Public Perception of Genetic Engineering and the Choice to Purchase Genetically Modified Food

Abdullahi O. Abdulkadri[1, *], Simone Pinnock[2] and Paula F. Tennant[2,3]

[1]Department of Economics
[2]The Biotechnology Centre
[3]Department of Life Sciences
The University of the West Indies
Mona Campus, Kingston 7
Jamaica

Selected short paper prepared for presentation at the American Agricultural Economics Annual Meeting, Denver, Colorado, August 1-4, 2004.

*Corresponding author: Direct enquiries to abdullahi.abdulkadri@uwimona.edu.jm

Abstract

This paper presents the results of a survey conducted on public perception of genetic engineering in Jamaica. Our findings suggest that the safety of genetically modified foods is a major concern for consumers and that the perception of the prospects for genetic engineering to improve the quality of life represents a major factor in a consumer's decision to purchase GM foods.

Introduction

Within a span of five years agricultural biotechnology and the development of genetically modified (GM) foods have progressed from small-scale field trials to large commercial plantings worldwide. According to recent figures, some 5.5 million farmers are presently growing crops obtained through Agricultural biotechnology that cover more than 58 million hectares mainly in the U.S., Argentina, Canada and China, representing a 35-fold increase in acreage devoted to GM crops between 1996 and 2002. (Hails and Kinderlarer). With regards to developing countries, the technology offers opportunities to complement traditional techniques and improve their agricultural systems. Research is being conducted in few regions in the Caribbean, including Jamaica. Field testing of genetically modified papayas has been in progress since 1998 under the supervision of the National Biosafety Committee (NBC). The transgenic papayas carry genes that confer resistance to *Papaya ringspot virus*. This represents a welcomed development given that Jamaica's papaya crop was devastated by the virulent ringspot disease in the mid- 1990's. With no resistance gene available in related plants, the development and propagation of transgenic papaya holds high promise of reviving the papaya industry (Tennant, Ahmad, and Gonsalves). Other crops such as pepper and tomato are being developed to fight against other plant pathogens in the island.

Agricultural biotechnology and GM foods are, however, surrounded by controversy; the technology is hailed as having the potential to alleviate world hunger and is criticized as dangerous. The latter concerns have induced heated debates about the safety, and hence acceptance, of GM foods (Jauhar; Moseley; Harlander). In the developing world, various surveys have been carried out in countries such as Brazil, Mexico, The Philippines and Zambia documenting public opinions about GM foods. In Jamaica, the NBC launched a public education program in 2001 aimed at informing students, teachers, farmers, seed importers and the general consumer about biosafety issues. Surveys were subsequently carried out to identify any gains in knowledge about biosafety issues. Although these surveys gave an indication of a general increase in level of awareness about biosafety issues, it provided little information for the drafting of any national policy on genetically modified organisms (GMO). A recent study by Abdulkadri and Duncan (2003) established relationships between consumers' perception and knowledge about GMO and their disposition to the introduction of GM crops in Jamaica. They found that the belief on the relative benefits and risks of GM foods as well as the perception on the availability of GM foods in the domestic market significantly influence consumers' stated preference for or against the introduction of GM crops in Jamaica. Specifically, they noted that those who believed that the benefits out-weigh the risks were more likely to be receptive to the introduction of GM crops in Jamaica while those who were of the opinion that GM crops were already in the domestic market were less likely to be receptive to the introduction GM crops.

It is interesting that despite the imminent introduction of genetically modified agricultural products into the marketplace, there is little published research on the perception of the Jamaican public on the technology and the products. This is particularly worrisome given that the U.S. is at the forefront of the commercialization of GM foods and occupies a dominant trading position

with Jamaica. For instance, in the year 2000, imports from the U.S. made up about 47% of total value of all imports from Jamaica's major trading partners, with the food category representing a sizeable 15% of the total imports from the U.S. With this proportion of food items among all imports from the U.S., it is possible that GM foods may find their way into Jamaican market. Hence, it is crucial to assess the perception of Jamaican consumers about these revolutionary food items. To this end, this study was designed to assess public perception of genetic engineering and the impact of an individual's perception on his or her decision to purchase genetically modified (GM) food items.

Method

A telephone survey was carried out among 170 individuals randomly selected from the telephone directory in the Kingston Metropolitan area between May and October 2002. A structured questionnaire to measure the image and awareness of genetic engineering, levels of acceptance of various GM products, and perceived risks and benefits of GM products was administered during this survey. Closed and Likert scale questions were used with provision for a "Don't know/ not sure" response. Each interview lasted between 15 and 20 minutes.

Post-survey evaluation showed that some respondents did not answer key questions on how likely they are to purchase produce like tomatoes or cucumber known to have been developed by genetic engineering to taste better or stay fresher for longer periods and the perception of the effect of genetic engineering on the quality of life. Since these represent important variables in our analysis, those individuals who did not provide a response to these questions were excluded from the dataset. This resulted in a total of 128 observations suitable for further analyses.

Responses to the Likert scale questions were analyzed using descriptive statistics in order to assess the level of knowledge and perception of consumers of genetic engineering as well as any convergence or spread in perception among consumers. In addition, a limited dependent variable model was specified to predict the probability that an individual, given his or her characteristics, knowledge and perception of genetic engineering, will be willing to buy GM farm produce. This model assumes that, in making such a decision or commitment, an individual possesses a utility ranking (y*), which is unobserved, and that the individual will be willing to buy genetically modified farm produce if his or her utility ranking surpasses a threshold level. If it does, we then observe a highly likely-type response; otherwise we observe a hardly likely-type response.

This model is stated as:

$$Y_i = \beta_1 EDD_i + \beta_2 EFV_i + \beta_3 ELA_i + \beta_4 GENG_i + \beta_5 SGRP_i + \beta_6 CGRP_i + \beta_7 LABEL_i + \beta_8 RELIG_i + \beta_9 EDU_i + \beta_{10} ONMKT_i + \beta_{11} NBC_i + \beta_{12} EFFECT_i + \beta_{13} GENDER_i + \varepsilon_i,$$

where $Y_i = 1$ if $y^* >$ the threshold value and $Y_i = 0$ if $y^* \leq$ the threshold value. The β's represent model coefficients, measuring the marginal impact of each explanatory variable, ε is a random error term, and the index i represents an individual respondent. Also, the explanatory variables are defined as follows:

EDD has a value of 1 if respondent approves of scientists using genetic engineering to enhance plants defenses against diseases and pests, otherwise has a value of 0.

EFV has a value 1 if respondent approves of scientists using genetic engineering to enhance the taste of fruits and vegetables, otherwise has a value of 0.

ELA has a value of 1 if respondent approves of scientists using genetic engineering to enhance the potential in livestock animals, otherwise has a value of 0.

GENG is a Likert scale variable that measures the respondent's level of knowledge of genetic engineering.

SGRP has a value of 1 if the respondent is a member of a scientific group, otherwise has a value of 0.

CGRP has a value of 1 if the respondent is a member of a consumer group, otherwise has a value of 0.

LABEL is a Likert scale variable that measures the respondent's opinion about labeling of foods produced through genetic engineering.

RELIG has a value of 1 if the respondent indicates an affiliation to a religious group, otherwise has a value of 0.

EDU is a Likert scale variable that measures the educational level of the respondent.

ONMKT has a value of 1 if the respondent believes that foods produced through genetic engineering is available in Jamaican supermarkets, otherwise has a value of 0.

NBC has a value of 1 if the respondent is aware of the National Biosafety Committee, otherwise has a value of 0.

EFFECT is a Likert scale variable that measures the respondent's opinion about the effect of genetic engineering on the quality of life.

GENDER has a value of 1 if the respondent is a male and 0 if the respondent is a female.

In order to generate the dependent variable Y_i, responses to the Likert scale question on the likelihood that a respondent will purchase a GM farm produce were condensed. In the survey questionnaire, respondents could answer 'very likely, 'somewhat likely', 'hardly likely', 'not at all' or 'don't know/not sure' to the following question: 'How likely would it be for you to buy produce (e.g. tomatoes or cucumber) if it had been developed by genetic engineering to taste

better or stay fresher for longer periods?' As mentioned earlier, any individual choosing 'don't know/not sure' was dropped from further analyses. The dependent variable was defined to have a value of 1 for those respondents answering 'very likely' or 'somewhat likely' and to have a value of zero for those answering 'hardly likely' or 'not at all.'

Once the transformation is done, the probability that $Y_i = 1$ could be estimated by specifying a particular cumulative distribution function (c.d.f.) for the model. We used a probit model by assuming a c.d.f. for a standard normal random variable as the c.d.f. for Y_i. Estimation of the probit model yielded values for the model coefficients. The probability that $Y_i = 1$ was then predicted for each respondent and the percentage of right predictions from the model noted.

Results

Results of our data analyses indicated that 53% of the respondents were female. The respondents were fairly knowledgeable about genetic engineering with only 30% of respondents indicating that they had no idea whatsoever about what genetic engineering is. The level of awareness about genetic engineering was observed to be positively correlated with the level of education. More than 92% of respondents indicated that their first thoughts or image of genetic engineering was that it was unsafe while 42% thought that it was progressive. More than three-quarters of respondents favored the use of genetic engineering to create or enhance new drugs. About 62% of respondents were against the use of genetic engineering to create or enhance the taste of fruits and vegetables. About 58% were in favor of using genetic engineering to create or enhance crop plants to have their own defenses against diseases or pests. In the case of livestock, 88% were against the use of genetic engineering to enhance livestock animals. As for the decision to buy produce developed by genetic engineering, the respondents were evenly

divided. On the effect of genetic engineering on quality of life, 11% of respondents thought genetic engineering would worsen the quality of life and 12% believed it would make the quality of life much better. About 88% of respondents agreed or strongly agreed that strict regulations should be put in place during the development and testing of genetically engineered products. In similar manner, about 96% of respondents agreed or strongly agreed that foods produced through genetic engineering should be labeled to indicate that it contains GM ingredients.

In evaluating the awareness of and trust in institutions involved in handling GMO (developing or monitoring use), only 17% of respondents indicated that they have heard of the National Biosafety Committee. About 12% of respondents indicated that they have no confidence in local university scientists on statement made about genetic engineering compared to 29% indicating that they have a high level of confidence in this group of professionals. In the case of local farmers, 26% of respondents indicated that they have no confidence in them compared to 18% indicating a high level of confidence in them. When asked about their level of confidence in the Jamaican Government, 42% of respondents indicated no confidence in the government compared to 11% indicting high level of confidence in the government.

The results of the estimation of the probit model are reported in Table 1. These indicate that only EDD, LABEL, NBC, and EFFECT are statistically significant at the 1% level. At the 5%, EFV also becomes a statistically significant variable. All significant variables, except LABEL, carry positive coefficients. In the case of Likert scale variables, this indicates that the stronger the opinion of a respondent about the issues represented by these variables, the higher the probability that they will chose to buy GM foods. As for the binary (dummy) variables, the presence of this characteristics will increase the probability that a respondent will chose to buy

GM foods. In the case of LABEL, the stronger the opinion of a respondent on labeling, the lower the probability that he or she will chose to buy GM foods.

In order to judge the predictive ability of our model, the probability that each respondent will chose to buy GM foods was predicted and compared to the original choice indicated in the survey. Our model has a 75.78% prediction accuracy, with purchasing choice of 97 out of 128 respondents predicted correctly.

Conclusions

This paper is focused on a topical issue in food safety concern; that of consumers' awareness and perception of GM foods. In as much as little in known about the long term health and environmental consequences of genetic engineering, consumers are faced with the reality that GM foods are in the market and must choose, when such opportunity exists, between purchasing and not. Many factors go into the decision to purchase and some key factors seem to be the level of knowledge, awareness, and more importantly, the perception of genetic engineering held by the individual. The results from the current study, in particular, suggest that those who support the use of genetic engineering for the enhancement of plants' resistance to diseases and pests and to enhance the taste of fruits and vegetables are more likely to choose to buy GM foods. The stronger an individual's feeling about the likelihood that genetic engineering will improve the quality of life, the higher the probability that the person will choose to buy GM foods. On the other hand, the stronger the views of an individual about labeling of genetically modified foods, the lower the probability that he or she will choose to purchase GM foods. Our study also points to the fact that respondents have a higher level of confidence in local university scientists than either the local farmers or the government. Hence, the National

Biosafety Committee will be more effective in its public education program if local scientists are featured more often. With the ongoing debate on GM foods across the globe, this paper has the potential of generating interesting discussions, not only because it adds to the literature that show that concerns for safety of GM foods remains a major issue in developing countries, but largely because it provides an empirical basis for why consumers, in a developing country, may choose to buy or not buy GM products.

References

Abdulkadri, A.O., and D. Duncan, 2003. "Consumer knowledge and perception of genetically modified foods." Paper presented at the Scientific Research Council Annual Conference, Kingston, Jamaica, November 19-22.

Hails, R. and Kinderlarer, J. 2003. "The GM public debate: context and communication strategies." *Nature* 4: 819-825.

Harlander S. 2002. "Safety assessment and public concern for genetically modified food products: The American View." *Toxicological Pathology* 30: 132-134.

Jauhar, P. 2001. "Genetic engineering and accelerated plant improvement: Opportunities and challenges." *Plant Cell, Tissue and Organ Culture*, 64: 87-91.

Moseley, B. 2002. "Safety assessment and public concern for genetically modified food products: The European View." *Toxicological Pathology* 30: 129-131.

Tennant, P.F., M.H. Ahmed, and D. Gonsalves, 2002. " Transformation of Carica papaya L. with virus coat protein genes for studies on resistance to papaya ringspot virus from Jamaica. *Tropical Agriculture* (Trinidad) 79: 1-9.

Table 1: Parameter Estimates of Probit Model for Consumers' Choice to Buy Genetically Modified Food in Jamaica

Variable	Coefficient Estimate	Asymptotic Standard Error	Asymptotic T-ratio
EDD	1.119***	0.534	2.093
EFV	0.923**	0.563	1.638
ELA	0.0675	0.563	0.120
GENG	0.283	0.283	1.000
SGRP	1.359	1.257	1.080
CGRP	33.346	6.474E08	0.271
LABEL	-0.584***	0.220	-2.661
RELIG	-0.436	0.664	-0.656
EDU	0.028	0.202	0.139
ONMKT	-0.0795	0.489	-0.162
NBC	1.378***	0.690	1.997
EFFECT	1.213***	0.379	3.199
GENDER	0.049	0.490	0.101

Log-Likelihood = -57.434

Chow R^2 = 0.402

Percentage of right predictions = 75.78%

Note: *** and ** indicate statistical significance at the 1% and 5% level, respectively.