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## A RISK PERCEPTION ANALYSIS OF GENETICALLY MODIFIED FOODS BASED ON STATED PREFERENCES

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- *Is there a market for GM foods?*
- *How much are consumers willing to pay for a GM food?*
- *Consumers seem more accepting of plant GM foods as opposed to animal GM foods*

The impact of perceived risk associated with new food technologies has important economic and food safety implications. A better understanding of consumer attitudes and behavior toward genetically modified (GM) food products is essential for designing new market strategies in the area of *neutraceutical products*, which recently have become very popular. Literature in the topic of consumer response toward GMO crops and foods is becoming increasingly important. However, to our knowledge, there is a need to identify the role played by different risk factors (such as environmental risks, potential health issues, or social and ethical concerns) in the consumer response toward these new types of food technologies.

This research project had three main objectives.:

1. To determine whether there is a market for the second generation of GM foods, which offer direct personal benefits to consumers over the conventional products. As most prior consumer

acceptance and demand studies have looked at WTP for non-GM products, this idea that consumers may actually be willing to pay a premium for GM products is different from the existing body of research about GM food. This part of the study compares consumer WTP for different types of genetic modifications in a tomato plant.

2. To analyze consumer trade-offs between potential benefits and potential risks associated with the GM technology, analyzing the role played by these subjective beliefs on consumer acceptance of GM products. Heterogeneous preferences were considered, thus willingness to pay (WTP) for the product is contrasted with willingness to accept (WTA) compensation to buy the product. Two empirical estimators were developed to account for both, positive and negative responses in order to estimate welfare measures. The first estimators were the mean WTP and mean WTA for a GM tomato and a GM beef product. The second estimator allows us to estimate a net benefit (WTP net of WTA). The net estimate would implicitly reflect the sample proportion of gainers and losers.
3. To analyze consumer response toward genetically modified foods that carry a known risk. Dichotomous choice questions are used to compare

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WTP/WTA measures for a GM tomato that carries a probability of human health risk (allergenicity) to that which carries a probability of environmental risk (cross-pollination).

### ***Data and Methods***

The data was gathered using a mail survey in the Western States of the United States. A total of 164 completed surveys were obtained. The survey included questions:

- Related to general knowledge and information about risks and benefits associated with genetically modified foods
- The level of consumer concern with social/ethical, health, and environmental issues surrounding genetic modifications
- Willingness to pay for different genetically modified processes in both animals and crops
- Socio-demographics variables

### ***Market and Policy Implications***

This research identifies the role played by different risk factors in the consumer response toward GM food technologies, as well as how consumer response may change if the GM product offers a direct personal benefit to the purchaser. The impact of perceived risks and benefits associated with new food technologies has important economic and food marketing implications. The results of this study provide essential information for designing new market strategies for this second-generation of GM products which, unlike the first-generation GM products, offer benefits to consumers.

The willingness to pay (WTP) values were derived for five different types of genetic modifications in a tomato plant. Claims of “Enhanced Nutritional Value,” “Pesticide Reduction,” “Increased Food Shelf-Life,” “Increased Profits for Farmers,” and “Enhanced Flavor” were compared in order to determine which attributes command the highest levels of consumer acceptance. Willingness to pay estimates indicate that highest premiums would be obtained by the “Enhanced Flavor” attribute, followed by the “Enhanced Nutritional Value” and “Pesticide Reduction” attributes. The conclusion that these attributes carry the highest

consumer acceptance and premiums, when compared to the other mentioned attributes, is particularly useful for food producers and marketers.

This analysis included two products, a genetically modified tomato and a genetically modified beef product. Results indicated that the main influencer of mean WTP measures is the bid amount a respondent is presented with. The higher the premium, the less likely it is that the consumer will pay it. Also, the results suggest that the across-the-board determinants of whether a person is a lover or hater of GM foods are their views on manipulation of natural species and their perceptions of the risks associated with GM technology. Other socio-demographic variables were also found to be significant contributors.

When comparing results of the two product categories analyzed, it seems a higher percentage of respondents prefer GM tomatoes than GM beef. It is possible then, that the general population is more accepting of plant modifications than of animal product modifications. However, the “lovers” of GM beef also seem to be willing to pay higher premiums than the “lovers” of GM tomatoes. Those respondents that enjoy this beneficial GM beef product, which offers higher nutritional content and fewer calories, are willing to pay premiums of approximately 46%. Future research should continue to explore the differences in perceptions and WTP/WTA measures of GM crop and GM animal products.

The results obtained in this research have clear implications. For those who are looking for new ways to improve attitudes and perceptions of genetic modification, the application of these results would indicate that emphasizing the direct personal benefits that such products may provide could prove to be a valuable tool. However, these findings may not prove to be applicable across all GM products. And, though it is beyond the scope of the research presented here, for future studies it may be beneficial to learn whether these findings hold for other products, perhaps looking at genetically modified meat or a further-processed product.

**Table 1. Socio-demographics**

	Description	Mean	St. Dv.	Cases
<i>Age</i>	1=Under 20	7.975000	1.999843	160
	2=20-24			
	3=25-29			
	4=30-34			
	5=35-39			
	6=40-44			
	7=45-49			
	8=50-54			
	9=55-59			
	10=60+ years			
<i>Gender</i>	1=Female	0.416149	0.494457	161
	0=Otherwise			
<i>Education</i>	1=Elementary school or less	5.354037	1.586702	161
	2=Some high school			
	3=High school graduate			
	4=Some college			
	5=Junior college graduate			
	6=4-year university graduate			
	7=Post graduate work			
	8=Any other education			
<i>Income</i>	1=Under \$20,000	5.137255	1.936692	153
	2=\$20,000-\$29,999			
	3=\$30,000-\$39,999			
	4=\$40,000-\$49,999			
	5=\$50,000-\$59,999			
	6=\$60,000-\$69,999			
	7=\$70,000+			
<i>Employment</i>	Student (1.25%)			160
	Full-time (51.25%)			
	Part-time (8.75%)			
	Stay at home (4.38%)			
	Retired (31.25%)			
	Not Employed (3.12%)			
<i>Household Members</i>	Continuous	2.509317	1.346839	161
<i>Children Under</i>	Continuous	0.490683	0.981822	161

**Table 2. Comparison of Sample Socio-demographic versus U.S. Population**

Socio-demographics	Sample	U.S. Population <sup>a</sup>
% Female	41.6%	50.9%
% Household with children under 18 years of age	25.2%	36.0%
% Bachelor's degree or higher	52.8%	24.4% <sup>b</sup>
Median income	5(\$50,000-\$59,999)	\$41,994
Median age	8 (50-54)	35.3

<sup>a</sup> Source: Consumer Survey and U.S. Census Bureau, Census 2000.

<sup>b</sup> Persons of 25 years and over, 2000.

**Table 3. WTP Estimates**

WTP	Mean WTP Estimate	
	% Premium	Cents per lb.
WTP for a Tomato Modified for Enhanced Nutritional Value	3.81	8.72
WTP for a Tomato Modified for Pesticide Reduction	3.05	6.98
WTP for a Tomato Modified for Increased Food Shelf-Life	1.87	4.28
WTP for a Tomato Modified for Increased Profits for Farmers	0.70	1.60
WTP for a Tomato Modified for Enhanced Flavor	4.58	10.49

**Table 4. Percentages and Distribution of the WTP Responses for the Different Attributes**

Intervals	Percentage Response by Interval				
	WTP for Enhanced Nutritional Value	WTP for Pesticide Reduction	WTP for Increased Food Shelf-Life	WTP for Increased Profits for Farmers	WTP for Enhanced Flavor
WTP=0 Not willing to pay					
WTP=1.5% premium	32.87%	38.10%	43.06%	46.53%	32.43%
WTP=6-10% premium	28.67%	27.21%	26.39%	24.31%	25.68%
WTP=11-15% premium	16.78%	16.33%	14.58%	14.58%	15.54%
WTP=15-20% premium	7.69%	6.80%	4.17%	5.56%	10.81%
WTP=21-25% premium	6.99%	6.12%	6.25%	3.47%	8.78%
WTP=26-30% premium	3.50%	2.72%	3.47%	2.08%	3.38%
WTP>30% premium	0.70%	0.68%	0.69%	0.69%	1.35%
	2.80%	2.04%	1.39%	2.78%	2.03%
	n=143	n=147	n=144	n=144	n=148