



Attitudes of Hawai'i Consumers Toward Genetically Modified Fruit

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Papaya is a tropical fruit that plays an important role in Hawai'i's agricultural sector. The 2004 farm value of papaya in Hawai'i totaled \$12.4 million, with fresh fruit accounting for 95 percent of the total value and exports accounting for 40 percent of the fresh fruit sold. Fresh papaya production totaled 34.1 million pounds in 2004, which was 16 percent below the 2003 total and represented the third consecutive year of declining production. As of August 2005, Hawai'i's total papaya acreage was estimated at 2400 acres. On the Big Island (Hawai'i), 156 papaya farms accounted for 92 percent of the state's total acreage, with growers planting mainly the Rainbow and Kapoho cultivars (USDA 2003).

The papaya industry has been plagued by the papaya ringspot virus (PRV), which can cause large yield losses and severely affected papaya production when it spread into the Big Island's papaya growing areas in the 1990s. To combat this problem, researchers developed two genetically engineered, or "genetically modified," papaya cultivars with resistance to PRV incorporated into their genome. The one most commonly planted is called Rainbow, and it represents a majority of the papaya currently grown in Hawai'i: 53 percent of the total acres in 2005. The Kapoho cultivar, which accounted for 30 percent of the acreage in 2005, was the papaya industry standard for many years. However, Kapoho is susceptible to PRV.

Genetic engineering is a biotechnology process in which genetic material from one organism is introduced into the genome of another, usually unrelated, organism. The result is a transgenic organism, commonly called a genetically modified organism, or GMO. In this

publication, the term genetically modified (GM) is used to refer to transgenic plants and animals or the foods prepared using them.

No federal guidelines currently require labeling of GM produce or products containing GM ingredients for U.S. marketing channels. Only organic foods are required to be free of GM material, although "GM free" labels may be used by a retailer or wholesaler as part of their individual marketing strategy. U.S. labeling requirements, if imposed, may affect exports of U.S. fruit because international markets may demand that GM products be labeled or may not accept them at all.

According to Pesante (2003), Hawai'i has been steadily losing market share in the Japanese papaya market to the Philippines since 1995. In 2002, the Philippines had 56 percent of the market, while Hawai'i had 43 percent. The competitive disadvantage of Hawai'i-grown papayas may stem from Hawai'i's distance from Japan, the higher relative price of Hawai'i papayas, and a limited supply of non-GM papayas from Hawai'i. Papayas from the Philippines are roughly half the price of Hawai'ian papayas, and the distance between the two countries is shorter, resulting in fresher, less damaged fruit. The U.S. government is making efforts to persuade the Japanese government to allow the importation of GM papayas. As of May 2003, the Japan Department of Agriculture has approved this measure, but Japan's Ministry of Health, Labour and Welfare is still examining the issue.

Attitudes toward GM foods

Research indicates that consumers in Europe and Japan are concerned about GM food products. In 2002,

Hirohisa et al. examined Japanese consumers' attitudes towards GM food products. They found that 69 percent of those surveyed felt that these products posed health risks, 38 percent felt they posed environmental risks, 60 percent were concerned about food allergies, and 60 percent had a fear of an unknown new disease. When asked whether they would consume GM food products if they were safe, 32 percent would not, 32 percent still feared health risks, 31 percent did not support the idea of genetically modifying any organism, and 30 percent were uneasy about the concept of genetic modification. More than 90 percent of those surveyed supported the labeling of GM foods, 68 percent indicated that such labeling was needed, and 50 percent felt that not labeling GM food products was a violation of the consumer's rights. Bredahl (1999) surveyed consumers in Denmark, Germany, the United Kingdom, and Italy. Respondents generally did not prefer to use GM food products. Genetic modification was associated with negative consequences, such as damage to the environment and moral problems. Positive attributes were noted but were not enough to overcome negative associations.

Research that examines U.S. consumer attitudes toward GM food products has also been done. Baker and Burnham (2001) concluded that women tended to be more concerned with food safety than men and that consumers with a relatively high degree of knowledge about biotechnology were more likely to accept GM food products. Lusk and Sullivan (2002) completed a study of consumer attitudes toward GM food products in Mississippi and found more than 70 percent believed that such products were acceptable. They also indicated that consumers have concerns about adverse health effects from GM food products. The majority thought they were "somewhat knowledgeable" about the subject, while 3 percent believed they were "very knowledgeable." Consumers who were older than the average and with relatively higher incomes and more education were more positive about GM food products. Hossein et al. (2003) found that 74 percent of respondents to a survey approved of the use of genetic modification of fruits and vegetables if the price were lower. They concluded that the respondent's level of knowledge about biotechnology was found to significantly affect approval and acceptance of GM food products. Consumers who check labels when shopping were less likely to accept genetically modified foods. Kaneko and

Chern (2003) found similar results based on a survey of U.S. mainland consumers. They found that 50–60 percent of the respondents were somewhat informed about GM organisms and 50 percent thought that GM food products pose a risk to human health. Religious or ethical concerns about GM food products were cited as important for 40 percent of the respondents, while 80 percent felt that such products should be labeled. Younger consumers were more likely to accept GM food products.

In Hawai'i, Ferguson et al. (2002) surveyed residents to assess their opinions about GM products. They found that respondents rated GM products as more favorable if their utilization contributed to increased environmental quality, a lowered cost of production, increased nutritional value, or increased resistance to crop disease. They also found that respondents' opinions varied depending on their age, gender, education, ethnicity, county, and income.

Given that Hawai'i's papaya industry, which is showing signs of contraction, relies heavily upon a single GM cultivar and that no specific information is available about the preferences of Hawai'i consumers toward GM fruit, this publication presents the result of a survey of Hawai'i residents about their attitude toward GM fruit. Members of the marketing channel can utilize this information about consumers' knowledge of GM fruit to design more appropriate marketing strategies and to educate policy makers.

The survey process

A telephone survey (see Appendix I) was conducted in February–June 2006. Five hundred thirty-eight (538) residents were selected at random from the telephone directories of the six major Hawai'ian Islands. If the resident declined to participate, another was selected. The questionnaire asked about the respondent's

- opinions on health, safety, and allergies
- willingness to consume GM products
- willingness to purchase if genetic modification reduced the need for pesticides
- willingness to purchase if the GM fruit is as nutritious as non-GM fruit
- willingness to purchase if GM fruit costs 10 percent more or 10 percent less
- opinion about labeling GM fruits
- demographic characteristics.

A Chi-Squared statistic was used to test for significant differences in the results for the cross-tabulations between questions, and the results have a confidence level of 95 percent, leaving a 5 percent chance of error. While 538 people responded to the survey, not all respondents answered every question.

Respondents' demographic information

The survey represents a cross-section of Hawai'i residents (Table 1). The respondents' characteristics generally represent the overall characteristics of the state's general population, although the state's urban population is generally larger than the urban population of the sample. It may be that respondents' definition of rural and urban are not the same as the U.S. Census definition.

Respondents' knowledge of and opinions about GM products

Thirty-six percent of the respondents indicated that they were well informed or somewhat informed about GM foods, 31 percent indicated they were very little informed, and 33 percent indicated they were not at all informed (Table 2).

In order to determine if respondents were at all knowledgeable about genes in fruit and the effect of genetic modification, three statements were included on the questionnaire that required a response of "true," "false," or "don't know." The first statement was "Genetically modified fruit contains genes," which is true. As Table 3 shows, 49 percent of respondents answered it correctly, 17 percent answered it incorrectly, and 34 percent did not know the answer. The second statement was "Non-GM fruits do not contain modified genes," which is false. Thirty-five percent answered it correctly. The third statement was "A person's genes could be altered by eating genetically modified foods," which cannot be answered definitively at this time. Thirty-five percent answered "don't know" and

Table 1. Respondents' demographic profile.

Variable	Categories	Percentage of respondents
Gender	Female	57
	Male	43
Age	Under 18	4
	18–30	17
	31–50	31
	56–60	23
	Over 60	25
County of residence	Hawaii	13
	Oahu	71
	Kauai	6
	Maui	11
Place of residence	Rural	43
	Urban	55
Education	Some high school	8
	High school graduate	45
	College graduate	28
	Graduate degree	22
Household annual income	Less than \$15,000	14
	15,000 to 30,000	18
	31,000 to 60,999	33
	61,000 to 100,000	23
	Over 100,000	12

Table 2. Respondents' level of information about GM food.

Level	Percentage of respondents
Well informed	8
Somewhat informed	28
Very little informed	31
None at all informed	33

Table 3. Respondents' knowledge about GM fruit/food.

Statement	True	False	Don't know
GM fruits contain genes.	49*	17	34
Non-GM fruits do not contain genes.	30	35	35
A person's genes could be altered by eating GM foods.	16	49	35

*In percentages

the remaining 65 percent selected true or false. From these responses we conclude that about two-thirds of the respondents are not knowledgeable about GM fruit. This finding is consistent with the result in Table 2, which indicated that 64 percent of respondents believed themselves to be either very little or not informed about GM food.

With respect to their perceptions about the safety of GM fruit, respondents were equally divided (Table 4). Thirty-four percent thought GM fruit is extremely risky or somewhat risky, and 36 percent believed it is extremely safe or somewhat safe to eat. Again, a large portion of respondents, 22 percent, did not know if GM fruit is safe or risky.

With respect to their willingness consume GM fruits, 51 percent of the consumers were extremely willing or somewhat willing to consume the product, and 32 percent were extremely unwilling or somewhat unwilling (Table 5). If growing a GM fruit reduces the amount of pesticides used in the crop's production, 68 percent of the respondents indicated they were extremely willing or somewhat willing to consume the fruit, while 21 percent were unwilling or extremely unwilling to do so. If GM fruit causes allergic reactions

for some people, 53 percent of the respondents indicated they were extremely unwilling or somewhat unwilling to consume it, while to 33 percent were willing or extremely willing. With respect to the nutritional value of GM fruit compared to non-GM fruit, 65 percent of the respondents indicated they were extremely willing or somewhat willing to consume the fruit, while to 21 percent were unwilling or extremely unwilling to consume the fruit.

If GM fruit costs consumers 10 percent more than non-GM fruit, 31 percent of respondent indicated they are extremely willing or somewhat willing to consume it, while 53 percent were unwilling or extremely unwilling to consume it. If the GM fruit costs 10 percent less than non-GM fruit, 63 percent of respondents indicated they are extremely willing or somewhat willing to consume GM fruit, compared to 22 percent who are unwilling or extremely unwilling to consume GM fruit. Thus, it appears that respondents will respond to a price differential between GM fruit and non-GM fruit. Roughly a third of the respondents would be more willing to buy GM fruit if it were less expensive than non-GM fruit and, by the same token, roughly a third will be less willing if GM fruit were relatively more expensive than non-GM fruit.

Respondents were asked how important ethical or religious concerns are in their decision whether or not to consume GM fruit. As Table 6 indicates, 18 percent considered it very important, while 33 percent did not consider it to be important. As far as the importance of labeling GM fruit, a large percentage, 71 percent, of the respondents considered it very important and only 5 percent said it was not important (Table 7).

Table 4. Respondents' attitudes about the safety of GM fruit.

Attitude	Percentage of respondents
Extremely risky	14
Somewhat risky	22
Neither risky nor safe	8
Somewhat safe	23
Extremely safe	11
Don't know	22

Table 5. Respondents' willingness to purchase GM fruit.

Purchase decision	Extremely willing	Somewhat willing	Neither	Somewhat unwilling	Extremely unwilling	Don't know
Don't know						
Degree of willingness	21*	30	10	12	20	9
If pesticide use is reduced	35	33	5	7	14	7
If the nutritional content is the same as non-GM fruits	33	33	7	6	15	6
If a risk of allergic reaction exists for some people	12	20	9	19	34	5
If the cost is ten percent more than non-GM fruit	11	20	11	24	29	5
If the cost is ten percent less than non-GM fruit	26	37	10	7	15	5

*In percentages

Table 6. Respondents' attitudes about the importance of ethical and religious concerns in their consumption of GM fruit.

Level of importance	Percentage of respondents
Very important	18
Somewhat important	14
Neither	13
Somewhat not important	14
Extremely not important	33
Don't know	8

Table 7. Respondents' attitudes about the importance of labeling GM fruit.

Level of importance	Percentage of respondents
Very important	72
Somewhat important	13
Neither	3
Somewhat not important	4
Extremely not important	5
Don't know	3

Respondents' knowledge and labeling

A cross tabulation between how well informed respondents were about genetic modification and their attitudes toward labeling (Table 8) found a significant relationship between these two variables. Among those who indicated that they felt labeling was very important were 49 percent of those who believed themselves to be very well informed. Of those who believed themselves to be somewhat informed, little informed, not informed at all, the percentages who felt labeling was very important were 71, 74, and 75 percent, respectively. Thus, those who said they were well informed felt the importance of labeling was less than those that were less informed, although labeling was still quite important to all groups. At the same time, survey respondents appear to rely on labels as an important source of information, and the same is likely to hold true for consumers in general.

With respect to labeling (see Table 9), 38 percent of the respondents who considered themselves well informed supported labeling and wanted labeling for both GM and non-GM foods, while 26 percent wanted it for GM foods only. In the case of uninformed respondents who wanted labeling, 44 percent wanted it for both GM and non-GM, and 42 percent wanted labeling for GM alone.

Table 8. Respondents' GM knowledge levels and attitudes about labeling.

Attitude	Very well informed	Somewhat informed	Very little informed	Not at all informed
Very important	49*	71	74	75
Somewhat important	22	16	17	8
Neither	0	5	3	2
Somewhat not important	12	5	0	5
Extremely not important	15	2	4	5
Don't know	2	1	2	5

*In percentages

Table 9. Respondents' GM knowledge level and preferred labeling policy

Policy	Very well informed	Somewhat informed	Very little informed	Not at all informed
Mandatory for all foods	38*	46	41	44
Mandatory for GM and non-GM foods	26	32	47	42
Voluntary	8	16	5	7
Don't support any labeling	28	7	7	8

*In percentages

As shown in Table 10, the gender of the respondent was also significantly related their attitude toward labeling. Eighty percent of the females want the GM fruit to be labeled, compared to 61 percent of male respondents. At the same time, 46 percent of the female respondents want the GMO labeling to be mandatory for all food products, compared to 40 percent of male respondents (Table 11).

Respondents' educational level and labeling

Positive correlation between education and attitudes toward labeling indicated that respondents with more education were more likely to feel labeling is important (Table 12). For example, 75 percent of the respondents with more than four years of college feel labeling is very important, while only 38 percent of those with some high school feel it is very important.

Positive correlation also exists between the educational level of the respondent and their support for mandatory labeling. As Table 13 indicates, 63 percent of the respondents with some high school want mandatory GM labeling for all food products, compared to 81 percent of respondent that are high school graduates, 84 percent for college graduates, and 88 percent for those with some post-graduate college.

The majority of the respondents felt that labeling is very important (Table 14). Those from households earning less than \$15,000 per year feel labeling is less important than do those from households in other income categories. However, the differences that were found among household income levels were not significant. As Figure 13 indicates, respondents with lower income level are more supportive of mandatory labeling, although this result is not significant.

Discussion and conclusion

Since only eight percent of the survey respondents characterized themselves as well informed about genetically modified food, more consumer education is needed to ensure that consumers have a thorough understanding of GM products and the role they can and do play in the agricultural sector. Many are wary of consuming GM food/fruit, and lack of information about GM food/fruit appears to affect consumers' willingness to purchase GM food/fruit. The agricultural sector in Hawai'i might consider developing a strategic plan to educate consumers about genetic modification. The benefits of genetic modification for specific

Table 10. Respondents' gender and attitudes toward labeling

Attitude	Male	Female
Very important	61*	80
Somewhat important	19	10
Neither	5	2
Somewhat not important	6	2

Table 11. Respondents' gender and preferred labeling policy

Policy	Male	Female
Mandatory for GM and non-GM foods	40	46
Mandatory for GM foods	35	42
Voluntary	12	6
Don't support any	13	6

products, such as reductions in pesticide use, reductions in postharvest losses, and improved nutritional value, should be included. These benefits are very important market attributes that appear to influence the survey respondent's decision-making, and providing more information about them to consumers may affect their willingness to purchase GM food/fruit.

At the same time, educational materials should be developed to explain the risks GM food/fruit poses to the environment and human health. Scientific findings about these risks would provide useful information to consumers, particularly those extremely adverse to GM food/fruit. Clearly, survey respondents were interested in purchasing GM fruit if it were relatively less expensive than non-GM fruit, and more information about the overall impact of GM food/fruit could further increase their willingness to purchase GM food/fruit.

While their acceptance of GM products varied, the survey respondents strongly believed that GM fruits should be labeled. Mandatory labeling of GM food was widely supported by survey respondents and might also be considered by Hawai'i's agricultural sector as a means of providing consumer information. The cost of labeling will become a production/marketing cost and likely will not result a significant price increase for consumers. Agribusinesses interested in marketing

Table 12. Respondents' educational level and attitudes toward labeling

Attitude toward labeling	Some high school	High school to some college	College graduate	More than four years college
Very important	38*	74	72	75
Somewhat important	17	12	15	17
Neither	13	4	2	1
Somewhat not important	16	2	5	3
Extremely not important	4	5	3	3
Don't know	12	3	3	1

*In percentages

Table 13. Respondents' educational level and preferred labeling policy.

Type of labeling	Some high school	High school to some college	College graduate	More than four years college
Mandatory for GM and non-GM foods	46*	43	42	44
Mandatory for GM	17	38	42	44
Voluntary	17	8	9	6
Don't support any	20	11	7	6

*In percentages

Table 14. Respondents' income level and attitudes toward labeling.

Importance of labeling	Less than \$15,000	\$15,000–\$30,000	\$31,000–\$60,000	\$61,000–\$100,000	Over \$100,000
Very important	50*	70	76	69	71
Somewhat important	25	15	12	16	15
Neither	25	4	4	3	2
Somewhat not important	0	3	2	3	9
Extremely not important	0	3	4	7	3
Don't know	0	5	2	2	0

*In percentages

GM and non-GM food/fruit will notice that women find labeling very important, as do those who have attended college and have relatively high incomes. While labeling may not currently be mandatory, the labeling of GM and non-GM food/fruit is likely to be an important element in a firm's marketing strategy. Any firm or industry marketing GM food/fruit would likely benefit from providing information to supplement a label. Otherwise, consumers who are not well informed about GM food/fruit may not have full information when they make a purchase decision because they only use the label as information and do not fully understand the benefits and costs associated with that particular GM food/fruit.

It appears that in the case of Hawai'i papaya, consumers in the Japanese market are wary of GM papaya. While labeling of the papaya, as this research suggests, is likely warranted, this may not be sufficient information for consumers to fully understand the benefits and costs associated with consuming GM papaya. Therefore, an educational effort, based on credible scientific information, is likely to be needed for papaya or any fruit if producers plan to develop and maintain a strong local and export market. This research indicates that such an effort will likely increase consumers' willingness to purchase GM fruit.

Literature cited

- Baker, G.A., and T.A. Burnham. 2001. Consumer response to genetically modified foods: Market segment analysis and implications for producers and policy makers. *Journal of Agricultural and Resource Economics* 26(2):387–403.
- Bredahl, L. 1999. Consumers' cognitions with regard to genetically modified foods. Results of a qualitative study in four countries. *Appetite* 33:343–360.
- Ferguson, C., C. Chan-Halbrendt, A. Wieczorek, and N. Wen. 2002. Results from a Hawai'i opinion survey on genetically modified organisms. University of Hawai'i at Manoa, College of Tropical Agriculture and Human Resources, www.ctahr.hawaii.edu/oc/freepubs/pdf/BIO-2.pdf. 6 p.
- Hossein, F., B. Onyango, B. Schilling, W. Hallman, and A. Adelaja. 2003. Product attributes, consumer benefits and public approval of genetically modified foods. *International Journal of Consumer Studies* 27:353–365.
- Imai, H., T. Katoh, and Y. Kuroda. 2002. Genetically modified crops: Consumer attitudes and trends in plant research in Japan. *Food Service Technology* 183–189.
- Kaneko, N., and W.S. Chern. 2003. Consumer acceptance of genetically modified foods: A telephone survey. Department of Agricultural Environmental and Development Economics, The Ohio State University, Working Paper AEDE-WP-0025-04.
- Lusk, J.L., and P. Sullivan. 2002. Consumer acceptance of genetically modified foods. *Food Technology* 56(10):32–37.
- Pesante, A. 2003. Market outlook report: Fresh papayas. Ministry of Finance, Japan Custom, www.ams.usda.gov/TMD/FSMIP/FY2000/HI0303papaya.pdf.
- United States Department of Agriculture. August 28, 2006. Statistics of Hawai'i Agriculture. National Agricultural Statistics Services, State of Hawai'i, Agricultural Development Division.
- United States Department of Agriculture. 2003. 2003 Statistics of Hawai'i Agriculture. National Agricultural Statistics Services, State of Hawai'i, Agricultural Development Division.

Appendix: Survey.

Do you feel you are well informed about genetically modified food?

- a) Very well, b) Somewhat, c) Very little, d) None at all

T or F:

- Genetically modified fruits contain genes.
- Non-genetically modified fruits do not contain genes.
- A person's genes could be altered by eating genetically modified foods.

Do you think genetically modified food is safe or risky to human health?

- a) Extremely risky, b) Somewhat risky, c) Neither, d) Somewhat safe, e) Extremely safe, f) Don't know

For the following questions, answer: a) Extremely willing, b) Somewhat, c) Neither, d) Somewhat not willing, e) Extremely not willing, f) Don't know

- How willing are you to consume fruits that have been

genetically modified?

- How willing would you be to purchase them if GM reduced the amount of pesticides applied to crops?
- What if they are as nutritious as non-genetically modified fruits?
- How willing would you be to purchase them if there is a risk of causing allergic reactions for some people?
- How willing would you be to purchase GM fruit if it cost 10% more than non-GM fruit?
- How about if it cost 10% less than non-GM fruit?

For the following questions, answer: a) Very important, b) Somewhat important, c) Neither, d) Somewhat not important, e) Extremely not important, f) Don't know

- How important are ethical or religious concerns when you decide whether or not to consume GM fruit?
- How important is it to you that genetically modified fruits are specifically labeled?

What type of labeling would you support?

- Mandatory for GM and non-GM fruits
- Mandatory for GM
- Voluntary
- Don't support any

Demographic

The shopper is:

- Male, b) Female

Did you grow up in rural area (farming community)?

- Yes, b) No

Is your age range:

- Under 18, b) 18–30, c) 31–50, d) 51–60, e) Over 60

Is your educational level:

- Some high school
- High school to some college
- College graduate
- More than four years college

Is your household income range:

- Less than \$15,000
- \$15,00 to \$30,000
- \$31,000 to \$60,000
- \$61,000 to \$100,000
- Over \$100,000

What is the number of people in your household?

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