Conjoint Analysis of Breaded Catfish Nuggets: Consumer Preferences for Price, Product Color, Cooking Method and Country of Origin

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Abstract. A new product, marinated, breaded catfish nuggets, was developed. This conjoint study was designed to evaluate consumers' preferences for certain attributes of the nuggets. An in-store survey was conducted to collect data. The data collected will be used to determine the market potential for the catfish nuggets.

Introduction

The nugget portion of the catfish has not been a popular product among consumers. It is considered an added-value product and has a negative image among consumers leading to low profit margin for catfish processors. In the 1990s, products such as heatset, breaded nuggets, strips and fillets were introduced (Silvia and Dean, 2001). And catfish processors have had a difficult time marketing the product. The nugget has several drawbacks that contribute to the negative image perceived by consumers.

The nugget is made from the belly flap that is cut away from the fillet of the catfish. It has a higher concentration of fat than other forms of the catfish (fillets, steaks, and whole dressed) and therefore is more likely to retain off-flavors. There is also a black membrane covering one side of the nugget that gives it an unappetizing appearance. The membrane, high fat content and potential for off-flavors have all contributed to the unappealing image with consumers.

To offset these drawbacks, a new product was developed to improve the nugget: a marinated, breaded catfish nugget that comes in four distinct flavors (Szechwan, Poblano, Buffalo, and Lemon Pepper). A test taste was done to evaluate participants' preference for the four different samples of nuggets in terms of flavor, appearance, texture, off-flavor perception and overall acceptability.

The taste test, as well as meetings and phone conversations with catfish processors, determined that a conjoint study would be beneficial in finding more information to successfully market this product. Several attributes were determined to be important for evaluation: price, color of breading, country of origin, and cooking method. The objective of this study was to

determine consumers' preferences for these attributes for catfish nuggets. The information obtained from the conjoint study would be beneficial in the exploration of the market potential for catfish nuggets. This information would also be helpful to catfish processors to provide better quality nuggets to consumers.

Methodology

Conjoint analysis is a multivariate technique developed specifically to understand how respondents develop preferences for any type of product, service, or idea (Hair et al., 2006). It is based on the simple premise that consumers evaluate the value of a product, service, or idea by combining the separate amounts of value provided by each attribute (Hair et al., 2006). By evaluating the respondent's rating for the combined features (attributes) for the product, the individual preference scores for each feature can be deduce that would have provided the overall evaluation.

Conjoint analysis is a technique widely used to measure consumers' trade-offs between competing products. It has been very useful in the marketing world to determine consumer's preferences for products. There has been a number of studies conducted using conjoint analysis. Harrison, Stringer, and Prinyawiwatkul (2002) used conjoint analysis to determine consumer preferences for three consumer-ready products derived from crawfish. There was a conjoint study conducted in Haiti by Nelson, Jolly, Hinds, Donis, and Prophete (2005) on consumer preferences for roaster peanut products. Huang and Fu (1995) conducted a conjoint experiment to determine Taiwanese housewives preferences for various Chinese sausage attributes. The advances made in conjoint analysis have created a powerful tool to predict consumers' preferences for product features.

The first step in a conjoint study is to determine the design. In a conjoint analysis, the features that are most important to the evaluation of the product must be determined. When determining the number of features to include in the conjoint analysis, it is important to keep in mind that respondents will only devote a limited time to the process, so it is important to select the few features that are critical to the product, while still able to obtain the information needed to estimate the respondents' utility functions. In this conjoint study of catfish nuggets, the features evaluated were price, color of breading, country of origin, and cooking method. The information received from food technologists, catfish processors, and past conjoint studies, these four factors were identified as the key characteristics that consumers would use to evaluate this product. Each feature will have two or more levels.

When the features and their levels are determined, the information is entered into the Bretton-Clark (1990) Conjoint Designer program. Conjoint Designer will produce a set of designs with a certain number of cards in each design. Each design will consist of cards displaying one of every feature identified and one of its levels for that feature. Therefore, there would be a set number of cards with the features: price and one of its specified levels, color of breading and one of its specified levels, country of origin and one of its specified levels, and cooking method and one of its specified levels. Conjoint Designer will randomize the cards to reduce any biasedness in the study. When choosing one of the designs produced by Conjoint Designer, it is best to choose the smallest design, which is the design with the least number of cards.

Selection of Product Features

As stated before, there were four features to be evaluated in this conjoint study of catfish nuggets. One of the features is price. Price is a factor included in many conjoint studies because it represents a distinct component of value for many products or services being studied (Hair et al., 2006). Price is an important factor to a consumer's decision making process. There were three price levels determined for this study: $1.49/lb., $4.59/lb., and $7.49/lb.

The color of the breading may also be a determinant factor for consumers. A taste test for catfish nuggets was conducted by an Alabama food technologist. The test revealed that respondents associated the color of the breading with cooking quality. Respondents believed that the darker color breaded nuggets suggested an over-cooked, while the lighter color breaded nuggets suggested an undercooked nugget. The three color levels determined to be included in the conjoint study were medium to golden brown, dark brown and light brown.

Following several food-related scares from other countries, there has been an increasing concern among consumers to know where their food products originated. The recent food scare from China has highlighted this issue among catfish consumers.   After several conversations with catfish processors, it was discovered that some processors deal with imported catfish products. Therefore, country of origin was determined to be an important factor to be evaluated in this study. There are two levels: imported products, which is represented by China and domestic products represented by the United States. China was chosen as the representing imported country because it was determined that catfish processors deal with imported catfish products from the country, however China was chosen as the representative country before the reports of tainted food products being imported from the country.

The fourth and final feature is cooking method. In the past several years, there has been a push by the food industry to provide healthier alternatives for certain food products because of consumers increasing concern with healthier eating. That is why two different cooking methods, oven baked and deep fried, are included in the study to be evaluated by respondents.

Experimental Design and Data Collection

There are four attributes and with all their levels, the required combinations to be evaluated would have 36 combinations (3^2 x 2^2). However, to minimize participants' fatigue, Conjoint Designer is used to reduce that number of combinations to nine. There were three more combinations added to the design as holdout cards, increasing the total number of combinations to 12. This increased the degrees of freedom in the model to be estimated. Conjoint Designer does this by using orthogonal rays, which is highly efficient technique reduces the size of the task necessary to estimate the respondent's preference (utility) function (Bretton-Clark, 1990).

Several photographs of cooked, breaded catfish nuggets were taken with a digital camera. The photographs were examined to determine which batch of nuggets best represented the medium to golden brown color desired. This photograph was chosen as the archetypical batch of nuggets.

Once the archetypical nuggets were determined, the photograph was copied into Adobe's Photoshop 7 (Adobe Systems Inc., Seattle, Washington). The adjusting of the picture to the dark and light shading, the hue, saturation, and light was changed on the original photo. The original settings for hue, saturation, and light were all zero. The dark shading was achieved by adjusting the hue to -5, the saturation to -15 and the light to -15 of the original photo. The light shading was achieved by adjusting the hue to +7, the saturation to +9, and the light to +15 of the original

photo.

There were 12 profile cards, each displaying a pictorial stimulus with the selected feature combinations and their specified levels. There were 3 sets of 2 posters that were used as displays for the in-store surveys. Each poster displayed six pictorial stimuli, one poster displayed panels A through F and the second poster displayed panels G through L. Each stimulus consisted of one of the levels for each of the four attributes. The attributes' levels were randomized using Conjoint Designer to reduce order biasedness, thus creating the three sets of posters. These kinds of props make the task more interesting to the respondent, provide easier and potentially less ambiguous ways of conveying information, and hence allow a greater number of attributes to be included in the full-profile method (Green and Srinivasan, 1990).

The in-store surveys were administered in Alabama, Georgia, and Florida, for a total of eight cities. The eight cities included were Opelika, Auburn, Luverne, Troy, Montgomery, and Prattville, all located in Alabama, as well as, Columbus, Georgia and Apalachicola, Florida. The grocery store chains visited were The Kroger Company, Bruno's, Piggly Wiggly, Southern Family Foods, and Food World.

A display was set up in each store either near the frozen meat section or toward the entrance. There was 1 set of 2 posters taken to each store on different days with the time spent in each store ranging from four to eight hours. When a new store was surveyed a different set of posters was used. Several grocery stores were revisited, however at a different date in time and with a different set of posters. The posters were set up on a table six feet in length, Panels A through F stood on one side and Panels G through L stood on the opposite side, with the backs facing each other or on occasion the posters were standing side by side with the edges touching.

Either way, respondents were allowed to take the survey starting at any panel of their choosing as long as the panel they were evaluating corresponded to the panel they marked on the survey. The respondents were asked to rate each stimulus on a rating scale of 1 to 7, where 1 meant that the respondent definitely would not buy the product and 7 meant that the respondent definitely would buy the product, as presented in the photograph. Participants could mark anywhere between 1 and 7, and their mark was later measured to the nearest tenth of a decimal place. During any time of completing the survey, respondents were allowed to opt out of the survey without penalty.

The survey also consisted of seven questions about catfish nuggets usage and six questions concerning demographics. The usage questions included: awareness of catfish nuggets (yes or no), previous consumption of catfish nuggets (yes or no), and purchasing habits; previous purchaser of catfish nuggets (yes or no), if yes would purchase them again, location of purchase (grocery, fish market, or other), and how many pounds per purchase on average. The last question that was included in the usage questions asked participants to rate ten alternative names including catfish nuggets on a scale of 1(least appealing name) to 7 (most appealing name). The questions about demographics were year of birth, gender, ethnic group, years of education completed, number of people in households and their age group, and income bracket. A total of 663 surveys were administered, however only 616 of those surveys were usable.

Model Specification and Estimation

Ordinary Least Squares was used to estimate each respondent's preference coefficients for the attributes' levels. The regression is used to estimate the part-worths for each feature and one level for each feature is dropped to avoid singularity. The following model specification was

used:

$$R_j = \beta_1 + \beta_2 (P1) + \beta_3 (P3) + \beta_4 (C1) + \beta_5 (C3) + \beta_6 (O1) + \beta_7 (CM2) + E_j \quad [1]$$

where, R_j denotes rating value assigned by respondent j on the 7-point scale; P1 = $1.49/lb. price

level; P3 = $7.49/lb. price level; C1 = light color breading; C3 = dark color breading; O1 =

China as country of origin, and CM2 = oven baked as cooking method.

The independent variables were effects coded. A conjoint study assessing the importance

of apple attributes (Manalo) also used effects coding. Effects coding is an alternative to dummy

coding in which the effects are uncorrelated with the intercept (Bech and Gryd-Hansen, 2005).

The reference level in effects coding is assigned a -1, as opposed to dummy coding, the reference

level is assigned 0. In effects coding: if the level is present a 1 is assigned, if the reference level

is not present a -1 is assigned, and 0 if otherwise (Bech and Gryd-Hansen, 2005). The reference

profile for this study was medium colored breaded catfish nuggets that are oven baked, the

country of origin is United States, and the price is $4.59/lb.

The estimated preference coefficients obtained through ordinary least squares regression

is used to determine each respondent's relative importance of each attribute. The relative

importance is calculated in the following way:

$$R.I._i = (range_i * 100) / \sum (ranges) \quad [2]$$

where, $R.I._i$ is the relative importance for feature i. The range is calculated by taking the

difference between the highest and lowest utility for each feature and then summing the ranges

across all of the features.

Conjoint Analysis Results

Bretton-Clark (1992) Conjoint Analyzer calculates the relative importance for the individual respondent. The values for relative importance are presented in table 1. Country of origin accounts for 30% of the decision buying process, followed by the color of the breading with almost 28% and price accounted for 27% of the decision buying process. According to the relative importance cooking method accounted for 14% of the decision buying process.

The average adjusted R^2 was 63.1 (standard error is 0.021), suggesting that the model does a good job of fitting the data. In table 2, the estimated part-worths for each feature's levels are presented. As stated before, the part-worths represent the respondent's utility for the specified level of each feature. The feature, price, has three levels, $1.49, $4.59, and $7.49. So the utility for $1.49/lb. is 0.391, for $4.59/lb is 0.001 and for $7.49/lb is -0.392. So therefore, the utility of a $1.49/lb of catfish nuggets is 0.783 rating points higher than a $7.49/lb. of catfish nuggets. The utility for the color of the breading for the light brown is -.218 rating points lower than dark brown, so respondents liked dark colored breading more than light colored breading. The country of origin utility is -1.5; this suggests that China imported catfish nuggets leads to ratings that are about 1.5 points lower than U.S. catfish nuggets. The cooking method utility is -0.264, suggesting that deep fried catfish nuggets lead to ratings that are 0.264 points lower than oven baked catfish nuggets.

Table 3 shows the preferred distribution levels for each feature's levels. By preferred, it is meant that the respondent had a greater utility for one level over the other levels. There were 616 respondents, and out of them nearly 55% preferred the price level $1.49. There was 49% that preferred medium colored breading, and 79% of them preferred U.S. catfish nuggets

compared to China catfish nuggets. And almost 58% of the respondents had a greater utility for oven baked catfish nuggets.

Conclusions

This conjoint study suggests that there is market potential for catfish nuggets and consumers do have strong preferences for certain attributes in catfish nuggets. The estimations from the conjoint analysis, as suspected show that respondents preferred the lower priced catfish nuggets, which were medium brown from the U.S. and oven baked.

Further analysis of the data will be conducted. Cluster analysis will group participants with similar preference coefficients into market segments. A multinomial logit model will be estimated to determine the relationship between membership in the segments and the demographic and usage information.

Table 1. Individual Relative Importance

Feature	Relative Importance (%)
Price per lb.	27.44
Breading Color	27.96
Country of origin	30.20
Cooking Method	14.40

Table 2. Estimated Part-Worths

Price per lb.		Breading Color		Country of Origin		Cooking Method	
Level	Part-Worth	Level	Part-Worth	Level	Part-Worth	Level	Part-Worth
$1.49	0.391 (0.036)[1]	Light	-0.251 (0.038)	China	-0.727 (0.037)	Deep Fried	-0.132 (0.022)
$4.59	0.001 (0.024)	Medium	0.285 (0.028)	U.S	0.727 (0.037)	Oven Baked	0.132 (0.022)
$7.49	-0.392 (0.036)	Dark	-0.033 (0.033)				

[1] Standard errors are in parentheses.

Table 3. Distribution of Preferred Levels

Price per lb.	Level	Percentage
	$1.49	54.55
	$4.59	25.08
	$7.49	20.37
Breading Color	**Level**	**Percentage**
	Light	24.68
	Medium	49.03
	Dark	26.30
Country of Origin	**Level**	**Percentage**
	China	20.86
	U.S.	79.14
Cooking Method	**Level**	**Percentage**
	Deep Fried	42.13
	Oven Baked	57.87

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