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Consumer Preference Regarding a New Corn Variety: A Willingness to Pay Study

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Abstract

The purpose of this study is to analyze willingness to pay (WTP) and consumer preference for a red, Hi-A™ (high-antioxidant) corn variety. This paper used the double-bounded contingent valuation method and a binary logit model to analyze the responses of an online survey conducted in the fall of 2021. Survey results indicated that nearly 69% of respondents were willing to pay a premium for the new variety with an overall average WTP value of 81.40 cents per ear. This research highlights the economic implications of introducing nutrient-dense agricultural products to meet emerging consumer demand for healthier food alternatives..

Keywords: consumer preference; contingent valuation; corn; double-bounded; local food; willingness to pay

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Introduction

Consumers have steadily exhibited an inclination toward healthier food alternatives in the last decade (Goetzke and Spiller, 2014; Martinez et al., 2018; Karpyn et al., 2020). This change can be attributed in part to economic and industrial disturbances in society and the food processing sector, causing disruptions in the food supply chain, leading companies to focus more on products that satisfy consumer demand for healthy alternatives (Bigliardi and Galati, 2013). Objective standards for what constitutes healthy foods are still unclear, but they are often categorized as foods with higher nutritional quality compared to alternatives (e.g., low sugar/calorie/saturated fat/sodium) (Motoki et al., 2021). A diet comprised of healthier foods is generally associated with a decreased risk of disease and an increase in overall well-being with consumers (Swinburn et al., 2015; Wahl et al., 2017). These risk factors have shifted individual preferences associated with food alternatives and provided an opportunity for new product entry. Heightened consumer awareness and a new focus on sustainability have also increased demand for healthy food alternatives (Grunert, 2006). These trends have helped decrease the intake of many negative nutrients but have not yielded a significant improvement in the overall diet of the American consumer (Miller et al., 2009)

Previous studies have indicated consumers with higher incomes have better access to healthy foods with relatively inelastic demand regarding changes in price, whereas lower income individuals resort to highly processed, cheaper alternatives (Andreyeva, Long, and Brownell, 2010; Chau, Zoellner, and Hill, 2013; Talukdar and Lindsey, 2013). Results from Feng and Chern (2000) reveal higher price elasticity for fresh fruits and vegetables, showing the importance of competitive pricing and understanding the average consumer's willingness to pay (WTP) for healthier alternatives. Price has shown to be a significant barrier to healthy food access, resulting in low-income individuals restricting their consumption (Jetter and Cassady, 2006; Steenhuis, Waterlander, and de Mul, 2011).

Among the primary drivers of consumer food choices has been product taste for the last several decades, prioritized far above healthiness (Verbeke, 2006; Aggarwal et al., 2016). Though taste is still a primary influence, health-focused labeling is devoid of this important attribute. Instead, health-focused labeling concentrates on nutritional benefits and verbal descriptions that mislead consumers to believe healthy alternatives taste worse and are less filling (Raghunathan, Naylor, and Hoyer, 2006; Suher, Raghunathan, and Hoyer, 2016). Often used as a signal for taste, the color of fresh produce has become an increasingly important factor in consumer decisions and consumption patterns. Many consumers associate divergent produce colors with nutritional benefits and the visual appeal of vibrant colors to good taste (Hein, 2023). For example, red, purple, and blue fruits may have high levels of antioxidants because they possess a subgroup of polyphenols called flavonoids, which includes anthocyanins (antioxidants). These factors have contributed to an increased demand for novel color selections among fruit and vegetable breeding firms and retailers looking to differentiate their product selection (Hein, 2023).

The increased demand for healthy food alternatives coincides with an increased consumer demand for locally sourced food products. There are a variety of reasons for consumers to have an increased

desire to buy locally sourced products, including environmental concern, local economic support, land preservation, perceived nutritional benefit, etc. (Zepeda and Leviten-Reid, 2004; Groves, 2005). These factors proved not enough to change the underlying trends present in the market. Local food production and consumption have been reduced over time due to the consolidation in the U.S. agriculture market, reducing the prospects available to small farms (Stephenson and Lev, 2004). This trend has begun to subside in recent years as consumers convey a growing demand and preference for locally grown, fresh food to highly processed and traveled alternatives. Recent marketing studies have also explored these trends in support of local food (Jekanowski et al., 2000; Darby et al., 2006).

Many Americans associate sweet corn with fresh and local food because it is routinely sold in roadside stands or farmers' markets, is widely available as seeds for home gardeners to produce, and many consumers prefer to consume it uncooked and fresh rather than frozen or canned. Sweet corn is also routinely voted as the most popular vegetable in the United States and is one of the top 10 vegetables in terms of per capita consumption and market value (USDA-ERS, 2016). Sweet corn also possesses a range of minerals, vitamins, and resistant starches that can contribute to positive health-related outcomes (Sheng, Tong, and Liu, 2018). Despite these factors, the consumption of sweet corn is decreasing, as Americans are eating fewer vegetables overall, according to the USDA (Bentley, 2017). However, the introduction of innovative varieties aims to redefine the perception and consumption patterns of sweet corn.

Hi-A^{TM} (high-antioxidant) sweet corn is a new variety currently being developed by selective breeding and field trials at the Texas A&M AgriLife Research facility in Lubbock, TX. The Hi-A^{TM} has a pronounced red coloration, elevated levels of antioxidants similar to that of a blackberry, and is less sweet with a slightly tougher texture than a generic, yellow variety of sweet corn. As consumers shift their preferences toward healthier food alternatives and the consumption of generic sweet corn declines among Americans, there is an opportunity for the Hi-A^{TM} variety to address these trends and potentially renew interest in sweet corn consumption. While many prior works have looked at consumer demand for healthy food alternatives, there is a lack of research related to consumer preference and WTP for specific enhanced nutritional attributes (e.g., elevated levels of antioxidants). Markosyan et al. (2009) found that consumers were willing to pay a premium for apples enriched with an antioxidant coating, especially when the health benefits of antioxidants were noted. While the research found small premiums for the average consumer, the additional antioxidants were from the wax coating rather than the produce itself. Additionally, Colson and Huffman (2011) found that consumers have positive valuations of enhanced levels of antioxidants and vitamin C, gained through genetic modification; however, the study focused solely on broccoli, tomatoes, and potatoes.

As consumers convey an increasing demand for healthy food alternatives and fresh produce with relatively elastic demand, there is an opportunity for novel food products to satisfy elevated demand and a need to evaluate the WTP of average consumers regarding new alternatives. Moreover, as taste is the primary driver of food choice, understanding the tradeoffs consumers make regarding product taste and enhanced nutritional benefits is essential in introducing new alternatives to satisfy changing consumer preferences (Aggarwal et al., 2016). Therefore, the

objective of this study is to evaluate WTP and consumer preference for a new variety of sweet corn that exhibits a red color and has higher levels of antioxidants compared to other varieties currently in the marketplace. This research aims to provide justification for further development of the variety to make it more competitive and desirable among consumers for its potential entrance into the marketplace.

Data

The data for this research were collected through a nationwide, online survey distributed by Qualtrics. Screening questions included a minimum age requirement of 18, and the respondent had to be the main shopper for their household. The Texas Tech University Human Research Protection Program Institutional Review Board and Qualtrics both approved the survey before it was distributed to participants. The survey was first released in September of 2021, with a soft launch (n = 95) to confirm the effectiveness of the questions and survey flow regarding the different blocks of the double-bounded contingent valuation questions. Additional responses were collected through October 2021. In total, 1,052 responses were collected, and 1,037 were used in the study after omitting partial responses.

The survey was designed so that respondents would engage in two rounds of bidding based on the double-bounded contingent valuation method (CVM). The bid amounts used in the survey were based upon regional fresh sweet corn prices in the United States. The price from each region (Northeast, South, Midwest, West) was determined by averaging the price from the top five grocery stores in each region to give an average price of ≈ \$0.50 per ear nationwide. Bid amounts of \$0.40, \$0.60, \$0.80, \$1.00, and \$1.20 were constructed from this average price, and the lowest initial bid of \$0.40 was used to capture the lower bound of WTP estimates from consumers wary of new, novel-colored produce.

Respondents were randomly presented with one of four blocks for the double-bounded contingent valuation questions while completing the survey. The blocks were the same taste/texture (\$0.40 starting price), different taste/texture (\$0.40 starting price), same taste/texture (\$0.60 starting price), and different taste/texture (\$0.60 starting price). The starting price refers to the base price of the generic, yellow sweet corn used for the comparison. The different starting prices were used to better model variability in produce prices and to estimate the entire distribution of WTP values more accurately. This method also helped control for inflated WTP estimates by providing different values that respondents could use to gauge their choices. Taste and texture were also stated in the description to determine if the added nutritional benefits of the red Hi-A^{TM} variety were enough to overcome the less sweet and tougher texture. For example, half of the respondents were presented with a description of the Hi-A^{TM} variety as "less sweet and slightly tougher," and the other half received a description of "identical sweetness and texture" as the generic yellow variety. All respondents were informed that the Hi-A^{TM} corn had elevated levels of antioxidants similar to those of a blackberry. Respondents were also presented with a cheap-talk script before

the WTP questions to help reduce the hypothetical bias often observed in CVM studies, given that no currency is actually exchanged.[1] Figure 1 presents a graphical interpretation of the survey flow.

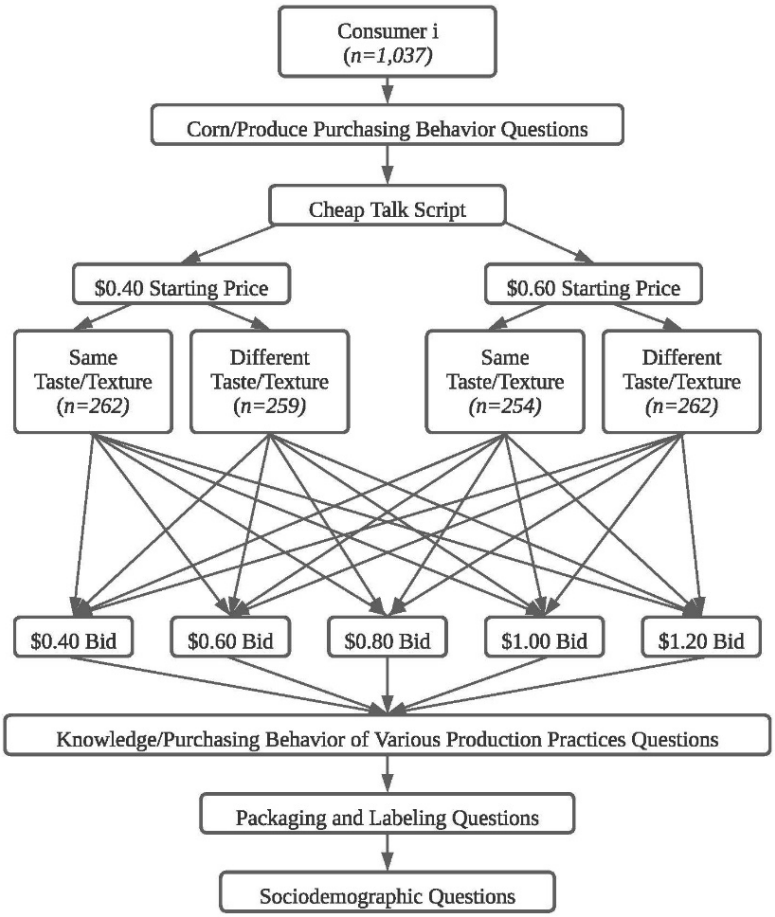

Figure 1. Survey Flow

In addition to the double-bounded contingent valuation questions, respondents were asked about their purchasing habits regarding fresh produce, preferences for packaging and labeling fresh corn, and sociodemographic questions.

Economic Framework/Methods

Contingent valuation is a method that uses nonmarket valuation to evaluate deviations from what is generally perceived to be "common." Respondents were asked to state their preference (i.e.,

[1]The cheap-talk script reminded respondents about their budget constraints and to make choices based upon their own preferences, asked them to make selections as if the choices were faced in an actual purchasing venue, and explained how previous research often found inflated consumer WTP values.

whether or not they will purchase a good if it costs x amount of dollars) regarding the alternatives that were presented. The double-bounded method for analyzing WTP in contingent valuation surveys has routinely been used to produce more accurate estimates than the single-bounded method (Hanemann, Loomis, and Kanninen, 1991). The efficiency of WTP estimates is improved by asking respondents to engage in two rounds of bidding (Hanemann, Loomis, and Kanninen; 1991; Kanninen, 1993; Riddel and Loomis, 1998). The follow-up bid, which is dependent on the response to the first bid, leads to asymptotically more efficient gains, improving upon the single-bounded approach and providing considerably improved statistical evidence from the response data (Hanemann, Loomis, and Kanninen, 1991). Also, the double-bounded approach allows each respondent's WTP to be placed in one of four choice categories with reduced, more statistically valuable intervals: "yes/yes," "yes/no," "no/yes," or "no/no" (Kanninen and Khawaja, 1995). For example, the WTP of participants who respond "yes" to an initial bid of \$0.60 and "no" to a follow-up bid of \$0.80 is narrowed down to the interval comprised of both the first and second bid amounts.

The following econometric interpretation was derived by López-Feldman (2012). y_i^1 and y_i^2 can be defined as the dichotomous variables that report the answers to the two close-ended questions (e.g., $y_i^1 = 1$ and $y_i^2 = 0$ if the responses to the first and second closed questions are "yes" and "no," respectively), where the probability that an individual responds yes to the initial question and no to the subsequent question can be expressed $Pr(y_i^1 = 1, y_i^2 = 0 | z_i) = Pr(s, n)$, where *s* represents "yes" and *n* represents "no" (the conditionality of the probability on explanatory variables is removed for simplification). Respondent *i*'s WTP can be written as follows:

$$WTP_i(z_i, u_i) = z_i'\beta + u_i \text{ and } u_i \sim N(0, \sigma^2), \tag{1}$$

where z_i is a vector of explanatory variables, β is a vector of coefficients to be estimated, and u_i is the error term (López-Feldman, 2012). In this case, the z_i vector contains sociodemographic variables and additional control variables related to the purchasing habits of fresh produce and fresh corn, specifically.[2] Additionally, it is assumed that an individual will answer "yes" when their respective WTP exceeds some bid value (i.e., $WTP_i > t^n$). Using the previous assumptions, we have the probability for the first of the four cases given by:

$$\begin{aligned} & y_i^1 = 1 \text{ and } y_i^2 = 0. \\ & Pr(s, n) = Pr(t^1 \leq WTP \leq t^2) \\ &= Pr(t^1 \leq z_i'\beta + u_i < t^2) \\ &= Pr\left(\frac{t^1 - z_i'\beta}{\sigma} \leq \frac{u_i}{\sigma} < \frac{t^2 - z_i'\beta}{\sigma}\right) \\ &= \phi\left(\frac{t^2 - z_i'\beta}{\sigma}\right) - \phi\left(\frac{t^1 - z_i'\beta}{\sigma}\right), \end{aligned} \tag{2}$$

[2]For a comprehensive list of explanatory variables included in z_i, please refer to the parameters included in Table 1.

where the last expression follows from $Pr(a \leq X < b) = F(b) - F(a)$. Therefore, using symmetry of the normal distribution we have that:

$$Pr(s,n) = \phi\left(z_i' \frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right) - \phi\left(z_i' \frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right). \quad (3)$$

The two outcomes when the respondent gives the same answer to both dichotomous choice questions (e.g., "yes/yes" or "no/no") do not correspond to a pre-existent model. Therefore, a likelihood function is constructed to directly estimate β and σ using maximum likelihood estimation (López-Feldman, 2012). The following likelihood function should be maximized to estimate the parameters for the model:

$$\sum_{i=1}^{N}[d_i^{sn} \ln\left(\phi\left(z_i' \frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right) - \phi\left(z_i' \frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right) + d_i^{ss} \ln\left(\phi\left(z_i' \frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right) + d_i^{ns} \ln\left(\phi\left(z_i{}' \frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) - \left(z_i{}' \frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right)\right) + d_i^{nn} \ln\left(1 - \phi\left(z_i' \frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right)], \quad (4)$$

where $d_i^{sn}, d_i^{ss}, d_i^{ns}, d_i^{nn}$ are indicator variables equal to 1 or 0 for each individual case, which means that a unique individual contributes to the logarithm of the likelihood function in only one of the four parts (López-Feldman, 2012). This approach directly estimates $\widehat{\beta}$ and $\hat{\sigma}$, which is contrary to the single-bounded approach. Using STATA, the *doubleb* command directly estimates these parameters and allows for accurate WTP measures with or without control variables using the *nlcom* command.

A binary logit model was used to estimate consumer preference because the dependent variable has a finite number of possible outcomes that is equal to 2 (i.e., choosing either the Hi-A™ variety or the generic variety). Using the assumption that the error terms of the model are independently and identically distributed (iid) allows for simplification in estimation. Therefore, following Train's (2009) formulation, the probability of the person choosing the Hi-A™ variety is:

$$\begin{aligned} Pr &= \int I[\beta' x + \varepsilon > 0] f(\varepsilon) d\varepsilon \\ &= \int I[\varepsilon > -\beta' x] f(\varepsilon) d\varepsilon \\ &= \int_{\varepsilon=-\beta' x}^{\infty} f(\varepsilon) d\varepsilon \\ &= 1 - F(-\beta' x) = 1 - \frac{1}{1 + e^{\beta' x}} \\ &= \frac{e^{\beta' x}}{1+e^{\beta' x}}, \end{aligned} \quad (5)$$

where $f(\cdot)$ is the density of ε, and assuming ε is distributed logistically where its density is $f(\varepsilon) = e^{-\varepsilon}/(1 + e^{-\varepsilon})^2$ and the cumulative distribution is $F(\varepsilon) = 1/(1 + e^{-\varepsilon})$. Using the above estimation, for any x, the probability can be calculated as $P = \exp(\beta' x)/(1 + \exp(\beta' x))$. The *logit* and *logistic* commands in STATA were used to estimate the coefficients and odds-ratios of the logistic regression, respectively. The difference between the model used to estimate WTP and

the binary logit model is in the dependent variable, which is changed to *Stated_Red* for the logistic regression. This is a dummy variable where the respondents were asked to state their preference for purchasing either the Hi-A^{TM} variety or a generic sweet corn variety if they were both equally priced.

Results

In the current study, we are interested in consumer preference and average WTP regarding the Hi-A^{TM} corn variety. Different methods are available for the estimation of WTP values. For example, WTP can be estimated for certain portions of the overall sample, for certain respondents in the sample possessing specific characteristics, or using average values of control variables to construct an overall mean WTP value. For the purposes of this research, the primary focus will be on the latter.

The summary of statistics of the survey respondents' sociodemographic characteristics and additional variables used in the analysis are presented in Table 1. The average age of the respondents was 46.72 years old with an average household size of between two and three people. Average household income was found to be $56,558, with 36.74% of the respondents having a college-level education, and 76.28% of the respondents were female. Our sample is older, has a lower income, is slightly less educated, and has a higher number females as a percentage compared to the general population (U.S. Census Bureau, 2020). The data are skewed toward female respondents, which is consistent with prior research looking at WTP for healthier food products where main household shoppers were most commonly found to be female (Alsubhi et al., 2023).

Table 1. Summary Statistics for the Survey Respondents

Variable	Description	Percentage of Occurrence	Mean	Standard Deviation
Age	Age of the consumer:		46.7195	16.7122
	1 = 18–30	20.73%		
	2 = 31–45	30.67%		
	3 = 46–60	22.47%		
	4 = > 60	26.13%		
Gender	Dummy variable:		0.7628	0.4256
	0 = Male	23.72%		
	1 = Female	76.28%		
Household size	Number of people living in the household		2.54	1.2309
	1 = 1	21.31%		
	2 = 2	35.58%		
	3 = 3	20.64%		
	4 = 4	12.73%		
	5 = > 4	9.74%		

Table 1 (cont.)

Variable	Description	Percentage of Occurrence	Mean	Standard Deviation
College educated	Dummy variable:		0.3674	0.4823
	0 = No	63.26%		
	1 = Yes	36.74%		
Income	Pre-tax level of household income:		$56,558	39,410
	1 = < $25,000	22.71%		
	2 = $25,000–$50,000	29.86%		
	3 = $50,001–$75,000	21.84%		
	4 = $75,001–$100,000	11.11%		
	5 = $100,001–$125,000	6.67%		
	6 = $125,000–$150,000	4.25%		
	7 = > $150,000	3.57%		
Venue	Where the consumer most frequently purchases fresh produce:		2.2324	0.7976
	1 = Farmers' market	9.93%		
	2 = Large grocery chain	66.54%		
	3 = Small, local grocery store	17.16%		
	4 = Health food store	3.09%		
	5 = Wholesale club store	3.28%		
Color	If the consumer would purchase novel-colored corn for additional health benefits:		0.81	0.3925
	0 = No	19.00%		
	1 = Yes	81.00%		
Local label effect	If a locally produced label would increase the likelihood of purchasing the Hi-A™ variety:		1.0415	0.6672
	Dummy variables:			
	1 = Yes	55.35%		
	1 = No	20.25%		
	1 = No change	24.40%		
Taste	If the taste was described as similar to a generic variety:		0.4976	0.5002
	0 = No	50.24%		
	1 = Yes	49.76%		

Table 1 (cont.)

Variable	Description	Percentage of Occurrence	Mean	Standard Deviation
Nutrition/health	The level of importance consumers place on nutrition/health benefits when purchasing fresh produce:		2.4291	0.5960
	1 = Low	5.50%		
	2 = Medium	46.09%		
	3 = High	48.41%		
Red/black	If a red or black color indicates higher levels of antioxidants, how likely would this affect purchasing habits regarding corn:		1.9826	0.6861
	1 = Not Likely	24.40%		
	2 = Somewhat Likely	52.94%		
	3 = Very Likely	22.66%		
Local purchasing	How often the consumer seeks out locally-produced products:		3.0087	0.8342
	0 = Never	3.38%		
	1 = Not sure	1.93%		
	2 = Not very often	18.42%		
	3 = Somewhat often	46.38%		
	4 = Very often	29.89%		
Social responsibility	If the consumer feels a responsibility to seek out locally-produced products to support local producers and their community:		0.7338	0.4422
	0 = No	26.62%		
	1 = Yes	73.38%		

Additional variables that were incorporated in the subsequent models include the following: *Nutrition/Health*—importance the consumer places on nutritional/health benefits when purchasing fresh produce*; Red/Black*—the effect on purchasing behavior when a red or black color indicates higher levels of antioxidants; *Local Purchasing*—how often the consumer seeks out locally produced products; and *Social Responsibility*—perception of social responsibility regarding local economic support.

Table 2 presents the overall responses to each combination of bid levels (i.e., how the participants responded to each combination of bid amounts). Results show that 68.85% of respondents were willing to pay a premium value for the Hi-A^{TM} corn variety, whereas 31.15% were not willing to pay any level of premium. The percentage of respondents who said yes to the first bid and no to the second bid was 15.53%, whereas 17.07% of respondents said no to the first and yes to the second. It is important to note that the percentage of Yes–Yes responses generally decreased as

the bid amounts increased. This choice combination had the highest percentage of respondents at 32.26%.

Table 2. WTP Premium Distributions

First Bid	Yes–Yes	Yes–No	No–Yes	No–No
$0.40	10.32%	3.95%	1.35%	4.15%
$0.60	8.20%	4.73%	3.76%	3.09%
$0.80	6.65%	3.86%	4.82%	5.50%
$1.00	4.63%	2.03%	4.34%	8.58%
$1.20	6.46%	0.96%	2.80%	9.84%
% Total	36.26%	15.53%	17.07%	31.15%

Willingness to Pay

Table 3 presents the results of the double-bounded WTP model. Because z_i from equation 1 is simply a vector of explanatory variables, the coefficients of each variable can be interpreted as the direct impact on WTP for each control variable on a per ear basis. The constant in the regression can represent a base price per ear (35.18 cents) that consumers are willing to pay. It is important to note that all reported WTP values are on a per ear basis. A mean WTP for the Hi-A^{TM} variety was calculated using the results of the regression and is equal to 81.40 cents with upper and lower bounds of 77.52 cents and 85.27 cents based on the 95% confidence interval, respectively. Using the base prices of the normal variety for comparison, this average value is equal to a 41.40 cent premium when the normal variety is priced at $0.40, or a 21.40 cent premium when the price of the normal variety is $0.60.

Table 3. WTP Estimates for the Red, Hi-A^{TM} Sweet Corn

Parameter	Coefficient	Std. Err.	Pr > z
Constant	0.3518***	0.1249	0.0050
Age	-0.1131***	0.0174	0.0000
Gender	-0.0648	0.0409	0.1140
Household size	0.0176	0.0150	0.2430
College education	-0.0152	0.0391	0.6980
Income	0.0015	0.0125	0.9040
Venue			
Farmers' market	0.0950	0.0692	0.1700
Large grocery chain	0.0369	0.0458	0.4210
Health food store	0.2503**	0.1139	0.0280
Wholesale club store	0.1679*	0.1017	0.0990
Nutritional/health			
Benefits	0.0011	0.0306	0.9720
Color	0.3758***	0.0513	0.0000
Red/black	0.0339	0.0421	0.4210

Table 3 (cont.)

Parameter	Coefficient	Std. Err.	Pr > z
Local label effect:			
Yes	0.2849***	0.0437	0.0000
No	-0.1032*	0.0538	0.0550
Local purchasing	0.0463**	0.0233	0.0470
Social responsibility	0.1016**	0.0438	0.0200
Taste	0.0594*	0.0345	0.0850
Log likelihood	-1186.07		

Note: The variables are described in Table 1 and in above discussions.
*, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

At the 1% level, the constant and variables *Age, Color,* and *Local Label* are statistically significant. The age of the consumer decreases WTP by 11.31 cents for each increase in the age category. Regarding the color of the corn, the estimated results show that consumers who are willing to purchase sweet corn that is not yellow for additional health benefits are willing to pay an additional 37.58 cents. Additionally, if the consumer indicated that a locally produced label would increase their likelihood of purchasing the red, Hi-A^{TM} (*Local Label Effect: Yes),* their WTP increases by 28.49 cents. This amount is compared to the base value of a locally produced label having no effect on likelihood of purchase. On the other hand, if a locally produced label would not increase likelihood of purchase, then consumer WTP decreases by 10.31 cents, as indicated by *Local Label Effect: No,* which is statistically significant at the 10% level. Further support for locally produced foods is shown by *Local Purchasing,* which is statistically significant at the 5% level. That is, the more often a consumer seeks out products labeled as "locally produced," the more often they are willing to pay an additional 4.63 cents for each increase on the Likert scale. *Social Responsibility* is also statistically significant at the 5% level. Consumers who felt it is their social responsibility to seek out locally produced foods in order to support their local producers and economy are willing to pay 10.16 cents more per ear for the Hi-A^{TM} variety.

Because the new variety is not yet available for purchase, it is important to determine at which purchasing venue consumers are willing to pay the highest level of premium. Five different venues were considered in the model, and a small local grocery store was used as the base for comparison. Of the venues considered, *Health Food Store* and *Wholesale Club Store* were statistically significant at the 5% and 10% levels, respectively. Consumers who most frequently purchase their fresh produce at a health food store or wholesale club store, as compared to a small local grocery store, were willing to pay an additional 25.03 cents and 16.79 cents for the new variety, respectively.

Taste is the primary driver of consumer food choices, so it was important to determine if the less sweet and tougher texture of the Hi-A^{TM} altered WTP estimates. In order to do so, the variable *Taste* was considered in the analysis. It is a constructed dummy variable that is equal to 1 if the respondent received a description of the new variety, stating that it was similar to a generic sweet

corn variety in both taste and texture, and equal to 0 otherwise.[3] *Taste* is statistically significant at the 10% level, showing that consumers are willing to pay 5.94 cents more for the Hi-A™ if the taste and texture are similar to a generic variety of sweet corn. This result is consistent with previous studies showing that consumers are driven by product taste, which is generally prioritized above healthiness (Verbeke, 2006; Aggarwal et al., 2016).

Consumer Preference

In order to analyze consumer preference toward the Hi-A™ corn variety, a binary logit model was utilized with the same components as the WTP model. The difference between the two models is in the dependent variable, which is changed to *Stated_Red* for the logistic regression. This is a dummy variable that indicates whether the respondent prefers the Hi-A™ variety to the normal variety when they are equally priced. The logit model results show which characteristics and preferences of the consumer increase the likelihood of purchasing the Hi-A™ variety. The logistic regression is specifically focused on consumers' stated preference toward a new variety of sweet corn with a unique color and additional health benefits.

Table 4 shows the results of the logistic regression. The estimated logit model results show that five variables are statistically significant, with *Color* having the largest effect on stated preference. Consumers who are willing to purchase sweet corn varieties that are not yellow for additional health benefits are 6.21 times more likely to purchase the Hi-A™ variety. Similarly, consumers who place a high importance (*Nutrition/Health* = 3*)* on the nutritional or health benefits of their fresh produce are 4.69 (3 × 1.5633) times more likely to prefer the new variety. Furthermore, if the Hi-A™ had the same level of sweetness as a generic sweet corn variety, the consumer was 1.74 times more likely to have stated that he or she prefers the Hi-A™ variety. Compared to the base of no effect, consumers who would be positively affected by a locally produced label are 1.75 times more likely to have a stated preference for the new variety.

Table 4. Stated Preference Regression for Red, Hi-A™ Sweet Corn

Parameter	Coefficient	Odds Ratio	Std. Err.	Pr > z
Constant	-4.1382***	0.0159	0.0099	0.0000
Age	-0.1359*	0.8729	0.0646	0.0660
Gender	-0.0638	0.9382	0.1630	0.7140
Household size	-0.0793	0.9237	0.0607	0.2270
College education	0.1278	1.1363	0.1904	0.4460
Income	0.0209	1.0211	0.0537	0.6920
Venue				
Farmers' market	-0.3362	0.7145	0.2154	0.2650
Large grocery chain	0.2047	1.2272	0.2446	0.3040
Health food store	0.0353	1.0359	0.4443	0.9340

[3]As pointed out by a reviewer, the Hi-A™ differs in both taste and texture, but texture is not explicitly controlled for in the regression. However, the variable *Taste* also controls for texture given the descriptions provided to respondents where taste and texture changed concurrently.

Table 4 (cont.)

Parameter	Coefficient	Odds Ratio	Std. Err.	Pr > z
Wholesale club store	-0.3087	0.7344	0.3371	0.5010
Nutritional/health	0.4468***	1.5633	0.2148	0.0010
Color	1.8257***	6.2073	2.0039	0.0000
Red/black	0.0577	1.0594	0.2048	0.7650
Local label effect:				
Yes	0.5609**	1.7522	0.3230	0.0020
No	-0.8989**	0.4070	0.1197	0.0020
Local purchasing	0.1446	1.1556	0.1249	0.1810
Social responsibility	0.1345	1.1440	0.2320	0.5070
Taste	0.5514***	1.7356	0.2572	0.0000
Log likelihood	-551.3249			

Note: The variables are described in Table 1 and in above discussions.
*, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

In contrast, for each increase in their age category the likelihood of the consumer having a stated preference for the Hi-A^{TM} variety decreases by a factor of 0.87, and those who would not change their purchasing habits based on a locally produced label are less likely to prefer the new variety.

Discussion

A significant result from this study is that consumers who are willing to purchase novel colors of sweet corn for added health benefits are willing to pay 37.58 cents more per ear for the new variety. Additionally, consumers who would respond positively to a locally produced label on the new variety are willing to pay an additional 28.49 cents. These same characteristics are also the two most important factors in predicting stated preference for the Hi-A^{TM} variety. Moreover, consumers who regularly seek out locally produced foods are more willing to pay a premium and have a stated preference for the new variety. These findings align with previous research indicating that consumers value both local sourcing and enhanced health attributes in their food choices (Zepeda and Leviten-Reid, 2004; Colson and Huffman, 2011).

It is also interesting to note that when using a local grocery store as a baseline comparison, consumers who most frequently purchase their fresh produce at health food stores and wholesale club stores are willing to pay an additional 25.03 and 16.79 cents for the Hi-A^{TM} corn, respectively. This result underscores the importance of understanding distribution channels in influencing consumer behavior, especially as the number of large grocery stores and chain stores that can handle more product variety has increased in the United States (Jekanowski and Binkley, 2000; Cho and Volpe, 2017). The results used to calculate mean WTP in this study are generated by using this entire specific sample, and the results can be generalized to a degree to estimate WTP values for specific segments of consumers. For example, the specific results above show that the

older the consumer is, the less likely they are willing to pay a premium or have a stated preference for the Hi-A^{TM} variety, *ceteris paribus.* Therefore, different venues that may hypothetically sell this product could target younger consumers and use other data from the results to determine specific price levels to market toward various consumers.

Conclusions

Results indicate that, on average, consumers are willing to pay 81.40 cents for the Hi-A^{TM} corn variety. This result is notable considering there are currently no other varieties of sweet corn in the marketplace that possess this particular combination of color and health benefits. Given that consumers may use color as a proxy for both taste and baseline levels of nutrition, the introduction of a red variety of sweet corn could have high economic value (Hein, 2023). This possibility is especially notable considering that nearly 70% of respondents were willing to pay some level of premium for the Hi-A^{TM} variety.

The models used in this research help identify which factors have the largest influence on both consumers' WTP and stated preference for the Hi-A^{TM} variety. In the double-bounded model, results showed that WTP was affected by the location where the consumer most frequently purchases fresh produce, how often they seek out products labeled as locally produced, and whether or not they feel a social responsibility to support local economies and producers. For the logistic regression, stated preference for the new variety was positively affected by the level of importance consumers place on the nutritional/health benefits of fresh produce. The age of the consumer had a significant negative effect on both WTP and stated preference for the new variety. If consumers were willing to purchase sweet corn that is not yellow for added health benefits, they had a higher WTP and were more likely to prefer the Hi-A^{TM} variety. Similarly, those who would be positively affected by a locally produced label were willing to pay more and were more likely to prefer the Hi-A^{TM} variety.

Taste was also an important factor in determining WTP and stated preference. When the Hi-A^{TM} variety was described as having the same level of sweetness and an identical texture as a generic sweet corn variety while simultaneously having high levels of antioxidants, consumers were more likely to prefer the new variety and were willing to pay more for it. This finding is consistent with previous research showing that taste is a primary driver of food choices, and consumers value taste above healthiness (Verbeke, 2006; Aggarwal et al., 2016). This result provides additional justification for further development of the Hi-A^{TM} variety to improve taste/texture and make it more competitive for hypothetical, future marketing purposes.

The research successfully identified that many consumers are willing to pay for and purchase a new, nutrient dense, and uniquely colored sweet corn variety and identified how they differ among specific characteristics. Future research should focus on the tradeoffs consumers make between product taste and the nutritional qualities they possess. Specifically, at what point are consumers not willing to sacrifice taste any longer for additional health benefits. Other research should focus on analyzing WTP and consumer preference for other types of novel-colored produce to determine whether the results of this study are reproducible for other fruits, vegetables, grains, etc.

The main limitation of the study is the use of contingent valuation in an online survey to collect the data for analysis. There are issues with hypothetical bias when using the CVM because there is not actually any money being transacted. Additionally, the sample data are not well balanced considering that around 75% of the respondents were female, and there are numerous opportunities to improve estimation in consumer-based experiments to help reduce bias in WTP studies. Future research could aim to have a more equal proportion of both male and female respondents to better reflect the population as a whole. Finally, although there may be increased demand for novel produce colors, it is still part of a niche market with lower market value compared to overall total market value.

Competing Interests

Authors declare no competing interest.

Data Availability Statement

For replication purposes, the data that support the findings of this study are available from the corresponding author, T.D.J, upon reasonable request.

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