Influence of Brand Name, Store Loyalty, and Type of Modification on Consumer Acceptance of Genetically Engineered Corn Chips

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Abstract

In an effort to counteract adverse consumer reaction to genetically engineered foods, the biotechnology industry has shifted attention to deriving and promoting foods that have been genetically modified to have benefits for the consumer. However, is it uncertain whether this strategic shift will be successful at changing consumer perception of biotechnology. Our survey results suggest that consumers are more accepting of corn chips that have been modified to increase shelf life as opposed to increasing farmer yields; however, willingness-to-pay premiums for these value-added corn chips are small. Results also suggest consumers are more accepting of genetically engineered foods when sold by agribusinesses with high levels of brand equity or store loyalty.

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In the United States, use of genetically engineered crops is widespread. In 2000, 25 percent of corn and 50 percent of soybean acres were planted with genetically engineered seeds (USDA/NASS 2000). The proliferation of genetically engineered crops is primarily a result of enhanced production efficiencies provided by new seed varieties. Despite widespread adoption and acceptance of genetically engineered crops by agribusinesses and farmers, consumers appear to be less convinced of the benefits of the technology. The controversy surrounding development and production of genetically engineered crops has escalated in recent years and much of the controversy stems from consumer fears and concerns for the new technology.

The disparity between the levels of acceptance at the farm and consumer levels is noteworthy. Many in the agribusiness industry have espoused the view that consumers will be more accepting of genetically engineered foods when they derive some benefit from the product. This benefit-acceptance hypothesis appears to be consistent with producer behavior at the farm level. Farmers are able to produce crops at lower costs, due to herbicide resistant or insect resistant varieties, and/or increase yields due to other genetic modifications. Because of these financial benefits, farmers and agribusinesses, in general, have become proponents of genetic engineering.

In contrast to agribusinesses, consumers currently see little benefit in purchasing genetically engineered foods, except perhaps for a small decline in price. These relatively small reductions in price, in conjunction with the fact that most US consumers spend a small percentage of their total income on food, do no appear to be enough benefit to outweigh fears of the new technology. Thus, it is reasonable to assume that most consumers view consumption of bioengineered foods as taking a risk without any return. As a result, agribusinesses have shifted biotechnology research, or at least public relations campaigns, toward developing foods that consumers can associate tangible benefits with. One such product is golden rice, a variety of rice engineered to contain high levels of beta-carotene, which the body can readily convert to Vitamin A. However, golden rice, and other such genetically engineered foods with enhanced end-use characteristics, have yet to appear in the marketplace.

The agribusiness industry has been criticized, both internally and externally, for not initially advocating the benefits of biotechnology to the consumer. The result of this strategy has been a mild backlash, in the case of US consumers, and an outrage, in the case of European consumers, toward genetically engineered foods. Although some research has suggested that US consumers were generally accepting of genetically engineered foods in the early to mid 1990s (Hoban), recent research indicates that most US consumers express alarm and concern when informed of the current level of food manufactured with genetically engineered ingredients (Levy and Derby). Consumer and media reaction to the recent Starklink corn recall also highlights the publics' growing concern for genetically engineered foods. In recent years, agribusinesses have altered their research and public relations strategies in an attempt to change consumers' perceptions of genetically engineered foods by focusing on modified products that have benefits for the consumer. Whether such a strategy will be successful in the long run is an issue open for debate. One of the primary goals of this research is to determine if consumers are more accepting of foods that have been genetically engineered to provide a benefit for them, as opposed to a benefit for the producer, to determine the potential success of current agribusiness promotion and research and development strategies.

The preceding discussion alludes to the hypothesis that consumers make trade-offs between their level of concern for a product and other positive quality characteristics that a food may possess. If this hypothesis is valid, it suggests that consumers may be more accepting of genetically engineered foods that are sold by retailers or processors that they perceive as possessing "high quality" attributes. Consumers may perceive an agribusiness as possessing "high quality" attributes if a) they place a high level of trust in the business, and therefore consider the food they sell safe, b) their taste and preferences are such that they prefer a particular agribusiness's product relative to the competition's substitute product, and/or c) consumers posses a degree of familiarity with a particular food or retail setting and are averse to the risk involved in trying new products or new stores that would be necessitated by "brand-switching" or "store-switching." Thus, factors such as brand equity and store loyalty may influence consumers' levels of acceptance of genetically modified foods. In this case, consumers' fear of genetically engineered foods may be outweighed by a high level of brand equity possessed by an agribusiness processor or store loyalty possessed by an agribusiness retailer.

Agribusiness firms may be able to counteract consumer fear of genetically modified foods by developing genetically engineered crops that have beneficial end-use characteristics or by relying on consumer trust in well developed product brands or store names. In this study, we estimated demand for corn chips that were produced with genetically modified corn. In this analysis, our goals are to: a) determine if consumer acceptance of genetically engineered food is dependent upon the type of genetic modification, i.e., are consumers less averse to corn chips that have been genetically modified to increase shelf life as opposed to increasing crop yields, b) estimate the premium that consumers are willing to pay for non-genetically modified corn chips (or equivalently, the price decrease necessary to invoke acceptance of genetically modified corn chips), c) determine if brand equity is sufficient to outweigh consumer concern for genetically engineered corn chips, and d) determine if consumers are more accepting of genetically engineered corn chips when sold by retailers with high levels of store loyalty.

Methods

To provide an initial investigation into the matters previously discussed, we conducted a survey of 271 students enrolled in a Principals of Marketing course at Mississippi State University. The sample was geographically and demographically restricted. However, little quantitative research has been directed toward analyzing consumer acceptance of alternative types of genetically engineered corn chips in the face of high/low brand equity and store loyalty and this research provides initial insights into these often cited, but little researched issues. However, results may not necessarily be extendable to all samples of respondents. Nevertheless, it should be noted that when estimating the value of "store loyalty," a geographically restricted sample is desirable since all consumers' choice sets must contain the same retailers.

In the survey, we employed a choice experiment (CE), a form of conjoint analysis. CEs and other conjoint methods are becoming popular methods of estimating the value of product attributes and measuring the degree of substitutability between attributes in consumer purchasing decisions (Baker; Green and Srinivasan; Louviere; Louviere and Woodworth; Unterschultz et al.). In the survey, consumers were asked several repeated questions. In each question, consumers were asked to make a choice between two alternative descriptions of bags of corn chips. Each bag of corn chips was described with four attributes: price, store where purchased, brand name, and type of corn used to make the chips. An example of a choice question respondents were asked to complete is shown in Figure 1. The four chip attributes were also varied at several levels. The price attribute was allowed to vary between the following values: \$4.00/bag, \$3.00/bag, and \$2.00/bag. The chips were identified as being bought at either Jitney Jungle or Kroger and were identified with the brand name of either Tostitos or No Brand. All students were familiar with the two grocery store chains (there were only three major grocery stores in the small college town), and one chain, Kroger, is widely acknowledged as being "higher quality" than the other. Lastly, the corn chips were identified as being manufactured with a) genetically modified corn used to increase chip shelf life, b) genetically modified corn used to increase farmers' crop yields, or c) no genetically modified corn.

Given the attributes and attribute levels, a large number of corn chips descriptions could be derived. To simplify the number of CE questions that the consumers had to respond to, an orthogonal fractional factorial design was generated using SAS (Addelman; Louviere and Woodworth). The resulting design consisted of 13 choice sets. Consumers were presented with the following instructions prior to administration of the survey,

> In this section of the survey, we want you to answer several repeated questions regarding what type of corn chips you would purchase. In each question, you are presented with two different descriptions of a bag of corn chips and you are asked to identify which bag of chips (option A or B) you would be most likely to purchase or none at all (option C). Each bag of corn chips has a level of price as well as having a specific brand, being sold in a particular store, and produced with different types of genetically modified corn (or no genetically modified corn). Please note that the word "Genetically Modified" has been replaced with the abbreviation GM. Each bag of corn chips is assumed to be 14.5 oz. (standard size). Please answer the questions as truthfully as possible and in such a manner that you would make the same choice if you were actually presented with these options in real life.

Conceptual Model

The CE is consistent with random utility theory (Ben-Akiva and Lerman). Assume that consumers derive utility (or satisfaction) from consumption of corn chips as shown in equation 1.

$$U_{ij} = W_{ij} + \varepsilon_{ij} \tag{1}$$

Where U_{ij} is the ith consumer's utility of choosing option j, W_{ij} is the systematic portion of the utility function determined by the chip attribute levels for alternative j, and ε is the stochastic element. Given that the consumer is faced with three choices in each CE question (options A, B, or C), the probability that a consumer will choose alternative j is:

$$\text{Prob}\{\text{j is chosen}\} = \text{prob}\{W_{ij} + \varepsilon_{ij} \geq W_{ik} + \varepsilon_{ik};\ \text{for all } k \in C_i\} \tag{2}$$

where C_i is choice set for respondent i. Equation 2 simply implies that consumers will make the choice (option A, B, or C), from which they derive the most utility, adjusted for randomness.

If the random errors in equation 2 are independently and identically distributed across the j alternatives and N individuals with a type I extreme value distribution and scale parameter equal to 1, then the probability of consumer i choosing alternative j becomes:

$$\text{prob}\{\text{j is chosen}\} = \frac{e^{W_{ij}}}{\sum_{k \in C} e^{W_{ik}}} \tag{3}$$

If W_{ij} is assumed to be linear in parameters, then the functional form may be expressed as:

$$W_{ij} = \beta_1 price_j + \beta_2 store_j + \beta_3 brand_j + \beta_4 GMcorn1_j + \beta_5 GMcorn2_j \tag{4}$$

where *price*, *store*, *brand*, and *GMcorn1 and GMcorn2* are the attribute values for alternative j for consumer i, and β_n represents coefficients to be estimated. Equation 3 is a multinomial logit model, which may be formulated using the attribute levels and the responses to the CE survey questions. Greene (2000) discusses procedures for estimation of the model. For estimation, attribute levels in equation 4 are effects coded, rather than the typical 0,1 dummy variable coding. Effects coding allows for recovery of the "left-out" dummy variable and it preserves the orthogonality of the design. Adamowicz et al. (1994) provide additional motivation and justification of the use of effects coding in a CE with an orthogonal design. Variable definitions are as follows: *price* = \$2.00, \$3.00, or \$4.00, *store* = 1 if Kroger; -1 if Jitney Jungle, *brand* = 1 if Tostitos; -1 if No Brand; *GMcorn1* = 1 if farmer used genetically modified corn to increase crop yield; 0 if genetically modified corn was used to increase chip shelf life; and –1 if no genetically modified corn were used; and *GMcorn2* = 0 if farmer used genetically modified corn to increase crop yield; 1 if genetically modified corn was used to increase chip shelf life; and –1 if no genetically modified corn were used.

As shown in equations 3 and 4, each chip attribute directly affects consumer utility, and thus probability of purchase. It is expected that increases in price will be associated with a reduction in the level of utility derived from chip consumption; thus β_1, is expected to be negative. Simply stated, a negative coefficient on the price attribute implies a downward sloping demand curve. Of primary interest is the relative magnitude of the coefficient estimates. For example, by comparing the magnitude of coefficient estimates one can determine if moving from one type of genetic modification to another has a larger/smaller influence on utility than changing from one brand to another. Furthermore, the price increase necessary to offset the positive utility associated with a particular attribute can be determined. For example, assume β_1 is negative - consumer utility declines as price increases. Also assume that β_3 is positive - consumers derive higher utility from Tostitos than from chips with no brand name. Given these assumptions, one may ask the question, "What is the maximum premium that Tostitos can charge for a bag of corn chips before consumers switch consumption to chips with no brand name?" This question is easily answered by choosing the price difference, $price_{Tostitos}$ - $price_{No\ Brand}$, such that $W_{Tostitos} = W_{No\ Brand}$.

Results

Two hundred and seventy one students completed the CE survey. The sample of participants was comprised of approximately 50 percent males and 50 percent females. All participants were between the ages of 18 and 23 and most were residents of Mississippi. The financial and racial background of the participants was relatively diverse and most students majored in a degree plan within the College of Business.

Estimation results of the multinomial logit model, outlined in equations 3 and 4, are reported in table 1. Results are consistent with expectations. The price coefficient is negative, indicating that an increase in the price of corn chips results in a decline in the utility derived from the chips, and thus a reduction in the probability of purchase. The negative price coefficient equivalently implies that lower priced corn chips are preferred to higher priced corn chips, holding all other attributes constant. Corn chips with the brand name Tostitos are strongly preferred to chips with no brand name. The relative magnitude of this coefficient suggests that brand equity has a stronger influence on chip choice than where the chips were purchased or if the chips were manufactured with genetically engineered corn. The store coefficient implies that the participants in this survey derived higher utility from purchasing corn chips from Kroger than from Jitney Jungle.

Of primary interest in this study are the signs and magnitudes of the coefficient estimates associated with the type of corn used in chip manufacture. Results in table 1 suggest, as expected, that consumers are averse to chips produced with corn that was modified to assist farmers in increasing crop yields. In contrast, consumers derive positive utility from corn chips produced without genetically modified corn and from corn chips produced with genetically modified corn engineered to increase chip shelf life.

The monetary values that consumers place on each chip attribute were calculated using the estimates in table 1. As previously described, we estimated the price increase necessary to offset the positive utility associated with the Tostitos brand name, shopping at Kroger, and using genetically modified corn to increase chip shelf life. These estimates are reported in table 2. The price premium necessary to invoke consumer indifference between Tostitos corn chips and corn chips with no brand name is $1.70/bag. At any premium less than this value, consumers, on average, derive higher utility from Tostitos than from chips with no brand name and will make their decision purchase accordingly. Conversely, if Tostitos are priced at a premium greater than $1.70 over chips with no brand name, the average consumer will shift consumption to the chips with no brand name. Thus, the value of the Tostitos brand name is $1.70. Estimates also suggest that Kroger can charge a higher price, $0.65/bag, for a bag of corn chips. This estimate indicates that consumers have a higher level of store loyalty for Kroger than for Jitney Jungle. There are numerous reasons why Kroger might be preferred to Jitney Jungle including wider product offering, cleanliness, convenience, location, perception of food safety and/or quality, degree of familiarity with the store, etc.

Estimates in table 2 also suggest that a relatively small premium exists for chips manufactured with corn genetically engineered to increase shelf life. Estimates indicate that the average consumers would be willing to pay a $0.33 premium for a bag of chips made from corn modified to increase shelf life as compared to a bag of chips made from corn modified to increase farmers' crop yield. Although the value is small, it is noteworthy that the value is positive. Given this result, it appears that consumers are more accepting of genetically engineered foods that have been designed to have a benefit for them. However, the added value provided by the modification appears, in this case, just enough to outweigh the perceived risk associated with genetically engineered food. Results in table 2 suggest that virtually no premium exists for chips made from corn modified to increase shelf life as opposed to chips made with no genetically modified corn. That is, the value consumers place on increase shelf life appears to be almost exactly offset by the reduction in value consumers place on genetically engineered chips. These results imply that if increased shelf life could be provided through traditional means, a larger premium could likely be obtained.

As a final step in the analysis, we sought to determine if brand equity and store loyalty were sufficient to outweigh consumer concern for chips that were manufactured with corn used to enhance crop yield. The answer to this question is clearly provided by the estimates in table 1; however, to further highlight these findings we constructed two simulated scenarios, which are reported in table 3. In each scenario, two bags of corn chips were constructed with a particular price, brand, location of purchase, and type of corn used in chip manufacture. Given these attributes and attribute levels, we calculated the utility of each option and the probability of purchase. In scenario 1, chip option A was priced at $3.00, had the brand name Tostitos, was purchased at Kroger, and was produced with genetically modified corn engineered to increase farm yields. Chip option B was identical to A except that it had no brand name and was produced without genetically engineered corn. Faced with these two options, our results suggest that the average or representative consumer is much more likely (69 percent versus 25 percent) to purchase the chips with genetically engineered corn. Scenario 1 clearly illustrates that brand equity, provided by the Tostitos brand name, is sufficient to compensate for the disutility associated with genetic engineering. A similar scenario was conducted to analyze the influence of store loyalty. Scenario 2 in table 3 illustrates that, in this case, store loyalty is also sufficient of offset the disutility associated with genetically engineered corn used to increase crop yields.

Conclusions and Implications

Agribusiness firms have shifted public relations and research and development efforts toward promoting genetically engineered foods that have benefits for the consumer rather than the producer. Despite the widely held view that consumers will be accepting of genetically engineered foods that have been designed to have a benefit for them, little quantitative research has confirmed this hypothesis. In an initial attempt to address this issue, we conducted a survey of over 250 students and asked participants to evaluate several bags or corn chips identified with various quality attributes, one of which being the type of corn used in chip manufacture.

For our particular sample of respondents, results confirm the hypothesis that consumers are more accepting of food that has been genetically engineered to have benefits for them; however, the value added by the genetic improvement was almost exactly offset by the disutility associated with consumer concern for the use of biotechnology. Our estimates suggest that chips manufactured with corn engineered to increase shelf life could sell at a $0.33/bag premium over chips manufactured with corn engineered to increase farmers' crop yield. However, our sample of consumers placed roughly the same value on chips manufactured with no genetically modified corn and on chips manufactured with corn engineered to increase chip shelf life.

Results of the analysis also indicate that factors such as brand equity and store loyalty have a larger influence on consumers' chip purchasing decision than does the type of corn used in chip manufacture. Our analysis indicates that consumers are likely to purchase genetically engineered foods from agribusinesses with high levels of brand equity or store loyalty even if competing agribusinesses with low levels of brand equity or store loyalty begin selling non-genetically engineered food. Whether a particular firm will lose sales if competitors begin to sell and advertise non-genetically engineered food depends on the degree of brand equity and store loyalty possessed by the particular firm relative to the competition.

Results of the analysis have both positive and negative implications for agribusinesses producing and selling genetically engineered foods and for the biotechnology industry as a whole. On the negative side, it appears that our sample of consumers preferred corn chips produced without genetically engineered corn and their preferences were such that they are willing to pay a premium for this product. Furthermore, even when corn chips were genetically modified to have a benefit for the consumer, acceptance was roughly equivalent to corn chips without any genetically modified corn. That is, the value added by enhancement in end-use characteristics of the foods was, in this case, only sufficient to offset consumer concern for biotechnology. Thus, agribusinesses may not be able to reap the benefit of value-added products if they are genetically engineered.

Conversely, results of the analysis have some positive implications for agribusinesses. While our sample of consumers was averse to foods that were genetically engineered to benefit the producer, it appears this aversion is small, in monetary terms, especially when compared to the importance that consumers placed on other food quality attributes. In our analysis, factors such as product brand name and location of purchase had a far larger influence on the consumers' purchasing decision than did the type of corn used to make the chip. Thus, consumer aversion to biotechnology may not be sufficient to affect sales of agribusiness firms that sell products with other positive quality attributes. Lastly, results imply that consumers actually derived positive utility from corn chips engineered to increase shelf life, supporting current agribusiness research and development and promotional campaign strategies. The extent to which our results are extendable to all cases and all samples of consumers is unknown, but we do find support for the prevailing benefit-acceptance hypothesis while providing new insight into consumer aversion to genetically engineered foods relative to their desire for other food quality attributes. Whether consumer aversion to genetically engineered foods will change in the future due to education, advertisement by the biotechnology industry, popular press, or future scientific discoveries, is an issue left to future research.

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Figure 1 – Sample Choice Experiment Question

Please choose A, B or C.

Chip attribute	**Option A**	**Option B**	**Option C**
Price/bag	$4.00	$2.00	Neither A nor B is preferred
Store	Kroger	Kroger	
Brand	Tostitos	No Brand	
Type of Corn Used to Make Chips	Farmer used GM corn to increase crop yield	No GM Corn used	
I would choose . . .	☐	☐	☐

Table 1 – Consumer Valuation of Corn Chip Attributes

Attribute	Variable	Coefficient[a]	Standard Error
Price	Chip price/14oz bag	-0.751***b	0.037
Brand[c]	Tostitos	0.638***	0.030
	No Brand	-0.638***	0.030
Store[c]	Kroger	0.242***	0.027
	Jitney Jungle	-0.242***	0.027
Type of Corn[c]	Farmer used GM corn used to increase crop yield[d]	-0.160***	0.045
	GM corn used to increase chip shelf life	0.085*	0.044
	No GM corn used	0.075*	0.041

Number of observations = 3523 (13 choice sets x 271 respondents)
Psuedo R^2 = 0.18; Log likelihood = -3167; Percent of correct predictions = 47 percent
[a]The model was estimated with alternative specific constants which are available from the authors upon request
[b]Three, two, and one asterisk represents statistical significance at the 0.01, 0.05, and 0.10 levels, respectively
[c]Attributes are effects coded such that the "left-out" category equal the negative sum of the "included" categories
[d]The words "genetically modified" have been replaced with the acronym "GM"

Table 2 – Estimated Value of Various Corn Chip Attributes

Premium for . . .	**Relative to . . .**	**Estimated Premium ($/14oz bag)**
Tostitos	No Brand	$1.70
Chips bought at Kroger	Chips bought at Jitney Jungle	$0.65
Chips made with GM corn used to increase shelf life	Chips made with GM corn used to increase crop yield	$0.33
Chips made with GM corn used to increase shelf life	Chips made with no GM corn	$0.01

Table 3 – Assessing the Ability of Brand Equity and Store Loyalty to Outweigh Consumer Concern for Genetically Engineered Food

Scenario	Chip Attributes	Option A	Option B
1	Price	$3.00	$3.00
	Brand	Tostitos	No Brand
	Store	Kroger	Kroger
	Produced with GM corn used to increase chip shelf life	No	No
	Produced with GM corn used to increase farm crop yield	Yes	No
	Produced without GM corn	No	Yes
	Utility of Option	2.29	1.25
	Probability of Purchase[a]	68.74%	24.27%[b]
2	Price	$3.00	$3.00
	Brand	Tostitos	Tostitos
	Store	Kroger	Jitney Jungle
	Produced with GM corn used to increase chip shelf life	No	No
	Produced with GM corn used to increase farm crop yield	Yes	No
	Produced without GM corn	No	Yes
	Utility of Option	2.29	2.08
	Probability of Purchase	53.16%	41.44%

[a]The probability of purchase was calculated by substituting the coefficient reported in table 1 and the alternative specific constants, set equal for options A and B, into equation 3.
[b]Percentages do not sum to 100 percent because of the "Neither A or B is preferred" option