Consumer Preference for Immune-Health Promoted Pork

Nina Takashino*, Yuki Chiba**, Katsuhito Fuyuki*
(*Tohoku University, **Sendai City Office)

Recently, consumer concerns towards "food safety" is rising all over the world due to various factors. Due to the increase in high consciousness, many universities have engaged in research and education on food safety. In April 2015, Tohoku University launched the International Education and Research Center for Food and Agricultural Immunology (CFAI). This Center is performing research focused on food and agricultural immunology. Agricultural immunology is a general term for new technologies that realize healthy fostering of agricultural and livestock products by strengthening immune functions. In order to disseminate such new food technologies, it is necessary to investigate consumer preferences. The aim of this paper is to examine consumer's preference for immune-health promoted pork which is a newly developed food technology. Using 300 Japanese respondents' data, conjoint analysis is applied to estimate individual preference for pork attributes. Selected attribute categories include production method, producing area, and prices. The results show that the consumers' evaluation for immune-health promoted pork is higher than pork raised under normal production method indicating that consumers evaluate unknown new food technology. Respondents' positive preference on pork produced in Japan is also examined. Detailed empirical analysis on pork choice shows that brand lovers tends to choose the new food technology pork. The impact of personal concern level on production method on pork choice is investigated. Furthermore, on the determinants of the concern level, it is shown that rich people tend to believe that the normal breeding method of pork is risky.

Keywords: food safety, consumers’ preference, stated preference method, pork, new food technology

1. Introduction

Recently, consumer concerns on "food safety" is rising all over the world due to various factors such as globalization of the food supply and public demand for health protection. Japanese citizens also have had great concerns regarding food safety issues due to various factors such as risks of food contamination by harmful chemicals, commercialization of genetically modified foods, and food producing area disguising scandals. Reflecting this situation in Japan, many studies on food safety have been conducted.

Receiving concerns about food safety, many universities have engaged in research and education on food safety. In April 2015, Tohoku University launched the International Education and Research Center for Food and Agricultural Immunology (CFAI). This Center is performing research focused on food and agricultural immunology. Agricultural immunology is a general term for new technologies that realize healthy fostering of agricultural and livestock products by strengthening immune functions. This center
integrates natural scientific research with social approach to create a drug-independent healthy cultivation and food safety system. To explore the possibility of new food technologies developed by this center, it is necessary to investigate consumer preferences.

The aim of this paper is to examine consumer’s preference for immune-health promoted pork which is a newly developed food technology. In Japan, many studies were conducted after specific food problems occurred. Because of BSE and food disguising problems, Aizaki et al. [2], Sawada et. al [14] and Sato et. al. [12] conducted study targeting beef. Hosono [8] and Chae et. al. [6] studied food safety on milk reflecting the food poisoning scandal of a milk company. These previous studies have examined the problems relating to the past incident which are different from our approach, as ours deal with the new food technology currently under development.

There are some studies targeting on-going issues. These studies focus on fruits and vegetables, reflecting the growing interest in organic cultivation and the increase in imported products due to trade liberalization (Nishi et. al [11], Kameyama and Goda [9], Matsuoka et. al [10]. Related to new food technology, Andreas and Yabe [5] assess the consumers' preferences for genetically modified foods. Their focus commodity is different from our concern.

Closely related to our approach, on food safety and consumers choice on livestock, Aizaki et al. [1] empirically clarifies the impact of food safety and consumer attitudes towards country of origin on purchase choice of beef. However, few studies analyze consumers’ preference on livestock using new food technology. An exception is Aizaki, Sato, and Iwamoto [4] that reveal the effect of consumers’ knowledge and attitudes related to cloned cattle on the evaluation of cloned cattle derived products (beef). This technology is different from our focus, the new technology developed by CFAI researchers. Therefore, we estimate the determinants of individual preference on food safety and new technology for pork attributes using the choice experiment.

The rest of this paper is organized as follows. Section 2 provides an overview of the survey method and explains the procedure of the choice experiments. Then, Section 3 presents an overview of the characteristics of sample respondents and their concern on safety. Section 4 shows the model and results of the econometric analysis. Finally, Section 5 presents the conclusions.

2. Survey method

1) Data

We collected data through WEB survey, on 2nd and 3rd December, 2016. We distributed questionnaires to consumers in the whole of Japan. To control respondents knowledge level, we asked them whether he or she bought pork more than once a week and cooked the dishes by themselves. 300 consumers those who answered “yes” continued the rest of the questionnaire related to consumer behavior and choice experiments. Table 1 shows the characteristics of sample respondents. The questionnaire was filled by both male and female respondents from the age of 20 years old to 69 years old. Around 73 percent of respondents were female and 26 percent work as a housekeeper.

2) Choice experiment modeling

To examine consumers preferences on pork attributes, the discrete choice experiment method is applied. The choice sets for sample respondents are designed as shown in table 2. To investigate consumers evaluation precisely, we specified the product as pork belly meat for ginger baking which is often bought by
standard consumers. In the choice experiment questions, we asked respondents to consider the price as per 100g of pork meat.

For pork attributes, country of origins, production methods, and prices are used to create choice set. For country of origins, following to Aizaki et. al [1], we consider pork produced in Japan and USA to capture consumers’ different consciousness on domestic and imported products.

For production method, three levels are used: “Normal”, “Reduced” and “Lactic”. In the “Normal” pork production, pigs are given antibiotics from 3 weeks of age until shipment to prevent disease. Normal breeding has a possibility that a stronger pathogen than the antibiotic may appear. Therefore some producers apply the “Reduced” method. This is a production method with less amount of antibiotics to prevent the stronger pathogen. The third method is “Lactic” which reduces the amount of antibiotics and feeds lactic acid bacteria to prevent disease. Suda et. al [15] shows that this method is strong against
diseases, and can produce large proportion of high quality meat. This method is the example of newly created food technology and we examine the consumers’ evaluation for this attribute. Actual instructions to the respondents are provided in Japanese (Figure 1). For the price attribute, it has six levels for the pork produced in Japan and USA separately to reflect actual market situation.

3. Consumers’ concern on safety

Table 3 describes the respondents’ food choice priority sorted by age groups. We asked them “what is the most important factor in purchasing the food?” 137 respondents chose the country of origin and 137 cared about the price. If we look at age difference, elder people tend to choose branding and safety more. Personal difference on choice priority might affect pork attributes evaluation. In empirical study, we examine this impact by using this priority dummy as explanatory.

Table 3. Choice priorities by age group

| Age | Price | Origin | Brand | Safety | Total |
|-----|-------|--------|-------|--------|-------|
| 20's| 6.0   | 5.1    | 0.0   | 0.0    | 5.0   |
| 30's| 25.6  | 19.7   | 0.0   | 12.5   | 20.7  |
| 40's| 38.3  | 38.7   | 27.3  | 25.0   | 37.3  |
| 50's| 18.0  | 29.2   | 31.8  | 50.0   | 25.0  |
| 60's| 12.0  | 7.3    | 40.9  | 12.5   | 12.0  |

Sample 133 137 22 8 300
Source: Study survey, 2016

Table 4. Consumers’ concerns on safety

| Level of feeling | Number | % |
|------------------|--------|---|
| Concern for "Normal" pork |        |   |
| Strongly unsafe | 64     | 21.3 |
| Weakly unsafe   | 170    | 56.7 |
| Not so concerned.| 59     | 19.7 |
| No concern      | 7      | 2.3 |
| Concern for "Lactic" pork |      |   |
| Strongly unsafe | 32     | 10.7 |
| Weakly unsafe   | 113    | 37.7 |
| Not so concerned.| 136    | 45.3 |
| No concern      | 19     | 6.3 |

Total 300 100.0
Source: Study survey, 2016

Table 4 shows sample respondents’ concern level on food safety for pork produced by “Normal” and “Reduced” method. 78.3 % of respondents feel strong or weak unsafe for “Normal” breeding method pork while 48.4 % feel unsafe for “Lactic” pork. More people felt unsafe to eat the “Normal” pork rather than the “Lactic” new food technology pork. We consider the impact of the different levels of concern on pork choice. Also, we examine the

As shown in table 2, all choice sets consists of 36 combination of choice sets. These full choice sets are separated into six groups (A to F) of six choices and each respondent are randomly assigned to any of them. In the questionnaire, each respondents are asked to choose an optimal combination of attributes from the 3 sets of choices (Figure 2). All choice experiment questions include “Buy neither” choice as one of the three alternatives.
determinants of the concern levels to understand the consumers’ concerns about each production method more.

4. Empirical analysis

1) Analytical framework

To understand consumers’ choice behavior, we estimate followig equations.

\[ V_{ih} = \sum \beta_{ih} X_{im} + \sum \gamma_{ih} X_{im} Z_{nh} + u_i \]  \hspace{1cm} (1)

\[ C_j = \theta_{j0} + \theta_{j1} X_j + u_2 \] \hspace{1cm} (2)

In equation (1), we examine the evaluation of each pork attributes using conditional logit estimation. \( V_{ih} \) is utility and \( X_{im} \) is a vector of the pork attributes. \( Z_{nh} \) is a vector of respondent’s characteristic variables. The pork attributes and levels are summarized in table 5.

In equation (2), using OLS, we regress level of concern (\( C_j \)) on a vector of respondents’ characteristics (\( X_j \)) to the determinants of consumers’ anxiety.

2) Pork attributes and consumers choice

Table 6 shows the estimation results of equation (1) with attribute only. It is seen that the coefficient for “Japan” and “Lactic” pork attributes are significantly high. It shows that consumers evaluate these attributes compared to “Normal” pork. Evaluation on “Japan” pork is high, reflecting Japanese consumers’ food safety consciousness. Even though they are not familiarized with this new food technology, they evaluated the method positively based on the information provided in the instruction section. Based on these results, marginal willingness to pay for “Reduced”, “Lactic” and “Japan” are 4.9, 33.5 and 123.5 respectively.

To clarify the impact of food choice priority, we add interaction terms of each pork attribute and priority dummies in equation (1). Table 7 shows the coefficients of such interaction terms. Other results (including Reduced single dummy, lactic single dummy and Japan single dummy) are not shown here and the coefficient shows the additional impact of interaction dummy. It shows that those who love the brand name evaluate “Lactic” positively. Nowadays, in Japanese food market, name of lactic acid bacteria and its enhancement of the probiotic effects have become increasingly popular. Some people might consider it as a kind of health promoting foods like lactic acid bacteria-containing chocolate.

Table 8 shows the estimation results with interaction term with concern level variables. Here we used different level of concern on pork producing method. This variable takes 4 if the respondent feel strongly unsafe on the production method and takes 1 if she or he has...
no concern. The result shows that those who feel “Normal” method unsafe choose “Lactic”, “Japan”. It’s natural that those who feel that the normal method is unsafe would choose the alternative breeding method. The finding shows that they significantly prefer “Lactic” while “Reduced” method is not chosen significantly. Also, those who feel “Lactic” is unsafe less prefer “Reduced”, “Lactic”. It indicates that those who consider “Lactic” unsafe are risk sensitive people and hence tends to avoid any choice and select the “buy neither” option.

3) Determinants of consumers’ concern

Finally we examine the determinants of the concern levels to understand the consumers’ concern about each production method. Table 9 shows the estimation result of equation (2). Dependent variable is the concern level of respondents on pork production method. We regressed the “Normal” and “Lactic” concern separately. The results shows that we cannot explain their concern level very well due to the data constraints. However, it does clarify that the income level has a positive relationship with their anxiety level on “Normal” pork significantly while the same has no impact on “Lactic” pork risk perception. Combining with the previous result in table 9, income has an indirect impact on lactic pork choice. It is seen that the more income they have, they tend to feel that the “Normal” pork is unsafe and choose the alternative “Lactic” method instead.

5. Conclusion

The aim of this study is to investigate preferences for immune-health promoted pork. The results of the questionnaire survey and estimation showed that sample consumers accept the “Lactic” immune-health promoted pork more than the “Normal” pork. It means that consumers evaluate unknown new food technology for the case of lactic acid bacteria fed pork. We examined respondents’ positive preference on “Japan” pork reflecting Japanese consumers’ food safety consciousness.

Detailed empirical analysis on pork choice shows that brand lovers tends to choose the “Lactic” pork. It indicates that the name of the lactic acid bacteria has a positive impact like a popular brand name. On concern levels of production method, it is clarified that those who feel that the “Normal” production method is unsafe prefer “Lactic” pork. Furthermore, on the determinants of the concern level, the rich people tend to feel “Normal” pork risky.

Based on the discussion so far, we can derive strategies to stimulate demand for “Lactic” pork. First, we can target the brand lovers and rich people as they tend to choose the lactic acid bacteria fed pork more than other groups. However, the questionnaire survey shows around half of the respondents feel weakly or strongly unsafe about this new food technology.
Therefore, we need to ease this anxiety when we disseminate this technology by showing safety evidences.

About limitation of this study, the analysis does not clarify the detailed determinants of risk perception on new food technology due to data constraints. To explore the possibility of new food technology diffusion, both the consumers’ and producers’ behavior should be taken into consideration. We only focused on the acceptance by consumers’ and nothing is discussed about technology adoption by producers’. Detailed analysis on risk perceptions and comparative study between additional willingness to pay and costs are required for future study.

Notes
1) Sawada [13] provides overview on economic evaluation on food safety. Most of the food safety studies in Japan are published in Japanese. Dhivya et al. [7] provide literature review on food safety analysis conducted in Japan and India, written in English.
2) Kobe University established the Research Center for Food Safety and Security in April 2006, and in February 2007, the University of Tokyo opened the Research Center for Food Safety.

Reference
[1] Aizaki, Sato, Yoshikawa, Sawada, “The effect of attitudes on food safety on beef selection behavior: Choice Experiments Considering Social Psychological Factors –” Japanese Journal of Farm Management, 42(2), 2004, 22-32 (in Japanese)
[2] Aizaki H., Sawada M., Sato K., Kikkawa T. "Consumer Preferences for Production Information Disclosed Beef and BSE-tested Imported Beef: An Application of Choice Experiments" Agricultural Information Research, 15 (3), 2006, 293-306 (in Japanese).
[3] Aizaki, H., Nishimura, K., “Introduction to conjoint analysis using R” NARO report (Noukouken Gihou) 206, 2007, 151-173 (in Japanese)
[4] Aizaki, Sato, Iwamoto, “Impact of consumer's knowledge and attitude against the social acceptance of fertilized egg cloned cattle derived products”, Nougyou Jouhou Kenkyu, 13(2), 2014, 130-154 (in Japanese)
[5] Andreas K., Yabe M., “Assessing the Impacts of Alternative ‘opt-out’ Formats in Choice Experiment Studies: Consumer ‘Preferences for Genetically Modified Content and Production Information in Food.” Journal of agricultural policy research, 5, 2003, 1-43 (in Japanese).
[6] Chae Y. W., Sasaki I., Wada D., and Seo S., U., “The Influence of The Food Poisoning Scandal on Milk Consumers' Willingness To Pay for Food Safety.” Journal of Agricultural Economics Society of Hokkaido, 11 (1), 2003, 16-31 (in Japanese).
[7] Dhivya, R. Takashino, N and Fuyuki, K “Food Safety and Consumer Behavior in India and Japan: Comparative Literature Review” Journal of Farm Management Economics, 48, 2017, 84-96
[8] Hosono H. "Consumer Preference for Milk Attributes: A Choice Experiment Approach with Focus on Food Safety and Nutrition" Proceedings of annual conference of the Agricultural Economics Society of Japan, 2003, 317-319 (in Japanese).
[9] Kameyama H., Goda K. "Choice experiment model for fresh vegetable: traceability is matter?" Journal of Kagawa University Agricultural Science, 61, 2009, 27-33 (in Japanese).
[10] Matsuoka A., Yamafuji A., Sumida S.
要旨:近年、有害化学物質による食品汚染のリスク、遺伝子組換え食品の商業化、食品産地等の偽装スキャンダルなど、さまざまな要因により、食品安全に対する消費者の懸念が世界中で高まっている。食品の安全性に関する懸念を受けて、多くの大学が食品安全に関する研究と教育に従事している。東北大学は、2015年4月に食物農業免疫学国際教育研究センター（CFAI）を立ち上げた。このセンターでは、食と農免疫に焦点を当てた研究を行っている。農免疫とは、農畜水産物の免疫機能を強化して健康的な育成を実現する新技術の総称である。このような新しい食品技術を普及させるためには、消費者の需要や選好を調査する必要がある。本稿では、新しく開発された食品技術である健康を増進させた豚肉に対する消費者の評価を検討することを目的とする。日本の消費者、300人の回答データを用いて、豚肉属性の個人的な選好を検証するためにコンジョイント分析を適用する。このデータをもとに、豚肉の属性（生産地、生産方法、価格）に関する個人の選好を推定する。その結果、消費者は免疫力を強化した豚肉を、通常の製造方法で飼育された豚肉よりも高く評価することが示された。また、国内産の豚を好む傾向や、ブランドを好む消費者ほど免疫機能を強化した豚肉を選ぶ傾向が明らかとなった。豚肉の生産方法への不安度の決定要因については、高所得であるほど通常の生産方法に懸念を持つ傾向が示された。

キーワード: 消費者、選択実験、豚肉、農免疫

(Accepted 26, April 2018.)