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Willingness to Pay for Fruit Attributes: A Conjoint Analysis

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ABSTRACT

Purpose: *Identification of consumer preferences is important in designing products. Producers will immensely benefit by knowing them to capture the market share. In light of this, we evaluate consumers' stated preferences for various attributes of four popular fruits: grapes, sweet orange, pear and pomegranate.*

Research Method: *We run a Rank Ordered Logistic Regression (ROLOGIT) and calculate Willingness to Pay (WTP) for fruit attributes.*

Findings: *We find that the perception of the fruits selected is contingent upon only a handful of attributes. We find that crispness and price are significant attributes in Pear. Price has a non-significant effect on preferences for grapes. Sweetness, shelf life and price significantly influence consumer choice when buying sweet oranges. Seeds that are relatively low in bitterness and softness are the two key attributes influencing the purchase decisions of Pomegranate.*

Research Limitations: *The number of attributes used in the choice card was limited to most important attributes. Additionally, only a main effect model was estimated without considering the interaction effects of attributes in this study.*

Originality/ Value: *Favorable features of fruits in Sri Lankan condition has not been studied so far. Thus, incorporating favorable features of the fruits considered into breeding programs of the local counterparts of these fruits may be fruitful.*

Keywords: *Conjoint analysis, Consumer preference, Fruit, Rank ordered logit, Willingness to pay*

INTRODUCTION

Fruit breeders worldwide continually attempt to create new varieties of fruit aiming at higher productivity and higher consumer acceptance. Breeding fruit varieties is a long and a time consuming process. For example, the Washington State University (WSU) breeding program for apples started in 1994 but the first release from the program was 'WA 2' variety, which was in 2009 (Evans, 2013). Thus, such innovations are a difficult and expensive process with usually low success rates. Success rates of commercial launches of innovations are about 10% (Jaeger and Harker, 2005). Innovators see the success or failure of these breeding programs only at the time of commercialization when consumers decide to accept or reject the product.

Therefore, Introducing new products into competitive markets need current and extensive

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information about consumer preferences to develop products to capture the market share. Preferences refer to consumers' expressed like or dislike for a product based on an overall evaluation or overall attitude toward the product (Deliza *et al*., 2005). When consumers pay for a preferred product, one can distill the preference by splitting down products into their constituent attributes (Green and Srinivasan, 1990). For a breeder, a quantitative measurement of how each attribute function in generating overall consumer use for the product is vital to maximize consumer demand. Additionally, consumer preference information can also help firms selling products to develop specific strategies targeting niche markets and increase sales through product diversification (Manalo, 1990).

As in most food products, a consumer's decision to buy fruits is influenced by three 'groups' of attributes: search, experience and credence. Consumers ascertain search attributes before they purchase the fruit. Price, color, shape, are some examples. After consuming the product, they ascertain the levels of 'experience' attributes such as taste. Consumers cannot fathom some attributes by neither searching nor experiencing the product. This last category is the credence. Thus, third party information is necessary to the consumer to obtain values of credence attributes. Quality is one major credence attribute. In this research, we take on the task of assessing the relative preference for various attributes of four selected fruits (Dominant fruit species among urban consumers namely, grapes (*Vitisvinifera*), sweet orange (*Citrus sinensis)*, pear (*Pyruscommunis*) and pomegranate (*Punicagranatum*)) falling into these three categories: search, experience and credence. We attempt to make quantitative measurements of consumer preference for each attribute considered.

METHODOLOGY

Conceptual framework

We hypothesize that utilities that a consumer generate is as random. This means that even if a consumer prefers a certain product over others, there is a chance that the consumer to choose a less preferred product in certain instances. This selection of non-preferred products are because of random shocks. Thus, we use the random utility framework (Manski, 1977) where we assume that utility generated from choosing an alternative (a fruit profile in this study) has a latent distribution. Therefore, the random utilities for respondent i are a set of latent variables $U_{i1,}. . .U_{iJ}$, defined as

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

Wherei = 1. . . N indexes individuals and j = 1. . . J indexes the items (fruit profiles).μ_{ij} is the deterministic component of the utility, decided by observed individual characteristics and ε_{ij} is the random component of the utility of alternative j for individual i. The deterministic component, μ_{ij} can be decomposed into a set of explanatory variables (Fok and Van Dijk, 2012; Allison and Christakis, 1998) as,

$$\mu_{ij} = x_i^{'} z_j \quad (2)$$

Where x_i denotes the characteristics of the respondent and z_j denotes characteristic of the alternative fruit profile j.

Assume that individual respondents rank the alternative fruit profiles. Keeping in line with the consumer behavior theory, we expect that a consumer to rank alternative k over j if utility from alternative k is greater than the utility of alternative j ($U_{ik}>U_{ij}$). If we denote the rank given to each alternative as r_{ij} (the number or rank given by individual i for fruit profile j), we know that

$$U_{iri1} > U_{iri2\ldots\ldots\ldots} > U_{irij} \quad (3)$$

Therefore, the probability of observing a particular ranking r_i equals,

$$\Pr[r_i; z] = \Pr\left[U_{ir_{i1}} > U_{ir_{i2}} > \ldots > U_{ir_{ij}}\right] = \prod_{j=1}^{J-1} \frac{\exp(\mu_{ir_{ij}})}{\sum_{i=j}^{J} \exp(\mu_{ir_{ij}})} \quad (4)$$

This is a series of Multinomial Logit Model (MNL) and the literature terms this as the Rank Ordered Logit Model (Beggs *et al.,* 1981; Chapman and Staelin, 1982). Thus, this model is suitable to analyze how decision makers combine attributes of alternative fruit profiles into overall evaluations of the attractiveness of these alternatives. Further, this uses richer information about the comparison of alternatives. For example, how consumers rank the fruit profiles given to them rather than just specifying the alternative profile that they like best. This is most suited to the CA situation discussed below.

Conjoint Analysis

The two broad categories of non-market valuation techniques used in identifying consumer preferences are the revealed preference and the stated preference technique. The revealed preference (RP), models assume that consumers reveal their preferences by their purchasing habits. On the other hand, the stated preference (SP) technique directly ask people what they are willing to pay for a product. SP methods exist with varying names. Conjoint analysis (CA), Functional measurement, Trade-off analysis, and transfer price method are best known. For assessing consumer preference on fruit attributes, we use the Conjoint Analysis (CA) technique. It is one of the most significant development in marketing research since its introduction in 1971 by Green and Rao. This method measures the satisfaction from a product with multiple attributes (Green and Srinivasan, 1990) *via* a systematical variety of product attributes by assigning to each attribute level a value that indicates the relative importance of that level to the respondents (Wang *et al*., 2003; Hair *et al*., 2010). In this study, we proceeded as given below. First, we selected attributes to be valued and their levels. We developed a stimulus set from the selected attributes. Afterwards we collected data using a pre-tested questionnaire and the stimulus and we analyzed data with a Rank Ordered Logit (ROLOGIT) procedure available in Stata software.

Attributes and levels selection

We conducted a literature search to understand the most important attributes of the selected fruits. Consumers in the northeastern US value apple crispness the most, followed by size, color, and flavor for apples for the fresh market (Manalo, 1990). For Satsuma mandarins, seeds followed by price, color and size are important attributes (Benjamin *et al.,* 2004). Simply flavor (e.g., sweetness and acidity), texture (e.g., flesh firmness and crispness), appearance (e.g., external color and size) and price premiums were important quality traits for the fruit crops (Gallardo *et al.,* 2014). To verify that the attributes ascertained from the literature review are in line with the local preferences, we had a focus group of experts in the area, mostly consisting of the Faculty members of the university. We also interviewed consumers in deciding on the attributes and their levels. In an effort to refine our attributes and their levels further, we conducted a pilot survey with twenty respondents. We asked the respondents to rank the product profiles first and thereafter to order the attributes according to their importance towards them. After refining, we opted to have seven attributes to evaluate pomegranate and six attributes for pear, grapes and orange respectively. Finally, all attributes had two opposite levels (Table 01).

Table 01: Attributes and their levels

Category	Attribute	Pear	Pomegranate	Grapes	Orange
Search	Peel Color	Green, Yellow	Pink, Yellow		Green, Orange
	Size	Small, Large	Small, Large	Small, Large	
	Shape	Round, Pear			
	Aril Color		Red, Pink		
	Firmness			High, Low	
	Flesh Color				Orange, Yellow
	Price*	100/=, 60/=	250/=, 100/=	100/=, 40/=	60/=, 30/=
Experience	Sweetness	High, Low	High, Low	High, Low	High, Low
	Crispness	High, Low			
	Hardness of		Hard, Soft		
	Bitterness		Bitter, Not		
	Seeds			Have, Seedless	Have, Seedless
Credence	Safety Assurance			Assure, Not	
	Shelf Life				High, Low

*Note: *Per fruit for pear, pomegranate and orange. For grapes, it is for 100g*

Stimulus Set Construction

Full factorial design of conjoint analysis includes all the combination of attribute levels. For example, six attributes with two levels for each attributes will come up with 2*2*2*2*2*2=64 product profiles leading to a total 128 combinations for pomegranate and 64 combinations for grapes, sweet orange, and pear. Because this is not practical for a respondent to evaluate, we obtained an orthogonal fractional factorial design in SPSS (version 23) to make the task convenient by reducing profile (stimulus card) number to eight for each fruit. Partial profile is a necessity when the number of attributes and the levels within the attributes become large. It considers a subset of the entire, which would be representative of the full profile. Orthogonal process makes sure that the profiles contain the levels equally or in proportion. We applied a full profile conjoint approach, the traditional conjoint approach in data collection, where, we presented the subjects with stimuli that include all attributes and each with one of their levels (Wehmeyer and Lankenau, 2005). We used pictures for external attributes like peel color, and shape to make the exercise more realistic by providing a real market situation for the respondent. We used verbal explanation to explain other characteristics. At the bottom of the card, we left a space for ranks. An example of the stimulus card used in the survey is in Figure 01 and Figure 02.

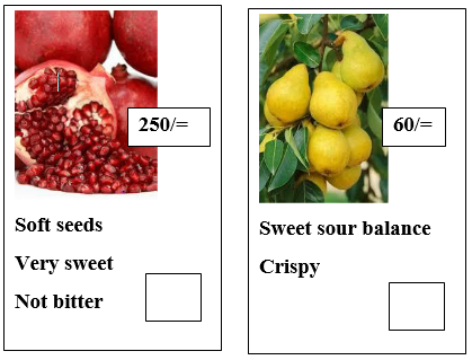

Figure 01: Stimulus cards for pomegranate and pear

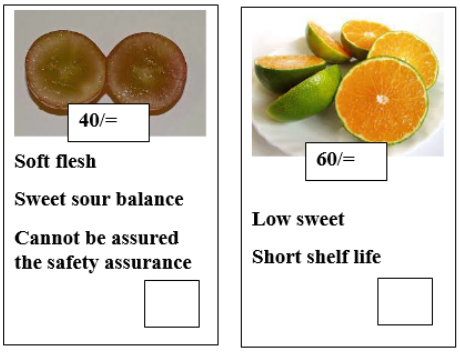

Figure 02: Stimulus cards for grapes and sweet orange

Data Collection

Our research strategy is a deductive approach using a survey. In addition to the stimulus cards to evaluate product attributes, we included general information to obtain respondent characteristics such as age, sex, monthly income, educational level and employment in the questionnaire administered. We conducted face-to-face interviews in three urban councils in the Colombo district, which is the commercial hub of Sri Lanka. We obtained a systematic sample from a household list taking every fifth household into the sample and we removed households who do not consume fruits from the sample. A respondent evaluated only two fruits: either grapes and sweet orange or pear and pomegranate to reduce the effects of respondent fatigue. This resulted in two different samples for the four fruits. The respondents' task was to rate each stimulus from one to eight where one indicates most preferred and eight indicates least for the product described. We administered 120 questionnaires in each sample but had to reject some of them because they were incomplete. The final evaluation samples were 120 for pear and pomegranate and 103 for grapes and sweet oranges. We collected data during February and March in 2016.

Data Analysis

We carried out the data analysis using the ROLOGIT procedure available in Stata (Version 14). For the ease of interpretation, we calculated odds ratios by exponentiation of the model's coefficients (Long and Freese, 2006). The relative importance of fruit attributes are a vital piece of information for breeders, thus, we calculated the Willingness to Pay (WTP) for each attribute enabling comparison of attributes. Equation (1) assumed that utility is composed of a systematic component (μ_{ij}) and a random component. We assumed that the random component has the following additive; linear relationship with fruit attributes (z) and price of the fruit (p);

$$\mu_{ij} = \gamma z_j + \alpha p_j \qquad (5)$$

By differentiating equation (5) with respect to each attribute ($\partial\mu_{ij}/\partial z_j$), we obtained the marginal utility provided by the attribute. By differentiating with respect to price ($\partial\mu_{ij}/\partial p_j$), we got the marginal utility of price. The WTP or the marginal rate of substitution between attribute z_j and money is the ratio between these two derivatives. Thus, the WTP that we calculated is the ratio between the coefficient of the attribute and the coefficient of the price variable (Breidert *et al.,* 2006).

$$WTP = -\frac{\partial\mu_{ij}/\partial z_j}{\partial\mu_j/\partial p_j} = -\frac{\gamma_j}{\alpha}$$

RESULTS AND DISCUSSION

Descriptive Statistics of the Samples

Both the samples used for the study are not considerably different from each other. Sample focusing on pear and pomegranate has79 females and 23 males. Descriptive statistics showed that 45 percent of them are educated up to their tertiary education level, 28 percent obtained higher education and only three percent of them had only primary education. More than 3/5 of the respondents in the sample have employment. The second sample is also female dominated (>70 percentage). Forty three percent of respondents have education up to tertiary level and 40 present covered their tertiary education. Eighteen percent obtained secondary education and only four percent up to primary education. There were 56 employed respondents and 47 reported as non-employees. The participants' ages ranged from 16 to 72 years. In both the samples, mean age was around 41 years and income is around Rs.50, 000.

Results of Rank Ordered Logistic Regression

The results of the ROLOGIT are in Table 2. We report coefficients, p-values and the Willingness to Pay (WTP) values for each attribute in the four fruits. For easy comparison, we plot WTP values in Figure 3.

Table 02 - Results of the Rank Ordered Logistic Regression

Attribute	Coefficient	P-Value	WTP
Pear			
Green Peel Color	-0.028	0.727	-0.144
Large Size	-0.089	0.271	-0.456
Pear Shape	0.065	0.419	0.333
Very Sweet	-0.040	0.636	-0.202
Crisp	0.588*	<0.000	3.002
Price	-0.196*	0.016	
Grapes			
Large Size	0.247*	0.003	1.984
Very Sweet	0.311*	<0.000	2.504
Seedless	-0.188*	0.027	-1.512
Low firmness	-0.255*	0.002	-2.052
Safety Assured	1.163*	<0.000	9.357
Price	-0.124	0.138	
Sweet Orange			
Green Peel Color	0.115	0.154	0.726
Very Sweet	0.203*	0.015	1.274
Seedless	0.070	0.391	0.438
Orange Flesh Color	-0.003	0.974	-0.017
High Shelf Life	0.729*	<0.000	4.582
Price	-0.159*	0.055	
Pomegranate			
Pink Peel Color	0.011	0.890	0.077
Large Size	0.137*	0.089	0.929
Very Sweet	-0.040	0.630	-0.269
Red Aril color	0.011	0.893	0.074
Soft Seeds	0.339*	<0.000	2.295
Not Bitter	0.360*	<0.000	2.437
Price	-0.148*	0.076	

**Significant values*

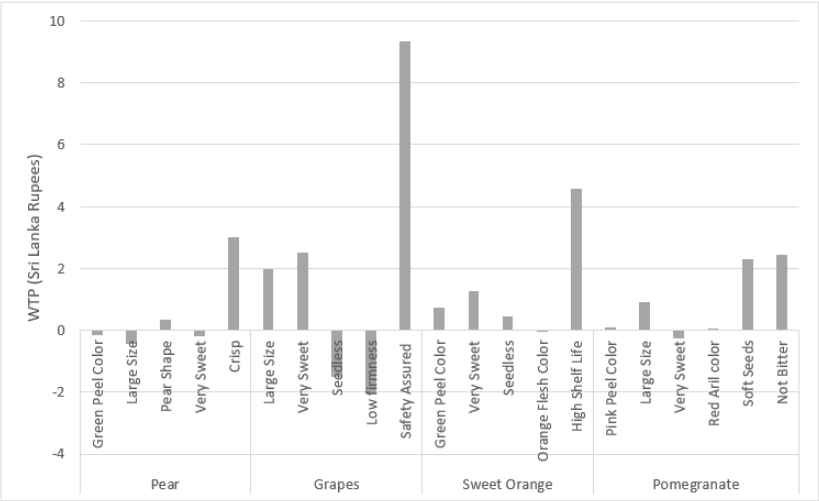

Figure 03: WTP values for fruit attributes

In pears, we considered six attributes including price. We find that only crispness and price are significant. From the calculated WTP values, crispness show the highest WTP among all attributes showing its importance relative to others (Table 02 and Figure 03). Accordingly, consumers are willing to pay Rs.3 more for 'crisp' pears. Crispiness of pears is a maturity indicator (Manning, 2009). Previous literature also reports consumer preferences for crispy pears (Hoehn *et al.,* 1996). We find that three attributes return negative values: peel color, size and sweetness. Pear comes in two colors: green and yellow. But the results tell us that consumers value yellow peel color over green. At present, the Sri Lankan Department of Agriculture is conducting research to introduce Asian pear (Pyrus pyrifolia) in the country because it is more suited for the climate than the previously introduced European varieties. These carry a yellow/brownish color peel and consumers may prefer these over the green ones. Contradictory to expectation, the size variable gave a negative sign meaning that consumer preference for smaller pears over larger ones. Also, the results suggest that consumers like less sweet pears than sweeter varieties. Results also show that consumers are interested in the shape of the fruit as well. However, the critical attribute in pears is the crispness.

In grapes all attributes are significant except price. Nevertheless, we calculate the WTP values in order to compare attributes. We see two attributes with negative WTP values: presence of seeds and firmness. Surprisingly, consumers prefer seeded grapes. They are willing to pay about Rs1.51 to avoid seedless grapes.However, seeded grapes may have a slight nutritional benefit over seedless grapes due to the additional protein, minerals and fats (including omega-3s) that are available in the edible seeds (Russell, 2009). This may be the reason to prefer seeded grapes. Further, they are willing to pay about Rs 2 to avoid soft fruits. Firm fruits are prefered. On the otherhand, consumers would be willing to pay Rs.9.36 for safety assured grapes. This is the highest willingness to pay for any trait with respect to grapes. However, safety cannot be searched or experienced unless provided by a third party to the consumer. Piva *et al.* (2006) also reported that demand for grapes in Spanish markets can be improved by using quality marks. Further, consumers are willing to pay for sweetness than the size of the fruit. Therefore, based on the WTP values, consumers consider safety, sweetness, firmness, absence of seeds and shape respectively in their buying decisions of grapes.

In sweet oranges, sweetness and shelf life are the significant attributes at five percent error level. However, shelf-life of the fruit is the key attribute. The WTP for shelf-life is 3.5 times greater than the WTP for sweetness. Consumers may be considering shelf-life of fruits because fungus such as *Penicillium digitatum* and *Penicillium italicum* are common to grow on citrus fruits. Some research are focussing on controlling this fungal activity (Chien *et al.,* 2007).

Results show that hardness of seeds, bitterness and size of the fruit are the significant attributes in pomegranate. The highest WTP is to the bitterness attribute. Consumers are willing to pay Rs.2.44 for bitter free fruits. The value of pomegranate fruits with soft seeds is Rs.2.29 greater than fruits with hard seeds to the consumers in the sample. From the WTP values calculated, consumers prefer bitter free (Rs.2.44) and soft seeds (Rs.2.29) respectively followed by very sweet (-Rs.0.27), large size (Rs.0.93), external color(Rs.0.08), and aril color (Rs.0.07).

CONCLUSIONS

This study investigated the consumer preference for fruit attributes using a conjoint analysis. Results show that there are key attributes that consumers are concerned on when they are purchasing fruits. Crispness is the critical attribute in pear while bitterness and hardness of seeds in pomegranate. Consumers look for food safety in grapes and shelf life in sweet orange. Sri Lanka imports most of these fruits

and the country has a substitute for each of these fruits. There is a 'general' preference for these imported varieties of fruits by consumers. However, for developing nations such as Sri Lanka, import substitution of these fruits may save a significant amount of foreign exchange while giving employment opportunities to the rural poor where agriculture is the mainstay. Thus, by incorporating these preferred attributes into local varieties may prove fruitful.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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