Factors Affecting Consumer Preferences for Fish in Taiwan

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Abstract. Stepwise logistic regression was used to explore consumption survey data to identify factors affecting consumer preference for fish in Taiwan. Most of the consumers responding prefer to eat fish, although the per capita consumption of fish was stagnant. Some demographic factors and consumer preference for food attributes were identified to affect preferences for fish. The older, white collar worker, those who believed in the religion of Daoism, those who paid more attention to food nutrition, to food taste, and/or to food quality had higher odds of preference for fish, while the unmarried, the female, those who believed in the religion of Yi-Guan-Daoism, those who lived in eastern, middle, or southern Taiwan had lower odds of preference for eating fish. The results implied that fish had an overall good perception in Taiwan. However, the fact that younger consumers and/or female consumers had lower odds in preference for fish implies a risk for future development. Further exploration of characteristics of food preference of these groups may be needed to illuminate information of marketing and product development for the fishery industry to further development.

Keywords: consumer preferences, fish, food attributes, demographic factors, Taiwan, logistic regression.

1. INTRODUCTION

Taiwan is an island with abundant of aquacultural and fishery products. Seafood was popular traditionally. The annual per capita fish and seafood supply increased from 32.55 kilograms (kg) in 1984 to a record of 48.71 kg in 1993. However, the per capita amounts were stagnant around 38 kg from 1994 to 1996 (Council of Agriculture, 1999a). There were 1332.4 thousand tonnes of seafood, with 920.5 thousand tonnes of fish, in production in 1997. The annual per capita consumption of fish was 23.57 kg, while per capita consumption of seafood was 42.35 kg. Comparing to other animal products -- per capita consumption of pork and poultry being 39.05 kg and 33.49 kg, respectively (Council of Agriculture, 1999b) -- fish was the third largest amount of consumption in animal products. Since there was less labor engaged in fishing and less production of fish in Taiwan, import of fish products increased. The annual per capita fish supply was around 23-25 kg. The consumption of fish was affected by the supply of fish, socio-demographic factors, and consumers' preferences for foods.

This study focuses on the exploration of factors affecting the preferences for fish. Since consumer choice of goods is affected by consumer preferences, endowments, prices, and other factors, the objective is to explore the relationship of these factors. Through the exploration of the influential factors and the status quo of consumer preferences, the preference for fish and the choice and consumption of fish may be explained.

We suggest that using the greatest amount of information available to explore these relationships will best illuminate the implications for the studied events. However, in a regression model, too many independent variables pooled together may incur the problem of multicollinearity and may generate many insignificant coefficients. To use personal judgment or to select variables based on references may not include those that were not considered in traditional approaches. With the development of social research, socio-demographic variables have been included in economic analyses to enrich models with not only the variables of price, quantity, and income, but also gender, age and other socio-demographic variables. To further explore consumer characteristics, consumer preference and degree of attention to food attributes were considered in this study. The theoretical inference is that consumers choose the attributes of foods to meet their demand for food. As food is consumed to maintain the healthy condition of life, food attributes may affect consumers' decisions on choices of food.

Among the choices of goods, consumers may select one instead of others based on the constraints of income. Goods may be substitute or complement as consumers choose them under the conditions of the changes of prices. However, among a list of preferred goods, consumers may show their preference ordering without consideration of income constraints. The preferences for some goods may be positively related to the preferences for other goods, although they may be substitutes in actual consumption. Under almost no consideration of endowment constraints, consumer preference for goods may be greatly affected by socio-demographic factors and only slightly affected by income, price and quantity, such as that included in traditional economic models. The preference for fish, especially, may be profoundly

affected by consumer preference for product attributes (and related products).

2. DATA AND METHODOLOGY

2.1 Data

The Food Industry Research and Development Institute (FIRDI) in Taiwan obtained data used in this study through a nationwide survey of food consumption from January to February 1999. The survey conducted a sampling of 1200 consumers based on the distributions of age and gender among 23 counties and cities in Taiwan. The interviewer searched the visited interviewee through going along the street or road, past three houses, and visited the fourth house to find a consumer with age and gender within the quota of sampling as interviewee. Then the interviewer went past three houses again and selected the next fourth house to find out a second consumer as interviewee, who was fitted to the designed sample qualification. After the sampling, each of the interviewees was asked to fill out the questionnaire within a mutually agreeable period. Then the interviewer returned to check the questionnaire and collect it. The questionnaire including the questions of whether there was a use/buy experience last year for each of the 188 kinds of processed foods, for each of 130 kinds of fresh agricultural foods, for each of 18 kinds of food channels. There were also 50 questions about the degree of attention to some kinds of life style, to some kinds of food attributes, to some kinds of food tastes, and how one liked to eat some kinds of foods. There were 14 demographic variables. A question related to the degree of like or dislike for eating fish was selected to serve as a dependent variable in this research. The variable included six levels for consumers to choose. In the study, it was defined to be integer from 1 to 6. The higher level was designed to be associated with a higher degree of liking to eat fish. The possible explanatory variables were socio-demographic variables, including gender, age, education, occupation, religion, residing area, family size, family monthly food expenditure, family monthly income, personal monthly food expenditure and personal monthly income (Table 1).

As to the independent variables, age, family size, education, income, and food expenditure were ordinal and categorical. Gender, marital status, religion, and occupation were nominal and categorical. This study used age as a continuous independent variable. For the nominal and categorical variables, each level or category was defined as a new variable: one for true and zero otherwise (Table 1).

Table 1. Description of Variables

Variable	Mean	Min	Max	Std	Missing
Preference for fish	4.475	1	6	1.144	1
Gender (female=1)	0.505	0	1	0.500	0
Age	36.938	14	71	14.511	0
Education	2.020	1	4	0.653	0
Marital status					
Unmarried	0.327	0	1	0.469	0
Married	0.651	0	1	0.477	0
Divorced/widowed	0.023	0	1	0.148	0
Personal income	2.865	1	9	2.084	0
Personal food exp	3.740	1	7	1.936	2
Family income	6.192	1	14	3.073	11
Family food exp	6.883	1	14	3.059	12
Family size	4.832	1	10	1.706	1
Residing area					
Northern	0.424	0	1	0.494	0
Middle	0.249	0	1	0.433	0
Southern	0.298	0	1	0.458	0
Eastern	0.028	0	1	0.166	0
Occupation					
Housewife	0.250	0	1	0.433	0
Chief	0.157	0	1	0.364	0
White collar	0.168	0	1	0.374	0
Manual labor	0.200	0	1	0.400	0
Unemployment	0.048	0	1	0.215	0
Student	0.147	0	1	0.354	0
Religion					
Christian	0.029	0	1	0.168	0
Buddhist	0.476	0	1	0.500	0
Yi-Guan-Daoism	0.023	0	1	0.148	0
Daoism	0.210	0	1	0.407	0
Other/none	0.262	0	1	0.440	0
Food attribute					
Food sanitation	4.861	1	6	1.028	0
Food nutrition	4.626	1	6	1.057	0
Food package	3.970	1	6	1.122	0
Food quality	4.617	1	6	1.082	0
Food price	4.377	1	6	1.081	0
Functionality of food	4.417	1	6	1.073	0
Content & ingredient	4.450	1	6	1.060	0
Food taste	4.622	1	6	1.046	1
Organic food	3.625	1	6	1.234	0

Note: Sample size=1200.

For example, the female gender was 1 for female and 0 for male. For the education, E_i was 1 for those having education of primary school or under, E_i=2 for those having high school education, E_i=3 for those having

college or university, E_i=4 for those having education beyond university, such as master and Ph.D. For religion, there were Christian, Buddhist, Yi-Guan-Daoism, Muslim, Daoism, and others including those with no religion. Each one was defined as a variable with level equal to 1 when it was true and 0 otherwise. The survey did not contact any Muslim. For the family monthly food expenditure, there were 14 ranges, with the lowest level of NT$ 2.5 thousand or under, and the highest level of NT$ 32.5 thousand or more. For the family monthly income, the lowest level was below 20 thousand dollars and the highest level was more than 140 thousand dollars. For the personal monthly food expenditure, there were seven ranges, with the lowest level less than one thousand dollars and the highest level more than six thousand dollars. For personal monthly income, there were nine ranges, the lowest level being no income and the highest level more than 80 thousand dollars. For family size, the smallest was one person and the largest was ten or more.

2.1 Methodology

To explore the factors affecting the dependent variable, the degree of like or dislike of eating fish, the study used all possible surveyed variables of demographic factors and consumer preference for food attributes as shown in Table 1. Nine kinds of food attributes and 12 kinds of demographic factors, which can totally be defined as 35 variables, were considered. Stepwise regression was employed to identify the significant explanatory variables.

By definition, the cumulative probability of events happening, which represented the degree of liking to eat fish, can be expressed:

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

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

$$\theta_{hi3} = \pi_{hi1} + \pi_{hi2} + \pi_{hi3} \tag{3}$$

$$\theta_{hi4} = \pi_{hi1} + \pi_{hi2} + \pi_{hi3} + \pi_{hi4} \tag{4}$$

$$\theta_{hi5} = \pi_{hi1} + \pi_{hi2} + \pi_{hi3} + \pi_{hi4} + \pi_{hi5} \tag{5}$$

where equation (1) denotes the probability of those who like exceptionally to eat fish. Equation (2) denotes the probability of those who like at least very much to eat fish. Equation (3) denotes the probability of those who like at least slightly to eat fish. Equation (4) implies 1-θ_{hi4}, which denotes the probability of those who at least very much dislike eating fish. Equation (5) implies 1-θ_{hi5}, which denotes the probability of those who extremely dislike eating fish.

The probability of each subgroup can be computed as following:

$$\pi_{hi1} = \theta_{hi1} \tag{6}$$

$$\pi_{hi2} = \theta_{hi2} - \theta_{hi1} \tag{7}$$

$$\pi_{hi3} = \theta_{hi3} - \theta_{hi2} \tag{8}$$

$$\pi_{hi4} = \theta_{hi4} - \theta_{hi3} \tag{9}$$

$$\pi_{hi5} = \theta_{hi5} - \theta_{hi4} \tag{10}$$

$$\pi_{hi6} = 1 - \theta_{hi5} \tag{11}$$

where π_1 denotes the probability of those who like extremely to eat fish, …, and π_6 denotes the probability of those who dislike extremely to eat fish.

The cumulative logistics can be computed as log odds of one group with more preferable response to those with less preferable response as following:

$$\log it(\theta_{hi1}) = \log[\frac{\pi_{hi1}}{(\pi_{hi2} + \pi_{hi3} + \pi_{hi4} + \pi_{hi5} + \pi_{hi6})}] \tag{12}$$

$$\log it(\theta_{hi2}) = \log[\frac{(\pi_{hi1} + \pi_{hi2})}{(\pi_{hi3} + \pi_{hi4} + \pi_{hi5} + \pi_{hi6})}] \tag{13}$$

$$\log it(\theta_{hi3}) = \log[\frac{(\pi_{hi1} + \pi_{hi2} + \pi_{hi3})}{(\pi_{hi4} + \pi_{hi5} + \pi_{hi6})}] \tag{14}$$

$$\log it(\theta_{hi4}) = \log[\frac{(\pi_{hi1} + \pi_{hi2} + \pi_{hi3} + \pi_{hi4})}{(\pi_{hi5} + \pi_{hi6})}] \tag{15}$$

$$\log it(\theta_{hi5}) = \log[\frac{(\pi_{hi1} + \pi_{hi2} + \pi_{hi3} + \pi_{hi4} + \pi_{hi5})}{\pi_{hi6}}] \tag{16}$$

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 the response variable. Cumulative logit analyses were employed. The data had likelihood with the models:

$$\log it(\theta_{hik}) = \alpha_k + X'_{hi}\beta_k \quad (17)$$

or

$$\log it(\theta_{hi1}) = \alpha_1 + X'_{hi}\beta_1 \quad (18)$$

$$\log it(\theta_{hi2}) = \alpha_2 + X'_{hi}\beta_2 \quad (19)$$

$$\log it(\theta_{hi3}) = \alpha_3 + X'_{hi}\beta_3 \quad (20)$$

$$\log it(\theta_{hi4}) = \alpha_4 + X'_{hi}\beta_4 \quad (21)$$

$$\log it(\theta_{hi5}) = \alpha_5 + X'_{hi}\beta_5 \quad (22)$$

Since the response levels were designed to be ordinal from 1 to 6, the higher level was associated with higher degree of preference for fish. Proportional odds among all types of preferences were assumed for the multiple response models. 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

$$\log it(\theta_{hik}) = \alpha_k + X'_{hi}\beta \quad (23)$$

To identify the multiple response models, a stepwise process was employed. Score Chi-square 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 of $\beta = 0$ 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 the 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 regrouped to fit into the model of eq(12) to eq(16), which were treated as binary response models. The justification of the identified model was the same as that of multiple response model, but 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 used in multiple response model (Stockes et al. 1995).

3. EMPIRICAL RESULTS

3.1 Description of Sample Data

Some 84.7% of Taiwan consumers liked to eat fish. The distribution of the degrees of preferences for eating fish tended to be skewed to the liking side (Table 2).

Table 2. Response profile of how one liked or disliked eating fish

Degree of preference	Count	Percent	Cumulative Percent
Like extremely	212	17.7	17.7
Like very much	431	35.9	53.6
Like slightly	373	31.1	84.7
Dislike slightly	117	9.8	94.5
Dislike very much	30	2.5	97.0
Dislike extremely	36	3	100

The results of independence tests are shown in Table 3. Religion, residing area, and preference for food attributes variables were significant influences on preferences for fish.

3.2 Models with Proportional Odds Assumption

The stepwise process identified six significant variables. In step 6, the score test for the proportional odds assumption with Chi-Square = 114.4127 with 24 df (p=0.0001) does not support the proportional odds assumption. The model fitting information and testing global null hypothesis $\beta=0$ with Chi-Square for covariates in criterion of score being 152.894 with 6 df (p=0.0001), and with residual Chi-Square = 28.7399 with 31 df (p=0.5828) partly support the adequacy of the model (Table 4). The identified model is shown in Table 5.

The odds ratio showed that each additional year of age indicated 1.013 times higher odds of liking to eat fish than the younger. Those who paid more attention to food sanitation had 1.231 times higher odds of liking to eat fish than those who paid less attention to it. Respondents who paid more attention to food quality had 1.294 times higher odds of liking to eat fish than those who paid less attention to it, and those who paid more attention to food taste had 1.359 times higher odds of liking to eat fish than those who paid less attention. On the other hand, those who lived in the eastern area had only 0.425 times higher odds of liking to eat fish as those who did not live in the east, and those who believed in Yi-Guan-Daoism had 0.134 times higher odds of liking to eat fish as those who did not believe in Yi-Guan-Daoism.

3.3 Binary Response Models – Restricted Information

Since the proportional odds assumption was not valid, regrouping the response level to be dichotomous and using binary response models based on the significant explanatory variables identified in Table 4 were further needed.

Table 3. The Independent test of Preference for Fish with Respect to Socio-demographic Variables

Variable	χ^2	df	P-value	
Gender (female=1)	3.921	5	0.561	
Age	32.804	25	0.136	
Education	17.368	15	0.297	
Marital status	19.851	10	0.031	**
Unmarried	15.146	5	0.010	***
Married	15.173	5	0.010	***
Divorced/widowed	4.455	5	0.486	
Personal income	31.777	40	0.820	
Personal food exp	31.146	30	0.408	
Family income	58.552	60	0.529	
Family food exp	75.194	65	0.182	
Family size	68.442	45	0.014	**
Residing area	50.798	15	0.001	***
Northern	3.224	5	0.665	
Middle	19.973	5	0.001	***
Southern	22.523	5	0.001	***
Eastern	18.679	5	0.002	***
Occupation	32.009	35	0.613	
Housewife	5.177	5	0.395	
Chief	6.128	5	0.294	
White collar	6.948	5	0.225	
Manual labor	1.582	5	0.903	
Unemployment	5.071	5	0.407	
Student	7.643	5	0.177	
Religion	87.817	25	0.001	***
Christian	8.388	5	0.136	
Buddhist	3.229	5	0.665	
Yi-Guan-Daoism	63.477	5	0.001	***
Daoism	11.257	5	0.047	**
Other/none	3.232	5	0.664	
Food attribute				
Food sanitation	167.374	25	0.001	***
Food nutrition	151.128	25	0.001	***
Food package	147.146	25	0.001	***
Food quality	210.858	25	0.001	***
Food price	131.466	25	0.001	***
Functionality of food	174.104	25	0.001	***
Content & ingredient	163.045	25	0.001	***
Food taste	230.792	25	0.001	***
Organic food	113.823	25	0.001	***

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

Table 4. Summary of stepwise procedure for entry to the multiple response model

Step	Variable entered	Score χ^2	P-value
1	Food quality	88.1496	0.0001
2	Food taste	22.2011	0.0001
3	Yi-Guan-Daoism	19.2113	0.0001
4	Age	13.6113	0.0002
5	Food sanitation	9.3013	0.0023
6	Eastern	6.9645	0.0083

Table 5. Maximum Likelihood Estimates of Multiple Response Model

Variable	Parameter Estimate	Std Error	Wald χ^2	P-value	Odds Ratio
Intercept1	-5.7067	0.3656	243.593	0.0001	.
Intercept2	-3.8576	0.3465	123.923	0.0001	.
Intercept3	-2.1138	0.3349	39.830	0.0001	.
Intercept4	-0.8988	0.3417	6.920	0.0085	.
Intercept5	-0.2099	0.3582	0.343	0.5578	.
Age	0.0131	0.0037	12.4819	0.0004	1.013
Eastern	-0.8550	0.3171	7.2697	0.0070	0.425
Yi-Guan-Daoism	-2.0117	0.3624	30.8086	0.0001	0.134
Food sanitation	0.2076	0.0623	11.1002	0.0009	1.231
Food quality	0.2581	0.0640	16.2497	0.0001	1.294
Food taste	0.3070	0.0631	23.6749	0.0001	1.359

Table 6. Parameter Estimates and Odds Ratio for Each Restricted Binary Model

Variable	Eq.(12)	Eq.(13)	Eq.(14)	Eq.(15)	Eq.(16)
Intercept	-6.8405	-3.5672	-1.1614	3.0271	3.7695
Age	0.0149 <1.015>	0.0112 <1.015>	0.0135 <1.014>		
Eastern			-0.8518 <0.427>	-1.1451 <0.318>	-1.8772 <0.153>
Yi-Guan-Daoism		-1.8066 <0.164>	-1.6668 <0.189>	-2.4520 <0.086>	-2.6342 <0.072>
Food sanitation	0.2928 <1.340>	0.2167 <1.242>			
Food quality	0.3490 <1.418>	0.2586 <1.295>	0.2507 <1.285>		
Food taste	0.3263 <1.386>	0.2358 <1.266>	0.3034 <1.354>		
Concord.	70.3%	67.3%	66.7%	20.5%	29.0%
P-value*	0.5424	0.0451	0.0138	.	.

Note: P-value* denoted the probability value of goodness-of-fit statistics. Odds ratios were included in < >.

We found that, at the 0.05 significance level, only the models of eq.(12) and eq (13) (i.e., those who liked extremely to eat fish versus those who did not like extremely to eat fish and those who liked very much to eat fish versus those who did not like very much to eat fish) were adequate. The age, sanitation, quality, and taste variables were identified to be significant and positive influences on consumers' taste for eating fish. The odds ratios for these factors were all greater than one (Table 6). Believers in Yi-Guan-Daoism were significantly less likely to prefer eating fish.

3.4 Binary Response Models - Full Information

Most of the models with restrictions on including only the significant variables identified in the multiple response model (i.e., those independent variables that appeared in Table 5) were not adequate and, thus, not valid. We found it essential to expand the possible explanatory variables to include all those used in the multiple-response modeling, listed in Table 1, for the further stepwise process. The newly identified models are thus shown in Table 7.

The full model had more identified variables (at the 0.05 significance level) that help explain different levels of the preferences for fish, had higher predictability and met the goodness-of-fit tests. The variables of quality and taste still positively affected the preference for fish. The older consumers liked to eat fish more than younger. Those who believed in the religion of Yi-Guan-Daoism, and those who lived in eastern Taiwan, were identified to be more disliking to eating fish. However, the sanitation variable was not found to significantly affect preferences for fish. The nutrition factor, however, became influential to the preference for fish. This seems to indicate that the image of nutrition dominated the image of sanitation in fish consumption.

As to the other newly included influential variables, those who believed in the religion of Daoism and those who were white-collar workers preferred eating fish. On the contrary, females and/or those who lived in the middle section of the island preferred eating fish relatively less.

Table 7. Parameter Estimates and Odds Ratios for Full Binary Response Models

Variable	Eq.(12)f	Eq.(13)	Eq.(14)	Eq.(15)	Eq.(16)
Intercept	-6.0537	-2.9905	-1.0517	2.8871	3.6060
Age	0.0145 <1.015>		0.0135 <1.013>		
Eastern			-1.1080 <0.330>	-1.2168 <0.296>	-2.0518 <0.129>
Yi-Guan-Daoism		-1.7257 <0.178?	-1.6134 <0.199>	-2.3093 <0.099>	-2.6963 <0.067>
Food sanitation					
Food quality	0.3402 <1.405>	0.2402 <1.271>	0.2596 <1.296>		
Food taste	0.3325 <1.395>	0.2365 <1.267>	0.2991 <1.349>		
Female	-0.3398 <0.712>				
Un-married		-0.4525 <0.636>			
Middle	-0.5158 <0.597>				
Southern			-0.5930 <0.553>		
Daoism			0.5075 <1.661>	0.9125 <2.490>	
White collar					2.2005 <9.030>
Nutrition	0.2787 <1.321>	0.2422 <1.274>			
Concord.	71.3%	66.7%	68.4%	35.1%	38.8%
P-value*	0.2434	0.0283	0.5612	.0.7412	.0.6517

Note: P-value* denoted the probability value of goodness-of-fit statistics. Odds ratios were included in < >.

4. CONCLUSION

More than 84% of Taiwanese consumers favor eating fish. The variables of religion, marital status, area of residence, and preferences for food attributes were identified to affect preferences for fish. A stepwise logistic process demonstrated that factors affecting the preference for fish were not proportional odds. Instead, factors affected the relative levels of preference for fish in different weights. Among all the identified models based on proportional odds assumption or based on different relative levels of preference, it was found that age, white collar, believing in the religion of Daoism, and degree of attention to food sanitation, food quality, food taste, and food nutrition raised the odds of preference for fish. Those who believed in the religion of Yi-Guan-Daoism, were unmarried, female, and/or those who lived in middle, eastern, or southern Taiwan had lower odds of preference for fish.

Since the variables of sanitation, nutrition, quality and taste are positively related to the preference for fish and the older are more likely fond of eating fish, we conclude that fish products convey an overall good perception to consumers nowadays in Taiwan. In consideration of the fact that fish consumption has been stagnant but among the three largest animal protein food sources in Taiwan, fish marketing seems to be meeting the challenges of the traditional environment. Further development of fish products having these kinds of food attributes may meet more consumers' need.

Females, younger, and/or unmarried consumers were identified to have lower odds of preference for fish. Since females often play the role of family food purchaser, and the younger and the unmarried play more important roles in future food consumption, the development of fish marketing in Taiwan would seem to call for further, perhaps targeted, efforts to attract and retain these consumption groups. Further exploring the characteristics of food preferences of females and younger consumers may illuminate information for new product development and education and promotion programs to further develop the markets for the fishery industry.

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