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［報告論文］

中国におけるHACCP認証豚肉の消費者評価と普及可能性

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Consumer Evaluation of and Potential Market Expansion for HACCP Certified Pork in China: The Potential Impact on the Pork Industry

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要旨

中国の豚肉生産・流通過程におけるHACCPシステムの導入は安全な豚肉を供給する方法の一つとして期待される。本研究では中国の消費者を対象とした選択型コンジョイント分析によって、豚肉のHACCP認証に対する評価とHACCP普及に必要な条件を明らかにした。その結果、豚肉のHACCP認証ラベルは消費者から肯定的に評価されていることがわかった。今後HACCP豚肉の普及を促進するには認証ラベルの掲示やHACCPの安全性を消費者に周知することが重要である。

I. Introduction

Pork is a traditional meat in China, and accounts for 65% of China's total meat consumption (National Bureau of Statistics of China [9]) China is also the largest pork producing and consuming country in the world; almost half of the world's total pork production is produced and consumed in this country. However, outbreaks of pork-related food poisoning have occurred with increasing frequency in recent years, and the number of infected patients is increasing (Hu et al. [6]).

Hazard Analysis Critical Control Point (HACCP) is an effective method employed to prevent food contamination from chemical and biological hazards (FAO & WHO [3]). HACCP-processed pork is sold on the Chinese market and pork-related food poisoning has never occurred from this kind of pork. However, the market share for HACCP-processed pork remains very low. Furthermore, the safety of HACCP-processed pork is not well known among consumers; therefore, while some pork producers have introduced the HACCP processing system to ensure the quality of their products, their products are not, as yet, labeled as HACCP certified. The willingness of consumers to pay a higher price for HACCP-processed pork would be a financial incentive for producers to implement the HACCP system. This would result in increased production of pork guaranteed to be safe, as well as improvement in sanitary conditions of the pork industry.

The HACCP system is still a novel approach to food safety in China, and, to date, little research has been done to evaluate consumer preferences towards HACCP labeling. Wang & Mao [16] analyzed the willingness of consumers to pay for the HACCP label on milk products in Beijing, and Wang [15] examined the profitability of introducing the HACCP system for milk producing companies, especially after the melamine poisoning scandal (Pei et al. [10]). Furthermore, some papers have discussed the merits of introducing the HACCP system to pork processing. For example, Deng et al.[2] discussed the role of HACCP in the pork production system and the advantages of its introduction. Gan [4] reported that the HACCP

system is an effective tool for restricting bacterial contamination during pork processing. However, while most of these studies relate to a discussion of the HACCP system, little effort has been made to determine the willingness of consumers to pay (WTP) for the HACCP label on pork products in China.

The purpose of this study is to assess the WTP for HACCP processed pork, as well as to investigate the factors affecting Chinese consumer preference for the HACCP label on pork. This study is organized as follows: Section II briefly explains of outbreaks of pork-related food poisoning in China, as well as the HACCP pork processing system. Section III describes study methodologies. Section IV presents the results and discussion. Concluding remarks are made in the final section.

II. Background

1. Safety Risk of Chinese Pork

In China, in 2001, over 1000 people became ill in Guangdong Province after consumption of a contaminated pork based product. One person even died in Guangdong Province on March 19, 2006. This death was the first reported death related to clenbuterol in the world. In addition, 300 people were poisoned in Shanghai in September 15, 2006 (Lai et al., [7]). Statistical data collected by the University of Shenzhen, from 1,680 reports of the National Knowledge Infrastructure and Chinese Science Citation Database, indicates that, from 1999 to 2005, at least 2,455 people in 13 provinces were hospitalized from pork-related clenbuterol poisoning (Hu et al. [6]).

Clenbuterol is a type of growth hormone. The addition of clenbuterol to animal feed can make pigs grow faster and produce leaner meat. Although the use of clenbuterol in feed is illegal in China, its use continues. About 95% of pig farms in China are small-scale, comprising a herd of less than 10, and pigs raising is the main income source for these farmers (Wang [14]). In a number of cases, clenbuterol was used to increase productivity. Even though an inspection system exists to detect clenbuterol contamination in pork, inspection rates vary among regions and detection is not always 100%. In some places, inspections are not strictly enforced and pork distributors can easily pass inspections even if this pork products are contaminated with clenbuterol (Zhou [17]).

On the other hand, while the presence of clenbuterol in pork is of grave concern, contamination with Salmonella and Escherichia coli is also a serious issue. According to the testing of meat samples collected in Shenyang, in 2003, approximately 85% and 40% of pork respectively was contaminated with Salmonella and Escherichia coli (Shun et al. [13]). Moreover, as an extreme example, meat from dead infected animals has been sold in China. This type of unethical crime is often reported in the newspapers (Peninsula City News [11]).

2. HACCP pork production system in China

In China, pigs are traditionally slaughtered in the middle of the night, and the meat is sold in the morning. The advantage of this slaughtering method is the freshness of the meat, while disadvantages include the lack of sanitary controls and lack of traceability concerning the origin of the pork. Traditional types of pork are mainly supplied by small-scale farmers with less than 10 head of pigs; one hundred and one millions such small-scale farmers were reported in 2005. Clenbuterol is widely used by these farmers (Wang [14]; Zhou [17]).

Compared to traditional pork, pork produced under the HACCP processing system is commonly referred to as "chilled pork", because the temperature during pork processing is controlled at between 0-4 °C. There are two advantages of employing HACCP to prevent pork-related food poisoning. The first advantage is the traceability of the HACCP system in finding sources of contamination. Under this system, data must be collected on pigs slaughtered, such as where the pigs were raised, the type of feed used, and any medicines administered for disease control. Therefore, if contamination, such as from clenbuterol, did occur in HACCP processed pork, the contamination source could easily be found, thereby preventing food-related poisoning and ensuring that those

responsible were held accountable (Deng et al. [2]). This is why clenbuterol pork poisoning has never occurred in HACCP processed pork. The second advantage of HACCP is limitation of the incidence and spread of bacterial contamination by restricting the temperature (0-4 ° C) of the entire processing and transportation system (Deng et al. [2]). To date, only a few large pork producers in China have introduced the HACCP system.

III. Methods

1. Questionnaire design

A survey for this study was conducted in Shenyang, China in October, 2010. At first, difficulties were encountered in obtaining data via supermarkets or the internet, because respondents were unwilling to provide personal information such as age and income, vital information for this study. Therefore, data collection relied on the main investigator's personal relationships. Data from 232 questionnaires were collected from the employees of six construction equipment companies, members of one civilian association, schoolteachers of two primary schools, and doctors at one hospital. The surveys filled out by 10 nonpork buying teenagers were discarded during the data analysis.

Conjoint analysis was employed in this study; two attributes with two levels, and the attribute of price with four levels generated 16 fullprofile cards for respondents to fill in (Table 1). Among these, four profiles were deleted because they were deemed unrealistic (i.e., the combination of "Not chilled but with HACCP label"). Prior to answering the survey, respondents were provided an explanation of what HACCP entails.

Table 1. Attributes and levels for conjoint analysis

Attributes	Levels	
Type of pork	Chilled=1;	Traditional=0
HACCP Label	With label=1;	Without label=0
Price	10, 12, 14, 16,	(Yuan/500g rib meat)

2. Model

The basis of conjoint analysis is the random utility theory, which assumes that choices are based on utility comparisons between available alternatives, and the alternative that provides the highest utility would be the preferred choice (McFadden [8]).

The utility function of this model assumes that the observable component of utility V_{ij} is known for each individual i and individual alternatives j. Without the covariates with the exception of the error term ε_{ij}, and not considering the individual attributes (Model A), the observable deterministic component of the indirect utility function V_{ij} is;

$$V_{ij} = \beta_{ASC}ASC_{ij} + \beta_1 CHILLED_{ij} + \beta_2 HACCP_{ij} + \beta_3 PRICE_{ij} \quad (1)$$

The variable ASC is an alternative-specific constant; it represents a dummy for the respondent's choosing the status quo alternative in the choice set. ASC captures the utility of an alternative that the attributes fail to capture.

However, in this study, individuals of different age groups should have different preferences for the HACCP label. To understand those differences, a new model (Model B) was created:

$$V_{ij} = \beta_{ASC}ASC_{ij} + \sum_{h=1}^{8}\lambda_h CHILLED_{ij}S_{h,i} + \sum_{h=1}^{8}\psi_h HACCP_{ij}S_{h,i} + \beta_3 PRICE_{ij} \quad (2)$$

In which $S=(S_1,S_2,S_3,S_4,S_5,S_6,S_7,S_8)$=(Age 20-29, Age 30-39, Age 40-49, Age 50-59, Age 60-69, Dummy sex [man=1], Dummy married [get married=1], Dummy education [4 year university degree =1]), and the λ_h, ψ_h and β_3 are the parameters which should be estimated in the conditional logit model.

IV. Result and Discussion

About 80% of the respondents ranged in age from 30 to 60, and their education level was relatively higher than China's average (Table 2). Furthermore, because most respondents were not familiar with the HACCP system (Figure 1), an explanatory note about HACCP pork processing system was presented in the questionnaire. The

respondents answered the conjoint questions after reading the explanatory note (a similar method has been employed in other research, i.e., Saito et al. [12]). Moreover, as there is currently no HACCP labeling of pork in China, the conjoint questions were included as a hypothetical choice. Therefore, there should be a bias because of the high age and education level of the respondents, as well as the note explaining HACCP.

The results of this study reveal a number of factors that contribute to consumers' WTP for the HACCP label among the working population in urban areas, and can be used in the targeting of HACCP advertising to a specific audience.

According to Hensher et al.[5], the values of McFadden's $\rho 2$ between 0.2 and 0.4 are considered to be extremely good fits. McFadden's $\rho 2$ indicate that both models have appropriate goodness-of-fit (Table 3). Furthermore, according to the Akaike Information Criterion (AIC), Models A and B have the same value, so that both models fit equally well to the data (Akaike [1]).

To test whether the conditional logit model is appropriate, the Hausman-test of the Independence of Irrelevant Alternatives (IIA) assumption was carried out (Hensher et al.[5]). The hypothesis of IIA means that the ratio of the choice probabilities of any pair of alternatives is independent of the presence or absence of any other alternative in a choice set (Hensher et al.[5]). There are three alternatives for this study: 1) pork not chilled and without HACCP label, 2) pork chilled and with HACCP label, 3) pork chilled and without HACCP label. To conduct the Hausmantest under the IIA assumption, the statistic software NLOGIT (Version 4.0) was applied, and the results are presented in Table 5. The table shows that the assumption of IIA is rejected at the 1% level of significance. Therefore, it would be desirable to use other choice-based models such as the nested logit model. However, for ease of computation and interpretation of the results, the authors continued to rely on the conditional logit model.

In the results of Model A, which did not consider individual attributes (Table 3), all coefficients on the attributes in the indirect utility function were statistically significant at the 1% level (Table 3). The mean WTP for the HACCP label calculated from this model was 9.96 Chinese Yuan (Table 4). In model B, which took into consideration individual attributes, the respondents in their 30s and 40s showed extremely high marginal WTP (13.72 and 10.86 Yuan, respectively: Table 4) for HACCP labeling, but marginal WTP was not significantly associated with sex, marriage, and education level (Table 3). Although respondents in their 30s and 40s showed high WTP, their education level was much lower than the sample average (among 126 people aged 30 to 49, only 27% attained more than a three-year college degree, whereas the sample average was 61.6 % (Table 2)). Therefore, it can be considered that the education level had no influence on the WTP, as indicated in Table 3.

Table 2. Summary statistics for demographic variables

	Numbers	Percentage %	China's average %
AGE			
20-29	27	11.6	14.0*
30-39	63	27.2	15.9*
40-49	63	27.2	17.6*
50-59	58	25	14.0*
60-69	21	9	8.2*
SEX			
Female	148	64.1	51.4*
Male	84	35.9	48.5*
MARITAL STATUS			
Married	193	16.8	#
Not married	39	83.2	#
EDUCATION			
Less than 3 year college	89	38.4	92.7*
More than 3 year college	143	61.6	7.3*

Note: #Indicates no available data. *Indicates the percentage of China's whole population
Source: Surveyed data, 2010, National Bureau of Statistics of China

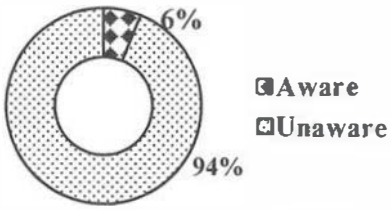

Figure 1. Awareness of HACCP

Table 3. The results of conjoint analysis

	Model A			Model B		
	Coefficient	t-value		Coefficient	t-value	
ASC	2.33	12.13	***	2.39	12.12	***
Chilled Pork	0.49	3.25	***			
Chilled*age20s				1.37	3.14	***
Chilled*age 30s				0.10	-0.19	
Chilled*age 40s				0.61	1.17	
Chilled*age 50s				1.32	2.51	**
Chilled*age 60s				0.85	1.44	
Chilled*sex				-0.41	-1.78	
Chilled*married				-0.18	-0.39	
Chilled*education				0.10	0.44	
HACCPLabel	2.79	17.42	***			
HACCP*age20s				1.51	2.46	**
HACCP*age30s				3.98	5.19	***
HACCP*age40s				3.15	4.10	***
HACCP*age 50s				2.49	3.27	***
HACCP*age 60s				2.69	3.18	***
HACCP*sex				0.13	0.42	
HACCP*married				-0.11	-0.17	
HACCP*education				-0.07	-0.21	
Price	-0.28	-17.51		-0.29	-17.39	***
Log likelihood function	-779.45			-761.31		
Restricted log likelihood	-1231.87			-1231.87		
Akaike Information Criterion	0.84			0.84		
McFadden's ρ^2	0.37			0.38		

Notes: *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Currency unit: Chinese Yuan (1 Yuan ≒ 14 Yen)

Table 4. WTP for HACCP label (Unit: Chinese Yuan)

	Model A	Model B
Mean WTP for HACCP label	9.96	
WTP for HACCP label (age 20s)		5.21
WTP for HACCP label (age 30s)		13.72
WTP for HACCP label (age 40s)		10.86
WTP for HACCP label (age 50s)		8.59
WTP for HACCP label (age 60s)		9.28

Notes: 1 Yuan ≒ 14 Japanese Yen

Table 5. Test of independence of irrelevant alternatives (IIA)

Alternative dropped	$\chi^2(9)$	Probability
1)Not chilled and without HACCP label	520.41	0.00
2)Chilled and with HACCP label	82.98	0.00
3)Neither 1) and 2)	259.27	0.00

Notes: The IIA property is rejected at the 1% level of significance ($\chi2(9)=2167$)

According to the consumer survey conducted in October 2010 in Shenyang, normal rib meat sold at the supermarket was 11 to 13 Chinese Yuan, whereas chilled pork processed according to HACCP standards and sold in a chain meat store was around 14 to 15 Yuan. Therefore, according to the results of this research, the WTP for HACCP-processed pork was estimated as 21 to 23 Yuan (11 to 13 plus 9.96). This indicates that among working urban dwellers, if they are aware of HACCP and the chilled pork is HACCP-labeled, the probability that this group will pay a higher price is high.

This study had some sampling bias associated with the consumer age group 30 to 49, who had higher incomes than the other age groups. This might be the reason for the very high mean WTP; however, even the respondents in their 20s showed a WTP of 5.21 Yuan. As the normal pork price is 11 to 13 Yuan, consumers in their 20s might view the HACCP-processed pork (16 to 18 Yuan) as much higher than the market price, but still be willing to pay the difference.

In this study, respondents in their 30s and 40s showed extremely high WTP for the HACCP label. This implies that there exists a huge potential demand for HACCP-processed pork among urban consumers in their 30s and 40s. According to these results, HACCP-processed pork producers could effectively develop market share for their products by focusing on consumers in urban areas aged 30 to 49.

Approximately 20% of China's population is in the 30 to 49 age category, and 60% of those live in urban areas (National Bureau of Statistics of China [9]). Multiply this by China's total population and it can be roughly estimated that there are 162 million people (1350 million x 20% x 60%) who might show great WTP for HACCP-processed pork. Even when solely focusing on urban dwellers in their 30s and 40s (162 million people is more than the total population of Japan), this represents a significant potential HACCP pork market, conceivably having huge benefits for the pork producers who implement HACCP standards.

In this study, conjoint analysis was conducted after respondents received an explanation of HACCP. Prior to this, most were unaware of HACCP and its significance (Figure 1). In order to stimulate a high WTP among the working population in urban areas for HACCP-processed pork, it is imperative they be made aware of the advantages of HACCP processing in pork. Therefore, effective and targeted advertising of HACCP is needed.

V. Conclusion

The survey data indicates that, after an explanation of HACCP, the WTP price point for HACCP-processed pork among the working population in urban areas is between 21 to 23 (11 to 13 plus 9.96) Yuan. The respondents in this group, who were in their 30s and 40s, showed high preference for HACCP-processed pork. Therefore, huge potential demand for HACCP-processed pork exists among urban dwellers aged 30 to 49. However, to stimulate this demand, strategically-targeted advertising of HACCP is required.

To create a market for HACCP-processed pork, producers should first target consumers in their 30s and 40s living in urban areas. The target population is large, greater than the total population of Japan; therefore, if target demand is stimulated, most producers would benefit from the introduction of the HACCP system. After establishing the core target group, the market strategy could be expanded to include other age populations in urban areas, and then the total population.

To stimulate a demand for HACCP, effective advertising is crucial. Although consumer concern regarding pork safety has increased, if the benefits of HACCP are not widely known, consumers might not view it as a viable choice. Therefore, if demand for HACCP pork is stimulated, resulting in a subsequent increase in its market share, not only would producers benefit from the introduction of a HACCP system, consumers would benefit from improvements in pork safety.

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