What Attributes Are Consumers Looking for in Sweet Cherries? Evidence from Choice Experiments

Xibei Zheng, Chengyan Yue, Karina Gallardo, Vicki McCracken, James Luby, and Jim McFerson

We investigate heterogeneous consumer preferences and willingness to pay (WTP) for various sweet cherry attributes using choice experiments. A mixed logit model and a latent-class logit model are used to estimate consumer WTP for the attributes and identify groups of consumers based on those preferences. We find that consumers of sweet cherries will pay the greatest premium for sweetness and the smallest premium for fruit size. Three groups of consumers are identified—flavor sensitive, price sensitive, and storage sensitive. The results are useful for suppliers of sweet cherries when adopting targeted marketing strategies.

Key Words: consumer segmentation, latent class model, mixed logit model, sweet cherry, willingness to pay, WTP

Sweet cherries have increased in popularity over the past decade because of their reported health benefits for consumers and the relatively high price premiums suppliers can charge (Kahlke et al. 2009). Although Europe has been the main producing center of them for centuries, the United States has become the world's second largest producer, accounting for more than 10 percent of world production in recent years (Economic Research Service (ERS) 2011). The United States is the world's largest exporter of sweet cherries and grows more than 20 percent of the cherries traded (ERS 2011). The level of U.S. domestic production is projected to be nearly 50 percent

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greater in 2020 than in 2011 (Long 2013). As shown in Figure 1, U.S. annual per-capita consumption of fresh sweet cherries has increased 150 percent since 1998 with an annual per-capita consumption of 1.31 pounds in 2010 (ERS 2011). The figure also shows the 36 percent decline in consumption of processed sweet cherries over the same period. The retail price of fresh sweet cherries steadily increased between 2009 and 2013, rising from $3.25 per pound to $4.55 per pound after accounting for inflation (ERS 2013). Despite the increase in real prices, consumption of fresh cherries is expected to continue to grow at a steady pace.

Many studies have investigated the value consumers place on fruit-quality traits and the price premiums they are willing to pay for improved traits for various fruits. Gallardo, Kupferman, and Colonna (2011) employed choice experiments and sensory tests to analyze consumers' willingness to pay (WTP) for quality attributes of Anjou pears. They found that consumers were less willing to pay for firm pears and would pay a premium for pears that had higher soluble solid concentrations (SSCs)—were riper. Shi, Gao, and House (2013) explored consumer preferences for the method of production, origin of production, and form of the fruit (frozen versus fresh) for blueberries. They found that locally produced blueberries were preferred and that less than 50 percent of the participants were willing to pay positive premiums for organic blueberries. Zhang et al. (2010) conducted a sensory experiment to analyze consumers' WTP for different levels of ethylene applied to Anjou pears. They found that consumers were willing to pay 8.5 cents, 3.7 cents, and 5.7 cents more per pound for an additional unit of

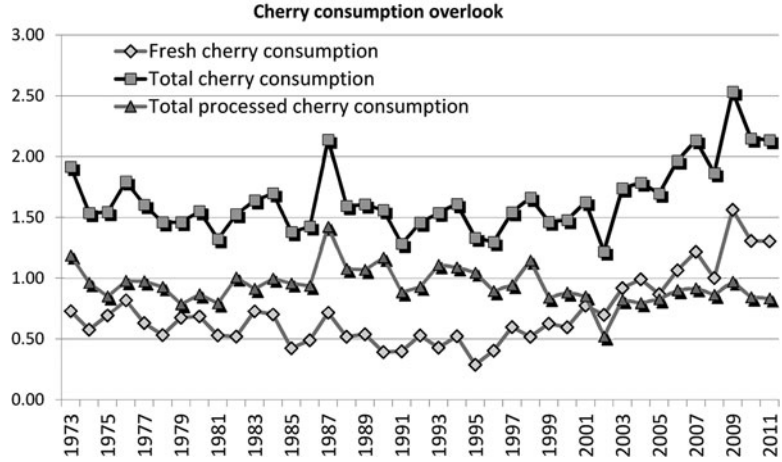

Figure 1. Per Capita Consumption of Sweet Cherries in the United States (1973–2011)

Source: Economic Research Service (2011).

firmness, juiciness, and sweetness respectively. Carrillo-Rodriguez et al. (2013) explored consumer preferences for quality traits in apples using sensory tasting tests and experimental auctions. Their results showed that the value consumers placed on the quality traits depended on the information they were given. For example, consumers were willing to pay the highest premium for size and color when they received information on the apples' appearance and for sweetness and crispness when they were provided information on the results of the sensory taste test.

In addition, some studies have focused specifically on consumer preferences or WTP for attributes of sweet cherries. Miller, Casavant, and Buteau (1996) found that Japanese consumer purchases of sweet cherries were positively correlated with attributes of taste, freshness, color, and shape/size. Guyer et al. (1993) concluded that sweetness, flavor, and firmness were positively correlated with overall acceptability for consumers in Michigan. A study of Norwegian consumers by Lyngstad and Sekse (1995) showed that consumers preferred dark cherries and large cherries. Kappel, Fisher-Fleming, and Hogue (1996) in a study of Canadian consumers of sweet cherries found that the optimal size was 29 millimeters in diameter, the minimum SSC was 17–19 percent, and the optimum acidity was a pH of 3.8. Another study of Canadian consumers by Cliff et al. (1996) reported that acceptability was positively correlated with color, size, flavor intensity, and sweetness. Crisosto, Crisosto, and Metheney (2003) examined acceptance of sweet cherries by California consumers and found that it was positively influenced by greater SSCs, lower titratable acidity (TA), a higher SSC/TA ratio, and darker skin color. Hu (2007) found that consumers in Portland, Oregon, were willing to pay a premium of $0.87 for an extra unit of sweetness and $0.35 for an extra unit of firmness.

Other studies of sweet cherries mainly focused on factors that affected price levels and variations in price. Carew, Florkowski, and Doroudian (2012) analyzed price-determination factors in sweet cherry markets in British Columbia, Washington, Oregon, and California. The study applied an inverse demand system to capture the effects of demand and supply factors relevant to cherry growers. They found negative substitution effects for prices of sweet cherries, raspberries, and strawberries for all four regions. Similarly, Flaming, Marsh, and Wahl (2007) used an inverse demand system to estimate factors that affected the farm-level price of sweet cherries in the Pacific Northwest and California. They found that each state's production, domestic consumption, and exports explained 60–78 percent of the variation in the annual price and that prices were most sensitive to the quantities supplied to foreign and domestic markets.

Miller, Casavant, and Buteau (1996), Lyngstad and Sekse (1995), Kappel, Fisher-Fleming, and Hogue (1996), and Cliff et al. (1996) found positive links between foreign consumers' acceptance and the taste, sweetness, color, shape, and size of sweet cherries. Guyer et al. (1993) and Crisosto, Crisosto, and Metheney (2003) studied consumer preferences for sweet cherries in

Michigan and California, respectively. The studies used regional consumer samples instead of a national consumer sample but did not investigate consumer WTP for the fruit's attributes. Hu's (2007) analysis of consumer WTP for sweet cherries is most similar to the present study, but Hu's sample was not representative of U.S. consumers and the study did not include a consumer segmentation analysis. Our study expands on prior investigations of consumer preferences for sweet cherries because it is focused on U.S. consumers' WTP for sweet cherry attributes. In addition, our study captures heterogeneous consumer preferences and explores potential market segmentation. The results are useful for breeders in prioritizing traits of sweet cherries in their breeding programs and shed light on potential targeted-marketing strategies that growers and retailers can adopt.

Methodology

Choice Experiment

Choice experiments are widely used by researchers as an efficient tool to study consumer preferences and WTP for goods (Lusk and Schroeder 2004, Yue and Tong 2011). Choice experiments are based on random utility theory and Lancaster's consumer demand theory, which assumes that consumers derive utility from attributes of a good rather than from the good itself. By presenting consumers with different combinations of choices, the experiment replicates consumers' rational decision-making process and derives their utility for each attribute. Additionally, choice experiments can force respondents to consider tradeoffs between attributes, allow for estimation of implicit prices for attributes, can be used to estimate customer demand for a service in nonmonetary terms, and can potentially reduce the incentive for respondents to behave strategically. One potential drawback of choice experiments is that participants do not make "real" purchases; instead, the choices are hypothetical. However, Lusk and Schroeder (2004) demonstrated that the bias associated with estimated marginal WTP from hypothetical choice experiments (relative to nonhypothetical choice experiments) is reduced when the questions are framed to closely simulate an actual purchasing situation.

In this study, we use a choice experiment to explore consumer preferences and WTP for six quality attributes of sweet cherries. Since it was not practical to present every possible combination of product attributes, we developed a fractional factorial design to minimize the number of scenarios and maximize the variety of profiles. For further discussion of fractional factorial designs, see Louviere (2000). The choice scenarios were designed using JMP® 8 software (SAS Institute, North Carolina). In the experiment, participants were presented with eight scenarios that each presented two options involving various combinations of product attributes. A third "opt out" option was also presented so participants could choose not to select either of the two options in a choice scenario.

Product Attributes

From prior studies and in consultations with experts in the sweet cherry industry, we identified six traits for the study: color, size, firmness, sweetness, flavor, and shelf life. These attributes were tested with a small sample of consumers, which confirmed that they are the most important quality traits for consumers. In addition, we included two prices, \$3.99 and \$2.99 per pound, to capture how price affects consumers' purchasing decisions. The prices were based on the average retail price of sweet cherries in 2011. The attributes and levels included in the choice experiment are described in Table 1.

Sampling Method

The choice experiment in this study was conducted online with randomly selected consumers from across the United States who were recruited by Qualtrics™, a professional survey company. Online surveys have become increasingly popular as a primary tool for collecting consumer preference data by researchers. To ensure that the sample was representative of consumers of sweet cherries, only consumers who had purchased sweet cherries in the past year were included in the experiment. Figure 2 presents one of the choice scenarios from the online survey. In addition to the eight choice scenarios, nineteen questions asked participants about their purchasing habits and socio-demographic backgrounds.

Econometric Models

Because consumers often display heterogeneous preferences that are unrelated to observable characteristics, it is important to employ a model that allows for evaluation of that heterogeneity (Lusk, Roosen, and Fox 2003, Ouma, Abdulai, and Drucker 2007, Tonsor, Wolf, and Olynk, 2009). Hence, we use a mixed logit model to estimate consumer WTP for the sweet cherry attributes. One advantage of the mixed logit model is that it allows the parameters to vary randomly when there are correlations between them (Train 2003). In other words, the mixed logit model relaxes the assumption of independence of irrelevant alternatives (IIA)[1] and the relative odds for two alternative outcomes depend exclusively on the characteristics of each outcome. Thus, the odds do not depend on the number and the nature of the other outcomes considered simultaneously. Another reason for using a mixed logit model instead of other discrete-choice models is that the mixed logit model estimates preference heterogeneity by allowing taste parameters to vary randomly across individuals.

The utility an individual consumer derives from choosing an alternative in a choice scenario is specified as

[1] An IIA test was conducted and showed that our data violated the IIA assumption so we adopted a mixed logit model.

Table 1. Sweet Cherry Attributes and Attribute Levels Used in the Choice Experiments

Attributes	Attribute Levels
Color	Dark red
	Red
Size	More than a quarter (large)
	Less than a quarter (small)
Firmness	Firm
	Soft
Sweetness	High
	Low
Flavor	Intense cherry flavor
	Mild cherry flavor
Shelf life	More than one week in refrigerator
	Less than one week in refrigerator
Price	$3.99 per pound
	$2.99 per pound

$$U_{ijt} = \beta_i \mathbf{x}_{ijt} + \varepsilon_{ijt} \tag{1}$$

where U_{ijt} is the utility of individual i ($i = 1, 2, \ldots, N$) derived from alternative j ($j = 1, 2, \ldots, M$) in scenario t ($t = 1, 2, \ldots, W$), $\mathbf{x}_{ijt}$ is a vector of observed variables that relates to individual i for alternative j in scenario t, and β_i represents the corresponding unobserved individual-specific coefficient vectors, which are assumed to follow a normal distribution with the density function $f(\beta \mid \theta)$ where θ is the fixed parameter vector of the normal distribution and ε_{ijt} is a random term that is assumed to be an independently and identically distributed extreme value.

The empirical specification for the mixed logit model is

$$\begin{aligned} U_{ijt} = {} & \beta_{i1} Price_{ijt} + \beta_{i2} Color_{ijt} + \beta_{i3} Size_{ijt} + \beta_{i_4} Firmeness_{ijt} \\ & + \beta_{i5} Sweetness_{ijt} + \beta_{i6} Flavor_{ijt} + \beta_{i7} Shelflife_{ijt} + \varepsilon_{ijt}. \end{aligned} \tag{2}$$

Conditional on β_i, the probability of individual i choosing alternative j in choice scenario t is given by

$$L_{ijt}(\beta_i) = e^{\beta_i x_{ijt}} / \sum_{j=1}^{M} e^{\beta_i x_{ijt}} \tag{3}$$

Scenario 1

For this scenario, there will be TWO OPTIONS simulating a situation in which you BUY fruit. You have the opportunity to visually inspect the sweet cherry and evaluate the external appearance and size. You can try/eat the sweet cherry and evaluate its flesh texture, sweetness, and flavor. You know the number of days the sweet cherry will last at home in your refrigerator. Price per pound varies for each option presented.

Please indicate which option (only ONE: either Option A or Option B) that best fits your preferences or if you do not like any option, choose "Neither Option A or B"

	Option A	Option B	Neither Option A or B
the External apperance is	You are in the supermarket and see these sweet cherries: 	You are in the supermarket and see thesesweet cherries: 	
the Size is	Less than a quarter (1 inch diameter) 	More than a quarter (1 inch diameter) 	Neither Option A or B
the Firmness is	Soft	Firm	
the Sweetness is	High	Low	
the Flavor is	Intense cherry flavor	Mild cherry flavor	
the Shelf life at home is	Will last more than 1 week at home in your refrigerator	Will last less than 1 week at home in your refrigerator	
the Price is	$3.99/lb	$2.99/lb	

I Would Choose Option A I Would Choose Option B I Would Choose Neither Option A or B

Figure 2. Example Choice Scenario in the Survey

In this application, β_i is unknown. The unconditional probability of the observed choices is the conditional probability integrated over the distribution of β_i:

$$Pr_{ijt}(\theta) = \int L_{ijt}(\beta_i) f(\beta_i|\theta) d\beta_i. \quad (4)$$

The mixed logit model estimates average WTP for the entire sample and allows us to test for heterogeneity of preferences using the estimated variance and covariance matrix of the coefficient estimates.

To identify groups of consumers based on their heterogeneous preferences for sweet cherry attributes, we use a latent class model. The model identifies the number of consumers in each segment and reveals the sources of heterogeneity through a comparison of the distinct characteristics of each segment. The model assumes that individuals can be sorted into a number of latent classes or

unobservable subgroups of the population and that those classes are characterized by homogeneous preferences. The preferences across classes are heterogeneous. In the model, the probability that individual i will choose option j in choice scenario t for a given latent class s is

$$Pr(ijt \mid s) = \prod_{t=1}^{W} e^{\boldsymbol{\beta}_s \mathbf{x}_{ijt}} / \sum_{j=1}^{M} e^{\boldsymbol{\beta}_s \mathbf{x}_{ijt}} \tag{5}$$

where $\mathbf{x}_{ijt}$ is a vector of observed attributes associated with alternative j and $\boldsymbol{\beta}_s$ is a vector of class-specific utility parameters (Ouma, Abdulai, and Drucker 2007). Since an individual respondent's class membership status is unknown, the weight for latent class s is the share of the total population in that class and is specified by a fractional multinomial logit. That is, the probability that individual i belongs to class (group) s is given by

$$Pr(s) = e^{\boldsymbol{\theta}_s m_t} / (1 + \sum_{s=1}^{S-1} e^{\boldsymbol{\theta}_s m_t}) \tag{6}$$

where m_t is a set of observable individual characteristics that affect class membership and $\boldsymbol{\theta}_s$ is a vector of unobservable but estimable coefficients associated with the class.

Results

Summary Statistics of Socio-demographic Backgrounds and Purchasing Habits

Summary statistics for the 783 participants who completed the choice experiment and related survey are presented in Table 2. The average age of participants was 42, and 65 percent were female. A relatively large share of the participants (43 percent) had at least a two-year degree or the equivalent and the majority (74 percent) were Caucasian. Twenty-seven percent of the participants had an annual household income greater than $75,000.

Table 2 also compares our sample to data on the U.S. population as a whole (U.S. Census Bureau 2010). Our sample included proportionately more women, which is not surprising since it included only individuals who had purchased sweet cherries in the past year and women are more often a household's primary grocery shopper (Shi, Gao, and House 2011). The incomes of our participants were slightly lower and a smaller percentage of their households included children relative to the general U.S. population.

About 53 percent of the surveyed consumers ate fresh sweet cherries less than twice a month, which is consistent with Florkowski and Carew (2011). The majority of the participants purchased sweet cherries from conventional grocery stores and warehouse retailers, followed by farmers' markets, natural food stores, and cooperatives. Labels on cherry containers appeared to

Table 2. Summary Statistics for Participants' Background Information in the Choice Experiment

Variable	Description of Variable	Mean		Standard Deviation
		Survey Sample	U.S. Census	
Age	Participant's age	41.766	37.200	14.065
Income	1 if household income is greater than $75,000; 0 otherwise	0.270	0.344	0.444
Education	1 if the education level is two years of college or equivalent or higher; 0 otherwise	0.435	0.419	0.496
Gender	1 if participant is male; 0 if female	0.350	0.492	0.477
White	1 if participant is white; 0 otherwise	0.744	0.779	0.437
Children	1 if participant has one or more children under 18 years old in the household; 0 otherwise	0.484	0.660	0.500
Frequency	1 if participant eats fresh sweet cherries less than two or three times a month; 0 otherwise	0.535		0.499
Conventional and warehouse	1 if participant purchases sweet cherries at conventional supermarkets or warehouses; 0 otherwise	0.745		0.436
Farmers' market	1 if participant purchases sweet cherries at farmers' markets; 0 otherwise	0.111		0.314
Natural food store	1 if participant purchases sweet cherries at natural food stores; 0 otherwise	0.093		0.291
Cooperatives and direct sales	1 if participant purchases sweet cherries at cooperatives or direct sales; 0 otherwise	0.050		0.218
Brand	1 if participant thinks brand is important information on sweet cherry labels; 0 otherwise	0.097		0.296

Continued

Table 2. Continued

Variable	Description of Variable	Mean		Standard Deviation
		Survey Sample	U.S. Census	
Organic	1 if participant thinks organic is important information on sweet cherry labels; 0 otherwise	0.451		0.498
Health	1 if participant thinks health-related information is important information on sweet cherry labels; 0 otherwise	0.751		0.433
Sustain	1 if participant thinks sustainably grown is important information on sweet cherry labels; 0 otherwise	0.020		0.141
Safety	1 if participant thinks safety-related information is important information on sweet cherry labels; 0 otherwise	0.908		0.289
Non-GMO	1 if participant thinks "not genetically modified" is important information on sweet cherry labels; 0 otherwise	0.222		0.416
Eco label	1 if participant thinks eco-label is important information on sweet cherry labels; 0 otherwise	0.350		0.477
n = 742				

influence their purchasing decisions: nearly 91 percent thought safety-related information on labels was important, 75 percent regarded health-related information as important, 45 percent preferred organic sweet cherries, 35 percent valued eco-labels, and 22 percent viewed non-GMO labels as important. Labels indicating the brand and sustainable production were the least important at about 9.7 percent and 2.0 percent respectively.

Results of the Mixed Logit Model

The coefficient estimates from the mixed logit model are presented in Table 3. The log-likelihood ratio test statistic is –3,305.588 with a p-value of less than

Table 3. Estimation Results of Mixed Logit Model

	Mean		Standard Deviation	
Variable	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Price	−0.431***	0.074	0.834***	0.084
Color	−0.008	0.072	1.618***	0.090
Size	0.260***	0.059	0.386***	0.109
Firmness	0.418***	0.056	0.971***	0.075
Sweetness	0.816***	0.072	1.228***	0.083
Flavor	0.622***	0.071	0.977***	0.083
Shelf life	0.324***	0.066	0.535***	0.086
n = 742				

Note: *, **, and *** denote significance at the $\alpha = 0.1$, 0.05, and 0.01 levels, respectively.

0.01, indicating that the overall model fits the data well. The coefficients for all of the sweet cherry attributes except color are positive and significant at the 1 percent level (p-value < 0.01). These results indicate that consumers prefer large, firm, sweet, and flavorful cherries that have a relatively long shelf life. The coefficient on price is significant and negative, indicating that price is a statistically important factor for consumers and that increases in price reduce the likelihood that consumers will purchase sweet cherries. The coefficient on the color variable is insignificant so we cannot draw a conclusion regarding consumers' color preferences (red versus dark). Sweetness and flavor are the two most sought-after quality traits, ranking higher than firmness, shelf life, and size. In other words, when consumers purchased sweet cherries, they looked for cherries that were sweet and had intense cherry flavor. The results do not support consumers making purchasing decisions based solely on fruit color given the insignificant coefficient of the color attribute. All of the coefficients on the standard deviations are significant, indicating that consumers' preferences for the attributes of sweet cherries are heterogeneous.[2]

Using the estimated coefficients, WTP values for the cherry attributes are calculated as the ratio of the mean coefficient associated with the attribute to the mean coefficient of the price (Train 2003). Those results are reported in Table 4. We find that consumers are willing to pay an additional $1.89 per pound for relatively sweet cherries, $1.44 per pound for intense flavor, $0.97 per pound for relatively firm cherries, $0.75 per pound for a relatively long shelf life, and $0.60 per pound for relatively larger cherries, *ceteris paribus*.

[2] We initially included the covariance matrix but the covariance elements were not significant at a 1 percent level. Hence, they are not included in the model presented.

Results of the Latent Class Logit Model

Information about consumers' WTP for sweet cherry quality traits can help producers prioritize traits when allocating resources in their breeding programs. The significance of the coefficients on standard deviation in the mixed logit model support our hypothesis that consumers' preferences for various attributes of sweet cherries are heterogeneous, spurring us to extend the analysis by categorizing consumers according to their preferences and examining the size of each consumer segment. Such information is particularly useful for producers interested in targeted marketing strategies.

To explore the unobservable subgroups within the sample, we use a latent class logit model. We applied the Bayesian information criterion to determine the optimal number of latent classes (Pacifico and Yoo 2012) and found that a three-class model was optimal and provided the greatest posterior prediction accuracy (89.8 percent). The model performed well in distinguishing unobservable subgroups from the observed choice behavior. The results of the latent class logit model are presented in Table 5 along with corresponding demographic characteristics and purchasing habits for each latent class. As shown in Table 5, the groups are labeled by their collective sensitivity to an attribute: flavor-sensitive, price-sensitive, and storage-sensitive consumers. The segments are similar to ones identified by Hu (2007) for apples.

Flavor-sensitive consumers account for 35.58 percent of the sample. The dominant characteristic of this group is a strong preference for sweetness and flavor as the coefficients for those traits are positive and significant. Sweetness is most strongly preferred. The other positive and significant quality trait is color; consumers in this group prefer dark red fruit.

Price-sensitive consumers account for 25.61 percent of the sample. The coefficient on price is negative, significant, and relatively large in absolute terms. Thus, consumers in this group are highly sensitive to price and prefer cheaper cherries. The coefficient on color for this group is positive and significant, indicating a preference for dark red fruit, and is larger than the color coefficient for flavor-sensitive consumers. The other attributes are not statistically significant in this group.

Storage-sensitive consumers accounted for the largest percentage of the sample (38.81 percent). Most were from Washington, California, Oregon, and Michigan, which are major sweet-cherry-producing states. This group of consumers valued color, firmness, shelf life, sweetness, and size (ordered by magnitude of the coefficients). The coefficients on size, firmness, and shelf life are larger than the coefficients on those traits in the other groups. Storage-sensitive consumers also prefer sweetness but not as much as the flavor-sensitive consumers do. Unlike the other groups, storage-sensitive consumers prefer light red fruit, perhaps because lighter fruit are considered less ripe and are therefore viewed as having a longer shelf life.

Table 4. Willingness-to-pay Estimates for Sweet Cherry Attributes from the Mixed Logit Model

Attribute	Mean (dollars per pound)	95-percent Confidence Interval
Color	−0.018	(–0.346, 0.310)
Size	0.603	(0.237, 0.969)
Firmness	0.969	(0.571, 1.368)
Sweetness	1.895	(1.320, 2.470)
Flavor	1.444	(0.933, 1.955)
Shelf life	0.753	(0.455, 1.050)
n = 742		

Socio-demographic Backgrounds and Purchasing Habits of the Groups

The mean statistics of the socio-demographic characteristics and purchasing habits of consumers in each group are listed in Table 6. Multivariate (MANOVA) and univariate (ANOVA) analysis-of-variance tests are used to determine whether the three groups of consumers differ significantly in terms of socio-demographic characteristics and purchasing habits for sweet cherries. MANOVA tests for differences among the three vectors of means while ANOVA tests for variable-by-variable differences in means among the three groups. The MANOVA p-value (for all demographic variables) is 0.0001, which rejects the null hypothesis that the mean vectors of the variables are the same. ANOVA is then used to test the variables individually. When an ANOVA p-value is significant, we conduct pair-wise t-tests to identify which groups differ. A p-value less than 0.1 is used as a threshold for significance.

Table 5. Estimation Results of Latent Class Logit Model

	Flavor-sensitive Consumers		Price-sensitive Consumers		Storage-sensitive Consumers	
Variable	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Price	0.021	0.199	−0.963***	0.269	−0.05	0.112
Color	0.351**	0.143	1.117***	0.276	−0.755***	0.155
Size	0.196	0.136	0.24	0.191	0.301**	0.138
Firmness	−0.011	0.124	−0.04	0.108	0.631***	0.124
Sweetness	1.226***	0.148	−0.14	0.119	0.310***	0.088
Flavor	1.027***	0.149	0.05	0.127	0.110	0.069
Shelf life	0.282	0.174	0.31	0.199	0.326***	0.102

Table 6. ANOVA and MANOVA Test Results for Consumer Demographic Characteristics and Purchasing Habits for the Consumer Groups

	Flavor-sensitive Consumers		Price-sensitive Consumers		Storage-sensitive Consumers		ANOVA p-Value
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	
Age	44.49	13.77	41.54	13.6	39.41	14.24	0.0001
Income	0.30	0.46	0.21	0.41	0.28	0.45	0.0837
Education	0.42	0.49	0.46	0.50	0.43	0.50	0.6153
Gender	0.33	0.47	0.34	0.47	0.38	0.48	0.5345
White	0.79	0.41	0.74	0.44	0.71	0.46	0.0984
Children	0.39	0.49	0.51	0.50	0.56	0.50	0.0004
Frequency	0.64	0.48	0.50	0.50	0.46	0.50	0.0001
Conventional and warehouse	0.84	0.36	0.82	0.39	0.89	0.31	0.1040
Farmers' market	0.10	0.30	0.12	0.33	0.11	0.32	0.8201
Natural food store	0.08	0.27	0.13	0.34	0.08	0.27	0.1052
Co-op and direct	0.08	0.27	0.05	0.22	0.02	0.15	0.0208
Brand	0.06	0.25	0.12	0.33	0.11	0.31	0.0777
Organic	0.44	0.49	0.43	0.50	0.47	0.50	0.6458
Health	0.77	0.42	0.80	0.40	0.70	0.46	0.0547
Sustain	0.02	0.15	0.03	0.18	0.01	0.10	0.2576
Safety	0.93	0.25	0.91	0.29	0.89	0.32	0.1677
Non-GMO	0.25	0.43	0.24	0.43	0.19	0.39	0.1813
Eco-label	0.33	0.47	0.41	0.49	0.33	0.47	0.1301
Share of sample	35.58%		25.61%		38.81%		
MANOVA p-value: 0.0001							

The consumer groups differ significantly in terms of average age. The flavor-sensitive consumers are oldest at 45 years, followed by price-sensitive consumers at 42 years and storage-sensitive consumers at 39 years. The t-test results show these differences are significant. We thus conclude that the older the consumer, the more likely the consumer is to care about sweetness and flavor. Younger consumers are likely to care more about being able to store sweet cherries for longer periods.

The groups differ in terms of income with price-sensitive consumers having a significantly lower average income than consumers in the other groups, and the flavor-sensitive group includes significantly more Caucasian consumers. The smallest percentage of Caucasian consumers is in the storage-sensitive group. The groups also differ in terms of the presence of children in the household and in frequency of consuming sweet cherries. Storage-sensitive consumers are most likely and flavor-sensitive consumers are least likely to have children.

Flavor-sensitive consumers consume fresh sweet cherries more often than the other groups. Since fresh cherries are highly perishable and lose flavor over time, we hypothesize that consumers who have a strong preference for flavor are frequent consumers (and buyers) so they can obtain fruit with the best flavor. Storage-sensitive consumers, on the other hand, would likely purchase sweet cherries relatively infrequently. The ANOVA and pair-wise t-test results support these hypotheses. Flavor-sensitive consumers consume sweet cherries most often, followed by price-sensitive consumers, and storage-sensitive consumers.

We also examine differences in the groups in terms of the types of shopping outlets used when purchasing sweet cherries. Our analysis of the whole sample shows that more than 80 percent of the participants made their purchases at conventional stores and warehouse retailers such as Wal-Mart, Target, and Costco. The ANOVA and pair-wise t-test results show a significant difference between storage-sensitive and flavor-sensitive consumers: the storage-sensitive group is most likely to purchase from conventional stores and warehouse retailers. We find no significant differences between price-sensitive and flavor-sensitive consumers in terms of outlets used. Flavor-sensitive consumers buy sweet cherries from cooperatives and directly from growers more often than storage-sensitive consumers do. We also find no significant differences between flavor-sensitive consumers and price-sensitive consumers in terms of outlets used. Sweet cherries sold directly are often fresher and more flavorful because they have not been transported. Thus, these results are consistent with our expectations.

In terms of label information, we find significant group differences in the preference for safety-related information. Almost 80 percent of consumers in the flavor-sensitive and price-sensitive groups indicated that health-related information was important when making a decision about purchasing sweet cherries while only 70 percent of consumers in the storage-sensitive group regarded that information as important. About 12 percent of price-sensitive

consumers, 11 percent of storage-sensitive consumers, and 6 percent of flavor-sensitive consumers viewed brand identification as a key factor.

Conclusion and Marketing Implications

Many prior studies have analyzed consumers' WTP for attributes of various fruit products, but our study is one of the first to focus on consumers' WTP for attributes of sweet cherries at a national level and to investigate heterogeneous consumer preferences for those attributes. The primary goal of this research is to identify the quality traits that are most important to consumers and segments of the sweet cherry market based on consumers' demographic characteristics and purchasing habits. Our results provide a direct assessment of the relative importance of such attributes to consumers and estimates of the amount consumers are willing to pay for each attribute. Our identification of market segments provides deeper insight into links between consumers' preferences for individual attributes of sweet cherries and their characteristics, allowing producers to target marketing efforts more effectively.

Preferences and Market Segments

Consumers have diverse preferences for quality traits of sweet cherries. On average, they are willing to pay the highest premiums for cherries that are sweeter and have more intense flavor. Darker color and larger size generate the lowest premiums, indicating that, on average, consumers care more about the sweetness and flavor of cherries than about their color. However, we need to take into account that consumers cannot judge the cherries' taste until after purchases are made. As a result, opportunities exist for producers and suppliers to inform consumers about their products' taste using labeling.

To identify market segments, we analyzed shared preferences for particular attributes in the consumer sample and assigned each consumer to one of three groups: flavor-sensitive, price-sensitive, and storage-sensitive consumers. We then examined the socio-demographic characteristics and purchasing habits of the consumers in each group and found distinct differences between the segments.

Compared to the other groups, flavor-sensitive consumers have the highest incomes, are oldest, and are mostly Caucasian. They are less likely to have children, and they consume sweet cherries relatively frequently. They also tend to purchase sweet cherries at cooperatives and via direct sales more often than consumers in the other groups do. Brand information is not an important factor for flavor-sensitive consumers when deciding whether to purchase sweet cherries.

The main characteristics of price-sensitive consumers are their intermediate age and much lower incomes than consumers in the other groups. Both the likelihood of children in their households and their frequency of consumption of sweet cherries are intermediate relative to the other two groups. Price-

sensitive consumers are least likely to purchase sweet cherries at conventional grocery stores and warehouse stores.

Storage-sensitive consumers are the youngest on average and are more likely to be non-white. Their households are most likely to have children and they consume sweet cherries least often. Storage-sensitive consumers are most likely to purchase sweet cherries at conventional grocery stores and warehouse stores and least likely to purchase them at cooperatives and through direct sales. Health-related information on labels is least important to storage-sensitive consumers.

Marketing Implications

This study contributes to a larger project funded by the U.S. Department of Agriculture aimed at promoting marker-assisted breeding for crops in the Rosaceae family (e.g., apples, pears, and sweet cherries) and increasing the long-term economic sustainability of those crops. The information on preferences and WTP for sweet cherry attributes of consumers presented here and of producers and market intermediaries (not presented) can be used by producers to prioritize traits in their breeding programs and by growers and retailers to establish targeted marketing strategies.

We find that consumers care most (have the highest WTP) about sweetness and then about flavor, firmness, shelf life, and size. The fruits' color does not significantly influence their purchasing decisions. This result contradicts the commonly held view that color is important to consumers when they purchase fruit. Instead, it supports the theory that consumers make sophisticated purchase decisions. Further evidence of sophisticated decision-making lies in our finding that the most frequent purchasers of sweet cherries also place the highest value on sweetness and flavor. Thus, producers should make sweetness and intense flavor a higher priority as long as threshold levels of color traits can be met.

The consumer-segmentation analysis provides important information by connecting consumers' preferences for attributes of sweet cherries to their demographic characteristics and purchasing habits. Companies gain an advantage over their competitors by understanding their customers' unique needs. By accurately identifying their target markets and better serving their customers, companies can maintain a competitive advantage, and market segmentation is an important tool for identifying the target markets.

We find that flavor and sweetness are important attributes for all three segments of consumers. But consumers cannot directly assess those attributes prior to purchasing cherries. We therefore recommend that suppliers label their especially sweet and flavorful varieties for consumer recognition at points of purchase. In addition, those varieties should be marketed to cooperatives and direct-sale outlets to attract flavor-sensitive consumers. Larger fruit sizes and greater firmness are also desirable to consumers, and those attributes are visible to consumers when shopping. Suppliers could market sweet cherries

that offer a longer shelf life to target storage-sensitive consumers and use in-store signs and labels to inform consumers about the expected shelf life of their products. Conventional and discount stores could stock sweet cherries that cost less and/or have a longer shelf life to attract price-sensitive consumers, generating greater profits for suppliers. And as sweet cherry consumers focus more on health-related aspects of sweet cherries, labels could address safety, health effects, and organic production to potentially add value relative to brand labels.

A limitation of our study is that we were not able to use taste tests of actual cherries since our goal was to look beyond the collective attributes in current varieties. To minimize the impact of this limitation, we created an online experiment that closely resembled the actual purchasing environment to ensure the validity of our results (Lusk and Schroeder 2004).

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