

Labeling of Genetically Engineered Foods: How University Student Perceptions Differ From National Opinion

Jennifer H. Schmidt and Charlene Hamilton
1011 Sudlersville Cemetery Road, Sudlersville, MD 21668

Abstracts: To assess and compare the perspectives of university students towards labeling of genetically engineered foods to that of a national opinion poll. Twenty-five question, multiple-choice survey, formatted into the university's online course management system. Introductory nutrition class at a large Mid-Atlantic University. 39 students, ages 18-64. Student familiarity with, attitudes towards, and perceptions of labeling of genetically engineered foods. Frequencies, ANOVA, Cross-tabs, and t-tests. Significance at $p = 0.05$. An equivalent percentage of students compared to national opinion agreed that genetically engineered foods should be labeled. (66% versus 62% respectively). Comparison of the two data sets revealed only slight variability between the groups in specific areas. The student sample, gender approached significance ($p = 0.100$) with females more in favor of labeling than males. These results suggest that further research is necessary in determining the expected effectiveness of labeling genetically engineered foods. A cost-benefit analysis should be conducted with consideration to the utilization of this information and of labeling in general by consumers. Further assessment of any effects a mandatory labeling system would have on the food supply and distribution system is needed. Education surrounding the entire process is imperative to consumer trust.

Key words: Genetically engineered foods, labeling, biotechnology

Introduction

The labeling of genetically engineered foods remains a contentious issue both domestically and internationally. Recent crises over food safety have caused European consumers to lose faith in regulatory oversight of the food supply (Harlander, 2002; Hoban, 1997 and Priest and Gillespie, 2000). The overall increase in suspicion has drawn genetically engineered foods into the debate. The European Commission (EC) has required mandatory labeling of genetically engineered foods since 1997. On June 4, 2002, the EC recommended a lower threshold for mandatory labeling of food containing genetically engineered ingredients and food components from 1% to 0.5% (Pew Initiative, 2002).

Domestically, the issue has received increasing legislative attention. In 2001, twenty-two pieces of state legislation regarding labeling of genetically engineered foods were introduced in the States of Colorado, Hawaii, Massachusetts, Maine, Michigan, New Hampshire, New York, Oregon, Rhode Island, Vermont, and West Virginia (Pew Initiative of Food and Biotechnology, 2002). Only one of these pieces of legislation passed. Maine Bill LD1733 established voluntary labeling of foods thought to be free of recombinant DNA (rDNA).

The labeling discussion has led several leading health organizations to publish position papers on the topic. The American Dietetic Association put forth a position paper in favor of food applications for biotechnology but does not specifically take a position on the labeling of these applications (American Dietetic Association, 1995). The American Medical Association position states "such labeling is useless unless the public is educated as to what genetic modification is. If foods are to be labeled, then readily available, explanatory information about genetic modification should be present at the point of sale in all stores carrying GM products." (American Medical Association, 2002).

Currently, federal policy does not require special labeling of genetically engineered foods. However, under the Federal Food, Drug, and Cosmetic Act Section 201(n), a genetically engineered food must be labeled if it is: 1) significantly different from its traditional counterpart; 2) if an issue exists regarding the food's usage or consequences of its use; 3) if it has a significantly different nutritional quality; or 4) if it contains an allergen otherwise unexpected based on the name of the food (Food and Drug Administration, 2002).

Surrounding the labeling controversy are debates surrounding science, safety, environment, ethics, morals, religion, and consumer choice (Brom, 2000; Chassy, 2002; Jackson, 2000; Kendall, 1997 and Reiss, 2001). Several studies have shown that faith and religion are negatively correlated with attitudes towards genetic engineering (Hoban, 1992 and Office of Technology Assessment, 2001). Environmental groups have weighed in with concerns over threats to crop diversity, herbicide resistant weeds, and other ecological issues (Kendall, 1997). Numerous surveys have found that consumers desire some level of disclosure on food packages containing genetically

engineered ingredients or food components (Food and Drug Administration, 2002; Center for Science in Public Interest, 2001; Hoban, 2001; International Food Information Council, 2001 and Zimmerman *et al.*, 1994).

A focus group survey conducted by the Center for Food Safety and Applied Nutrition found that while mere disclosure of genetically engineered ingredients on a food label was valued by subjects, they preferred labeling statements about how and why a food was genetically engineered (Food and Drug Administration, 2002). Likewise, the International Food Information Council survey on food biotechnology revealed that a majority of participants felt that simple labeling of genetically engineered ingredients was insufficient (International Food Information Council, 2001). Most agreed that consumers should have access to more detailed information through websites, brochures, and toll-free numbers. Ironically, while 58% of subjects were more likely to agree that foods produced through biotechnology should be labeled even if the food has the same safety and nutritional content as other foods, only 5% of the total number of subjects ($n = 1000$) had taken any action out of concern over genetically engineered foods.

Other surveys reveal consumers are overwhelmed with the level of nutrition information currently available (Hoban, 2001). When asked an unaided question about what additional information was needed on a food label, only 2% wanted information on genetic engineering (International Food Information Council, 2001). The primary concern for consumers was specific nutrition characteristic information. While consumers who utilize the information provided on food labels have healthier diets (Kreuter *et al.*, 1997), overall usage of the Nutrition Facts label declined with only 27% of Americans reporting they pay "very close attention" to food labels, while 36% pay "no" attention (American Dietetic Association, 2002).

The use of identity preservation systems as a means to segregate genetically engineered from non-genetically engineered food crops is expected to add a 12% premium over the per bushel farm price (Lin *et al.*, 2000). The Center for Science in the Public Interest surveyed consumers on the issue of labeling of genetically engineered foods and their willingness to pay additional costs for such information on food packages (Center for Science in Public Interest, 2001). The survey revealed that while 70% of consumers felt that genetically engineered foods should be labeled, only 28% of consumers were willing to pay more than \$50 of their annual food budget towards this labeling.

Growing consumer interest and increased media attention to the topic of genetically engineered foods has spurred numerous surveys and opinion polls. This investigation sought to understand the perspectives of university students, a unique consumer group, toward the issue of labeling of genetically engineered foods. The specific research question asked was: Do the perspectives of university students towards the labeling of genetically engineered foods differ from that of national opinion? To that end, we replicated a national opinion poll on the labeling of genetically engineered foods within our student population.

Description of Intervention: Permission was granted from the Center for Science in the Public Interest (CSPI) Biotechnology Project to utilize their survey tool, which had been conducted in April of 2001. Approval to conduct this study was granted by the University's Human Subjects Review Board. Students were drawn from a large, Mid-Atlantic University.

The survey questions were uploaded into the University's course management system WebCT, for the Nutrition Concepts (NTDT 200) class, which is a core science, introductory level nutrition class. The survey was conducted during the winter session of 2002. Four supplemental demographic questions were added to the survey related to age, gender, college class, and the college of their major. One open-ended question was added at the end of the survey for students to type general comments about the survey subject. The homepage of NTDT 200 contained a link labeled "research opportunity" which when clicked, brought the student to the study explanation and informed consent. It also contained a link to the survey questions if the student decided to continue with completion of the survey. Students were recruited by class-wide email at the beginning of the semester as well as by a headline banner on the classes' WebCT homepage. The survey was available 24 hours a day, 7 days per week for the duration of the 4 week long semester.

Data analysis was conducted using SPSS 10.0. Statistical analysis included frequency data, ANOVA, Cross-tabs, and t-tests within the student sample data. Analyses with an alpha value of $p = 0.05$ or less were considered significant. Descriptive data from the two surveys was analyzed and compared between the student data and the national opinion data.

Description of Evaluation: Of the 90 students enrolled in the class, 39 (43%) completed the online survey. This is a surprisingly high response rate for electronically transmitted surveys, which have been cited as having an average response rate of 6% (Ranchhod and Zhou, 2001).

As can be expected with this population, 95% of respondents were between the ages of 18-24 whereas the national data had 12% representation within this age bracket. The student sample was 74% female and 26% male compared to CSPI's sample that was 48% and 52% respectively. The majority of participants (62%) were from the College of Arts and Sciences. The student subjects represented a fairly typical distribution of college class for this course with 31% freshman, 18% sophomores, 28% juniors and 21% seniors.

Familiarity: The majority of the students (75%) reported being "not very" or "not at all" familiar with genetically engineered foods themselves, as compared to 55% of the national sample. None of the students reported being "extremely familiar" with genetically engineered foods.

Labeling: When asked if foods containing ingredients from genetically engineered crops should be required, 66% of students agreed, compared to 62% of the national sample. With regards to having the option to choose one piece of information subjects would like to see added to a Wheaties label, 28% chose "contains pesticides in minute amounts", 26% chose "contains genetically engineered wheat", 23% responded "don't know", and 8% chose "something else". In the open-ended option, students posted preferences for such information as complex versus simple carbohydrates, amount of trans-fat, and information on pesticide residue. Table 1 summarizes the responses to survey questions categorized into the labeling theme. These questions gave the subject a specific example of a labeling statement and asked if they would purchase the food based on the labeling information provided.

Table 1: Consumer perception of purchasing behaviors towards certain genetically engineered foods labeling statements

Believe item should appear on a label if any ingredient in the food product has been	NTDT ^b	CSPI ^c
Sprayed with pesticides	79%	76%
Genetically Engineered	72%	70%
Treated with Plant Hormones	69%	65%
Made with Cross-Bred Corn	33%	40%
Would buy a fruit or vegetable if it were labeled:		
Sprayed with pesticides	21%	40%
Genetically engineered	36%	43%
Treated with Plant Hormones	15%	37%
Made with Cross-Bred Corn	31%	44%
Would buy a processed food if one minor ingredient (such a corn starch from corn) was labeled:		
Sprayed with pesticides	21%	31%
Genetically Engineered	36%	40%
Treated with Plant Hormones	13%	34%
Made with Cross-Bred Corn	44%	40%
Foods that should be identified as "genetically engineered" if labeling were required.		
Whole foods, such as a tomato	77%	61%
Major ingredient, such as wheat in Wheaties cereal	77%	53%
Minor ingredient, such as corn starch in a frozen dinner	23%	42%
Derived from GE crop but contains no GE materials (soybean oil)	18%	38%

^aQuestions slightly modified for brevity ^bn = 39, ^cn = 100

Safety: Safety was another category containing a series of questions based on four different labeling statements with regards to a loaf of bread. Table 2 demonstrates that the student data did not differ significantly from the national sample. The student sample did reveal this group to feel that the labeling statement "contains genetically engineered wheat" was just as safe, but not safer than standard bread without such labeling. Furthermore, the explanatory statement "contains genetically engineered wheat – reduces pesticide use" was more acceptable to the student sample.

Perceptions: Consumers elicit many perceptions of a product from the food label (Baltas, 2001). A series of questions were posed to elicit the subjects' perceived response to a labeling statement and their decision to purchase a box of corn flakes. Table 3 compares both the student and the national samples with regards to questions related to perceptions of genetically engineered versus non-genetically engineered labeling statements.

Table 2: Consumer perception of safety towards certain genetically engineering food labeling statements^a

Level of perceived safety for a loaf of bread labeled "Contains genetically engineered wheat"	NTDT ^b	CSPI ^c
Safer	0%	7%
Just as Safe	51%	34%
Not as Safe	23%	31%
Don't know	23%	27%
Level of perceived safety for a loaf of bread labeled "Contains wheat developed with biotechnology"		
Safer	8%	6%
Just as Safe	40%	33%
Not as Safe	39%	30%
Don't know	13%	31%
Level of perceived safety for a loaf of bread labeled "Contains genes from wheat"		
Safer	3%	6%
Just as Safe	38%	44%
Not as Safe	26%	15%
Don't know	33%	35%
Level of perceived safety for a loaf of bread labeled "Contains genetically engineered wheat-reduces pesticide use."		
Safer	44%	21%
Just as Safe	20%	29%
Not as Safe	18%	28%
Don't know	18%	22%

^aQuestions slightly modified for brevity^bn = 39^cn = 1000

Table 3: Consumer perception of choices between food items labeled "genetically engineered" versus "non-genetically engineered"

If a box of cereal carried a certain label, which would you choose?	NTDT ^a	CSPI ^b
Cereal labeled "contains genetically engineered wheat"	8%	8%
Cereal labeled "does not contain genetically engineered wheat"	46%	52%
Would not care	33%	38%
If corn flakes were labeled "does not contain genetically engineered corn", would they be better, same or worse than corn flakes without such labels?		
Better	36%	35%
Same	41%	42%
Worse	8%	8%
Don't know	15%	15%
If corn flakes were labeled "made from genetically engineered corn" would they be better, same, or worse than corn flakes without such labels?		
Better	13%	12%
Same	38%	42%
Worse	28%	28%
Don't know	20%	17%

^an = 39^bn = 1000

Interestingly this revealed that while a majority of both samples would choose non-genetically engineered over genetically engineered, over a third of each sample reported they "would not care". Not unexpectedly, when asked how much they were willing to pay towards the increased cost of foods that this labeling system would incur, 88% of the student sample were not willing to pay more than \$50 annually as compared to 77% of the national sample. Regression analysis run on the student data using college, gender, age, and class to predict attitudes towards labeling of genetically engineered foods revealed no statistically significant effects. Gender did approach statistical significance with a $p=0.100$. Females tended to be more in favor of labeling than males. However, due to the small sample size and therefore lack of statistical power, no clear conclusions can be established.

The final question provided students with an open-ended option to submit general comments on the issue of labeling of genetically engineered foods. Nine of the 39 students (23%) chose to post comments. These were categorized into 3 pro-labeling and 6 neutral comments. Some comments included: "I would feel safer knowing if the food I am taking into my body was genetically engineered or not... as such, I think the food should be labeled"; "I do not necessarily think that genetically engineered foods are unsafe or not good for consumption... I would like to know more about the issue", and "I feel like I should read up on genetically engineered foods..."

Discussion

This study examined how university students felt toward the issue of labeling of genetically engineered foods and compared the results to that of a national opinion poll. While familiarity with genetically engineered foods themselves was low, students had strong opinions about what and how foods should be labeled. Heffernan and Hillers (2002) found that consumers felt they had too little input into whether biotechnology is used in the food supply. This study's sample of consumers indicated a desire to know more about what is in the food supply and how they can discern that information at the grocery store. The inference being that these consumers also feel they have little input into how genetic engineering is applied and distributed in foods.

Based on a comparison of frequency data, the student responses were similar to that of the national opinion poll and in some questions, mirrored the same results. Indeed, the majority of subjects in consumer surveys reveal a desire to have genetic engineering disclosed on a food label in some fashion (Food and Drug Administration, 2002; Center for Science in Public Interest, 2001; Hoban and Kendall, 1993 and Hallman and Metcalfe, 1993). However, consumers have not considered the labeling of genetically engineered food components a priority on unaided survey questions (International Food Information Council, 2001).

There was no great differentiation among this sample between the terminology "genetically engineered" and "biotechnology". Clarification on the purpose of the biotechnology process such as "reduces pesticide use" improved the perception of some consumers towards the term "genetically engineered".

Safety appears to be the greatest concern in the student sample with submitted comments generally concerned with unknown and long-term health consequences being the reason for which these consumers desire labeling. Only a minority of consumers felt these products to be safer (Table 2).

The limitations of this study include: the small sample size; these students may not represent others within the university, across other campuses, or consumers at large; and students who participated may have characteristics different than those who did not based on the technology used to conduct the survey. The computerized design did not allow for nuanced opinions that may have been elicited by the national opinion poll, which was conducted by telephone. Additionally, the self-reported measures may have produced incomplete or inaccurate responses.

Implications for Research and Practice: A better understanding of how consumers perceive the process and the purpose of genetic engineering and food biotechnology is imperative to a technology that is still in its infancy (Falk *et al.*, 2002). Consumers have voiced concern not only to have the nutritional characteristics made available, but also certain food production processes. Consumers often make negative inferences when a desired piece of information is not available on a food label (Zarkin and Anderson, 1992). Policy makers need to carefully consider the percentage of consumers who desire such labeling, compared to the actual utilization of food labels by consumers at large, as well as the costs of instituting mandatory labeling for genetically engineered foods and the implications that holds for the entire US food supply.

Registered Dietitians and other health care professionals have consistently been ranked by consumers to be reliable providers of food and nutrition information (American Dietetic Association, 2002; McMurchy and Vujicic, 2001 and Pennbridge *et al.*, 1999), and specifically regarding food biotechnology (Hoban, 1997 and Hoban, 2001 Zimmerman *et al.*, 1994 and Heffernan and Hillers, 2002). Nutrition, health, and other educators need to become well versed in the science of genetically engineered foods, as well as the issues and policies surrounding the topic in order to be able to provide reliable, science-based education to consumers. Therefore, these professionals not only need to understand the nutritional characteristics and health benefits of foods, but also the food production and agricultural practices that so greatly contribute to our food supply.

Acknowledgements

Appreciation and acknowledgment is extended to Dr. Doug Gurian-Sherman, Co-Director of the Center for Science in the Public Interest's Biotechnology Project for permission to replicate the survey tool and for sharing the national data set information.

References

- American Dietetic Association, 2002. Survey says labels have impact on consumer food purchases. <http://www.eatright.com/pr/press090397c.html>
- American Dietetic Association. 1995. Position of The American Dietetic Association: Biotechnology and the future of food. J. Amer. Diet. Ass., 95: 1429-1432.
- American Medical Association, 2002. Council on Scientific Affairs. Genetically Modified Foods and Crops. <http://www.ama-assn.org/ama/pub/print/article/2036-4030.html>
- American Dietetic Association, 2002. Americans' food and nutrition attitudes and behaviors – American Dietetic Association's Nutrition and You: Trends 2000. <http://www.eatright.com/pr/2000/010300a.html>

- Baltas, G., 2001. The effects of nutrition information on consumer choice. *J. Advert. Res.*, 3: 57-63.
- Brom, F.W.A., 2000. Food, consumer concerns, and trust: food ethics for a globalizing market. *J. Agric. Environ. Ethics.*, 12: 127-139.
- Chassy, B.M., 2002. Food safety evaluation of crops produced through biotechnology. *J. Amer. Coll. Nutr.*, 21: 166S-173S.
- Center for Science in the Public Interest, 2001. National opinion poll on labeling of genetically engineered foods. http://www.cspinet.org/reports/op_poll_labeling.html
- Food and Drug Administration, 2002. Center for Food Safety and Applied Nutrition. Voluntary labeling indicating whether foods have or have not been developed using bioengineering. <http://www.cfsan.fda.gov/~dms.biologu.html>
- Food and Drug Administration, 2002. Center for Food Safety and Applied Nutrition. Report of consumer focus groups on biotechnology. <http://www.cfsan.fda.gov/~comm/biorpt.html>
- Falk, M.C., B. M. Chassy, S. K. Harlander, T. J. Hoban, M. N. McGloughlin and A. R. Akhlagi, 2002. Food biotechnology: Benefits and concerns. *J. Nutr.*, 132: 1384-1390.
- Heffernan, J.W. and V. N. Hillers, 2002. Attitudes of consumers living in Washington regarding food biotechnology. *J. Amer. Diet. Ass.*, 102: 85-88.
- Hoban, T.J. and P. A. Kendall, 1993. Consumer attitudes about food biotechnology. Project Report 1993. Raleigh, NC. North Carolina State University and Colorado State University., 1-36.
- Hallman, W.K. and J. Metcalfe, 1993. Public perceptions of agricultural biotechnology: a survey of New Jersey residents. New Brunswick, NJ. Ecosystem Policy Research Center, New Jersey Agricultural Experiment Station, Cook College.
- Harlander, S.K., 2002. The evolution of modern agriculture and its future with biotechnology. *J. Amer. Coll. Nutr.*, 21: 161S-165S.
- Hoban, T.J., 1997. Consumer acceptance of biotechnology: An international perspective. *Nature Biotech.*, 15: 232-234.
- Hoban, T., 1992. Woodrum E, Czaja R. Public opposition to genetic engineering. *Rural Sociology*, 57: 476-493.
- Hoban, T.J., 2001. Consumer attitudes about agricultural biotechnology. The Forum for Family and Consumer Issues. Issue 6.1. <http://www.ces.ncsu.edu/depts/fcs/pub/2001w/hoban.html>
- International Food Information Council, 2001. More U.S. consumers see potential benefits to food biotechnology. <http://www.ific.org>.
- Jackson, D., 2000. Labeling products of biotechnology: towards communication and consent. *J. Agri. Environ. Ethics.*, 12: 319-330.
- Kendall, P., 1997. Food biotechnology: boon or threat? *J. Nutr. Edu.*, 12: 112-115.
- Kreuter, M.W., L. K. Brennan, D. P. Scharff and S. N. Lukwago, 1997. Do nutrition label readers eat healthier diets? Behavioral correlates to adults' use of food labels. *Amer. J. Prev. Med.*, 13: 277-283.
- Lin, W., W. Chambers and J. Harwood, 2000. Biotechnology: US grain handlers look ahead. *Agricultural Outlook*.
- McMurphy, D. and M. Vujicic, 2001. The changing dynamics of the patient-provider relationship. *Hospital Quarterly*. Winter, 40-43.
- Office of Technology Assessment, 2001. New Developments in Biotechnology. Background Paper: Public Perceptions of Biotechnology. <http://www.wws.princeton.edu/~ota/disk2/1987/8721n.html>.
- Priest, S.H., A. W. Gillespie, 2000. Seeds of discontent: Expert opinion, mass media messages, and the public image of agricultural biotechnology. *Sci. Eng. Ethics.*, 6: 529-539.
- Pew Initiative on Food and Biotechnology, 2002. U.S. vs. EU: An examination of the trade issues surrounding genetically modified food. <http://www.pewagbiotech.org/resources/issuebriefs/europe.pdf>.
- Pew Initiative of Food and Biotechnology, 2002. State Legislative activity in 2001 related to agricultural biotechnology. <http://www.pewagbiotech.org/resources/factsheets/bills.html>.
- Pennbridge, J., R. Moya and L. Rodrigues, 1999. Questionnaire survey of California consumers' use and rating of sources of health care information including the internet. *Western J. Med.*, 171: 302-306.
- Reiss, M.J., 2001. Ethical considerations at the various stages in the development, production, and consumption of GM crops. *J. Agri. Environ. Ethics.*, 14: 179-190.
- Ranchhod, A. and F. Zhou, 2001. Comparing respondents of email and mail surveys: understanding the implications of technology. *J. Mark. Intell. Plan.*, 19: 254-262.
- Zimmerman, L., P. Kendall, M. Stone and T. Hoban, 1994. Consumer knowledge and concern about biotechnology and food safety. *Food Tech.*, 11: 71-77.
- Zarkin, G.A. and D. W. Anderson, 1992. Consumer and producer response to nutrition label changes. *Amer. J. Agric. Econ.*, 74: 1202-1207.