Factors Affecting Consumer Choice of Canned Fish in Taiwan

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Abstract. Survey data on the choice of canned fish were analyzed through stepwise logistic regression. Those who lived in northern Taiwan, those who paid more attention to food taste, those who preferred to eat fish, those who liked to eat sour food, those who liked to eat bitter gourds, those employed in manual labor, and those who paid more attention to food content and ingredient had higher odds of eating canned fish, while those who believed in the religion of Yi-Guan-Daoism, those who paid greater attention to food nutrition, and females had lower odds of eating canned fish. To promote the development of canned fish, the taste and nutrition attributes of the products should be strengthened, especially in markets targeted at females.

Keywords: consumer choice, canned fish, logistic regression, food attributes, consumer preference, demographic factors.

1. PRELIMINARY

Fish are caught and then transported to market in fresh or frozen type products. Since fresh fish is biodegradable and perishable, fish often disperse a special odor. Processing may make the fish products more presentable in terms of good smell and taste. Canned fish is one kind of processed fish products. Compared to frozen, dehydrated, or other preserved products, canned products have the longest storage period. Usually made under high temperature (more than 123°C) and lasting for more than 23 minutes of commercial sterilization, canned fish can be stored and transported and sold for 2 to 3 years into the future. During the process of sterilization, fish must be well cooked to have the fish bone be edible. However, the period of high temperature may destroy vitamins in the original fish body and thus lose some nutrition value. On the other hand, the edible fish bone may increase the digestible fish bone, and thus increase the absorbable amount of calcium for consumers.

In this study, factors affecting consumer choice of canned fish in Taiwan were analyzed. The Food Industry Research and Development Institute (FIRDI) in Taiwan obtained the data in a national survey during January and February 1999.

2. DATA AND METHODOLOGY

2.1 Data

For the dependent variables of canned fish consumption, questions of whether one used/chose canned fish or not in the last year, whether one used/chose canned fish in the last month or not, and how many times the consumer used/chose canned fish in the last month were posed in the questionnaire. The dependent variables were thus developed, based on binary, or yes/no, responses.

As to the explanatory variables, demographic factors and consumer preferences for perceived food attributes and for fish were tested. The variables are listed in Table 2 and the paper, "Factors Affecting Consumer Preferences for Fish in Taiwan".

The sample size was 1200. However, since there were missing values in some samples, the number of useable observation was reduced to 1150 in the stepwise logistic regression.

2.2 Methodology

To explore the factors affecting the choice of canned fish, the study used all surveyed variables of demographic factors and consumer preferences for food attributes. Nine kinds of food attributes and 12 kinds of demographic factors, which can totally be defined as 35 variables, were considered. We employed a stepwise regression process to select the variables significant in explaining consumer choice of canned fish in Taiwan.

By definition, the cumulative probability of events happening, which in this case represented the degree of frequency of choice of canned fish, can be expressed as:

$$\theta_{hi1} = \pi_{hi1} \tag{1}$$

$$\theta_{hi2} = \pi_{hi1} + \pi_{hi2} \tag{2}$$

$$\theta_{hi3} = \pi_{hi1} + \pi_{hi2} + \pi_{hi3} \quad (3)$$

$$\theta_{hi4} = \pi_{hi1} + \pi_{hi2} + \pi_{hi3} + \pi_{hi4} \quad (4)$$

$$\theta_{hi5} = \pi_{hi1} + \pi_{hi2} + \pi_{hi3} + \pi_{hi4} + \pi_{hi5} \quad (5)$$

where equation (1) denotes the probability of those who chose canned fish at least 13 times last month. Equation (2) denotes the probability of those who chose canned fish at least 9 times; equation (3) denotes the probability of those who chose canned fish at least 5 times; equation (4) of those who chose canned fish at least three times; and equation (5) of those who chose canned fish at least one time last month.

The probability of each subgroup can be computed as following:

$$\pi_{hi1} = \theta_{hi1} \quad (6)$$

$$\pi_{hi2} = \theta_{hi2} - \theta_{hi1} \quad (7)$$

$$\pi_{hi3} = \theta_{hi3} - \theta_{hi2} \quad (8)$$

$$\pi_{hi4} = \theta_{hi4} - \theta_{hi3} \quad (9)$$

$$\pi_{hi5} = \theta_{hi5} - \theta_{hi4} \quad (10)$$

$$\pi_{hi6} = 1 - \theta_{hi5} \quad (11)$$

where π_1 denotes the probability of those who chose canned fish at least 13 times last month, π_2 denoting the probability of those who chose canned fish 9-12 times last month, π_3 …, π_5 denotes the probability of those who chose canned fish 1-2 times, and π_6 denotes the probability of those who did not choose canned fish in the last month. The cumulative logit can then be computed as log odds of one group with choice response to those with non-choice response.

Since the data were collected through randomly stratified sampling, it was assumed that the data were at least conceptually representative of a stratified population. There were six ordinal levels for choice variable. Cumulative logit analyses were employed, such that the data had likelihood with the models:

$$\log it(\theta_{hik}) = \alpha_k + X_{hi}^{'}\beta_k \quad (12)$$

or

$$\log[\frac{\pi_{hi1}}{(\pi_{hi2} + \pi_{hi3} + \pi_{hi4} + \pi_{hi5} + \pi_{hi6})}] = \alpha_1 + X_{hi}^{'}\beta_1 \quad (13)$$

$$\log[\frac{(\pi_{hi1} + \pi_{hi2})}{(\pi_{hi3} + \pi_{hi4} + \pi_{hi5} + \pi_{hi6})}] = \alpha_2 + X_{hi}^{'}\beta_2 \quad (14)$$

$$\log[\frac{(\pi_{hi1} + \pi_{hi2} + \pi_{hi3})}{(\pi_{hi4} + \pi_{hi5} + \pi_{hi6})}] = \alpha_3 + X_{hi}^{'}\beta_3 \quad (15)$$

$$\log[\frac{(\pi_{hi1} + \pi_{hi2} + \pi_{hi3} + \pi_{hi4})}{(\pi_{hi5} + \pi_{hi6})}] = \alpha_4 + X_{hi}^{'}\beta_4 \quad (16)$$

$$\log[\frac{(\pi_{hi1} + \pi_{hi2} + \pi_{hi3} + \pi_{hi4} + \pi_{hi5})}{\pi_{hi6}}] = \alpha_5 + X_{hi}^{'}\beta_5 \quad (17)$$

While $X_{hi}^{'}$ is the matrix of independent variables, β_k is the vector of parameters estimated. Since the response levels were designed to be ordinal from 1 to 6 for the choice of last month, the higher level was associated with higher degree of choice of canned fish. Proportional odds among all type of choice were assumed for the multiple- response model. That is, $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5$ (i.e., $\beta_k = \beta$ for all k). Then the models were simplified to

$$\log it(\theta_{hik}) = \alpha_k + X_{hi}^{'}\beta \quad (18)$$

To identify the multiple response models, a stepwise process was employed. Score χ^2 was used as the entry criterion to include new variables in the model (Stockes et al. 1995). A 0.05 significance level was used to select the entry variable. The score test was used to test the proportional odds assumption. The model fitting information and testing global null hypothesis $\beta = 0$ such as Chi-square for covariates in the criterion of likelihood –2 log L, Chi-square for covariates of score, and residual Chi-square were used.

For valid proportional odds, the score test should show insignificant. For a valid model fitting, the Chi-square for covariates in the criterion of likelihood –2 log L, and in the criterion of score, should be significant, while residual Chi-square should not be rejected at a 5% significance level (Stockes et al. 1995).

If the proportional odds assumption was not valid, the binary response model for each logit might be applied.

The levels of response were thus regrouped to fit into the models of equations (13) to (16), which were treated as binary response models. The justification of identified model was the same as that of multiple-response model, except that there was no need to test the proportional odds assumption. However, Hosmer and Lemeshow goodness-fit test was used to judge the model instead of the residual chi-square, which was used in multiple-response model (Stockes et al. 1995).

3. EMPIRICAL RESULTS

3.1 Description of Sample Data

It was found that 68.1% of consumer respondents had eaten canned fish in the last month in Taiwan (Table 1).

Table 1. Frequency of Choice of Canned Fish Last Month

Frequency	Count	Percent	Cumulative Percent	Cumulative Percent
None	372	31.85	31.85	100.00
1-2 times	152	13.01	44.86	68.15
3-4 times	409	35.02	79.88	55.14
5-8 times	173	14.81	94.69	20.12
9-12 times	44	3.77	98.46	5.31
13 or more	18	1.54	100.00	1.54
Total response	1178			

The results of independent tests are shown in Table 2. Religion, preference for food attributes, and preference for fish were significant.

3.2 Binary Model for Choice of Canned Fish Last Year

Treating the choice of canned fish last year, the model of equation (18) can be applied. Three variables were identified to be significant in stepwise process. In step 3, the model fitting information and testing global null hypothesis $\beta=0$ with Chi-Square for covariates in criterion of score being 32.146 with 3 df (p=0.0001), and with residual Chi-Square=42.1428 with 40 df (p=0.3784). The Hosmer and Lemeshow goodness-of-fit test showed goodness-of-fit statistic = 6.0161 with 8 df (p=0.6454), supporting the adequacy of the model (Table 3). The identified model is shown in Table 4.

Table 2. Independent Tests of Choice of Canned Fish in Past Month with Respect to Socio-demographic Variables

Variable	χ	df	P-value	
Gender (female=1)	0.219	1	0.640	
Age	48.105	57	0.793	
Education	3.185	3	0.364	
Marital status				
Unmarried	1.142	1	0.285	
Married	0.779	1	0.377	
Divorced/widowed	0.297	1	0.586	
Personal income	1.586	8	0.694	
Personal food exp	6.343	6	0.386	
Family income	19.420	12	0.079	
Family food exp	10.655	13	0.640	
Family size	12.000	9	0.213	
Residing area				
Northern	0.076	1	0.782	
Middle	0.011	1	0.917	
Southern	0.175	1	0.676	
Eastern	0.004	1	0.949	
Occupation				
Housewife	0.010	1	0.921	
Chief	0.455	1	0.500	
Manual labor	2.095	1	0.148	
White collar	1.620	1	0.203	
Unemployed	0.117	1	0.732	
Student	0.023	1	0.879	
Religion				
Christian	0.003	1	0.957	
Buddhist	0.953	1	0.329	
Yi-Guan-Daoism	7.156	1	0.007	***
Daoism	0.210	1	0.647	
Other/none	0.477	1	0.490	
Food attribute				
Food sanitation	7.409	5	0.192	
Food nutrition	12.097	5	0.033	**
Food package	6.940	5	0.225	
Food quality	17.998	5	0.003	***
Food price	3.763	5	0.584	
Functionality of food	5.594	5	0.348	
Content & ingredient	5.115	5	0.402	
Food taste	16.418	5	0.006	***
Organic food	7.211	5	0.205	
Preference for fish	25.897	5	0.001	***

Note: ***: 1% significance level. **: 5% significance level.

Table 3. Summary of Stepwise Procedure for Entry to the Canned Fish Model – Past Year

Step	Variable entered	Score χ^2	P-value
1	Preference for fish	21.5686	0.0001
2	Food tastes	5.3082	0.0212
3	Food nutrition	5.2965	0.0214

Table 4. Parameter Estimates of Choice of Canned Fish Model – Past Year

Variable	Parameter Estimate	Std Error	Wald χ^2	P-value	Odds Ratio
INTERCP1	-0.4460	0.3754	1.4114	0.2348	.
Food nutrition	-0.1543	0.0672	5.2669	0.0217	0.857
Food taste	0.2002	0.0669	8.9645	0.0028	1.222
Preference for fish	0.2398	0.0568	17.8484	0.0001	1.271

For the canned fish model, those who paid more attention to food taste and those who preferred to eat fish had higher odds of eating canned fish. Conversely, those who paid more attention to food nutrition had lower odds of eating canned fish.

3.3 Models for Choice of Canned Fish in Past Month with Proportional Odds Assumption

Based on the model of equation (18), the stepwise process identified five significant explanatory variables. From step 1 to step 4, the p-values of score test for proportional odds assumption were larger than 0.05, which did support the proportional odds assumption. However, in step 5, the score test for the proportional odds assumption with Chi-Square = 32.1820 with 20 df (p=0.0414) does not support the proportional odds assumption at 5% significance level. The model fitting information and testing global null hypothesis $\beta=0$ with Chi-square for covariates in criterion of score being 43.651 with 5 df (p = 0.0001), and with residual Chi-Square = 36.4790 with 38 df (p = 0.5398) partly support the adequacy of the model (Table 5). The identified model is shown in Table 6.

Results of the test for canned fish in the past month were similar to prior findings in the past year model in that there were higher odds of eating canned fish for those who paid more attention to food taste and to those who preferred to eat fish, and that there were lower odds of eating canned fish for those who paid more attention to food nutrition. In addition, the multiple choice of canned fish in the past month model also indicated that those who live in northern Taiwan had higher odds ratios of eating canned fish, while those who believe in the religion of Yi-Guan-Daoism had lower odds of eating canned fish.

Table 5. Summary of Stepwise Procedure for Entry to the Multiple Response Model – Last Month

Step	Variable entered	Score χ^2	P-value
1	Food tastes	21.9864	0.0001
2	Preference for fish	9.2191	0.0024
3	Food nutrition	5.4609	0.0194
4	Yi-Guan-Daoism	4.0984	0.0429
5	Northern	4.0669	0.0437

Table 6. Parameter Estimates of Choice of Canned Fish Model in Past Month

Variable	Parameter Estimate	Std Error	Wald χ^2	P-value	Odds Ratio
INTERCP1	-5.5749	0.4083	186.4321	0.0001	.
INTERCP2	-4.2932	0.3564	145.1312	0.0001	.
INTERCP3	-2.7823	0.3374	67.9916	0.0001	.
INTERCP4	-1.1469	0.3288	12.1634	0.0005	.
INTERCP5	-0.5705	0.3276	3.0314	0.0817	.
Northern	0.2229	0.1092	4.1692	0.0412	1.250
Yi-Guan-Daoism	-0.7750	0.3843	4.0667	0.0437	0.461
Food nutrition	-0.1283	0.0563	5.1927	0.0227	0.880
Food taste	0.2625	0.0582	20.3751	0.0001	1.300
Preference for fish	0.1517	0.0500	9.1967	0.0024	1.164

3.4 Binary Models for Choice of Canned Fish Last Month

Since the proportional odds assumption was not valid at the 5% significance level, regrouping response level to be dichotomous and using binary response models were further considered necessary. Employing the model from equation (13) to equation (17), it was found that under 0.05 significance level, excepting the model of eq(15), all other four models were adequate (Table 7).

Based on equation (13), those who preferred to eat sour food had higher odds of eating canned fish at least 13 times during previous month. Based on the model of equation (14), those who paid more attention to food contents and ingredients had higher odds of eating canned fish at least 9 times during past month.

From results based on equation (15), those who lived in northern Taiwan, those who paid more attention to food tastes, and those who preferred to eat bitter gourds had higher odds of eating canned fish at least 5 times last month. From equation (16), those who lived in northern Taiwan, labored manually, paid more attention to food tastes, and/or preferred to eat fish had significantly higher odds of eating canned fish at least 3 times last month, while females and those who paid more attention to food nutrition demonstrated lower odds of eating canned fish at least 3 times last month.

From equation (17), those who paid more attention to food tastes and those who preferred to eat fish had higher odds of eating canned fish at least once in the past month, whereas those who paid more attention to food nutrition showed lower odds of eating canned fish at least once in the past month.

Table 7. Parameter Estimate and Odds Ratios for Each Binary Model – Last Month

Variable	Eq.(13)	Eq.(14)	Eq.(15)	Eq.(16)	Eq.(17)
Intercept	-5.9644	-4.6301	-3.2177	-0.8959	-0.5523
Northern			0.4339 <1.543>	0.3156 <1.371>	
Yi-Guan-Daoism					
Food nutrition				-0.1550 <0.856>	-0.1433 <0.866>
Food tastes			0.2690 <1.309>	0.2638 <1.302>	0.2095 <1.233>
Pref. for fish				0.1667 <1.181>	0.2337 <1.263>
Pref. for sour food	0.4797 <1.616>				
Content and ingredient		0.3807 <1.463>			
Pref. for bitter gourds			0.1042 <1.110>		
Female				-0.0085 <0.992>	
Manuel labor				0.3047 <1.356>	
Concord.	56.5%	46.0%	58.7%	60.9%	57.0%
P-value*	0.0712	0.2952	0.0431	0.3377	0.5618

Note: P-value* denotes the probability value of Hosmer and Lemeshow goodness-of-fit statistic. Odds ratios are included in < >.

3.5 Discussion

Comparing the binary and multiple-response models, preference for fish, food taste, and nutrition were all identified to affect the choice of canned fish. The effect of the religion of Yi-Guan-Daoism was identified to be significant in multiple-response models, but it was not significant in the binary models. While the effects of preference for sour food, preference for bitter gourds, gender, and manual labor were identified significantly influential in binary models, they were not significant in the multiple-variable model.

We found that females and those who paid more attention to food nutrition had lower odds of eating canned fish. Since females often play the role of food purchaser in their families, their actions importantly influence the sale of canned fish. Improving the image of canned fish, especially related to nutritional value and possibly convenience, could be very important in capturing a larger segment of consumers in this group. As calcium is important for females, we suggest that the promotion information of canned fish highlight the calcium-enriched attribute of canned fish products to attract female consumers to use more canned fish.

The fact that those who paid more attention to food contents and ingredients demonstrated higher odds of eating canned fish at least five times in the past month implied that canned fish had adequate labeling information. That is, consumers could readily know and relate what they were consuming in the products.

4. CONCLUSION

Survey data of the choice of canned fish were analyzed through stepwise logistic regression. It was found generally that those who lived in northern Taiwan, those who paid more attention to food taste, those who preferred to eat fish, those who liked to eat sour food, those who liked to eat bitter gourds, manual laborers, and/or those who paid more attention to food contents and ingredients had higher odds of eating more of canned fish. On the other hand, those who believe in the religion of Yi-Guan-Daoism, those who paid more attention to food nutrition, and/or female consumers had lower odds of eating canned fish.

That the choice of canned fish was positively associated with consumer preferences for fish, for taste, for sour food and bitter gourds, and for food content and ingredient indicates that consumers found these attributes more than satisfactory. However, the negative association with preferences for nutrition indicates that

canned fish is at least perceived as being less nutritious than other foods, which is consistent with the fact that canned fish has been cooked in high temperatures to meet the conditions of commercial sterilization, and, thus, loses some of the vitamins available in fresh fish. To encourage more people to eat more canned fish, the development of canned fish products should search for processes that improve the nutrition value of the products and should promote current and added values.

Those who paid more attention to food contents and ingredients have higher odds of eating canned fish at least five times past month. An implication from this response is that canned fish provide good labeling information for consumers. The higher the intensity of preference for fish and fish products expressed in the responses, the higher was the degree of choice of canned fish. Generic promotion to encourage more people to choose fish would likely increase the predilection of more people to eat canned fish.

An odds ratio larger than one in northern Taiwan indicates that residents in the north were more concentrated consumers of canned fish. Conversely, those who believe in the religion of Yi-Guan-Daoism ate less canned fish. In fact, those who believe in the religion of Yi-Guan-Daoism are vegetarian and do not eat animal meat, and thus consistent with expressed preferences.

Since females often play the role of food purchaser in a family, their actions are very important for the sale of canned fish. Encouraging females to have a better image of canned fish is thus very important. Because females may need calcium supplements, emphasizing the calcium value information of canned fish may help to increase the sale of canned fish in this segment of the market.

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