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Potential Consumer Acceptance of Canned Bighead Carp: A Structural Model Analysis

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Abstract *The effects of socio-demographic factors on consumer ratings of product attributes of an experimental canned bighead product were analyzed. OLS techniques were used to evaluate the effects of experience consuming other canned fish products, race, gender, age, and income on the taste, texture, appearance, and aroma of canned bighead. A logit analysis was then used to measure the effects of these variables on binary choice variables related to preference comparisons and willingness-to-pay as much for canned bighead as for canned salmon and canned tuna. Responses between the comparisons of canned bighead and canned salmon or canned tuna varied. Income, region, and gender significantly affected ratings on product attributes while taste variables significantly affected consumers' willingness-to-pay as much for canned bighead as for canned tuna. Conditional probabilities showed more clearly the effects of age, income, and gender on taste ratings, the subsequent effects of taste on preferences, and ultimately on willingness-to-pay. Probabilities estimated showed that canned bighead competes more favorably with canned tuna than with canned salmon.*

Keywords consumer preferences, structural model analysis, logit, marketing, aquaculture

Introduction

Bighead carp (*Hypophthalmicthys nobilis*) have been raised in Arkansas in polyculture with catfish in commercial fish ponds in an attempt to improve water quality since the 1970s. Although other countries (particularly in Asia) have established markets for this freshwater fish, it has not been marketed on a wide scale in the United States. Arkansas fish farmers have sold bighead to livehaulers for re-sale in Asian ethnic markets in the United States as a live product. However, the limited volume of the ethnic market has resulted in wide fluctuations of the market price for live bighead. A higher-volume market outlet, such as a cannery, would provide stability and a constant market for bighead. Yet little is known about potential consumer acceptance of such a product.

The largest increases in seafood consumption across the United States in recent years have been in fresh and frozen fish and seafood, but consumption of canned fish products continues at high levels and has increased among several market segments (Keithly and Prochaska, 1987). Canned seafood is consumed by more households (31.7%) than other fish and seafood forms. Canned fish, partic-

ularly tuna, has constituted a steady proportion of the diet of U.S. consumers. In 1987, the U.S. imported 10.8 million standard cases (105,000 tons) of canned tuna (Parks *et al.*, 1990).

Descriptive analyses of consumer acceptance and preferences has been used to evaluate consumer attitudes toward aquaculture products. Nationwide telephone survey data were used to assess consumer attitudes towards farm-raised catfish (Engle *et al.*, 1990; Engle *et al.*, 1991) and crawfish (Dellenbarger, 1989). Household (McGee *et al.*, 1989), grocery store (Hatch *et al.*, 1990) and restaurant surveys (Pomeroy and Nyankori, 1990) provided data on buyer attitudes and preferences at different marketing levels. The linkages among advertising, recall, attitudes and catfish consumption based on a consumer survey were analyzed (Kinnucan and Venkateswaran, 1990). Local restaurant and grocery sales of fish and seafood have been studied (Swinton *et al.*, 1987), and local marketing alternatives and strategies have been developed (Engle *et al.*, 1988; Jolly and Engle, 1988). While these studies have been informative, questions regarding consumer acceptance of a new fish product still need to be addressed.

Early marketing studies (Crawford *et al.*, 1978; Engle, 1978; Engle, 1992) demonstrated that fresh bighead carp was readily accepted by consumers for its taste but was too bony to be acceptable to a wide range of consumers. Since the canning process softens bones, a canned product has the potential to take advantage of the taste and circumvent the problem of bones. Canned silver carp (*Hypophthalmichthys molitrix*), which is closely related to bighead carp, were prepared, tested and evaluated in various sauces (Woodruff, 1978). Consumer acceptance ratings were positive.

Choice models have been used to analyze the influence of income and sociodemographic factors on consumer ratings of organic versus conventional produce (Groff *et al.*, 1993), household expenditures for fresh vegetables (Capps and Love, 1983) and for at-home consumption of seafood (Cheng and Capps, 1988). Olowolayemo et al. (1992) used logit analysis to assess potential U.S. retail grocery markets for farm-raised catfish while Pomeroy et al. (1990) assessed the likelihood of restaurants adding catfish to their menu.

There has been increasing attention paid to the structure of consumer preferences for fish and seafood. Kinnucan *et al.* (1993) used the concept of an "evoked set" to evaluate the structure of U.S. preferences for fish and seafood. Conjoint analysis has been applied to the market for aquacultural products (Anderson, 1987; Anderson and Bettencourt, 1991) and was used to examine the structure of buyer preferences toward farm-raised hybrid striped bass at the wholesale, retail, and restaurant levels (Halbrendt *et al.*, 1991).

The general objective of this study was to evaluate potential consumer acceptance of canned bighead carp. Specific objectives were to: 1) determine the overall probabilities and marginal demographic effects for consumer ratings of canned bighead carp and 2) determine the importance of various factors in consumer purchasing decisions that may affect purchase intentions towards canned bighead carp.

Conceptual Framework

Attitudes are important in marketing decisions because of the assumed relationship between attitudes and behavior. Attitudes are typically represented as a

series of sequential components leading to behavior. However, research evidence indicates that the link between attitudes and behavior is not simplistic. Attitudes are only one influence on behavior.

Theory of buyer behavior suggests that a hierarchy of response leads from evaluative criteria (product attributes) to beliefs, and attitudes that affect purchase intentions and ultimately result in a decision to purchase a product (Ajzen and Fishbein, 1980; Fishbein, 1963; Holbrook, 1979). Evaluative criteria include product attributes such as taste, texture, appearance, aroma and cost. Beliefs represent a cognitive element of awareness and knowledge. Attitudes reflect an affective component that comprises the respondent's liking or preference for an object or phenomenon. Attitudes are based on beliefs, and they affect purchase intentions and ultimately the decision to purchase a product. Socioeconomic and demographic characteristics affect and may determine beliefs and are critical in assessing marketing opportunities for new products.

Figure 1 illustrates the linkages between product attributes such as taste, texture, appearance, and aroma with product preferences and finally with purchase decisions. Positive ratings on product attributes would be expected to be reflected in positive product preferences which, in turn, would be expected to positively affect purchase decisions.

Model

Potential consumer acceptance of a product is not the same for all individuals. Consumers' reactions to specific product attributes may vary according to house-

Figure 1. A Simplified Structural Model of Consumer Choice.

hold income as well as socio-demographic factors. The effects of these factors on consumers' ratings of attributes and comparisons with other similar types of products should be considered simultaneously. Models that account for product attributes as well as socioeconomic factors were developed.

The following models were estimated:

$$A_i = f(Z_t); \quad \begin{matrix} i = 1 \ldots 4 \\ t = 1 \ldots n \end{matrix} \tag{1}$$

$$B_i = g(A, Z_t) \tag{2}$$

$$C_i = h(A, B, Z_t) \tag{3}$$

where A is the ranking of each of the four product attributes (taste, texture, appearance, aroma); B is the preference for bighead carp relative to other canned fish products; C is willingness-to-pay for bighead carp relative to other canned fish products, and Z_t are vectors of socioeconomic variables.

Each of the three equations was estimated separately. OLS techniques were used to estimate Equation (1) for each of the four attributes (taste, texture, appearance, and aroma) as well as experience in terms of consuming other types of canned fish products and frequency of consumption of canned fish products. However, because B and C are binary choice variables, OLS techniques would not produce consistent estimates. Due to the nature of the problem at hand, logit techniques were used to estimate Equations (2) and (3).

Equation (1) was used to estimate the effect on each of the four attributes of the following sociodemographic factors: experience in consuming various types of canned fish products, frequency of consumption of canned fish products, race, sex, age, income, and region. Equation 2 was used to analyze the influence of both the product attributes and socio-demographic factors on whether or not respondents considered canned bighead to be better than or equal to canned salmon and canned tuna. Similarly, Equation (3) was used to examine effects of these variables on respondents' willingness to pay the same price for canned bighead as for canned salmon and for canned tuna.

The logit model, which uses the cumulative logistic probability function (Pindyck and Rubinfeld, 1981), can be designated by:

$$P_i = F(Z_i) = \frac{1}{1 + e^{-z_i}} \tag{4}$$

where:

P_i = probability that the individual will make a certain choice
Z_i = $a + X_i'B$, which is an index determined by X_i' (vector of sociodemographic vectors) and B (vector of the logit coefficients associated with the sociodemographics' vector X_i')
e = base of the natural logarithm

Equation (4) is estimated as:

$$\log \frac{P_i}{1 - P_i} = Z_i = X_i'B \tag{5}$$

Since Equation (3) included all variables, its mathematical form alone is described below:

$$\begin{aligned}\log \frac{P_i}{1 - P_i} = {} & \beta_0 + \beta_1(TASTE) + \beta_2(TEXT) + \beta_3(APPEAR) + \beta_4(AROMA) \\ & + \beta_5(SALMBET) + \beta_6(TUNABET) + \beta_7(EXPTUNA) \\ & + \beta_8(EXPMACK) + \beta_9(EXPSALM) + \beta_{10}(EXPSARD) \\ & + \beta_{11}(RACE) + \beta_{12}(SEX) + \beta_{13}(AGE) + \beta_{14}(INCOME) \\ & + \beta_{15}(METRO) + \beta_{16}(DELTAR) + \beta_{17}(HIGH) + V_i\end{aligned} \tag{6}$$

The variable names and notations are shown in Table 1. For both Equations (2) and (3), separate models were estimated for comparisons with canned salmon and canned tuna.

Coefficients reflect the effect of a change in the independent variable upon:

$$\log \frac{P_i}{1 - P_i} \tag{7}$$

The sign associated with the β coefficient can be interpreted as directly influencing the dependent variable, but probabilities are calculated by substituting values derived from regression equation (6) into Equation (4).

Conditional probabilities were calculated for willingness-to-pay responses given the effects of significant variables on consumer preferences. Equation (4) estimated unconditional probabilities for each equation. Conditional probabilities were calculated as:

$$P(R) \mid E = \frac{P(R \cap E)}{P(E)} \tag{8}$$

where P = probability
R = willingness to pay
E = preferences

Results of the preference models were used in the willingness-to-pay equations to trace the effect of preferences.

The following variables were expected to affect positively ratings on taste, texture, appearance, and aroma: experience consuming tuna and salmon, age, female, white, and living in the Delta region. Income levels and other regions were expected to negatively affect these attribute ratings. In the logit models, it was hypothesized that attribute ratings (particularly taste), experience consuming tuna and salmon, female, white, age and delta regions would positively affect probabilities of preferences and willingness-to-pay as much for canned bighead as for canned salmon and tuna. It was further expected that income and other regions would negatively affect probabilities.

Table 1
Explanatory Variables Used in the Analysis

Variable Name	Description	Mean	Range
Product Attributes			
TASTE	Ranking of taste	4.1	1–5
TEXT	Ranking of texture	4.2	1–5
APPEAR	Ranking of appearance	4.5	1–5
AROMA	Ranking of aroma	4.1	1–5
Comparisons W/Other Canned Fish Products			
SALMBET	1 if rated as better than or equal to canned salmon	0.72	0–1
TUNABET	1 if rated as better than or equal to canned tuna	0.77	0–1
Willingness-To-Pay			
SALMWILL	1 if willing to pay as much as for canned salmon	0.58	0–1
TUNAWILL	1 if willing to pay as much as for canned tuna	0.84	0–1
Experience Consuming Other Canned Fish Products			
EXPTUNA	1 if consumes canned tuna, 0 otherwise	0.97	0–1
EXPMACK	1 if consumes canned mackerel, 0 otherwise	0.31	0–1
EXPSALM	1 if consumes canned salmon, 0 otherwise	0.88	0–1
EXPSARD	1 if consumes canned salmon, 0 otherwise	0.42	0–1
Consumption Frequency			
EXPFREQ	Number of times/mo consumes canned fish	2.65	0.5–24
Sociodemographic			
RACE	1 if black, 0 otherwise	0.16	0–1
SEX	1 if female, 0 otherwise	0.78	0–1
AGE	age of respondent	51.00	17–87
INCOME	household income level (in $10,000)	3.60	1–6
METRO	1 if resides in metropolitan region, 0 otherwise	0.37	0–1
DELTA	1 if resides in delta region, 0 otherwise	0.19	0–1
HIGH	1 if resides in highland region, 0 otherwise	0.20	0–1

Data

Preference tests were conducted to assess consumer attitudes and preferences to the taste, texture, appearance and aroma of canned bighead carp. Product evaluations were conducted with panels of consumers assembled via a modified informal quota sampling procedure.

Bighead carp ranging in size from 8 to 12 lb (3.6 to 5.4 kg) were canned in 16-ounce cans at the Food Science Laboratory located at the Agricultural Experiment Station in Fayetteville, Arkansas. The product was canned in water with no other additives.

A structured direct questionnaire was designed to elicit information on the respondents' preferences for canned fish products. Pilot tests of the questionnaire were conducted in two locations in Pine Bluff with different demographic representations. A three-category ordinal scale was used to evaluate responses comparing canned bighead to other canned fish products. Responses on whether respondents would be willing to pay the same amount for canned bighead and

other canned fish products currently on the market also were evaluated. Respondents' rankings of attributes, taste, texture, appearance and aroma, were based on a five-category, modified, stapel, interval scale (Kinnear and Taylor, 1983).

The study sample consisted of 19 counties across Arkansas with an average of 25 respondents per county and a total of 471 respondents. The counties were selected to represent demographic differences in the state. The 19 counties involved in the survey were divided into four regions: Metropolitan, Delta, Coastal Plains and Highland (Arnold *et al.*, 1989).

At each sample site, a sign stating that a new freshwater canned fish product was being tested for consumer acceptance was displayed. The respondents were told only that they were testing the new product's appeal. No questions about the type of fish were answered until all participants had completed the questionnaire. This was done to avoid any bias that would result from the name bighead carp. For further detail on data collection and descriptive analysis, see Thomas and Engle (1995).

Results

OLS Model Estimates

Table 2 presents the OLS regression estimates for the models estimated for each of the four attributes (taste, texture, appearance, and aroma). Signs of the coefficients, in general, were as expected. Significant coefficients were identified for the gender, age, income, and regional variables.

Coefficients for the socio-demographic variables of female and age were positive for all four attribute models (except for the texture model), but were negative for the income variable in all attribute models, as expected. For the regional variables, the sign of the variable for the metropolitan region was negative in all attribute models, and significant in the taste, texture, and aroma models. The highland region variable was negative in all models and significant in the texture and aroma models. Likewise, the coefficient for the delta region was negative for the texture, appearance, and aroma models, but positive in the taste model. None of the delta region coefficients were significant.

These results support evidence by Keithly and Prochaska (1987) who showed that factors including white, female and older had a significantly positive effect on weekly expenditures on canned seafood products. In this study, older white females tended to rate the canned bighead higher than did other categories of consumers. Fresh fish has been shown to be income elastic; these results show that higher income households tended to rate canned bighead lower on product attributes than did lower income households. Overall, living in the metropolitan and highland regions negatively affected ratings of taste, texture, appearance, and aroma. It is interesting to note that experience consuming salmon negatively affected ratings, particularly those on aroma.

Logit Model Estimates

Preference Comparisons. Table 3 presents results of the logit regression models for respondents' preference comparisons (better than or equal to) to canned

Table 2
OLS Estimates of Taste, Texture, Appearance, and Aroma

	Taste		Texture		Appearance		Aroma	
Variable	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio	Coef.	t-ratio
EXPTUNA	.326	.758	.976E-3	.24E-2	.441	1.278	.447	1.051
EXPMACK	−.173	−.963	.114	.678	−.496E-1	−.343	.911E-1	.512
EXPSALM	−.144	−.616	−.218	−.1002	−.196	−1.045	−.502	−.2173*[a]
EXPSARD	.113	.701	.175E-2	.116E-1	.112	.860	.106	.665
EXPFREQ	.104E-1	.422	.153	.666	−.128	−.643E-1	−.137	−.560
RACE	−.136	−.756	−.202	−1.207	−.994E-1	−.690	−.149	−.837
SEX	.287	1.489**[b]	.252	1.403**	.196	1.268	.274	1.441**
AGE	.366E-2	.640	−.374E-3	−.702E-1	.266E-2	.579	.101E-1	1.786*
INCOME	−.721E-1	−1.394**	−.102E-2	−.213E-1	−.612E-1	−1.473*	−.249E-1	−.487
METRO	−.496	−2.562*	−.458	−2.542*	−.128	−.824	−.417	−2.178*
DELTA	.191	.862	−.980	−.474	−.220	−1.235	−.204	−.931
HIGH	−.241	−1.080	−.433	−2.087*	−.226	−1.264	−.350	−1.587**
Constant	3.976	6.936*	4.447	8.332*	4.302	9.343*	3.769	6.647*
R^2	.100		.064		.057		.082	

[a] Asterisk indicates significant at 0.05 level.
[b] Double asterisk indicates significant at 0.10 level.

salmon and canned tuna. The variables on taste, texture, and the variables indicating consumption of canned tuna, canned salmon, and canned sardines, along with the age variable were significant.

Most of the signs of the coefficients were as expected, but the product attribute variable coefficients differed between the models comparing preferences of bighead carp to salmon and to tuna. For example, texture was significant in the salmon, but not in the tuna model. Aroma was the only attribute variable that was not significant in either model. However, the taste variable was significant and positive in both models. As Kinnucan and Venkateswaran (1990) have shown, taste is a critical factor in determining attitudes and purchase decisions.

Several of the variables related to previous consumption of canned fish were significant. In the salmon model, experience with canned tuna and salmon were significant although with opposite signs. However, in the tuna model, only sardine experience was significant and positive. Salmon is a distinctively-flavored fish

Table 3
Maximum Likelihood Estimates of the Logit Model of the Likelihood that Consumers Would Consider Canned Bighead Carp Better than or Equal to Canned Salmon and Canned Tuna

	Compared to Canned Salmon		Compared to Canned Tuna	
Variable	Coefficient	Asymptotic t-ratio	Coefficient	Asymptotic t-ratio
TASTE	0.672	2.876*[a]	1.284	4.509*
TEXT	0.731	2.691*	−0.497E-1	−0.161
APPEAR	0.313	0.968	0.505	1.383**[b]
AROMA	−0.812E-1	−0.310	0.280E-1	0.949E-1
EXPTUNA	2.866	2.416*	−29.341	−0.16E-3
EXPMACK	−0.229E-2	−0.466E-2	0.704	1.145
EXPSALM	−1.901	−2.238*	0.786	1.266
EXPSARD	0.106	0.249	0.916	1.765*
EXPFREQ	−0.709E-1	−1.086	−0.104	−1.249
RACE	0.267	0.550	−0.577	−1.056
SEX	−0.161	−0.314	−0.328	−0.588
AGE	0.830E-2	0.516	0.385E-1	2.156*
INCOME	−0.113E-1	−0.771E-1	0.153	0.885
METRO	−0.677E-1	−0.135	0.477	0.838
DELTA	0.611	0.925	0.544	0.748
HIGH	0.348	0.569	−0.996E-1	−0.154
CONSTANT	−7.070	−3.069*	20.105	0.110E-3
N = 196				
Likelihood Ratio Test	59.751 with 16 d.f.		71.696 with 16 d.f.	
McFaddens R^2	0.259		0.306	
Pct. of Right Predictions	80.612		85.714	

[a] Asterisk indicates significant at 0.05 level.
[b] Double asterisk indicates significant at 0.10 level.

product while the canned bighead had a very mild or bland flavor that favors tuna-style preparations more than those used for salmon.

Most of the socio-demographic variables were not significant. The only exception was the positive coefficient of the age variable in the bighead-tuna comparison model.

Willingness-to-pay Comparisons. Table 4 presents the bighead-salmon and bighead-tuna willingness-to-pay comparisons. Signs were generally as expected and the coefficients for taste, preference comparison, experience consuming salmon and living in the delta region were significant.

The taste variable has a significant and positive effect on consumers' willingness to pay as much for canned bighead carp as for canned tuna. The variable of

Table 4
Maximum Likelihood Estimates of the Logit Model of the Likelihood that Consumers Would be Willing to Pay as Much or More for Canned Bighead Carp as for Canned Salmon and Canned Tuna

	Compared to Canned Salmon		Compared to Canned Tuna	
Variable	Coefficient	Asymptotic t-ratio	Coefficient	Asymptotic t-ratio
TASTE	−0.807E-1	−0.311	0.715	2.205*[a]
TEXT	0.980E-1	0.367	0.301	0.873
APPEAR	0.996E-1	0.313	0.138	0.360
AROMA	0.103	0.423	−0.188	−0.623
SALMBET	2.349	4.770*	0.142	0.236
TUNABET	0.714E-1	0.133	2.205	3.320*
EXPTUNA	1.496	1.078	−26.274	−0.111E-3
EXPMACK	0.505	1.134	0.824E-1	0.119
EXPSALM	−0.922	−1.506**[b]	0.134	0.173
EXPSARD	0.114	0.278	0.326	0.533
EXPFREQ	0.606E-1	0.912	0.272E-1	0.371
RACE	−0.239	−0.546	.703	0.819
SEX	0.466	0.976	−0.172	−0.269
AGE	0.165E-1	1.193	−0.120E-1	−0.486
INCOME	−0.704E-2	−0.54E-1	−0.848E-1	−0.428
METRO	0.482	1.019	0.596	0.855
DELTA	1.03	1.85*	−0.518	−0.302
HIGH	0.328	0.610	−0.115	−0.146
CONSTANT	−4.959	−2.256*	23.300	.990E-3
N = 196				
Likelihood Ratio Test	63.950 W/18 D.F.		62.053 with 18 d.f.	
McFaddens R^2	0.240		0.363	
Pct. of Right Predictions	77.551		90.816	

[a] Asterisk indicates significant at 0.05 level.
[b] Double asterisk indicates significant at 0.10 level.

preference response comparing bighead to tuna was also significant and positive in the tuna model. Therefore, taste and preference ratings had direct effects on consumers' willingness-to-pay. Since age, experience with other canned fish, taste, and appearance significantly affected preference ratings in the tuna model, these variables have an indirect effect on willingness-to-pay as much for canned bighead as for canned tuna. Likewise, since taste ratings were affected by gender, income and living in the metropolitan region, these variables indirectly affect willingness to pay through their effect on taste.

In the salmon model, the preference ratings for salmon had a significant and positive effect; experience consuming salmon had a significant, but negative effect while living in the Delta region had a significant and positive effect. The taste, texture, and experience consuming salmon and tuna variables indirectly affected willingness-to-pay for canned bighead through their effect on preference ratings. Taste, again, was affected by gender, income, and living in the metropolitan region, while texture ratings were affected by gender and by living in the metropolitan and highland regions. These variables had indirect effects on willingness-to-pay for bighead carp by operating through the perception variables taste and texture.

Probability Estimation

Table 5 presents both unconditional and conditional probabilities associated with consumers' willingness-to-pay as much for canned bighead carp as for canned tuna and canned salmon. In this table, the conditional probabilities are conditional upon the preference comparisons with tuna given different age levels (age was a significant variable in the tuna preference model). In the salmon preference models, experience with other canned fish products was significant and the conditional probabilities are calculated given the preferences associated with the experience variables as calculated from Equation (2).

In Table 5, unconditional probabilities were higher than conditional probabilities, but only slightly. Inclusion of preference values into the willingness-to-pay

Table 5
Unconditional and Conditional Probabilities Associated with Consumers' Willingness-to-Pay as Much for Canned Bighead Carp as for Canned Tuna and Canned Salmon

Sociodemographic Characteristic	Preferences (unconditional)	Willingness-To-Pay	
		Unconditional	Conditional
Tuna Model			
Young	.60	.97	.95
Middle-aged	.80	.96	.95
Old	.91	.95	.94
Salmon Model			
Experience w/salmon	.11	.05	0
Experience w/tuna	.94	.37	.33
Experience w/salmon & tuna	.68	.19	0

probabilities did not drastically alter the willingness-to-pay probabilities. Taste was the most significant variable affecting preference comparisons for both canned salmon and canned tuna. Gender and income were significant determinants of taste; yet the effects of both the variables affecting taste and the effect of taste ratings on preferences were not included in the above probabilities.

Table 6 presents conditional and unconditional probabilities of willingness-to-pay as much for canned bighead as for canned salmon given taste ratings and gender effects on those taste ratings. The conditional willingness-to-pay probabilities were lower than the unconditional probabilities as well as the preference probabilities. However, at the higher taste ratings, probabilities were similar. At the lower taste ratings, the conditional probability of females with a taste rating of 1 was 0.34 while the unconditional probability was 0.58. One would expect that those who rate this product at the lowest possible score on taste would also have lower probabilities of being willing to pay for it and the conditional probabilities demonstrate this. The unconditional probability of 0.58 is higher than what would be expected for a taste rating of 1. Thus, probabilities that take into account the effects of sociodemographic variables on taste and its effect on preferences and then on willingness-to-pay appear to have greater intuitive appeal.

Willingness-to-pay probabilities were lower for males than for females, Table 6. The difference was greater at lower levels of taste ratings. Gender effects on taste were significant and these differences are reflected in the conditional probabilities.

Figure 2 presents conditional and unconditional probabilities of willingness-to-pay for canned tuna given both age and taste ratings. Clearly, older individuals who rated it 3 or higher were more likely to be willing to pay as much for canned bighead as for canned tuna. Younger respondents who rated it 3 or below had extremely low probabilities.

The conditional probabilities showed more clearly the effect of age on taste; its subsequent effect on preferences; and, ultimately, on willingness-to-pay. Unconditional probabilities were similar to conditional probabilities at high taste ratings, but much higher at low taste ratings than the conditional probabilities. At low taste ratings, low probabilities of willingness-to-pay would be expected. Thus,

Table 6
Conditional and Unconditional Probabilities of Willingness-to-Pay as Much for Canned Bighead as for Canned Salmon Given Gender and Taste Determinants of Preferences

	Taste Ranking				
	5	4	3	2	1
Female					
Preference	.96	.93	.87	.78	.64
Willingness (unconditional)	.94	.89	.82	.71	.58
Willingness (conditional)	.94	.88	.79	.63	.34
Male					
Preference	.97	.94	.89	.80	.68
Willingness (unconditional)	.91	.86	.77	.65	.50
Willingness (conditional)	.91	.85	.74	.56	.26

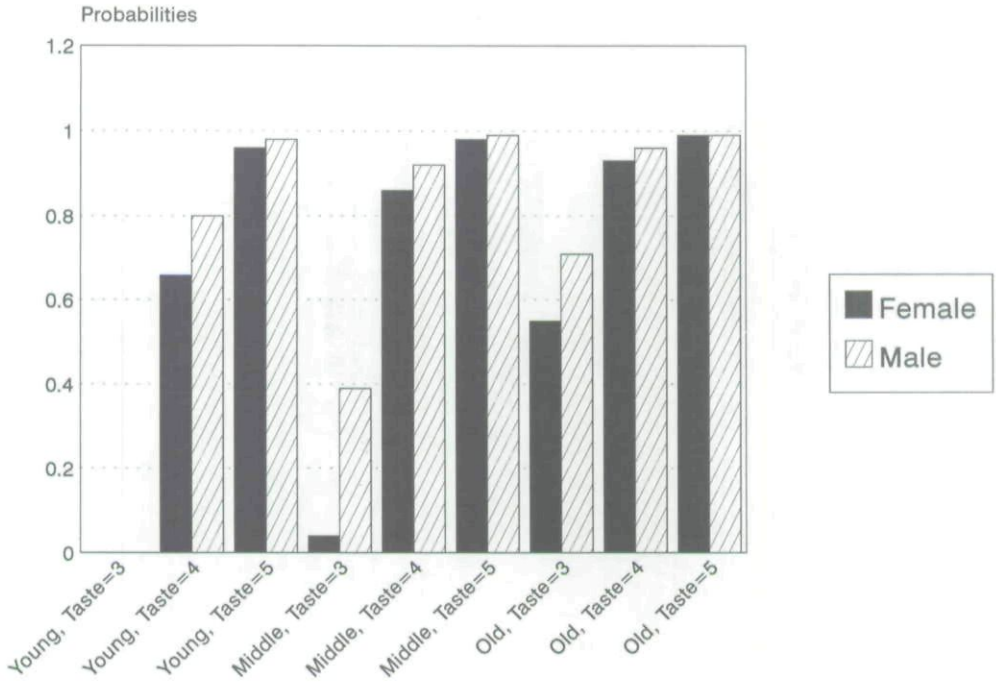

Figure 2. Willingness-to-pay conditional probabilities given gender and age effects on preferences for canned bighead as compared to canned tuna.

unconditional probabilities appear to be overestimated by not taking into account the indirect effects on willingness-to-pay of sociodemographic variables.

Figure 3 presents similar results for conditional and unconditional probabilities for age groups, income levels, and taste ratings for willingness-to-pay as much for canned bighead as for canned tuna. Again, the importance of taste is clear. Willingness-to-pay probabilities increased two to ten-fold as taste scores increased from three to five. Taste ratings were relatively more important to probabilities of younger people being willing-to-pay as much for canned bighead carp as for canned tuna, than for older people. For example, for young people of low income, probabilities increased from 0 to 0.95 for low-income young people, but from 0.64 to 0.99 for older respondents, as taste ratings increased from 3 to 5.

Probabilities increased with income levels. Changes were most notable at taste ratings of 3 and 4. For example, for middle-aged respondents, the probability of being willing to pay as much for canned bighead as for canned tuna was 0 at a taste rating of 3 at the lowest income level, but 0.26 at the highest income level. Likewise, for older respondents, probabilities increased from 0.42 to 0.63 from the lowest to the highest income category, at a taste rating of 3.

Conclusions

This study provides insight into the effect of socio-demographic factors on consumer acceptance of new fish products like canned bighead. Responses varied between comparisons of canned bighead and either canned salmon or canned tuna. In general, probabilities estimated showed that canned bighead competes more favorably with canned tuna than with canned salmon.

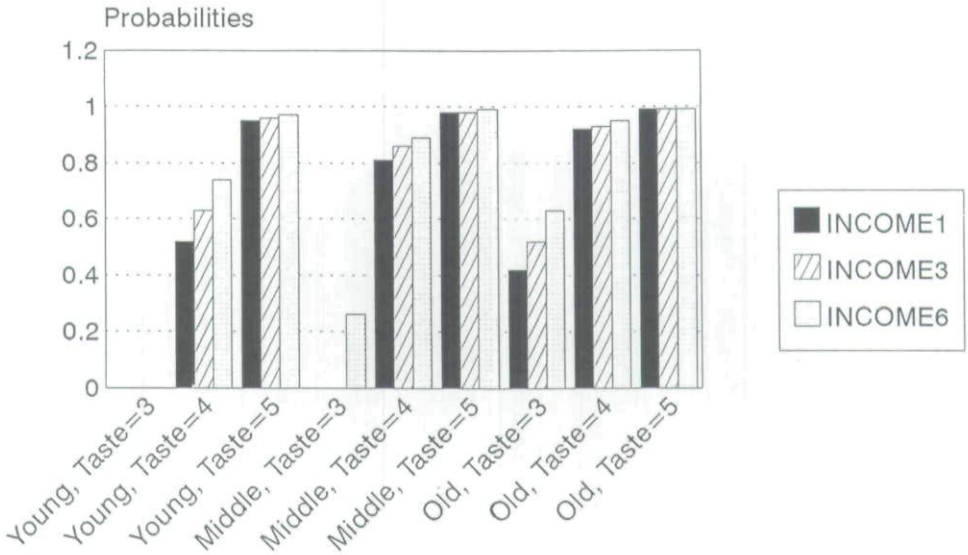

Figure 3. Conditional probabilities given income and age effects on preferences for canned bighead as compared to canned tuna.

Income, region, and gender significantly affected ratings on various product attributes and taste variables significantly affected consumers' willingness-to-pay as much for canned bighead as for canned tuna. Conditional probabilities showed more clearly the effects of age, income, and gender on taste ratings and the subsequent effects of taste on preferences and ultimately on willingness-to-pay. The sociodemographic variables affected willingness-to-pay indirectly through effects on taste and the effect of taste on preferences.

Efforts to develop product concepts for this type of product should focus on a tuna-style type of preparation. Product taste should be emphasized and primary targets should be female shoppers. While preliminary cost estimates indicate that prices of canned bighead carp could be competitive with those of canned tuna and canned salmon, additional cost analysis is needed on different forms of canned products.

This study is limited to responses from Arkansas households alone. However, the metropolitan region is the Little Rock area that is relatively cosmopolitan when compared with the other, highly rural, regions of Arkansas. Additional research is needed in other regions of the country as well as on refining product concepts.

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