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ANALYSIS OF CONSUMER PREFERENCES FOR RICE-BASED NOODLES AND BISCUITS

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ABSTRACT

Sri Lanka is nearly self-sufficient in rice production and promotion of rice-based food products appeared to be one of the best alternatives to absorb any surplus resulting in from increased production, while moving consumers away from wheat-based products. This study attempted to analyze the consumer preferences for rice-based noodles and biscuits using conjoint analysis. The necessary data were collected from a conjoint survey covering a sample of 185 consumers in Kurunagala and Kandy districts. The data were analyzed using ANOVA (GLM) and an ordered Logit regression. Results revealed that the thickness of rice noodle strands is the most important attribute, and thin strands were the most preferred. White coloured noodles were preferred over red/yellow. In the case of rice biscuit, the type, shape and price attributes were significant except shelf life. Consumers preferred the savory type biscuits than plain or sweet tastes with round shape. The consumer preferences could be useful parameters in developing rice-based products for a competitive market.

KEYWORDS: Consumer preference, Rice-based products, Conjoint analysis

INTRODUCTION

Rice production in Sri Lanka has recorded a substantial growth over the years mainly due to technological improvements, fertilizer use, land expansion, and various policy supports by the government. Expansion of lands with new production entries in North and East as well as re-cultivation of abandoned lands in the country will further enhance the production. Current rice market in Sri Lanka can be characterized as nearly self-sufficient, but the country still could not enter the export market due to lack of comparative advantage in terms of price and quality. Therefore, continued increase in production could result in a surplus in the market. One strategy to handle the surplus would be to promote rice-based food production in value added forms.

The five-year work plan of the Department of Agriculture (DOA) has identified processing rice into value added products as one of the objectives, and to reduce per capita wheat flour consumption by 20% from present 40 kg/head by 2010. The accelerated food production programme aimed by the government has given a special emphasis to boost rice consumption by means

of rice-based products. The Food Research Unit (FRU) of the Horticultural Crops Research and Development Institute (HORDI) of the DOA has introduced several rice-based products in line with the accelerated food production programme. It is important to look into the consumer response for rice-based value added products, for the success of this exercise. However, rice-based value added products in Sri Lanka is marketed with low priority due to poor consumer awareness and the early stages of production and product development compared to those of the wheat-based products. The growing middle class population with health concerns is the target group but, they consider the quality aspects of rice-based products when making decisions on purchase.

In a competitive market, new products are accepted only if the customer expectations are fulfilled. Hence, understanding the consumer preference is useful in positioning products in the market and aids in product matching. Consumer preference is also valued as a strategy for product design and formulating pricing strategies. In economic terms, identifying consumer choice is desirable in assessing the substitution possibilities of a product.

In light of this, the overall objective of this study is to assess the consumer preference for selected rice-based products namely, rice biscuits and rice noodles, among the middle-income population of Sri Lanka. The specific objectives were to identify product attributes and their levels needed for product acceptance by consumers, to test the significance of selected product attributes of rice biscuits and rice noodles, and to calculate the relative importance of the product attributes.

METHODOLOGY

Theoretical framework

Conjoint analysis involves eliciting people's stated preference for different options in a hypothetical setting. As per the Lancaster's (1966) "Characteristics Theory of Value", conjoint analysis approaches assume that any product can be described in terms of its attributes and its levels. The technique involves the measurement of psychological judgments (such as stakeholder preferences, or acceptable thresholds) or perceived similarities or differences between choice alternatives. Conjoint analysis is a technique in which respondents are given various choices (stimuli) for which they express their preferences. These choices are selected, in advance, to incorporate all the outcome dimensions that result from the selection of a particular alternative. The responses thus obtained result in a preference structure for the stakeholders.

Conjoint analysis has typically been used for new product development (Wittink and Cattin, 1989; Green and Srinivasan, 1978, 1990) and service industry settings (Neslin, 1983). Harrison *et al.* (1998) investigated the market potential for minced meat products derived from underutilized small crawfish. Tano *et al.* (1998) used conjoint analysis to estimate farmers' preferences for cattle traits in West Africa. Consumers' preferences of multiple attributes of organic rice were studied using conjoint analysis (Ara, 2003). Huang and Fu (1995) used conjoint analysis to examine consumer preferences for various Chinese sausage attributes. Halbrendt *et al.* (1991) used the technique to determine the utility values for nine different hybrid striped bass products. Schaupp and Belanger (2005) employed conjoint analysis in order to measure the customer satisfaction with online shopping to gauge the successes and failure of e commerce. Mclennon (2002) carried out a conjoint analysis for consumer perceptions towards biotechnology and their preferences for biotech food labels.

Conjoint analysis technique involves a series of interrelated steps, which can be categorized into three main steps. First is to identify the product attributes and their levels as stimuli for consumer choice. The second is to select an experimental design and to formulate a survey instrument to collect conjoint data. Finally, the technique involves choosing an appropriate composition model and estimating buyer part-worth utilities (Harrison *et al.*, 1998).

Once the data are choice-based, researchers use random-utility models in which the basic idea is the assumption of utility maximization (Hauser and Rao, 2002). Under the random utility model hypothesis, utility (U_{ij}) is portioned into a systematic (observable deterministic part) component (V_{ij}) and a random unobserved component (ε_{ij}). Thus, the indirect utility function of i^{th} individual for the j^{th} alternative can be represented as shown in Equation 1.

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Eq. 1}$$

If an alternative j is superior to alternative k, then $U_{ij} > U_{ik}$, then the individual would chose alternative j instead of k. The probability of choosing alternative j over k can be expressed shown in Equation 2.

$$P[(U_{ij} > U_{ik})] = P[(V_{ij} + \varepsilon_{ij}) > (V_{ik} + \varepsilon_{ik})] = P[(V_{ij} - V_{ik}) > (\varepsilon_{ik} - \varepsilon_{ij})] \ldots \text{Eq. 2}$$

The Equation 2 states that respondent 'I' would choose alternative 'j' over alternative 'k' if the difference in the deterministic parts of their utilities exceeds the difference in the error parts. It is of vital importance to identify the distribution of the error term, in order to derive explicit distribution of this probability. Such probabilities can be obtained by fitting a Multinomial Logit Model (Gunatilake, 2003).

Empirical work

Rice noodles and rice biscuits were selected as the targeted rice-based products. The attributes and levels were chosen based on a focus group discussion. The second stage was dealt with constructing an experimental design and questionnaire for the conjoint analysis. Four main attributes together with three levels were identified based on the focus group discussion and expert views, thus making 3^4=81 profiles. However, as stated by North and Vos (2002), all stimuli cannot be used, as the information overload and cognitive burden reduce the accuracy of evaluation of respondent's preference. Thus, the number of profiles should be reduced and fractional factorial design (Cochran and Cox, 1957) was used to define the optimal number of choice sets. Hence, this study used one-third of the total profile.

A research officer, a nutritionist, a bakery producer and a marketing agent participated in the focus group discussion. Identified attributes and levels for rice noodles and rice biscuits are given in the Table 1.

Table 1. Selected product attributes and levels from the focus group discussion

Rice noodles		*Rice biscuits*	
Attribute	*Level*	*Attribute*	*Level*
Colour	Red	Type	Plain
	White		Savory
	Light yellow		Sweet
Thickness	Thin (<1 mm)	Shape	Irregular
	Medium (1-3 mm)		Round
	Thick (>3 mm)		Rectangular
Cooking time	7-8 minutes	Shelf life	1 month
	5-6 minutes		2 month
	4 minutes		3 month
Price/400 g	Rs 50	Price/100g	Rs 30
	Rs 75		Rs 40
	Rs 90		Rs 50

The four attributes (Table 1) were identified separately for the two products, each attribute having three levels. Following Wind *et al.* (1989), for each product, three choice sets were prepared in a card format for sorting by the respondents according to their preference. The choice set 1, choice set 2 and choice set 3 were given to block 1, block 2 and block 3 (described below), respectively.

Sampling and field survey

The overall sample consists of 185 middle-income consumers, which were randomly selected, representing three profiles namely, non-professional upper class, non-professional middle class and professionals. They were

referred to as block 1, 2 and 3, respectively. A structured interview method was followed in primary data collection administered by a pre-tested questionnaire. The questionnaire included two sections for rice noodles and rice biscuits. Each section contained questions to collect general information of the respondents, their perceptions for the selected food and conjoint data. The survey was conducted from May to August 2008 in Kandy and Kurunagala districts.

The respondents were requested to sort the nine cards of one choice set from 1 to 9, selecting the most preferred combination of attributes in the first place. Then the sorted cards were ranked as the most preferred attribute combination was given rank 1.

Two models were used in the analysis. In the ANOVA model, block effect, main effects and two-way interactions were included. In the multinomial logit model (*i.e.*, ordered logit model), levels of attributes were re-coded using dummy variables (D_1, D_2....) and effect codes were used instead of typical 0,1 dummy variable coding (Adamowicz *et al.*, 1994, Harrison *et al.*, 1998; Mclennon, 2002; Lusk *et al.*, 2002), as it allows for recovery of the "left out" dummy variable while preserving the orthogonality of the design.

Relative importance (RI) of product attributes

The relative importance of the product attributes were computed based on part-worth estimates of the Logit regression following Halbrendt *et al.* (1991). The relative importance of the attribute is defined as [(utility range/Σ utility ranges of all attributes) * 100].

RESULTS AND DISCUSSION

Consumer preference for rice noodles

The ANOVA was based on the General Linear Model since the design used was Fractional Factorial Design. The overall model was significant at $p<0.01$.

The block effect was not significant ($p<0.05$) implying that preferences among three groups of consumers have no clear difference. Since interaction effects were not significant ($p<0.05$), the LS means were computed separately for the main effects. Of the three colour levels, white colour was the most preferred and red and light yellow colours were not contrastingly different. Thin type of strands was preferred ($p<0.05$) over the medium and thick types.

The lowest cooking time was the preferred choice than the other two time periods. The 4 min. time duration was significantly different ($p<0.05$) to

that of 7-8 min, but no significant difference was observed ($p>0.05$) with the 5-6 min. cooking time. Obviously, the lowest price was preferred mostly, which was significantly different ($p<0.05$) from the highest price level, but did not significantly differ ($p>0.05$) from the middle price level (Table 2).

Table 2. Results of mean separation for rice noodles

Attribute	*Level*	*LS mean**
Colour	Red	5.349 a
	Light yellow	5.094 a
	White	4.447 b
Thickness of strands	Thin (<1 mm)	4.243 a
	Medium (1-3 mm)	4.793 b
	Thick (> 3 mm)	5.853 c
Cooking time	7-8 minutes	5.180 a
	5-6 minutes	4.928 ab
	4 minutes	4.782 b
Price (Rs/400g)	Rs 50	4.664 a
	Rs 75	4.910 a
	Rs 90	5.315 b

* The LS means denoted by the same letters are not statistically significant at p=0.05.

Part-worth estimates of rice noodles

Table 3 provides the estimates of Ordered Logit model (the model was significant at 1% level) , which provide the part-worth utilities. The results are consistent with the findings of ANOVA.

Table 3. Part-worth estimates* for rice noodles

Attribute	*Level*	*Estimate*	*Z value*
Colour	Red	-0.292	-4.66
	White	0.397	6.49
	Light Yellow	-0.106	-1.72
Thickness of strands	Thin (< 1mm)	0.535	8.60
	Medium (1-3 mm)	0.114	1.90
	Thick (> 3 mm)	-0.650	-10.82
Cooking time	7-8 minutes	-0.148	-2.45
	5-6 minutes	0.025	0.42
	4 minutes	0.123	2.02
Price Rs/400g	Rs 50	0.220	3.62
	Rs 75	0.020	0.34
	Rs 90	-0.240	-3.98

*Sample size = 185; Log likelihood = -3565.89

Relative importance of product attributes

The thickness of strands was the most important factor for the consumers in selecting a noodle type followed by the colour. Price was the third important factor while cooking time was the least important attribute (Table 4).

Table 4. Relative importance of product attributes of rice noodles

Attribute	*Utility Range*	*Relative Importance (%)*
Thickness	1.185	45.50
Colour	0.689	26.44
Price (Rs/400g)	0.460	17.65
Cooking Time	0.271	10.40

Consumer preference for rice biscuits

Except the attribute 'shelf life, all other attributes were significant ($p<0.05$) implying that all the attributes affect the consumer choice. The block effect was not significant ($p>0.05$) suggesting that the preference across the three consumer groups are the same. Of the two-way interactions, shape x shelf life interaction was significant ($p<0.05$), and the results of mean separation of the attribute 'shelf life' using LS means at given levels of biscuit shapes are shown in table 5.

Table 5. LS means for shape-shelf life interaction of rice biscuit

Attribute 1 - Shape	*Attribute 2 - Shelf life*	LS means*
Irregular	1month	5.708 a
	2 months	5.000 b
	3 months	5.070 bc
Round	1 month	4.767 a
	2 months	4.178 b
	3 months	4.962 a
Rectangular	1 month	4.578 a
	2 months	5.091 b
	3 months	4.659 ab

* Means denoted by the same letter are not significant at p=0.05.

Shelf life of rice biscuits was not significant, but the interaction between shape and shelf life was significant. If the biscuit shape was irregular or round, 2- month long shelf life was preferred than one and 3 months (Table 5). The one-month shelf life was preferred mostly if the shape was rectangular. Across the 'shape' levels, a significant difference ($p<0.05$) was reported between one- month and two-months of shelf life, while the difference

between one-month and three-months of shelf life were not significant ($p>0.05$) if the shape was either irregular or rectangular.

Part-worth utilities for rice biscuits

The estimates of the specified Ordered Logistic Model are given in Table 6 (the model was significant at 1% level). Lower pseudo R^2 of the model is due to the aggregation effect of the subjective differences of each individual for a specific product.

Table 6. Part-worth estimates of rice biscuits

Attribute	*Level*	*Estimate*	*Z value*
Type	Plain	-0.034	-0.57
	Savory	0.536	8.72
	Sweet	-0.501	-8.16
Shape	Irregular	-0.257	-4.20
	Round	0.188	3.07
	Rectangular	0.069	1.13
Shelf life	1 month	-0.095	-1.55
	2 months	0.087	1.44
	3 months	0.007	0.12
Price Rs/100g	Rs 30	0.295	4.80
	Rs 40	-0.029	-0.48
	Rs 50	-0.266	-4.39

N=185, Log likelihood = -3548.38, Pseudo R^2= 0.019

The part-worth estimates of rice biscuits indicated that all the shape attributes (round, irregular and rectangular), savory and sweet attributes from the "type" of biscuit and Rs 30 and Rs 50 price levels were statistically significant. Part-worth estimates of shelf life were not significant as the time differences was not adequate which affects the consumer preference in selecting a biscuit type. The highest utility is derived by consuming round shaped savory type rice biscuits of Rs 30 with 2 months shelf life. The negative signs indicate that plain and sweet type biscuits, which are of irregular shape and 1 month shelf life and Rs. 40, Rs. 50 price levels negatively, affect the consumer preference

Relative importance of product attributes

Relative importance of product attributes was calculated using the part-worth estimates and the output is given in Table 9.

Table 7. Relative importance of attributes of rice biscuits

Attribute	*Utility Range*	*Relative Importance (%)*
Type	1.037	46.62
Price	0.560	25.18
Shape	0.445	20.00
Time	0.182	8.19

The type of rice biscuit was the most important attribute and the shelf life was the least important attribute in terms of consumer preference. However, the consumers were also concerned of price and shape in selecting a biscuit type.

CONCLUSIONS

The analysis revealed that, for rice noodles, thickness of strands was the most important attribute while preparation time was the least concerned. The highest utility was derived from consuming white-coloured noodles. The preference declined if the colour of the strands is light yellow or red. With respect to thickness of strands, noodles with thin strands were preferred more than the medium strands. The preference declined with increasing cooking time.

The type of biscuit was the main criterion to choose rice biscuits followed by the price and shape of the biscuits, with shelf life as the least significant attribute. Savory type biscuits were preferred mostly while the plain type and sweet biscuits received a negative preference. Round-shaped rice biscuits was preferred than the rectangular shape. The shelf life is not a significant attribute to be considered in purchasing rice biscuits.

In the case of both products preference tend to decline with increasing price.

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