unknown effects. As previously mentioned, stakeholders would benefit from educating consumers on the benefits of accepting biotechnology.

Salmon is the largest modern farmed species of fish. Additionally, it is the first farmed species that is sold globally in competition with wild species in all main markets (Asche et al., 2004). According to Knapp et al. (2007), the world supply of salmon has

increased fivefold since 1980 because of aquaculture, and that farmed salmon represent two-thirds of the supply. Aquaculture is the main source of continued growth in the seafood industry (Anderson, 2002). Fish farming has the advantage of flexibility in responding to expected changes in prices and costs. World demand for frozen farmed salmon is price inelastic (-0.37) and world demand for fresh-farmed salmon is slightly elastic (-1.02); both segments would benefit from increases in market size due to income. Demand for farmed salmon is becoming less price elastic, because of increases in world income and declines in real price (Xie et al., 2009). The real price of farmed salmon has decreased as aquaculture gained popularity (Anderson, 2002). According to Xie et al. (2009), the less elastic demand implies the limited ability of world markets to absorb continuous increases in supply without damaging farm value.

Methodology

For this research paper, a survey was conducted on the campus of the University of North Carolina at Pembroke. The survey was anonymous, and did not ask for any method of identification or contact information. 300 surveys were handed out to students, faculty, and staff around campus and 74 were returned answered. Some questions regarding demographic information was included in the survey questionnaire so as to identify some factors affecting the differences in responses. The information asked included: age, gender, level of education, marital status, employment status, own yearly income, people living in the household, and race. In coding the results for statistical analysis (in Excel and SPSS), the following designations were used: for gender (female = 0, male = 1); level of education (high school graduate = 0, some college = 1, Associate Degree = 2, Masters Degree = 3, Ph.D. = 4, Bachelors Degree = 5); marital status (single, never married = 0, married = 1, divorced = 2); employment status (out of work and not looking = 0, out of work and looking = 1, employed for wages = 2, self-employed = 3, unable to work = 4); own yearly income (less than $10,000 = 0, 10000 to 19999 = 1, 20000 to 29999 = 2, 30000 to 39999 = 3, 40000 to 49999 = 4, 50000 to 59999 = 5, 60000 to 69999 = 6, 80000 to 89999 = 7); race (white = 0, black = 1, American Indian or Alaska native = 2, Hawaiian or Pacific Islander = 3, Hispanic = 4, Asian = 5). The responses to age and number of people in the household did not need coding as they were in numerical form already, and could be analyzed by the statistical tools.

Some questions in the survey were in the Yes/No format, giving respondents the option to check "yes" or "no" for the 5 questions in this portion. In inputting the results

for statistical analysis (Excel and SPSS), "no" was coded as "0" and "yes" was coded as "1".

The next part of the survey included 5 questions that could be answered by checking Likert scale responses. Each question had a different set of possible responses. For the question *How knowledgeable are you about genetically modified food?*, the coding was: not informed = 0, somewhat knowledgeable = 1, very knowledgeable = 2. For *How do you feel about genetically modifying food?*: don't know = 0, very negative = 1, somewhat negative = 2, neutral = 3, somewhat positive = 4, very positive = 5. For *How much risk to yourself do you associate with GM food?*: don't know = 0, no risk = 1, low risk = 2, moderate risk = 3, high risk = 4. For *How important is it to label GM foods?*: not at all = 0, not very = 1, somewhat important = 2, very important = 3. For *What type of labeling would you support?*: don't support any = 0, voluntary = 1, mandatory for GM = 2, mandatory for both = 3.

The last part of the survey were Likert scale as well. Strongly agree = 1, agree = 2, neutral = 3, disagree = 4, strongly disagree = 5. This part of the survey was divided into 5 categories: health statements, environment statements, risk statements, ethics statements, and other statements. Other statements included statements on quality, labeling, and pricing differences between GM and non-GM salmon.

After the results of the survey were coded into Excel and SPSS, they were analyzed using descriptive statistics. Using Excel, the data was grouped into tables showing the frequencies and percentages of the demographic factors, and the frequency of the answers for the first two sets of questions (the Yes/No questions and the various Likert scale

questions). Using SPSS, the data was analyzed using Crosstabs. Crosstabs, as the name suggest, cross-tabulates two variables, revealing their relationship in tabular form; it creates tables that summarizes information on every combination of categories or pairs between 2 variables. There is an option when running Crosstabs to include the calculations of chi-squares and correlations. A chi-square reveals whether a pattern revealed in Crosstabs is statistically significant. The chi-square test generates a value called "significance" which is similar to a probability. If the significance is greater than the expected value, then the pattern is not significantly related.

ANOVA tests were run through another software called R Documentation. R Documentation implements coding in running tests, making it faster to handle large amounts of data. ANOVA tests are used to compare means among variables to determine if the null hypothesis can be accepted or rejected. The null hypothesis states that there is no significant deviations among the means. For the data gathered in this study, the ANOVA test was used to calculate the p-values for each question, corresponding to each demographic. If the p-value is less than 0.05, then with a 95% significance, the null hypothesis can be rejected.

The results from the tests mentioned above were analyzed to identify the significant factors affecting consumer perception on genetically modified food and salmon. The ANOVA tests and Crosstabs identified the significant demographic factors that could prove to strongly affect an individual's willingness to pay and consume GM food, specifically salmon. It also revealed the population's views on important aspects of the GM food market, such as the issues of labeling and pricing. In addition to the analysis of data gathered from survey responses, the research also included a study of existing

literature. Together with the results from the analysis, a conclusion was reached regarding consumer perception on GM salmon, and recommendations geared toward effective marketing.

Results and Discussion

From the 300 surveys handed out, 74 were returned usable for analysis. Among these respondents, 28 were female, 46 were male. Most of them were between the ages of 18 and 26 (a total of 65 respondents) and the other 9 ranged from 28 years old to 55. They were either employed for wages (30), unemployed and looking for work (15), unemployed but not looking for work (19), self-employed (2), or unable to work (8). As such, most of them earned an income of less than $10,000 (55). The rest earned incomes ranging from $10,000 - $19,999 to $80,000 - $89,999. A total of 69 respondents are single and have never married, 5 were either married or divorced. Most have only completed some college education (60), the rest varying from being a high school graduate to having a Doctorate degree. There was a wide variety of races, including: Asian, white, black, Hawaiian/Pacific Islander, Hispanic, American Indian/Alaskan native. These frequencies may be viewed in table form in Appendix B.

The following figures show the frequencies of each response corresponding to each of the first set of Likert scale questions.

Figure 1. How knowledgeable are you about GM food?

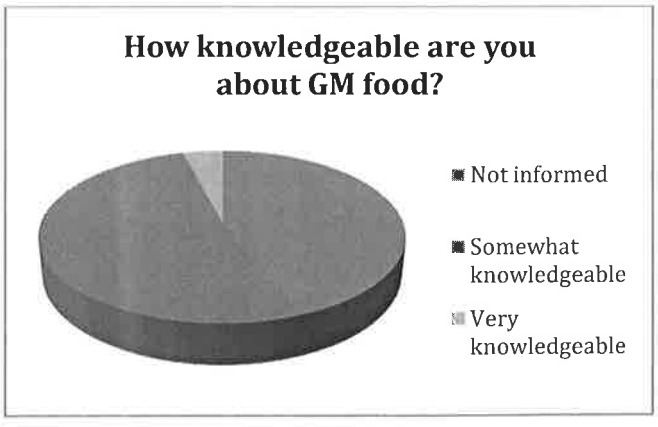


Figure 2. How do you feel about genetically modifying food?

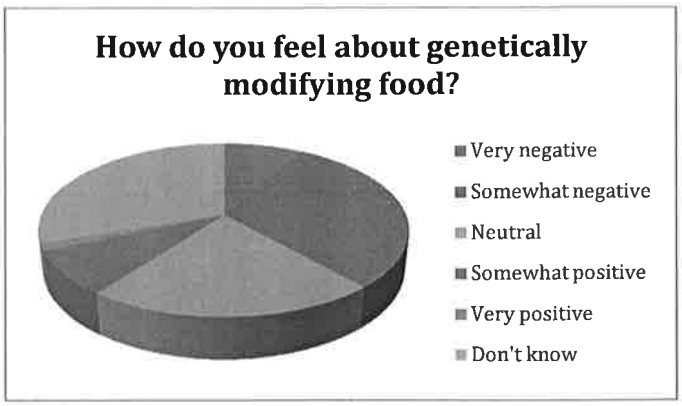


Figure 3. How much risk to yourself do you associate with GM food?

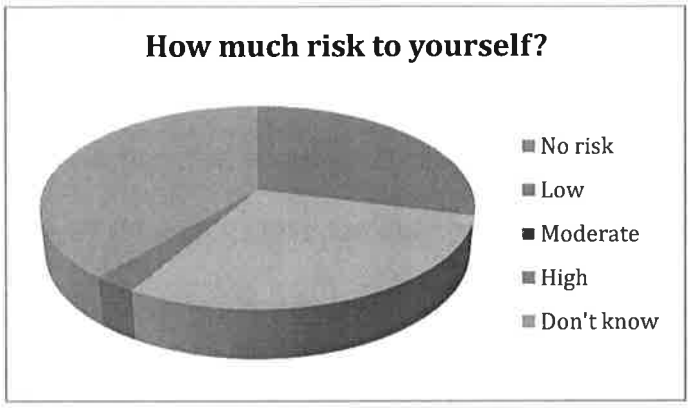


Figure 4, How important is it to label GM foods?

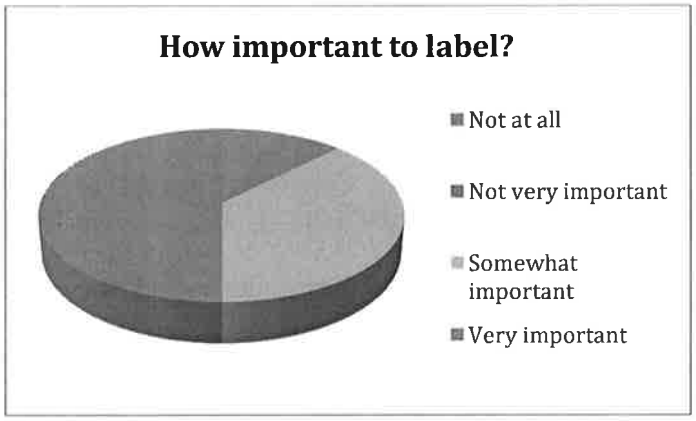


Figure 5. What type of labeling would you support?

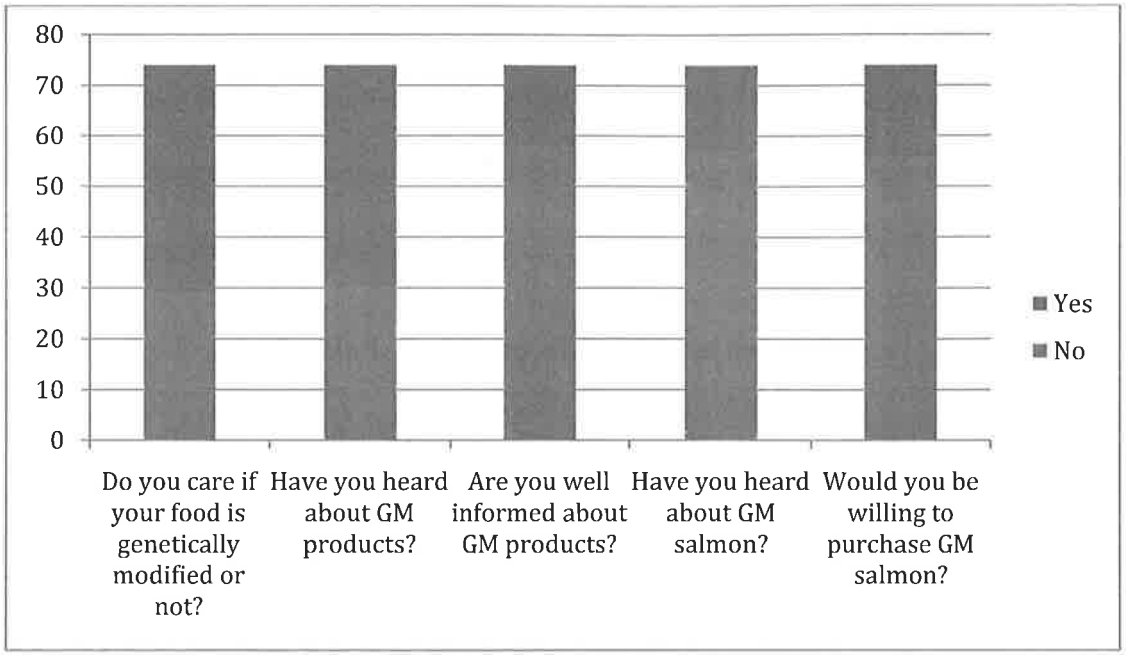
Only 4% of the respondents described themselves as being "very knowledgeable" about GM food, while 44% said they were "not informed" [Figure 1]. It is not surprising that 30% don't know how they feel about genetically modifying food, and another 30% feel "somewhat negative" [Figure 2]. 39% don't know how much risk they associate with themselves due to GM food. Only 3% perceive a high risk, and 29% perceived moderate risk, while 21% perceived only a low amount of risk to themselves [Figure 3]. Most respondents described labeling as having some degree of importance, and in fact 50% of the responses for that question stated labeling as being "very important" [Figure 4]. Thus, as expected, the majority supported mandatory labeling (mandatory for both: 46%, mandatory for GM: 31%) [Figure 5].

Given the large number of uninformed individuals, it is understandable that once the issue of labeling came up, a majority would support mandatory labeling. There is an opportunity here for stakeholders in the GM food market to educate their consumers so as to reduce the tendency to feel somewhat negative towards genetically modifying food, especially given that there is still a large percentage of the population who "don't know"

what to think about it. From these questions, one can infer that the issue is lack of knowledge and information, not an actual distaste for GM food.

Figure 6 shows the summarized results of the five Yes/No questions.

Figure 6. Results from the Yes/No questions.



61% of the population care if their food is genetically modified or not. Meaning that people are generally not indifferent about the issue of genetic modification. 59% have at least heard about GM products, though 77% have not heard of GM salmon. It is interesting to note that there are more people who care if food is GM or not, than there are who have heard about it. An overwhelming 78% are not well informed about GM products. Again, there is a need to increase awareness and disperse information about genetic modification. From this sample, 76% would not be willing to purchase GM salmon. There seems to be a positive relationship between how well informed one is to the negative feeling or unwillingness to purchase GM salmon. So far, the questions and the answers they generated have provided a general overview of the state of genetic

modification: consumers are concerned about their food being genetically modified but are still generally unknowledgeable. Furthermore, a lot are still on the fence with this issue. In order to fully determine what causes the varying opinions toward it, the results from the ANOVA testing must be analyzed. Significant p-values must be identified, and further analysis will be conducted using SPSS (Crosstabs and chi-square tests).

Most of the p-values from the ANOVA were large values (larger than or equal to 0.05), as expected. However, there were 19 out of the 231 p-values that were worth taking a further look.

Table 1. Summary of significant p-values.

Question/Statement	Demographic → p-value
Have you heard about GM products?	Income: 0.03
Are you well informed about GM products?	Education: 0.00 Marital Status: 0.02 Income: 0.00
GM food improves nutritional quality.	No. of People in Household: 0.04
Lower food safety risks are more important than lower prices.	Employment Status: 0.01 Race: 0.01
Raising GM salmon endangers other species.	Race: 0.03
Eating GM salmon should be discouraged.	Race: 0.04
Genetically modifying animals is morally unacceptable.	Race: 0.04
Food derived from GM food is beneficial.	Marital Status: 0.01
If GM salmon has the same price as non-GM salmon, I will purchase the GM salmon.	Gender: 0.03 Marital Status: 0.00
If GM salmon was offered at a lower price than non-	Gender: 0.02

GM salmon, I will purchase the GM salmon.	Marital Status: 0.00
GM salmon has better quality than non-GM salmon.	Marital Status: 0.00
I will pay a little extra to avoid GM salmon.	Marital Status: 0.00
I will pay more to avoid GM salmon.	Marital Status: 0.00
If not labeled as GM, I will assume food products are non-GM.	Education: 0.01

These values mean that the null hypothesis H_0 ($\mu_1 = \mu_2 = \ldots = \mu_n$) can be rejected. We accept H_1 (meaning at least 2 of the means are not equal). So for these statements, the differences in the responses were statistically significant based on the corresponding demographic.

The chi-square test generates a value called significance, abbreviated as "Sig." If this value is less than or equal to .05, then the variables involved in the chi-square test are significantly related. The chi-square testing was completed during the Crosstab process, and revealed some relationships among the variables in the survey.

Health Statements

For the negative health statements (GM food poses hidden dangers to my health, I am worried about unknown effects of the consumption of GM food), the significant factors were: education, and gender. For the positive Health Statements (GM salmon is safe to eat, GM salmon is more nutritious than non-GM salmon) the significant variables were education, race, gender, and age. The only difference between the positive and negative health statements was that race and age proved to be significant for positively stated opinions on the health aspects of GM salmon.

Environment Statements

For the environmental statements, the significant variables were race, education,

gender, and age. The environment statements were risk statements as well, just specified to the risks genetic modification poses to the environment. As such, there were similarities between the significant factors in this section and the risk statements in the following section, namely race and gender.

Risk Statements

For one Risk Statement (lower food safety risks are more important than lower prices), the significant variables were employment status, marital status, number of people in the household, gender, and race. Interestingly, the chi-square value for income was high, with a value of .175. For two other risk statements (eating GM salmon is risky, and raising GM salmon endangers other species) the significant variables were education and gender for both.

Ethics Statements

For the ethics statements, the chi-square values were less than .05 for the factors: education, gender, and income. This suggests that opinions on the ethical aspects of genetic modification are influenced by education level, income level, and gender. It is conventional wisdom that higher educational attainment leads to higher income levels so this is not so surprising.

Willingness to Pay

For some statements regarding willingness to pay, one significant variable was income. Though it was expected to be significant, the chi-square values for statements regarding willingness to pay and the employment status of the respondents were actually high, much higher than .05.

Labeling

For the importance of labeling (it is important for GM food to be labeled) the significant variable was education. For the labeling questions introduced in the first set of Likert scale questions (how important is it to label GM foods? What type of labeling would you support?), the significant variables were race, income, education, and gender. Regardless of how a question regarding labeling was posed, education plays a significant role in shaping people's opinions on labeling requirements.

Conclusion and Recommendations

Based on the results of the survey, there is a need to rectify the lack of knowledge regarding genetic modification. Not only was the sample largely uninformed, there was a tendency toward negative feeling toward genetically modifying food. The large number of individuals claiming neutrality or stating they "don't know" what they feel regarding certain issues certainly prove that there is a pool of potential consumers that could be convinced of the safety or even benefits of genetic modification if more information was disseminated. Part of the strategy toward improving the level of information currently out there in the market would be to determine labeling policies. Labeling foods as GM or non-GM is important in consumers' points of view. Perhaps eventually there would be requirements to label genetically modified food. With the large number of food products being commercially sold everyday that use GM ingredients, people would probably be surprised at first at how much GM food they have actually already consumed. Once consumers are convinced that they have been exposed to it but have not in fact experienced any detrimental side effects, there should be a move toward more acceptance.

To successfully market GM salmon, the producers would be better off specifying their target market. People of different races have varying opinions on how ethical genetic modification is. However, as far as pricing behavior goes, gender and marital status are important factors as well. Marital status, especially, is significant in determining consumers' willingness to pay GM salmon compared to prices of non-GM salmon, or how much they would pay to avoid GM salmon completely. Education was a variable that has statistical significance among most of the different aspects of genetic

modification (health, environment, ethics, and labeling requirements). Though other variables affected each aspect, education was obviously one of the most influential. This ties in with the conclusion that before any steps to market GM salmon can be fully successful, consumers have to be educated about its benefits and possible risks before accepting GM salmon on their dinner plates.

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APPENDIX A

Table 1. Summary of significant p-values.

Question/Statement	Demographic → p-value
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GM food improves nutritional quality.	No. of People in Household: 0.04
Lower food safety risks are more important than lower prices.	Employment Status: 0.01 Race: 0.01
Raising GM salmon endangers other species.	Race: 0.03
Eating GM salmon should be discouraged.	Race: 0.04
Genetically modifying animals is morally unacceptable.	Race: 0.04
Food derived from GM food is beneficial.	Marital Status: 0.01
If GM salmon has the same price as non-GM salmon, I will purchase the GM salmon.	Gender: 0.03 Marital Status: 0.00
If GM salmon was offered at a lower price than non-GM salmon, I will purchase the GM salmon.	Gender: 0.02 Marital Status: 0.00
GM salmon has better quality than non-GM salmon.	Marital Status: 0.00
I will pay a little extra to avoid GM salmon.	Marital Status: 0.00
I will pay more to avoid GM salmon.	Marital Status: 0.00
If not labeled as GM, I will assume food products are non-GM.	Education: 0.01

APPENDIX B

Table 2. How knowledgeable are you about GM food?

How knowledgeable are you about GM food?	Count
Not informed	32
Somewhat knowledgeable	38
Very Knowledgeable	3
TOTAL	**73**

Table 3. How do you feel about genetically modifying food?

How do you feel about genetically modifying food?	Count
Very negative	6
Somewhat negative	22
Neutral	16
Somewhat positive	6
Very positive	1
Don't know	22
TOTAL	**73**

Table 4. How much risk to yourself do you associate with GM food?

How much risk to yourself?	Count
No risk	6
Low	15
Moderate	21
High	2
Don't know	28
TOTAL	**72**

Table 5. How important is it to label GM foods?

How important to label?	Count
Not at all	4
Not very important	5
Somewhat important	27
Very important	36
TOTAL	**72**

Table 6. What type of labeling would you support?

What type of labeling do you support?	Count
Don't support any	14
Voluntary	3
Mandatory for GM	22
Mandatory for both	33
TOTAL	**72**

APPENDIX C

Table 7. Results from the Yes/No questions.

Questions	No	Yes
Do you care if your food is genetically modified or not?	29	**45**
Have you heard about GM products?	30	**44**
Are you well informed about GM products?	**58**	16
Have you heard about GM salmon?	**57**	17
Would you be willing to purchase GM salmon?	**56**	18

APPENDIX D

Table 8. Education Level

EDUCATION LEVEL	NUMBER
ASSOCIATES DEGREE	7
BACHELORS DEGREE	1
MASTERS DEGREE	1
HS GRADUATE	3
PHD	2
SOME COLLEGE	60
TOTAL	**74**

Table 9. Age

AGE	NUMBER
18	10
19	15
20	12
21	16
22	6
23	2
24	1
25	1
26	2
28	1
30	1
31	3
32	1
37	1
48	1
55	1
TOTAL	**74**

Table 10. Employment Status

EMPLOYMENT STATUS	NUMBER
EMPLOYED FOR WAGES	30
LOOKING FOR WORK	15
NOT LOOKING	19
SELF-EMPLOYED	2
UNABLE TO WORK	8
TOTAL	**74**

Table 11. Gender

GENDER	NUMBER
FEMALE	28
MALE	46
TOTAL	**74**

Table 12. Income

INCOME	NUMBER
<10000	55
10000-19999	6
20000-29999	4
30000-39999	2
40000-49999	1
50000-59999	3
60000-69999	2
80000-89999	1
TOTAL	**74**

Table 13. Marital Status

MARITAL STATUS	NUMBER
DIVORCED	1
MARRIED	4
SINGLE	69
TOTAL	**74**

Table 14. Race

RACE	NUMBER
ASIAN	11
BLACK	21
HAWAIIAN/P ISLANDER	1
HISPANIC	1
INDIAN/ ALASKAN	13
WHITE	27
TOTAL	**74**

Table 15. Number of People in Household

# OF PEOPLE IN HOUSEHOLD	NUMBER
1	12
2	16
3	15
4	21
5	7
6	2
TOTAL	**73**

*note: 1 no answer

APPENDIX E

Table 16. How knowledgeable are you about GM food?

How knowledgeable are you about GM food?	Count
Not informed	32
Somewhat knowledgeable	38
Very knowledgeable	3
TOTAL	**73**

Table 17. How do you feel about genetically modifying food?

How do you feel?	Count
Very negative	6
Somewhat negative	22
Neutral	16
Somewhat positive	6
Very positive	1
Don't know	22
TOTAL	**73**

Table 18. How much risk to yourself do you associate with GM food?

Risk to yourself?	Count
No risk	6
Low	15
Moderate	21
High	2
Don't know	28
TOTAL	**72**

Table 19. How important is it to label GM foods?

How important to label?	Count
Not at all	4
Not very	5
Somewhat	27
Very	36
TOTAL	**72**

Table 20. What type of labeling would you support?

What type of labeling do you support?	Count
Don't support any	14
Voluntary	3
Mandatory for GM	22
Mandatory for GM and non-GM food	33
TOTAL	**72**

APPENDIX F

Table 21. Chi-square test: educationit is unethical to produce GM salmon***

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.399[a]	24	.025
Likelihood Ratio	25.733	24	.367
N of Valid Cases	74		

a. 31 cells (88.6%) have expected count less than 5. The minimum expected count is .05.

Table 22. Chi-square test: educationeating GM salmon should be discouraged***

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43.350[a]	24	.009
Likelihood Ratio	27.262	24	.292
N of Valid Cases	74		

a. 32 cells (91.4%) have expected count less than 5. The minimum expected count is .05.

Table 23. Chi-square test: genderfood should not be genetically modified***

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.166[a]	8	.010
Likelihood Ratio	8.531	8	.383
N of Valid Cases	74		

a. 10 cells (66.7%) have expected count less than 5. The minimum expected count is .05.

Table 24. Chi-square test: gender*_it is unethical to produce GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.841[a]	8	.011
Likelihood Ratio	8.402	8	.395
N of Valid Cases	74		

a. 11 cells (73.3%) have expected count less than 5. The minimum expected count is .05.

Table 25. Chi-square test: gender*_eating GM salmon should be discouraged_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.064[a]	8	.015
Likelihood Ratio	7.540	8	.480
N of Valid Cases	74		

a. 11 cells (73.3%) have expected count less than 5. The minimum expected count is .05.

Table 26. Chi-square test: income*_food should not be genetically modified_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	64.916[a]	32	.001
Likelihood Ratio	44.541	32	.069
N of Valid Cases	74		

a. 42 cells (93.3%) have expected count less than 5. The minimum expected count is .05.

Table 27. Chi-square test: income*_it is unethical to produce GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	54.477[a]	32	.008
Likelihood Ratio	40.445	32	.145
N of Valid Cases	74		

a. 41 cells (91.1%) have expected count less than 5. The minimum expected count is .05.

Table 28. Chi-square test: income*_eating GM salmon should be discouraged_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	55.716[a]	32	.006
Likelihood Ratio	39.190	32	.179
N of Valid Cases	74		

a. 42 cells (93.3%) have expected count less than 5. The minimum expected count is .05.

Table 29. Chi-square test: education*_GM food poses hidden dangers to my health_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	44.954[a]	24	.006
Likelihood Ratio	20.673	24	.658
N of Valid Cases	74		

a. 33 cells (94.3%) have expected count less than 5. The minimum expected count is .04.

Table 30. Chi-square test: education*_I am worried about unknown effects of the consumption of GM food_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	67.322[a]	24	.000
Likelihood Ratio	22.382	24	.556
N of Valid Cases	74		

a. 32 cells (91.4%) have expected count less than 5. The minimum expected count is .03.

Table 31. Chi-square test: gender*_GM food poses hidden dangers to my health_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.010[a]	8	.010
Likelihood Ratio	12.456	8	.132
N of Valid Cases	74		

a. 11 cells (73.3%) have expected count less than 5. The minimum expected count is .04.

Table 32. Chi-square test: gender*_I am worried about unknown effects of the consumption of GM food_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.938[a]	8	.000
Likelihood Ratio	13.365	8	.100
N of Valid Cases	74		

a. 9 cells (60.0%) have expected count less than 5. The minimum expected count is .03.

Table 33. Chi-square test: race*_GM salmon is safe to eat_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	49.987[a]	24	.001
Likelihood Ratio	22.878	24	.527
N of Valid Cases	74		

a. 31 cells (88.6%) have expected count less than 5. The minimum expected count is .03.

Table 34. Chi-square test: race*_GM salmon is more nutritious than non-GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	55.380[a]	24	.000
Likelihood Ratio	28.201	24	.252
N of Valid Cases	74		

a. 30 cells (85.7%) have expected count less than 5. The minimum expected count is .03.

Table 35. Chi-square test: education*_GM salmon is safe to eat_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	63.631[a]	24	.000
Likelihood Ratio	25.158	24	.397
N of Valid Cases	74		

a. 33 cells (94.3%) have expected count less than 5. The minimum expected count is .03.

Table 36. Chi-square test: education*_GM salmon is more nutritious than non-GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	65.269[a]	24	.000
Likelihood Ratio	26.427	24	.332
N of Valid Cases	74		

a. 32 cells (91.4%) have expected count less than 5. The minimum expected count is .03.

Table 37. Chi-square test: gender*_GM salmon is safe to eat_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43.539[a]	8	.000
Likelihood Ratio	15.852	8	.045
N of Valid Cases	74		

a. 12 cells (80.0%) have expected count less than 5. The minimum expected count is .03.

Table 38. Chi-square test: gender*_GM salmon is more nutritious than non-GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.126[a]	8	.000
Likelihood Ratio	11.515	8	.174
N of Valid Cases	74		

a. 11 cells (73.3%) have expected count less than 5. The minimum expected count is .03.

Table 39. Chi-square test: age*_GM salmon is safe to eat_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	107.313[a]	64	.001
Likelihood Ratio	56.906	64	.723
Linear-by-Linear Association	6.307	1	.012
N of Valid Cases	74		

a. 81 cells (95.3%) have expected count less than 5. The minimum expected count is .03.

Table 40. Chi-square test: age*_GM salmon is more nutritious than non-GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	101.416[a]	64	.002
Likelihood Ratio	54.063	64	.807
Linear-by-Linear Association	.405	1	.524
N of Valid Cases	74		

a. 81 cells (95.3%) have expected count less than 5. The minimum expected count is .03.

Table 41. Chi-square test: income*_if GM salmon has the same price as non-GM salmon, I will purchase the GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	82.200[a]	40	.000
Likelihood Ratio	38.053	40	.558
N of Valid Cases	74		

a. 51 cells (94.4%) have expected count less than 5. The minimum expected count is .01.

Table 42. Chi-square test: income*_if GM salmon was offered at a lower price than non-GM salmon, I will purchase the GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	86.615[a]	40	.000
Likelihood Ratio	47.948	40	.182
N of Valid Cases	74		

a. 50 cells (92.6%) have expected count less than 5. The minimum expected count is .01.

Table 43. Chi-square test: income*_I will pay a little extra to avoid GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	58.490[a]	40	.030
Likelihood Ratio	36.910	40	.610
N of Valid Cases	74		

a. 51 cells (94.4%) have expected count less than 5. The minimum expected count is .01.

Table 44. Chi-square test: income*_I will pay more to avoid GM salmon_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	50.227[a]	32	.021
Likelihood Ratio	32.032	32	.465
N of Valid Cases	74		

a. 42 cells (93.3%) have expected count less than 5. The minimum expected count is .04.

Table 45. Chi-square test: education*_it is important for GM food to be labeled_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	45.323[a]	18	.000
Likelihood Ratio	29.757	18	.040
N of Valid Cases	74		

a. 25 cells (89.3%) have expected count less than 5. The minimum expected count is .04.

Table 46. Chi-square test: race*_GM food is risky for the environment_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	52.777[a]	30	.006
Likelihood Ratio	23.937	30	.775
N of Valid Cases	74		

a. 37 cells (88.1%) have expected count less than 5. The minimum expected count is .01.

Table 47. Chi-square test: education*_GM food is risky for the environment_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	60.444[a]	30	.001
Likelihood Ratio	24.175	30	.764
N of Valid Cases	74		

a. 39 cells (92.9%) have expected count less than 5. The minimum expected count is .01.

Table 48. Chi-square test: gender*_GM food is risky for the environment_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.935[a]	10	.000
Likelihood Ratio	12.658	10	.243
N of Valid Cases	74		

a. 14 cells (77.8%) have expected count less than 5. The minimum expected count is .01.

Table 49. Chi-square test: age*_GM food is risky for the environment_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	112.832[a]	80	.009
Likelihood Ratio	60.639	80	.948
Linear-by-Linear Association	.049	1	.825
N of Valid Cases	74		

a. 98 cells (96.1%) have expected count less than 5. The minimum expected count is .01.

Table 50. Chi-square test: employment status*_lower food safety risks are more important than lower prices_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	40.437[a]	25	.026
Likelihood Ratio	25.377	25	.441
N of Valid Cases	74		

a. 30 cells (83.3%) have expected count less than 5. The minimum expected count is .03.

Table 51. Chi-square test: marital status*_lower food safety risks are more important than lower prices_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.377[a]	15	.014
Likelihood Ratio	13.759	15	.544
N of Valid Cases	74		

a. 21 cells (87.5%) have expected count less than 5. The minimum expected count is .03.

Table 52. Chi-square test: people in household*_lower food safety risks are more important than lower prices_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	47.283[a]	30	.023
Likelihood Ratio	32.899	30	.327
Linear-by-Linear Association	.028	1	.868
N of Valid Cases	74		

a. 37 cells (88.1%) have expected count less than 5. The minimum expected count is .05.

Table 53. Chi-square test: gender*_lower food safety risks are more important than lower prices_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.484[a]	10	.002
Likelihood Ratio	11.839	10	.296
N of Valid Cases	74		

a. 12 cells (66.7%) have expected count less than 5. The minimum expected count is .03.

Table 54. Chi-square test: race*_lower food safety risks are more important than lower prices_

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	47.978[a]	30	.020
Likelihood Ratio	31.881	30	.373
N of Valid Cases	74		

a. 37 cells (88.1%) have expected count less than 5. The minimum expected count is .03.

APPENDIX G

Survey

This survey is for a senior thesis entitled *Consumer Perception on Genetically Modified (GM) Salmon.* You are one of approximately 300 participants of this survey. It will take approximately 15 minutes to complete the survey. Your participation is greatly appreciated.

Genetically modified (GM) salmon include those that have either been fed GM feed or have been given hormones (such as growth hormones).

Please begin by telling us a little about yourself. Please check where appropriate.

1. How old are you? _____

2. Are you male or female? _____Male _____Female

3. What level of education have you completed?

___ No schooling completed
___ 8th grade or below
___ Some high school
___ High school graduate (high school diploma or equivalent, such as GED)
___ Some college (If in college, please circle one: Freshman, Sophomore, Junior, Senior)
___ Associate Degree (such as AA, AS)
___ Bachelors Degree (such as BA, BS, AB)
___ Professional Degree (such as MD, DDS, JD)
___ Masters Degree
___ Ph.D.

4. What is your marital status?

___ Single, never married ___ Married ___ Widowed
___ Divorced ___ Separated

5. What is your employment status?

___ Employed for wages
___ Self-employed
___ A homemaker
___ Retired
___ Out of work and looking for work
___ Out of work but not currently looking for work
___ Unable to work

6. What is your own yearly income?

___ Less than $10,000
___ $10,000 to $19,999
___ $20,000 to $29,999
___ $30,000 to $39,999
___ $40,000 to $49,999
___ $50,000 to $59,999
___ $60,000 to $69,999
___ $70,000 to $79,999
___ $80,000 to $89,999
___ $90,000 to $99,999
___ $100,000 to $149,999
___ $150,000 or more

7. How many people live in your household? _____

8. What is your race? (Please check below)

____ American Indian or Alaska Native
____ Asian
____ Black or African American
____ Native Hawaiian or Other Pacific Islander
____ White
____ Hispanic

Please answer Yes or No to the following:

1. Do you care if your food is genetically modified (GM) or not? ____Yes ____No
2. Have you heard about GM products? ____Yes ____No
3. Are you well informed about GM products? ____Yes ____No
4. Have you heard about GM salmon? ____Yes ____No
5. Would you be willing to purchase GM salmon? ____Yes ____No

Please check the line that corresponds to your answer.

1. How knowledgeable are you about genetically modified food?
____ Very knowledgeable
____ Somewhat knowledgeable
____ Not informed

2. How do you feel about genetically modifying food?
____ Very positive
____ Somewhat positive
____ Neutral
____ Somewhat negative
____ Very negative
____ Don't know

3. How much risk to yourself do you associate with GM food?
____ High risk
____ Moderate risk
____ Low risk
____ No risk
____ Don't know

4. How important is it to label GM foods?
____ Very important
____ Somewhat important
____ Not very important
____ Not at all

5. What type of labeling would you support?
____ Mandatory for GM and non-GM food
____ Mandatory for GM
____ Voluntary
____ Don't support any

For the following statements, please check from the corresponding columns.

Health Statements	Strongly Agree (1)	Agree (2)	Neutral/ Neither (3)	Disagree (4)	Strongly Disagree (5)
GM food is good for my health.					
GM salmon is safe to eat.					
GM food improves nutritional quality.					
GM salmon is more nutritious than non-GM salmon.					
GM food poses hidden dangers to my health.					
I am worried about unknown effects of the consumption of GM food.					

Environment Statements	Strongly Agree (1)	Agree (2)	Neutral/ Neither (3)	Disagree (4)	Strongly Disagree (5)
GM food is risky for the environment.					
I am worried about unknown effects on the environment.					
Raising GM salmon will have a negative effect on other species.					

Risk Statement	Strongly Agree (1)	Agree (2)	Neutral/ Neither (3)	Disagree (4)	Strongly Disagree (5)
Lower food safety risks are more important than lower prices.					
Food should not be genetically modified.					
Eating GM salmon is risky.					
Raising GM salmon endangers other species.					
Risks with GM foods do not outweigh the benefits.					

Ethics Statements	Strongly Agree (1)	Agree (2)	Neutral/ Neither (3)	Disagree (4)	Strongly Disagree (5)
Food should not be genetically modified.					
It is unethical to produce GM salmon.					
Eating GM salmon should be discouraged.					
Genetically modifying animals is morally unacceptable.					

Other Statements	Strongly Agree (1)	Agree (2)	Neutral/ Neither (3)	Disagree (4)	Strongly Disagree (5)
Food derived from GM food is beneficial.					
It is important for GM food to be labeled.					
If GM salmon has the same price as non-GM salmon, I will purchase the GM salmon.					
If GM salmon was offered at a lower price than non-GM salmon, I will purchase the GM salmon.					
I want to know more about GM food.					
If genetic modification lowers costs, it is good.					
GM salmon has better quality than non-GM salmon.					
I will pay a little extra to avoid GM salmon.					
I will pay more to avoid GM salmon.					
If not labeled as GM, I will assume food products are non-GM.					