Consumers' willingness-to-pay for low-calorie labeled Rice

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Abstract

The purpose of this study is to examine the importance of low calorie content in Japanese consumers' rice purchasing decisions. The Choice Modeling (Random Parameter Logit Model) is used in order to quantify the welfare change associated with the change in the level of low calorie content, local origin label, price attribute for the sample of Japanese consumers in March 2009.

The consumer has a positive perception of local origin and rice cultivar label. Average evaluation of the low calorie content attribute is negative (-116 yen/5kg). But, half of samples have positive perception of low calorie content. Their willingness to pay for low-calorie content attribute range from 800-900 yen/5kg.The results suggests that latent demand for low calorie labelled rice exists on a limited scale.

Keywords

Choice Experiment, Quality of Life (QOL), Wellness Market

Introduction

The topic of this paper is to consider low-calorie rice from consumers' evaluation in the possibility of added value for agricultural products in the health and medical sector.

It is becoming more and more important to improve the quality of life (QOL) of people who cannot consume certain foods due to food such things as allergies and adult diseases. Moreover, in Japan, according to a special medical examination system introduced from 2008, the concept of metabolic syndrome has become widely known and there is greater interest in the problem of obesity.

The background of this increased interest in calorie intake, in particular, is the situation in which there are many type of foods on the market that claim to be low calorie foods. Therefore, this report focuses on low-calorie rice as one of the agricultural products that can maintain and improve the quality of life in relation to food intake in the health and medical sector. It could be made a meaningful contribution to clarify consumers' evaluation of low calorie rice in considering the matter of possibility of added value to the health and medical sector with agricultural products.

Methods and Data

(1) Method of Analysis

In the survey concerning the low calorie rice that is analyzed in this paper, the respondents were presented with "100% rice that can be cooked as normal in a rice cooker and not products such as *konnyaku* that use low-calorie rice." The low-calorie rice that has these types of characteristics involves technology at the patent level. [1)] However, it is hard to say that there is sufficient commercialization and distribution of this product to be able to carry out customer evaluation analysis. Therefore, stated preference methods that apply to non-market goods such as Choice Experiment and CVM (Contingent Valuation Method) are the most suitable methods of analysis. [2)]

In this paper, Choice Experiment that can be evaluated the value of each attribute individually is employed as method of analysis in consideration of multiple attributes in rice such as low-calorie attribute, local origin and rice cultivar of production attribute, price, etc.

(2) The Determination of the Attributes for Evaluation

This paper focuses on the evaluation of rice and the respondents were limited to people who participated when they were in the act of going to purchase the rice that they normally buy. The survey was carried out at places where rice is sold such as at supermarkets and rice stores and the following three attributes were set for evaluation.

Firstly, "Local origin and rice cultivar" was set attribute for evaluation. The origin of the product in terms of the prefecture it comes from and the name of the product were explained. The respondents were presented with 3 different standards: "Koshihikari from Niigata Prefecture", "Akitakomachi from Akita Prefecture", and "Kirara 397 from Hokkaido Prefecture".

Secondly, "low-calorie" was set as an attribute to be evaluated. The explanation for the display of "low-calorie" was that it is 100% rice, can be cooked in the normal rice cooker and has 25% less calories than normal rice. Thus, there are two standards such as "with" and "without" the "low calorie" display.

Thirdly, "Price" of a 5kg bag was set as an attribute to be evaluated. For the evaluation of price it is necessary to set different prices. There are three standards such as 1,480 yen, 2,480 yen and 3,480 yen per 5 kg bag.

There were profile patterns for the rice consisting of a combination of the attributes to be evaluated: "local origin and rice cultivar", "low-calorie", and "price". A fourth choice of "I would not buy any of them" was also added to create a chose set of 4 choices (Figure 1).Based on the orthogonal design, 16 sets of choice set in different standard of each attribute are made and divided into 8 sets each, and presented the respondents of 2 groups as 8 times repeated questions. [3)]

(3) Analytical Model

This paper employs as Random Parameters Logit Model (RPL) in analytical model. Data from choice experiments are consistent with random utility theory. If the function U_j when choice j is selected, is composed of a part determined by observable factors V_j and non-observable factors ε_j then U_j can be expressed as follows.

$$U_j = V_j + \varepsilon_j \qquad (1)$$

In the usual logit model, the parameters of each explanatory variable that define V_j are held constant. In RPL, V_j is allowed to vary according to the respondents. Therefore, when respondent *i* selects choice j the derived V_{ji} can be expressed as follows.

$$V_{ji}=(\beta_j+\sigma_j w_{ji})X_j \qquad (2)$$

In this case, V_{ji} is the average of each attribute parameter β_j in the *j* ordinal choice. The difference between the coefficients of the respondents is a standard probability distribution w_{ji} and its standard deviation σ_j and is expressed by the vector X_j for each attribute. In this paper, the linear expression of V_{ji} was the most common linear expression, and the average parameter and standard deviation parameter of each of the attributes of "local origin and rice cultivar", "low-calorie" and "price" were set and measured. In the case of RPL, besides the characteristic of allowing variation in the parameters of respondents being different and differences in the place of where the selection is made, it has the characteristic of relaxing the restriction of independence (IIA) from non-related choices imposed by the IID assumption that the distribution of errors is independent and identical.

The valuation derived from the average value of measured results is obtained by

$$CS=-1/\beta_m(VC-VN) \qquad (3)$$

as compensating surplus.

(4) Data

Choice experiment data was collected by using the Macromil Corporation's internet survey. The demographics of the subjects surveyed are men and women over the age of 20 living in Tokyo, Kanagawa Prefecture, Saitama Prefecture, and Chiba Prefecture. It was carried out in March, 2009. There was a total of 620 respondents, and excluding those who did not which to participate and those who could not decide, the total became 586 respondents, and consequently the data base of 586 respondents was used in the analysis. [4)]

Results and Discussion

(1) Estimated Result Using the RPL Model

The estimated result using the RPL model are shown in Table 1. [5)] In the estimation, there was panel data consisting of responses to 8 questions and from the group of 586 respondents 4,688 samples were used. The adjusted ρ^2, revised degrees of freedom, was 0.430 and this value satisfies the required standard for demonstrating the applicability of the model. [6)]

As for the estimated results of each variable parameter, the "price" attribute was significant at 1% significance level and the sign was negative. This indicates that as the price rises the probability of selection decreases. This shows evidence of income constraints in the choice experiment made by the respondents.

As for the attribute local origin and rice cultivar, the Alternative Specific Constant (ASC) parameter for Koshihikari from Niigata Prefecture, Akitakomachi from Akita Prefecture, and Kirara 397 from Hokkaido Prefecture, were all significant at a level of 1% significance and the sign was positive. Therefore, the origin of these rice varieties increases the probability of

selection, which means that they were positively evaluated by the respondents. In addition, from the magnitude of the parameters, the order of preference, from the highest in descending order was Koshihikari from Niigata Prefecture, Akitakomachi from Akita Prefecture, and Kirara 397 from Hokkaido Prefecture. The results obtained reflect the actual market evaluation for each locality.

The attribute of low calorie, was significant at 10% significance level and the sign was negative. This means that selection declines for rice that has added low calorie attribute. However, when observing the standard deviation parameter, the parameter for the low calorie attribute, likewise for that of the dummy variable, was large in comparison to the standard deviation parameter for the attribute local origin and rice cultivar. This indicates that the responses for the low calorie attribute had greater variability than the local origin and rice cultivar attribute and it suggests that there was a mix of both positive and negative responses. When estimating the parameter for each respondent, it is seen that not all of the respondents' parameters were negative, in fact, 55.3% had non-negative parameters.

(2) Estimation of Consumers' Valuation Price

Based on the estimation results of the RPL model, the results of the valuation price of each attribute are shown in Table 2.

With reference to the valuation of 5kg of Koshihikari rice in are surveyed (Tokyo, Kanagawa Prefecture, Chiba Prefecture, and Saitama Prefecture), if the valuation price of Koshihikari from Niigata Prefecture is assumed to be 2,500 Yen, then the valuation price of Akitakomachi from Akita Prefecture would be 2,159 Yen and the valuation price of Kirara 397 from Hokkaido Prefecture would be 1,594 Yen. From the parameter estimated results, if the preference order is expressed in monetary terms, the valuation difference between Koshihikari from Niigata Prefecture and Akitakomachi from Akita Prefecture would be 341 Yen, and the valuation price difference with Kirara 397 from Hokkaido would be 906 Yen.

The low calorie valuation price was a negative -116 Yen on average. This means, without consumer targeting, if low-calorie rice is introduced on the market, in order to obtain the same competitiveness (selection probability) as rice of the same origin of production the price would have to be discounted.

Table 3 shows the estimated valuation price of the attribute low calorie using the average value and the percentage point of the valuation price by respondent calculated in the same manner, the minimum value, and maximum value. The 1% point and 5 % point represents and negative valuation price, however, but the valuation price becomes positive at the 50% point. Specifically, the consumers' valuation price becomes positive at the 44.9% point. Thus, approximate 50% of the respondents would give a positive valuation price to the low calorie attribute.

The estimation of the valuation price of the low calorie by this stratum yields an average value of 1,586 Yen (with 5% trimming it would be 965 Yen), and the median was 857 Yen. This shows that it is possible for the value added to fill the valuation price difference of 397 between Kirara from Hokkaido Prefecture with the lowest value and Koshihikari from Niigata. Prefecture. Therefore, attempts to add value to rice through the addition of the low calorie attribute may be promising when targeting this approximate 55% stratum of respondents.

(3) Estimated Result Using the RPL Model (Final)

The results of the final model are presented in Table 4. The main objective here is to understand the factors that increase utility from the low calorie rice. The interaction terms for consumer's characteristics as promiscuous eating habits, nutritional supplement user, patient suffering with adult disease, consciousness overweight are added.

The promiscuous eating habits, nutritional supplement user, patient suffering with adult disease, consciousness overweight are statistically significant, as are their interactions with the low calorie attribute. Consumers, who eat irregularly, take supplements, suffer with adult disease, worry about their overweight have positive perception for low calorie rice.

Conclusion

The issue addressed in this paper is the possibility of value-added agricultural products for the health and medical sector, and consumers' evaluation of low-calorie rice has been examined. A choice experiment for the low-calorie rice was carried out involving the attributes of price, local origin and rice cultivar, and low-calorie. The results of the quantitative analysis employing the Random Parameters Logit Model (RPL) on the consumers' evaluation reveal the following 3 points.

First, the average value of the consumers' valuation of the low calorie attribute was negative, and in monetary terms the valuation was -116 Yen.

Second, though the average value of the consumers' valuation of the low calorie attribute was negative, 55% of the respondents gave a positive evaluation and the monetary value was about 800~900 Yen in this stratum of respondents.

Third, consumers, who eat irregularly, take supplements, suffer with adult disease, worry about their overweight have positive perception for low calorie rice.

The results of the above analysis mean that the low-calorie attribute is not an attribute like the food safety attribute for which there is positive acceptance by everyone. Therefore, it is difficult to imagine that the value added to rice by the addition of the low-calorie attribute in the case of the average consumer. On the other hand, the fact that half of the respondents surveyed gave a positive valuation suggests that it is possible to popularize low-calorie rice by clearing targeting this group of consumers. Consumers, who eat irregularly, take supplements, suffer with adult disease, and worry about their overweight, suggest becoming latent customer.

Notes

1) Examples include "low-calorie rice and low calorie cooked rice as well as their production methods" (Patent Number 4038450) which is for the development and commercialization of low-calorie rice that can be prepared in the same way regular rice is prepared in a rice cooker.

2) Examples of research in which the stated preference method is used include the analysis by Sawada[2] on consumers' valuation of food safety.

3) If you directly apply an orthogonal design, there is the possibility that unrealistic combination profiles and similar profiles may be generated. In this paper, in order to maintain orthogonality, profiles and choice sets were not deleted.

4) Here the meaning of a resistance response is the case in which the respondent answered "would not buy any of them" for all the 8 questions in the choice experiment. Therefore it excluded from analytical data as showing resistance in the framework of choice experiment.

5) Econometric Software Company's NLOGIT ver.4.0 was used for estimations.

6) In the case of the discrete model of Hensher and Johnson[1], if the modified ρ^2 is about 0.3 it means that there is appropriate model fit.

References

[1] Hensher, D. A. and L. W. Johnson, *Applied Discrete Choice Modeling*, John Wiley and Sons, New York, 1981.

[2] Sawada, Manabu (ed.), "*The Economic Evaluation of Food Safety – by the Stated Preference of Approach"*. Forestry Statistical Association, 2004

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Calorie	Low-Calorie	Normal	Normal	
Production Area and Rice Cultivar	Koshihikari from Niigata Pref	Akitakomachi from Akita Pref	Kirara397 from Hokkaido Pref	Would not buy
Price	1,480yen/5kg	3,480yen/5kg	2,480yen/5kg	
	( )	( )	( )	( )

Figure 1: Examples of Choice Experiment Questions

Table 1: Random Parameter Model Estimates (1)

Definition	Random Parameter	Derived Standard Deviations of Random Parameter
Price	-0.0024 (-26.774)	0.0035 (18.877)
Koshihikari from Niigata Pref (ASC)	9.2709 (34.402)	2.6105 (17.455)
Akitakomachi from Akita Pref (ASC)	8.4378 (33.469)	1.3726 (5.849)
Kirara397 from Hokkaido Pref (ASC)	7.0560 (29.168)	1.4969 (4.437)
Low-Calorie	-0.2826 (-1.887)	4.9529 (21.569)
Number of Observations	4,688	
Maximum Log Likelihood	-3,703.645	
Adjusted ρ^2	0.430	

Note): t statistics in parentheses.

Table 2: Economic Welfare Estimations

Koshihikari from Niigata Pref (Standard Value)	2,500 yen/kg
Akitakomachi from Akita Pref	2,159 yen/kg
Kirara397 from Hokkaido Pref	1,594 yen/kg
Low-Calorie	-116 yen

Table 3: Summary of Valuation Price by Respondents for the Low-Calorie Attribute

Minimum	-183,998
1%	-7,007
5%	-2,571
10%	-1,834
50%	138
90%	1,243
95%	2,054
99%	7,862
Maximum	59,738

Note): The unit is Yen. Each point corresponds to a valuation price when valuation price is estimated from the individual respondent's coefficients and arranged in ascending order.

Table 4: Random Parameter Model Estimates (2)

(A) Random Prameters		
Koshihikari from Niigata Pref (ASC)	9.34807998	(34.270)
Akitakomachi from Akita Pref (ASC)	8.4979668	(33.318)
Kirara397 from Hokkaido Pref (ASC)	6.99074264	(29.067)
Low-Calorie	-1.82481699	(-7.906)
Price	-0.00245271	(-28.056)
(B) Nonrandom Parameters		
Low-Calorie × Promiscuous Eating Habits	0.89753938	(3.401)
Low-Calorie × Nutritional Supplement User	0.99344276	(3.427)
Low-Calorie × Obsesion with Dieting	1.33281096	(4.872)
Low-Calorie × Patient Suffering with Adult Disease	1.50553935	(4.732)
Low-Calorie × Consciousness of Overweight	1.12344843	(4.341)
(C) Derived Standard Deviations of Random Parameter		
Koshihikari from Niigata Pref (ASC)	2.69960411	(17.053)
Akitakomachi from Akita Pref (ASC)	1.30535564	(5.882)
Kirara397 from Hokkaido Pref (ASC)	1.77437605	(8.299)
Low-Calorie	4.90568647	(22.102)
Price	0.00342356	(20.204)
Number of Observations	4,688	
Maximum Log Likelihood	-3,655.721	
Adjusted ρ^2	0.437	

Note): t statistics in parentheses.