*Journal of Agricultural and Applied Economics*, 39,3(December 2007):597–609


# Fresh-Cut Melon—The Money Is in the Juice

**Carlos Mayen, Maria I. Marshall, and Jayson Lusk**

Fruit is an important component of the food industry in the United States, and "fresh-cut" products are an increasing portion of that consumption. We found that packaging and juice content played a significant role in the choices Indiana consumers made when purchasing fresh-cut melon products. Brand was not as important as the other fresh-cut melon attributes. Indiana consumers had a clear dislike for cup-shaped transparent packages compared with tamper-proof, bowl, and squared packages. However, they were willing to pay a premium for packages that have no fruit juices on the bottom.

*Key Words:* conjoint, consumer preferences, demand, fruit

**JEL Classifications:** Q13, D12, M31, P46

Fruits and vegetables are an important component of the food industry in the United States. In 2000, consumers spent about $75.8 billion on fresh fruits and vegetables (Cook). In 2003, per-capita consumption of all fruit was 124.69 kg (274.9 lbs.); more fruit was consumed than beef, pork, and poultry combined (USDA-ERS). While per-capita beef and pork consumption declined by 18% and 8%, respectively from 1970 to 2003, total fruit consumption increased by almost 14% over the same time period (USDA-ERS). An increasing portion of the consumption of fruits and vegetables are "fresh-cut" produce items that include bagged specialty salads, baby carrots, stir-fry vegetable mixes, and fresh-cut melons. Total yearly sales of fresh-cut products have recently reached $10 to $12 billion (IFPA), which represents approximately 10% of total produce sales in the United States. The consumption of these products is increasing in popularity because of the increasing demand by the American consumer for healthy and convenient foods. Food service institutions are also demanding more fresh-cut products in order to reduce labor and waste costs (Shwedel and Costa).

Fresh-cut fruit is the newest class of products to be offered both in retail markets and quick-service restaurants. Industry experts predict that this category will likely overshadow the sales of fresh-cut salads and vegetables in the future. The volume of sales is projected to grow by 20% to 30% annually for the next 4 years and expected to reach as high as $2 billion in retail sales by 2008 (Miller). Most of the fresh-cut fruit products offered at the retail level contain some type of melon, as a single fruit or a mix of melons such as honeydews, muskmelons, and watermelons.

Despite the size and growing importance of the fresh-cut vegetable and melon markets, there is a dearth of information available about consumer demand and preferences for fresh-cut fruit. Indeed, we are aware of only one other study that investigates the fresh-cut industry; Thompson and Wilson investigated demand for bagged salads. In light of this lack of information more research is needed to

Carlos Mayen is a graduate student and Maria I. Marshall is assistant professor, Department of Agricultural Economics, Purdue University, West Lafayette, IN. Jayson Lusk is professor, Department of Agricultural Economics, Oklahoma State University, Stillwater, OK.

understand what consumers want when buying fresh-cut fruit so that producers can manufacture a product that better matches consumer preferences.

The overall objective of this research is to better understand consumer preferences for fresh-cut melon products. We tackle this issue by focusing on the case of a proposed fresh-cut melon product, branded "Indymelon," by Indiana melon growers. The first specific objective of this study is to assess consumer loyalty to existing fresh-cut melon products (e.g., Del Monte) and the acceptability of new brands such as the fictitious Indymelon brand. Second, we determine which attributes of the value-added melon product consumers favor most. The attributes assessed are type of package, type of fruit mix, and amount of fruit leakage (i.e., fruit juices that accumulate at the bottom of the package).

To our knowledge, no previous study has assessed how consumers make tradeoffs in price, packaging, fruit mix, brand, and juice content when purchasing fresh-cut fruit. The attributes included in this study belong to other fresh-cut fruit products besides melon; thus the results may also apply to other products, such as fresh-cut pineapple. Information generated by this study will allow processors, marketers, and suppliers of fresh-cut fruit to cater to the needs and preferences of consumers successfully.

## Previous Work

Consumers may have an emotional and sensory connection with food (Baker, Thompson, and Engelken; Lund et al.). Fillion and Kilcast found that consumers can discern freshness from appearance. Dantas et al., in their study of 144 Brazilian consumers, found that when looking at consumer preferences and intention of purchasing minimally processed cabbage, production method, color, and price were significant. Lund et al. found that consumer liking and preferences for apples was strongly influenced by appearance.

Several experimental studies have been conducted to ascertain the willingness to pay for a range of fruit products (Jaeger and Harker; Lund et al.; Roosen et al.). Conjoint analysis has also been used to estimate the demand and consumer preferences for fresh fruit and vegetables (Loader; van der Pol and Ryan). However, the previously mentioned studies did not investigate consumer preferences for fresh-cut fruit. Fruit and vegetable studies have generally been more concerned with the production methods or consumer preferences for a single whole fruit or vegetable. Harker, Gunson, and Jaeger demonstrated how researchers have focused on the effect of fruit texture, taste, and flavor on consumer preferences but have ignored consumer perceptions of product quality.

## Methods

A choice-based conjoint (CBC) analysis experiment is conducted to assess the importance and preference for several attributes of fresh-cut melon products. CBC analysis is the integration of two microeconometric tools that were initially used in market research in the early 1970s. It is the integration of conjoint analysis and discrete choice modeling. Conjoint analysis is a multiattribute judgmental method used for the development of an algebraic description of the utility of a good (Louviere). Utility, as postulated in Lancaster's 1966 classical work and applied to conjoint analysis, is derived from the attributes or characteristics that a good possesses. With discrete choice analysis, consumer choice from a set of mutually exclusive alternatives can be modeled. These models are based on the axiom that consumers are "rational" in the sense that they will choose the alternative with the highest utility, subject to economic constraints on expenditures. In discrete choice models, choice is considered a function of observable product attributes and the known characteristics of the choice-maker such as age or gender (Ben-Akiva and Lerman).

The first step in setting up the CBC analysis experiment is identifying the important attributes of a melon product. Two attributes required as part of this experiment are brand and price. Brands of available fresh-cut melon products are included to assess their

**Table 1.** Attributes and Attribute Levels for a Fresh-Cut Melon Product

| Attributes | Levels |
|---|---|
| Brand | ○ Del Monte (national brand) |
| | ○ Ready Pac (national brand) |
| | ○ Meijer (private/store brand) |
| | ○ Indymelon (fictitious brand) |
| Price | ○ $5.51 per kg ($2.50 per lb.) |
| | ○ $6.39 per kg ($2.90 per lb.) |
| | ○ $7.28 per kg ($3.30 per lb.) |
| | ○ $8.16 per kg ($3.70 per lb.) |
| Fruit mixes | ○ Cantaloupe only |
| | ○ Watermelon only |
| | ○ Cantaloupe, honeydew, and watermelon |
| | ○ Cantaloupe, honeydew, watermelon, and grapes |
| Fruit leakage | ○ No juice at bottom of package |
| | ○ Slight amount of juice at bottom of package |
| | ○ Moderate amount of juice at bottom of package |
| | ○ Considerable amount of juice at bottom package |
| Package | ○ Bowl with push-on lid |
| | ○ Inverted cup with push-on lid |
| | ○ Tamper-proof bowl |
| | ○ Squared container with push-on lid |

brand equity. Price is included to calculate the monetary valuation of the attributes. Through conversations with industry experts and consumers, it was found that other important attributes were fruit mix, package, and juice content. Juice content is a proxy for freshness. Products with less juice are considered fresher. For this study, four different levels are assigned to each attribute, and these are described in Table 1.

The second step in setting up a CBC analysis experiment is executing an experimental design to create product concepts or profiles from which consumers will choose. The random method is used when attribute levels are randomly allocated to product profiles, and product profiles are randomly assigned to choice tasks. The random method has been shown to be the most flexible in estimating all possible attribute interactions, accurate when estimating willingness to pay, and more efficient than orthogonal fractional factorial designs (Boyle et al.; Chrzan and Orme; Lusk and Norwood; Roe, Sporleder, and Belleville). For each choice task, a respondent would be presented with five alternatives from which to choose. Four alternatives refer to branded product profiles (one alternative for each brand) and the last refers to an opt-out alternative, which states "I would not buy any of these product alternatives."[1]

The third and final step in setting up the CBC analysis is formatting the experiment the way it will be presented to respondents. The respondents targeted for this study are fresh-cut fruit consumers at supermarkets. Anticipating that consumers at supermarkets would be in a hurry, the survey instrument was designed to be easy to complete. Four choice tasks are presented to each respondent. To ease the recognition of attribute levels, pictures of fruit mix, package, and brand are included. Price and fruit juice content are written on the pictures. Respondents were asked to provide demographic information such as age, income, and ethnicity.

## Data

The CBC analysis experiment was conducted in the produce departments at two different locations of a regional retail supercenter in Indiana. The supercenter was chosen because it has devoted a sizeable area of the produce department to fresh-cut products. Thus, the supercenter was expected to have a higher traffic of fresh-cut produce consumers than other stores. The two locations where consumers were surveyed were Avon and Lafayette.

The surveys were administered orally to consumers who were purchasing fresh-cut melons. This allowed us to obtain information from actual shoppers, with a point-of-sale context to maximize the validity of the preferences stated in the choice experiment

[1] A sample choice task is available from the authors.

(Batsell and Louviere; Enneking). Consumers of fresh-cut melons were recruited to participate in the survey at random times of the day and week during the months of July and August of 2004. Approximately 90% of the customers, who were asked to volunteer, agreeably completed the survey in its entirety. At both stores, sampling selection bias with respect to fresh-cut melon consumers is believed to be nonexistent. It was observed that people across gender, income categories, education levels, and race were willing to participate in the survey. By using a convenience sample for this study, the findings may not represent the true preferences of the population of fresh-cut melon consumers in the United States. Instead it represents the preferences of a typical fresh-cut melon shopper at the two retail stores in Indiana. Nevertheless, the information gained through this experiment would be the first of its kind that focuses on packaged fresh-cut fruit. A total of 126 respondents completed the survey. Ninety-nine of the respondents were from Lafayette and 27 from Avon. The demographic and purchasing behavior of the aggregated respondents can be seen in Table 2.

The demographics presented in the respondent sample closely resemble the characteristics of the Indiana population. According to the 2000 U.S. Census, the population in Lafayette was 89% Caucasian, 3% African American, 9.1% Hispanic, and 1% Asian. The population in Hendrix County, where Avon is located, was 94% Caucasian, 3% African American, 2% Hispanic, and 1% Asian.[2] The population in Indiana was 88% Caucasian, 9% African American, 4% Hispanic, and 1% Asian (U.S. Census Bureau).

Median household income in Indiana in 2003 was $43,323. Household income in Hendrix County and Lafayette was $61,475 and $35,859, respectively (U.S. Census Bureau). Of the population in Avon, 92% had a high school degree or higher and 28% had a bachelor's degree or higher (U.S. Census Bureau). Of the population in Lafayette, 83% had a high school degree or higher and 24% had a bachelor's degree or higher (U.S. Census Bureau).

**Table 2.** Respondents' Demographics and Purchasing Behavior

| Gender | Frequency | Proportion (%) |
|---|---|---|
| Male | 16 | 12.7 |
| Female | 110 | 87.3 |
| Age | | |
| 18–25 | 22 | 17.5 |
| 26–45 | 34 | 27.0 |
| 46–63 | 53 | 42.0 |
| Above 63 | 17 | 13.5 |
| Children in household | | |
| Present | 43 | 34.1 |
| Absent | 83 | 65.9 |
| Income (thousands of dollars) | | |
| 25 or less | 28 | 22.2 |
| 26 to 50 | 41 | 32.5 |
| 51 to 75 | 34 | 27.0 |
| Above 76 | 23 | 18.3 |
| Ethnicity | | |
| Caucasian | 118 | 93.7 |
| African American | 4 | 3.0 |
| Hispanic | 3 | 2.4 |
| Asian | 0 | 0 |
| Other | 1 | 0.9 |
| Highest level of education | | |
| Some high school | 2 | 1.6 |
| High school | 73 | 57.9 |
| Bachelors | 35 | 27.8 |
| Graduate | 16 | 12.7 |
| Fresh-cut fruit purchases per month (0.45 kg [1 lb.] packages) | | |
| None | 0 | 0 |
| 1 to 3 | 54 | 42.9 |
| 4 to 7 | 51 | 40.5 |
| 8 to 12 | 17 | 13.5 |
| More than 13 | 4 | 3.1 |

## Conditional Logit Model

In CBC, the utility that the $i$th person ($i = 1, \ldots, I$) derives from the $j$th alternative and may be represented as $U_{ij}$. This utility is considered a linear function of the alternative

[2] There are no specific data for the city of Avon, which is located 8 km (5 miles) west of Indianapolis in Hendrix County.

product attributes, represented by

$$(1) \quad U_{ij} = \beta x_{ij} + \varepsilon_{ij}$$

where $\beta$ is a vector of coefficients, $x$ is a vector of attributes represented by choice $j$ and respondent $i$, and $\varepsilon$ is a stochastic error term.

The probability $P_{ij}$ that the $i$th respondent chooses the $j$th alternative from choice set $C$ is the probability that the utility for the $j$th choice is greater than the utility for all other $k$ choices in the choice set. This can be represented mathematically as follows:

$$(2) \quad P_{ij} = P(U_{ij} > U_{ik}), \quad j \neq k \in C$$

$$(3) \quad P_{ij} = P(\beta x_{ij} + \varepsilon_{ij} > \beta x_{ik} + \varepsilon_{ik})$$

$$(4) \quad P_{ij} = P(\varepsilon_{ij} - \varepsilon_{ik} > \beta x_{ij} - \beta x_{ik}), \quad j \neq k.$$

Assuming that the error terms $\varepsilon_{ij}$ are independent and identically distributed with an extreme value distribution (also referred to as Weibull, Gumbel, and double exponential distributions) and scale parameter equal to 1, the probability that respondent $i$ chooses alternative $j$ is

$$(5) \quad P_{ij} = \frac{\exp(\beta x_{ij})}{\sum_{k=1}^{J} \exp(\beta x_{ik})}.$$

This model was fit to the choice data by means of maximum likelihood estimation. The LIMDEP statistical software is used to fit the conditional logit model to the choice data. For analysis, the choices made by the respondents and attributes of the melon products are coded with dummy variables. The response variable, whether or not an alternative is chosen, is coded with a 1 when chosen and 0 otherwise. There are five alternatives for each choice task. Each brand alternative is described by four columns, a 1 for the actual brand and a 0 for each of the other brands. The "none" option is omitted and was assigned a value of 0 for each of the brand columns. For each of the product attribute categories, one of the attribute levels is omitted and the others are assigned a value of 1 if chosen and 0 otherwise.

*Models with Interactions*

The random method of assigning attributes to product profiles and profiles to choices allows for the estimation of two types of models: main effects models and models that include interaction effects that may occur between attributes (Louviere, Hensher, and Swait). Thirteen different models that include interactions are estimated. Only interactions between two factors are assessed. Four models contain interactions of product attributes, including price, brand, juice content, fruit mix, and package. Nine models contain demographic information that is interacted with either the price or brand of the melon products. Demographic variables that are interacted with price and brand include presence of children in the household, age, income, education, and average amount of melon packages bought in a month. Table 3 shows the results of the likelihood ratio (LR) test used to compare models that included interactions with the main effects model.

The interaction effects were not statistically significant, which results in failure to reject the null hypothesis that all the coefficients for interaction effects are equal to zero. Therefore, the effects of price, juice content, fruit mix, and package do not depend on brand. Because the interactions of brand and price with demographic variables are also not statistically significant, we determined that the main effects model would not be improved significantly by the inclusion of interaction effects. However, there is a possibility that the demographic variables were not statistically significant because of the small sample size.

*Effects of Locality on Preferences*

Data were obtained through surveys that were distributed in two different locations. Avon represents 21% of the sample and Lafayette the other 79% of the sample. For the data to be pooled, the preferences for melon products in both locations need to be similar. A way to test for similar preferences or preferences

**Table 3.** Statistical Significance of Models That Include Interaction Effects

| Model | Log-Likelihood (LL) | LL Ratio | DF Difference[a] | Significance |
|---|---|---|---|---|
| Main effects only | −675.4 | 0 | 0 | No |
| Brand × price | −673.5 | 3.79 | 3 | No |
| Brand × juice | −671.1 | 8.47 | 9 | No |
| Brand × fruit mix | −669.3 | 12.2 | 9 | No |
| Brand × package | −669.6 | 11.62 | 9 | No |
| Price × no children | −675.3 | 0.12 | 1 | No |
| Price × ages | −674.0 | 2.72 | 3 | No |
| Price × incomes | −674.9 | 1.01 | 3 | No |
| Price × education | −673.6 | 3.62 | 3 | No |
| Price × quantity purchased | −674.6 | 1.62 | 3 | No |
| Brand × ages | −670.0 | 5.4 | 12 | No |
| Brand × income | −670.3 | 10.2 | 12 | No |
| Brand × education | −667.5 | 15.8 | 12 | No |
| Brand × quantity purchased | −667.3 | 16.12 | 12 | No |

[a] DF stands for degrees of freedom. Statistical significance was assessed at a 5% level. Critical chi-square values for 1, 3, 9, and 12 DF are 3.8, 7.8, 16.9, and 21.0, respectively.

regularity is to examine whether there is a statistical difference in the estimated conditional logit coefficients between the Lafayette and Avon locations (Louviere, Hensher, and Swait).[3] The null hypothesis, which states equality of preferences in Avon and Lafayette, could not be rejected, indicating that data from Lafayette and Avon can be pooled to estimate a single model.

### Main Effects Model

The main effects model consists of 14 different estimated coefficients. The first four coefficients pertain to alternative specific constants for the Del Monte, Ready Pac, Meijer, and Indymelon brands. These constants are estimated relative to the "none" alternative, which has an implicit value of zero. The rest of the attribute coefficients are estimated relative to one of the attribute levels. That attribute level is omitted from the model since its effect can be defined from the estimated effects of the other three attribute levels. For example, for the fruit mix attribute the melon plus grape fruit mix is omitted. The estimated effects of watermelon mix, cantaloupe mix, and melon mix are relative to the melon-grape mix. Any statistical differences that occur are estimated relative to the attribute level that is omitted. The other omitted attribute levels in this model are square package and considerable juice. Utility is modeled as

$$
\begin{aligned}
(6)\quad Utility = {} & \beta_1(\text{Del Monte}) + \beta_2(\text{Ready Pac}) \\
& + \beta_3(\text{Meijer}) + \beta_4(\text{Indymelon}) \\
& + \beta_5(\text{Price}) + \beta_6(\text{Watermelon Mix}) \\
& + \beta_7(\text{Cantaloupe Mix}) \\
& + \beta_8(\text{Melon Mix}) \\
& + \beta_9(\text{Bowl Package}) \\
& + \beta_{10}(\text{Tamper} - \text{Proof Package}) \\
& + \beta_{11}(\text{Cup Package}) + \beta_{12}(\text{No Juice}) \\
& + \beta_{13}(\text{Slight Juice}) \\
& + \beta_{14}(\text{Moderate Juice}),
\end{aligned}
$$

where $\beta_1$, $\beta_2$, $\beta_3$, and $\beta_4$ are brand-specific constants, and $\beta_5$ through $\beta_{14}$ are coefficients that denote the effect of the respective attribute level on utility.

Respondents were expected to prefer the well-known brands over the fictitious Indymelon brand (Roosen et al.; Steenkamp).

[3] The hypothesis is $\beta s_{\text{Lafayette}} = \beta s_{\text{Avon}}$ and the statistic that is employed to test this hypothesis is $-2(LL_J - \sum \text{LL}_l)$, where $LL_J$ is the log-likelihood value at convergence of the model that takes into account data from both locations and $\sum \text{LL}_l$ is the summation of the log-likelihood value of the estimated models for each location. Equality of error variance for both locations is assumed.

**Table 4.** Results of Main Effects Model

| Variable | DF | Coefficient | $Pr > \chi^2$ |
|---|---|---|---|
| Del Monte constant | 1 | 2.90901 | <0.0001 |
| Ready Pac constant | 1 | 3.00461 | <0.0001 |
| Meijer constant | 1 | 3.13736 | <0.0001 |
| Indymelon constant | 1 | 2.88341 | <0.0001 |
| Price | 1 | −0.51754 | <0.0001 |
| Watermelon mix | 1 | −0.59974 | <0.0001 |
| Cantaloupe mix | 1 | −0.89549 | <0.0001 |
| Melon mix | 1 | −0.11002 | 0.4448 |
| Bowl package | 1 | −0.19304 | 0.2014 |
| Tamper-proof package | 1 | 0.17775 | 0.2204 |
| Cup package | 1 | −1.10481 | <0.0001 |
| No juice | 1 | 1.01019 | <0.0001 |
| Slight juice | 1 | 0.97389 | <0.0001 |
| Moderate juice | 1 | 0.72889 | <0.0001 |
| Likelihood ratio | 22 | | <0.0001 |
| Pseudo-$R^2$ | 0.17 | | |

Consumers were also expected to prefer fruit mixes over single fruit products because of increasing consumer preference for variety and emotional response to color (Baker, Thompson, and Engelken; Lund et al.). Since juice is a proxy for freshness it was hypothesized that no juice at the bottom of the package would be preferred over slight, moderate, or considerable amounts of juice (Jaeger and Harker; Loader; Lund et al.). Because of increasing food safety concerns, we expected consumers to prefer a tamper-proof package over the other types of packages (van der Pol and Ryan).

## Results and Discussion

Table 4 contains the estimated coefficients, *p*-values, and statistical significance of the main effects model. The main effects model is statistically significant at the 0.01% level as denoted by the likelihood ratio test. This test rejects the null hypothesis that the probability of an individual choosing a melon product alternative is independent of the value of the parameters in the utility function obtained through the conditional logit model. Thus it can be inferred that at least one of the attribute effects is nonzero. The pseudo-$R^2$ value of 0.17 also suggests that the conditional logit model is a good fit.

All brand-specific constants are statistically different from the "none" option. This means that all branded alternatives are preferred over a no purchasing option. Surprisingly, the fictitious Indymelon brand has an estimated coefficient similar to the other brands. To test whether the brand coefficients are equal, a LR test was conducted. A model with a single constant, identifying whether one buys fruit versus whether one does not, is compared with an unrestricted model that contains all four brands. The LR statistic is 4.34 with 3 degrees of freedom. Thus, there is not sufficient evidence to reject the hypothesis that brand coefficients are equal. Therefore, a fresh-cut melon product produced by the fictitious Indymelon brand can give consumers utility similar to the utility of other recognizable brands. The brand equity of brands that have existed for a long time, such as Del Monte, does not apply to fresh-cut melon products and indicates that consumers are interested in other attributes besides brand.

In the experimental design there are four discrete price levels. In the econometric model, marginal utility of price is estimated as a linear function of price. By fitting a linear function through the price points, we investigate the exact price level at which individuals would be indifferent between two products, i.e., willingness-to-pay estimates. Price is negative and statistically significant. This agrees with consumer theory, which states that the quantity demanded of a good or service decreases as its own price increases.

Three fruit mix levels are compared with the melon-grape mix. The melon-grape mix was anticipated to give consumers the highest utility, since as noted from retail scan data consumers tend to prefer variety in their fresh-cut fruits. The preference for fruit variety in a fresh-cut melon product is supported by the results. The preferences for watermelon and cantaloupe mixes are significantly less than for a product with a melon-grape mix. The melon mix is not significantly different to the melon-grape mix. The utility of a product with a melon mix is less than that of a melon-grape

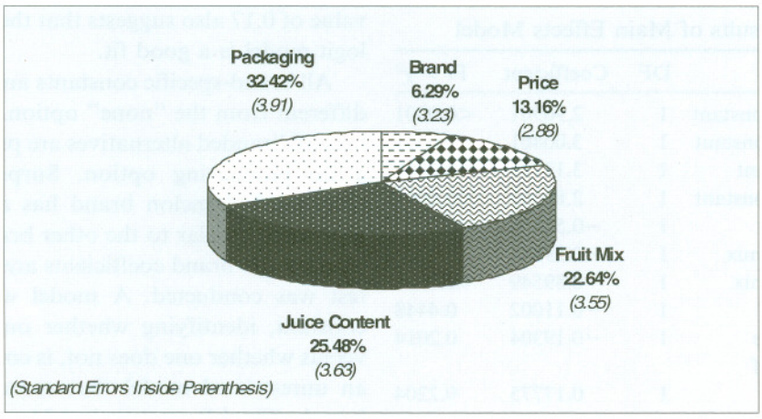


**Figure 1.** Relative Importance of Fresh-Cut Melon Attributes

mix product. In order of increasing preference, consumers prefer cantaloupe, watermelon, melon, and melon-grape mixes. The results indicate that fruit mixes have a significant effect on the purchasing decisions of our surveyed fresh-cut melon consumers.

In terms of packaging, only the cup package is statistically significant. The cup package has a negative coefficient, an indication of the dislike that fresh-cut melon consumers in our study have toward this package and that it is significantly less preferred than the squared package. The utility of the tamper-proof bowl might also reflect preferences for safety, yet the effect of a package with a tamper-proof device is not statistically different from the effect of a simple bowl or squared package. This implies that there is some preferential advantage in packages available for fresh-cut products.

An attribute that consumers are highly concerned with is the amount of melon juices that accumulate at the bottom of the package. The moderate juice, slight juice, and no juice levels are all significantly more desired than the considerable juice level. Consumers in our study preferred fresh-cut melon products with the least amount of juice on the bottom of the package as possible. Consumers preferred no juice above all other levels of juice. Therefore, fruit juice at the bottom of the package was an important choice attribute for Indiana consumers.

All attributes have some level of statistical significance. To understand which of the attributes has the most impact on consumer choice, the relative importance of the attributes can be assessed. For this, the range from lowest to highest coefficient value for each attribute is divided by the total range of all attributes. The following equation demonstrates the relative importance (*R.I.*) for the packaging attribute:

$$(7)\quad R.I. = \beta_{10} - \beta_{11}/[\beta_3 - \beta_4] + [\beta_5(2.50) - \beta_5(3.70)] + [0 - \beta_7] + [\beta_{10} - \beta_{11}] + [\beta_{12} - 0],$$

where the βs refer to the estimated coefficients of the conditional logit model, the numbers in parenthesis refer to the lowest fresh-cut melon price ($2.50) and the highest price ($3.70). A zero is used whenever the lowest or highest coefficient refers to an omitted variable in the model. The standard errors were calculated using the bootstrap technique developed by Krinsky and Robb. Figure 1 illustrates the relative importance of the attributes for the fresh-cut melon product included in the survey.

The most important attribute of the fresh-cut melon product is packaging. The package is the first experience that a consumer has with a product (Bernstein and Moskowitz). The second most important attribute is the amount of fruit juice on the bottom of the package. Consumers in our study prefer packages with

**Table 5.** Marginal Effects of Attributes on Melon Products

| Attribute | Del Monte | Ready Pac | Meijer | Indymelon |
|---|---|---|---|---|
| Price | −9.17 (2.28)* | −9.78 (2.45) | −10.62 (2.64) | −8.99 (2.25) |
| Moderate juice | 12.74 (3.21) | 13.56 (3.39) | 14.76 (3.78) | 12.49 (3.20) |
| Slight juice | 17.05 (3.14) | 18.16 (3.27) | 19.75 (3.57) | 16.71 (3.02) |
| No juice | 17.74 (3.20) | 18.88 (3.29) | 20.52 (3.55) | 17.35 (2.97) |
| Watermelon mix | −10.55 (2.89) | −11.23 (3.03) | −12.22 (3.30) | −10.35 (2.82) |
| Cantaloupe mix | −15.77 (3.08) | −16.79 (3.22) | −18.24 (3.36) | −15.43 (2.90) |
| Melon mix | −1.92 (2.47) | −2.05 (2.65) | −2.23 (2.86) | −1.89 (2.44) |
| Bowl package | −3.53 (2.61) | −3.76 (2.80) | −4.08 (3.02) | −3.45 (2.57) |
| Tamper-proof package | 3.12 (2.47) | 3.33 (2.65) | 3.61 (2.84) | 3.07 (2.44) |
| Cup package | −19.39 (3.33) | −20.65 (3.46) | −22.43 (3.64) | −18.99 (3.17) |

*Standard errors in parentheses.

no juice on the bottom of the package. They associate juice content with the freshness of fresh-cut fruit; thus a product with no juice is considered fresher.

The third most important attribute is fruit mix, and the least important attributes are price and brand. Consumers favor fruit variety when purchasing fresh-cut fruit, but are not as concerned with price. Brand is the least important attribute of all. This may be due to the fact that fresh-cut fruit products are relatively new and Indiana consumers have not yet become loyal to a specific brand.

### *Marginal Effects of Attributes on Choice*

The coefficients that are estimated for the conditional logit model pertain to a utility function and can only be interpreted as the effect that a certain attribute has on the overall utility of a product. To assess the impact that attributes have on the probability of choice, marginal effects need to be estimated. Marginal effects measure the change in the probability of choosing a particular melon product given a change in an attribute of the product and can be estimated as $P(j - 1|D = 1) - P(j = 1|D = 0)$, where $D$ is a dummy variable that can take on the value of 1 or 0. The standard errors were estimated using Krinsky and Robb's bootstrap technique. The marginal effects of all attributes on a Del Monte, Ready Pac, Meijer, and Indymelon product are tabulated in Table 5.

All marginal effects have the same signs across branded alternatives. The marginal effect of price on choosing an Indymelon product is −8.99. This means that a one dollar increase in the price of an Indymelon product would result in 8.99% decrease in the probability of choosing that product. The marginal effect of price for the other brands can be interpreted similarly. The Indymelon brand is the least price sensitive, followed by Del Monte, Ready Pac, and Meijer.

The marginal effects for the other attributes (package, fruit mix, and juice) are relative to their omitted attribute levels. The attribute levels with a positive effect on the probability of purchase are tamper-proof package and juice content. The attributes with the highest effects on probability of purchase are recommended to be included in a melon product to increase its overall probability of purchase.

Using Indymelon as an example, it can be shown that a cup package will decrease the probability of choosing an Indymelon product by 18.99% compared with the probability of choosing an Indymelon product with a square package. However, the probability of choice is increased by 3.07% when using a tamper-proof package instead of a square package. The probability of choosing an Indymelon product is increased by 17.35% when the product has no juice instead of a considerable amount of juice at the bottom of the package. Similar interpretations can be made about the other attribute levels for each branded alternative.

**Table 6.** Willingness-to-Pay Estimates and Confidence Intervals

| Change in Attributes | Mean WTP | 95% Confidence Interval |
|---|---|---|
| Indymelon to Del Monte | $0.05 | −$0.50–$0.60 |
| Indymelon to Ready Pac | $0.23 | −$0.31–$0.77 |
| Indymelon to Meijer | $0.49 | −$0.06–$1.05 |
| Cantaloupe to watermelon mix | $0.57 | −$0.13–$1.28 |
| Cantaloupe to melon mix | $1.52 | $0.59–$2.44 |
| Cantaloupe to melon-grape mix | $1.73 | $0.72–$2.74 |
| Cup to bowl package | $1.76 | $0.67–$2.85 |
| Cup to square package | $2.13 | $0.92–$3.35 |
| Cup to tamper-proof package | $2.48 | $1.14–$3.82 |
| Considerable to moderate juice | $1.41 | $0.47–$2.35 |
| Considerable to slight juice | $1.88 | $0.79–$2.89 |
| Considerable to no juice | $1.95 | $0.82–$3.08 |

*Willingness to Pay for Melon Product Attributes*

Willingness to pay (*WTP*) is the estimate of the amount of money an individual is willing to pay to obtain a benefit from a specific change in attribute level, such as obtaining a melon product with a melon mix instead of a product with just cantaloupe. The *WTP* estimates are derived by determining the price difference between attribute levels that will invoke indifference between them. This can be calculated by the difference of beta coefficients of two attribute levels divided by the negative of the price coefficient (Lusk and Norwood; Mark, Lusk, and Daniel). For example, a consumer is willing to pay $0.49 more to obtain a Meijer product than an Indymelon product. This is calculated as

$$(8)\quad WTP = \left(\beta_{\text{meijer}} - \beta_{\text{Indymelon}}\right)/(-\beta_{\text{Price}}) = (3.13 - 2.88)/(-0.52) = \$0.49.$$

Similar calculations are performed to estimate *WTP* for the different brand names and attributes levels. To account for variability in *WTP* estimates, the confidence intervals at a 95% level are also estimated. The variance of *WTP* estimates needed to calculate the confidence intervals can be estimated by the following equation (Greene):

$$(9)\quad Var[WTP] \approx \left(\frac{\partial WTP}{\partial \beta}\right)' \left(Var\left[\hat{\beta}\right]\right) \left(\frac{\partial WTP}{\partial \beta}\right).$$

The derivatives of *WTP* with respect to the model parameters are obtained by plugging in the parameter estimates. The derivatives are then multiplied by the variance-covariance matrix of the parameters. The square root of the variance is then multiplied by the critical *t*-value of 1.96. The *WTP* estimates and their respective 95% confidence intervals are shown in Table 6.

The *WTP* estimates to move from an Indymelon product to other branded products are positive, yet the confidence intervals range from negative to positive values. Confidence intervals that contain a zero *WTP* within the range indicate that *WTP* estimates are not statistically different from zero. Therefore, WTP estimates between two brands (i.e., Indymelon and Del Monte) are not statistically different from one another.

*WTP* estimates to move from least to most preferred levels for the other attributes are positive, with 95% confidence intervals above zero except for the change from cantaloupe to watermelon mix. A fresh-cut fruit consumer in this study is willing to pay $1.73 on average for a product with melons and grapes instead of just cantaloupe. Similarly, a consumer would pay $2.13 more for a product in a squared package than a cup package. Consumers were willing to pay $1.95 to obtain a product with no juice instead of a product with considerable juice at the bottom of the package.

The marginal *WTP* estimates may seem too high for a melon product that typically

sells for $3.00. Yet a study by Lusk and Schroeder found that marginal WTP estimates are in general not statistically different across hypothetical and actual payment situations. The benefit of WTP estimates is that they indicate the preference of an attribute in units that consumers are familiar with, monetary units. The magnitudes of the WTP estimates agree with the relative importance of attribute levels. The more important an attribute is to the consumer, the higher the WTP will be for that attribute.

The conditional logit model in this study expresses the probability of purchase of a branded fresh-melon product. The sum of the probabilities for all brands equals one; thus the probabilities can be used as a proxy to market shares. Owing to the assumption of independence of irrelevant alternatives (IIA), the market share for two competing brands can be assessed. For example, in our study a Meijer and an Indymelon product having the same attribute levels would capture a 56% and 44% market share, respectively. This is a sizeable portion considering that Indymelon is a fictitious brand. The market share of the Indymelon product could be increased by offering a more appealing fresh-cut melon product than Meijer. Consider a Meijer product that had a moderate amount of juice and an Indymelon product that had no juice, all else equal, the Indymelon product would be preferred by consumers and would capture a market share of 51%, compared with 49% for a Meijer product. Similarly, Indymelon could capture a higher market share by improving on the current characteristics of fresh-cut melon products already offered in retail markets.

## Implications and Conclusions

In our study, existing brands in the market place have not gained statistically significant brand equity, which would give them a competitive advantage over new brands. An Indymelon product, *ceteris paribus*, may be able to penetrate the market and compete with existing brands such Del Monte, Ready Pac, and Meijer. Yet, the viability of an Indymelon commercial enterprise would need to be studied further, since an Indiana fresh-cut melon product would only be seasonal.

We found that brand is not as important as other fresh-cut melon attributes. Consumers in our study had a clear dislike for cup-shaped transparent packages compared with the other types of packages. However, a tamper-proof, bowl, and squared package were equally preferred by consumers. Consumers in our study were willing to pay a premium for packages that have no fruit juices on the bottom. Producers could consider using a package with a better absorption mechanism so that juices are not visible to consumers. The cost of this package may be higher than other packages, yet the premium that consumers may be willing to pay for a product with no juice leakage may cover the cost. Including grapes in addition to the melon mix may seem more appealing to consumers, yet consumers in this study showed no statistically significant difference in preference between a melon mix and a melon-grape mix.

Producing a fresh-cut melon product with the most desirable attribute levels will have the most acceptability and capture the highest market share at the retail level. A product that offers the most desirable characteristics to consumers will have a competitive advantage over products that do not, regardless of brand. Marketing opportunities that exploit consumers' emotional response to freshness could be explored. This may mean that the marketing margin including packaging will continue to increase. Products such as fresh-cut fruit require more members in the distribution channel. Because these members add value to the product to make it acceptable to consumers, it causes an increase in the marketing margin.

The effects of five fresh-cut melon attributes were examined. Packaging was the most important attribute. A study that focuses solely on packaging could provide more specific preferences regarding the package. Attributes that could be included as part of the study are color of the package, absence or presence of nutritional information, different logos for the same brand, and type of fruit juice absorbing devices used with the package. A larger scale study could also be conducted

to test whether similar preferences for fresh-cut melon products hold in other states or nationally. Preferences in the food service sector should also be assessed, since it is also a potential market for fresh-cut melons.

Fruit quality and taste were considered to be the same across all products. In reality, there are plenty of melon varieties with different colors, tastes, and aromas that are used in fresh-cut products. Existing processors do not take into account consumer preferences regarding the taste, color, and aroma of raw products. A study that assesses the preferences for specific melon colors, tastes, and aromas would be very useful at aiding production decisions at the farm level.

Consumer characteristics that may be useful to explore beyond demographics include benefit beliefs, attitudes, health, and behavior toward fruit. Another focus that may be explored is the possibility that consumers choose fruit based on emotional interpretations or perceptions of quality. The consumer's emotional connection to the food he or she eats should be explored further.

This study has applied a well-known quantitative tool in market research to assess preferences for a relatively new convenience at retail stores. No other study has assessed the tradeoffs in price, packaging, fruit mix, brand, and juice content that fresh-cut melon consumers make when purchasing these types of products. Although our study is limited by its small sample, the results point out what may be some of the most important attributes of a fresh-cut melon product. The attributes included in this study belong to other fresh-cut fruit products too, thus the results may also apply to other products, such as fresh-cut pineapple. Information generated by this study is a start that will allow processors, marketers, and suppliers of fresh-cut fruit to begin to identify the needs and preferences of consumers successfully.

*[Received July 2005; Accepted November 2006.]*

## References

Baker, S., K.E. Thompson, and J. Engelken. "Mapping the Values Driving Organic Food Choice: Germany vs. the U.K." *European Journal of Marketing* 38(2004):995–1012.

Batsell, R., and J. Louviere. "Experimental Analysis of Choice." *Marketing Letters* 2(1991):199–214.

Ben-Akiva, M., and S. Lerman. *Discrete Choice Analysis: Theory and Application to Travel Demand.* Boston: MIT Press, 1985.

Bernstein, R., and H. Moskowitz. "The Marriage of Graphic Design & Research—Experimentally Designed Packages Offer New Vistas and Opportunities." Paper presented at Advertising and Consumer Psychology: Visual Persuasion Conference, Ann Arbor, MI, May, 2000.

Boyle, K.J., T.P. Holmes, M.F. Teisl, and B. Roe. "A Comparison of Conjoint Analysis Response Formats." *American Journal of Agricultural Economics* 83(May 2001):441–54.

Chrzan, K., and B. Orme. "An Overview and Comparison of Design Strategies for Choice-Based Conjoint Analysis." Working paper, Sawtooth Software Research Paper Series, 2000.

Cook, Roberta, L. "The U.S. Fresh Produce Industry: An Industry in Transition." *Postharvest Technology of Horticultural Crops*, A. Kader ed., University of California Division of Agriculture and Natural Resources, Publication 3311, 2001.

Dantas, M.I.S., R. Deliza, V.P.R. Minim, and D. Hedderley. "Consumer Intention to Purchase for Minimally Processed Cabbage." *Ciêcia e Tecnologia de Alimentos, Campinas* 25(October/December 2005):762–67.

Enneking, Ulrich. "Willingness-to-Pay for Safety Improvements in the German Meat Sector: the Case of the Q&S Label." *European Review of Agricultural Economics* 31(2004):205–23.

Fillion, L., and D. Kilcast. "The Meaning of Freshness in Fruit and Vegetables: A Preliminary Study." Paper presented at the Fourth Pangborn Sensory Science Symposium Conference, Dijon, France, July 22–36, 2001.

Greene, W.H. *Econometric Analysis*, 4th ed. Upper Saddle River, NJ: Prentice-Hall, 2000.

Harker, F.R., F.A. Gunson, and S.R. Jaeger. "The Case for Fruit Quality: An Interpretive Review of Consumer Attitudes and Preferences for Apples." *Postharvest Biology and Technology* 28(2003):333–47.

IFPA (International Fresh-Cut Produce Association). "The International Fresh-Cut Industry." Alexandria, Virginia: International Fresh-Cut Produce Association, 2004.

Jaeger, S.R., and F.R. Harker. "Consumer Evaluation of Novel Kiwifruit: Willingness to Pay." *Journal of the Science of Food and Agriculture* 85(2005):2519–26.

Krinsky, I., and L.A. Robb. "On Approximating the Statistical Properties of Elasticities." *Review of Economics and Statistics* 68(1986):715–9.

Lancaster, K. "A New Approach to Consumer Theory," *Journal of Political Economy* 74(1966): 132–57.

Loader, R. "Conjoint Analysis of Fresh Fruit Purchasing: A Report on a Survey." Mimeo. Reading, UK: University of Reading, 1990.

Louviere, Jordan. *Analyzing Decision Making Metric Conjoint Analysis*. Newbury Park, CA: Sage Publications, 1988.

Louviere, J., D. Hensher, and J. Swait. *Stated Choice Methods: Analysis and Applications*, 1st ed. Cambridge, UK: Cambridge University Press, 2000.

Lund, C.M., S.R. Jaeger, R.L. Amos, P. Brookfield, and F.R. Harker. "Tradeoffs between Emotional and Sensory Perceptions of Freshness Influence the Price Consumers Will Pay for Apples: Results from an Experimental Market." *Postharvest Biology and Technology* 41(2006): 172–80.

Lusk, J., and B. Norwood. "Effect of Experimental Design on Choice-Based Conjoint Valuation Estimates." *American Journal of Agricultural Economics* 87(August 2005):771–85.

Lusk, J., and T. Schroeder. "Are Choice Experiments Incentive Compatible? A Test with Quality Differentiated Beef Steaks." *American Journal of Agricultural Economics* 86(May 2004):467–82.

Mark, D.R., J. Lusk, and M. Daniel. "Recruiting Agricultural Economics Graduate Students: Student Demand for Program Attributes." *American Journal of Agricultural Economics* 86(February 2004):175–84.

Miller, Lynne. "Fresh-Cut Category Bearing Fruit." *Supermarket News*, August, 2003.

Roe, B., T. Sporleder, and B. Belleville. "Hog Producer Preferences for Marketing Contract Attributes." *American Journal of Agricultural Economics* 86(February 2004):115–23.

Roosen, J., J.A. Fox, D.A. Hennessy, and A. Schreiber. "Consumers' Valuation of Insecticide Use Restrictions: An Application to Apples." *Journal of Agriculture and Resource Economics* 23(December 1998):367–84.

Shwedel, K., and F. Costa. "U.S. Fruits and Vegetables: Adjusting the Business Model in 2004." *2005 North American Food and Agribusiness Outlook*. New York: Rabobank International, 2005.

Steenkamp, J. "Conjoint Measurement in Ham Quality Evaluation." *Journal of Agricultural Economics* 38(July 1987):473–80.

Thompson, G.D., and P.N. Wilson. "Market Demands for Bagged, Refrigerated Salads." *Journal of Agricultural and Resource Economics* 24(December 1999):463–81.

U.S. Census Bureau, Internet site: http://quickfacts.census.gov/qfd/states/18000.html.

U.S. Department of Agriculture—Economic Research Service (USDA-ERS), Internet site: http://www.ers.usda.gov/data/FoodConsumption/FoodAvailSpreadsheets.htm.

Van der Pol, M., and M. Ryan. "Using Conjoint Analysis to Establish Consumer Preferences for Fruit and Vegetables." *British Food Journal* 98(1996):5–12.