ARE BEEF MERCHANDISERS IN SOUTH KOREA WILLING TO ADOPT FOOD-SAFETY ENHANCING TREATMENTS OF IMPORTED CHILLED BEEF?

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Key words: Food safety technology, Korean Beef Buyers, Willingness to pay premium for food safety attributes Beef Quality and Safety

ABSTRACT

This study examined a survey data set of 840 observations from 105 beef merchandisers in South Korea, regarding their perceptions toward food safety-enhancing treatments on imported chilled beef products. Estimation of a multinomial logit model (MNL) indicated that price and meat color attributes are important in determining Korean beef buyers' purchase choice. The study results showed that the Korean beef buyers are willing to pay a premium (10 %) for bio-preservatives packaging, while they are reluctant to accept steam pasteurization technology. The Korean beef merchandisers' positive response toward bio-preservative treatment suggests that adoption of this food safety technology may contribute to improvement of quality control of imported chilled beef in the Korean beef market.

Ⅰ. Introduction

Highly publicized international food safety incidents had significant negative impact on the Korean beef market. Outbreaks of *Foot &*

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Mouth Disease (FMD) and *E.coli* O157:H7, and *Bovine Spongiform encepphalopathy* (BSE)-known as 'Mad Cow' disease in the beef industries around the world in recent years have led to significant loss of consumer confidence in the safety of imported beef in South Korea. For example, per-capita beef consumption marked 8.1 kilograms in 2003, sliding from 8.5 kilograms in 2002 (Korea Times 2004). This decline in beef consumption is primarily due to the outbreak of BSE in major beef exporting countries such as Canada and the U.S. The profile of the beef industry in South Korea has increased to unprecedented heights and several other countries and exporters are required to develop strategies to assure the quality and safety of imported beef. This may involve extensive product differentiation and value-added processing that enhance the safety of beef products.

As buyers from beef exporters and sellers to consumers, purchasing patterns and behaviors of beef merchandisers (i.e. importers, wholesalers and retailers) have significant impacts on demand for imported beef in South Korea. Therefore, beef exporters should develop marketing strategies that would respond to these beef merchandisers' concern on the safety and quality of imported beef products.

Objective of This Paper

While bio-preservative packaging and steam pasteurization on imported chilled beef suggest several benefits for beef exporters and merchandisers in South Korea, the value which the merchandisers derive from these value adding process has not been verified through independent research. The objective of this paper is to empirically identify the Korean beef merchandisers' willingness to pay for the food safety-enhancing treatments on the imported chilled beef.

This study examined a survey data set of 840 observations from 105 beef merchandisers in South Korea, regarding their perceptions toward these food safety-enhancing treatments on beef. The information derived from this study sheds light on the potential prospects of selected food safety-enhancing treatments as effective

quality assurance and safety measures, contributing to improvement of food safety system in Korea's chilled-beef sector. Findings from this study may facilitate an effective development of food quality and safety control system throughout Korean beef supply chain as it helps exporters' planning process for future beef marketing activities in South Korea regarding product/service design, pricing and packaging strategy, and selection of distribution channel and communication strategy.

II. Marketing Issues in Korea's Beef Sector

1. Impacts of Beef Import Liberalization on Beef Merchandising

The Korean beef market is undergoing a number of structural changes to accommodate marketing of imported chilled beef. On January 2001, the Korean government liberalized importation of beef in South Korea by replacing import quota with tariff at 41.6 percent (USDA 2001). Prior to the market liberalization, imported beef was distributed and retailed mainly in frozen form which led to substantial perceptual quality difference from domestic chilled beef. Korean consumers have a negative perception of the quality of imported beef, associating imported beef with lower quality and frozen beef (Kim 2003). As the Korean market liberalized, beef exporters and Korean importers are increasingly marketing chilled imported beef to improve Korean consumers' negative image on the quality of imported beef.

Currently a few major import trading companies in South Korea are preparing to establish more efficient distribution system of imported chilled beef by building large scale cold storage system (Interview 2001). These companies usually have vertically integrated retail outlets for beef marketing. Retailers and wholesalers in South Korea emphasize the importance of packers' ability to supply specific cuts of chilled beef in large volume, particularly high-value cuts such as tender loin and chuck eye roll. Korean retailers are emphasizing the quality and safety attributes of imported beef, and promoting store-branded imported chilled beef

by forming vertical integration with foreign packers (Interview 2001). Thus, brand image and quality consistency and safety of beef in the supply of foreign packers are becoming important in the highly integrated marketing chain of Korean chilled-beef market segment.

2. Importance of Consumer Concerns for Food Safety and Introduction of Traceability in the Korean Beef Supply Chain

Outbreaks of several animal diseases such as Foot and Mouth Disease (FMD), BSE, bird-flu and *E.coli* O157:H7 in recent years led to significant reduction in consumer confidence of food safety system in South Korea. Restaurant sector in Korea, serving beef dishes as their main menu, is suffering from substantial sales decline in the first quarter of 2004 as Korean consumers are avoiding beef serving restaurants since the BSE outbreak in the U.S. in December 2003 (Yeo 2004). This is suspected to be due in large to Korean publics' distrust in overall food safety level in Korea and in Korean government's food safety regulation.

In order to restore consumer confidence in beef and regain consumer beef consumption, several large retailers and wholesalers are implementing a "traceability" system in beef marketing. Traceability, by definition, is the "ability to trace the origin of materials, parts, the processing history and the distribution and location of the product after delivery" (Codex Alimentarious Commission 2001). For example, Korea Cold Storage Co. introduced a Hanwoo traceability system in February 26, 2004. Korean Consumers would be able to obtain this traceability information over the internet on their homepage (www.hannaeng.co.kr). Other major Korean beef suppliers such as Nonghyup, Lotte and Hanaro are also introducing this supplier driven traceability system to enhance consumer confidence in beef safety (Kim 2004). This market trend suggests that consumer interest and concerns for safety and quality of beef is a major factor determining the dynamics of beef supply operation in South Korea.

As the Korean beef merchandisers are adopting this new

food safety control measure, they are expected to increasingly consolidate vertical integration with specific foreign packers since traceability system requires specificity at various stage of beef supply chain. Foreign packers who can provide quality assurance and enhanced food safety measures may become competitive in South Korea as the Korean beef merchandisers are likely to integrate with beef supplier who has reliable quality assurance system in place.

3. Changes in Food Safety Regulatory Policy Regarding Chilled Beef Imports

The Korean government decided to remove an important food safety regulation of imported beef that control marketing of beef products stored in different physical states (frozen vs. chilled) in 2003. This handling regulation required imported beef that enter Korean market in chilled condition to be marketed only as chilled products within South Korea. This has been a significant constraint for distributors in handling of imported chilled beef, since shelf life of imported chilled beef is much shorter than that of domestic chilled beef. The shelf life of imported chilled beef is approximately 90 days from the date of processing, and transportation of products from exporting nations to South Korea usually takes about 30 days, leaving 60 days of shelf life for imported chilled beef to be merchandised within the Korean market (Interview 2001).

The removal of this food safety measure allows the freezing of chilled meat as it gets close to the end of its shelf-life and gives meat retailers more flexibility in handling more imported chilled meat than in the past (USDA 2003). The option of freezing chilled meat has allowed retailers to carry more high value chilled imported beef. Thus, it is anticipated that Korean retailers' interest in marketing chilled imported beef will significantly increase as it provides opportunity to market more product varieties to consumers and increases their competitiveness relative to competing retailers.

One major hurdle faced by beef exporters in marketing chilled beef to South Korea is the quality assurance issue since

longer distance between South Korea and exporting nations dampens quality aspects of chilled beef regarding color stability and microbial contamination. The consistency of quality and assurance of safety in imported beef are reported to be crucial in improving overall image of imported beef compared to domestic beef in the Korean beef market (Interview 2001).

4. Food Safety and Quality Enhancing Technologies

Beef exporters and packers are attempting to improve the quality control management of chilled meat and to add value to their products in import markets by applying food technologies such as bio-preservative packaging that reduce food safety risks (Interview 2001). Application of natural anti-microbial agents (i.e. NAD + ascorbate) into the packaging system can provide opportunity to stabilize and reduce transient discoloration of meat and protect against premature microbial deterioration, extending storage period to longer than eight weeks (Holley 2001). Thus, application of bio-preservative packaging allows beef exporters to differentiate their beef products by maintaining important quality attributes (i.e. meat color) and by reinforcing the safety of beef products. The bio-preservative also extends the shelf life of chilled beef, allowing more flexible marketing of chilled beef to distant oversea market.

Steam pasteurization is another value adding process that is promoted by some beef exporters and packers as a control measure to assure food safety of imported beef in South Korea (Interview 2001). Several large beef producers in the U.S. and Canada have adopted steam pasteurization systems, which gained USDA approval for use on beef in December 1995 (Majchrowicz 1999).

These systems pass freshly slaughtered beef carcasses, already inspected, washed, and trimmed, through a chamber that exposes the beef to pressurized steam for approximately for 6 to 8 seconds, and cool the carcasses with a cold-water spray. This treatment has proven successful in reducing pathogens, such as *E.coli* O157:H7, *Salmonella*, and *Listeria*, without use of any chemicals (Majchrowicz 1999). Thus, packers may promote this treatment as a natural approach to assure the safety of their products in Korean chilled-beef sector.

III. Empirical Modeling and Survey Methodology

1. Conceptual Model

We used Lancaster's characteristics model to determine the Korean beef merchandisers' response to quality and food safety attributes of imported chilled beef. Lancaster's framework conceptualize that goods are not viewed as the direct objects of utility, rather it is the attributes of the goods from which utility is derived (Lancaster 1991). Lancaster's characteristics models have been widely used in evaluating the characteristics of meat products (Chen et al. 2002; Kuperis et al. 1999; West and Larue 2001; Grannis and Thilmany 2002; Bryhni et al. 2002; Umberger et al. 2002; Roosen et al. 2003; Unterschutlz et al. 1997; Quagrainie et al. 1998).

In this study, a merchandiser is assumed to select a product between alternative product choices (Figure 1) that provides the greatest utility. Thus, the probability of selecting an alternative increases as the utility associated with it increases. A merchandiser's utility function associated with the purchase of beef is postulated in terms of the characteristics (i.e. attributes) of a beef product. The overall utility is composed of a systematic component (V), which is a function of the selected attributes, and a random component (e)

FIGURE 1. Sample Question for Beef Merchandisers

Assume that the following alternatives are the only ones available on your next order for Chuck eye Roll Chilled Beef (116D). Would you choose A or B or would you choose neither?

Product Attribute	Alternative A	Alternative B	Alternative C
Price	5852 won	5300 won	
Bio-preservative	Yes	No	Neither
Steam Pasteurization	No	No	Alternative
Meat Color	Good	Average	A nor B
I would choose	( )	( )	( )

(1) $U = V + e$

where V is the indirect utility function that is associated with the attributes of the alternative. Assuming that V is linear in parameters, the indirect utility function can be characterized as:

(2) $V_i = \beta_k X_i$

where $X = (x_{1i} + x_{2i} + \cdots + x_{ki})$ is a vector of k attributes associated with alternative i, and β_k is a coefficient vector. The X vector includes the following characteristics: price, bio-preservative packaging, steam pasteurization treatment and color of the meat. The distribution of the error term is assumed to be IID Gumbel distributed with a scale parameter μ=1 and the probability of choosing an alternative i is defined as the multinomial logit (MNL) model:

(3) $$\pi(i) = \frac{\exp(\mu V_i)}{\sum_j \exp(\mu V_i)}$$

The multinomial logit (MNL) model of Equation (2) was estimated using, the non-linear logit procedure of the statistical program LIMDEP 7.0.

2. Development of Survey Questionnaire and Data Collection

To obtain data of the merchandisers' responses to selected attributes of imported chilled beef, stated preference (SP) survey method is used. The SP survey method has been widely used in evaluating the characteristics of meat products (Kuperis et al. 1999; Unterschutlz et al. 1997; Quagrainie et al. 1998). SPmethod is used to illuminate the relative trade-offs buyers are willing to make across beef products. The respondents were asked to choose between two alternatives with varying attribute levels.

One of the main advantages of using this SP method is valuation of tradeoffs in a dollar metric that are made by buyers in answering SP questions. In other words, SP analysis allows quantification of beef attribute values that are placed by Korean

beef merchandisers.

Preliminary interviews and a focus group discussion were conducted with twenty Korean beef industry experts in January 2001 to determine the specific attributes and the levels of each attribute.

Four attributes were selected from these preliminary interviews: (a) price, (b) bio-preservative packaging (c) steam pasteurization treatment, and (d) color of the meat (Table 1).

TABLE 1. Estimated Coefficients of the Multinomial Logit Model

Factor	Factor Level	Coefficient	t-statistic
Price / 1.	5100 won	-0.221	-2.610*
	5352 won	0.784	7.634*
	5500 won	0.136	1.508
	5852 won	-0.699	-6.631*
Bio-Preservative	Bio-preservative added	0.201	3.605*
	No bio-preservative	-0.201	-3.605*
Steam Pasteurization	Steam Pasteurization treated	-0.168	-0.329
	No steam pasteurization treatment	0.168	0.329
Color	Very Good	0.427	4.899*
	Good	0.913	9.581*
	Average	0.240	2.458*
	Poor	-1.579	-11.295*
Log likelihood function		-769.687	
Log likelihood ratio test (χ^2 statistic)		297.18*	
Pseudo R^2/ 2.		0.154	
N (number of respondent)= 105			

Note: * indicates significance at 95% confidence level.

1. Range of price level was determined based on wholesale price of imported beef in 2000 in South Korea.
2. Following Ben-Akiva and Lerman (1985), McFadden's adjusted R^2

Identified attributes and attribute levels were used to construct alternatives of hypothetical beef products by employing the design of fractional factorial experiments. The preliminary interviews also suggested that a specific beef cut should be given in the survey questionnaire as an example that respondents can consider as a reference in their decision-making. Our survey questionnaire was framed to elicit merchandisers' purchasing choice for 'chuck eyeroll 116D' chilled beef, which is considered to be one of the major type of high value beef cuts that are traded in the Korean beef import market.

The survey questionnaire was pre-tested on a small sample to ensure that respondents would find the survey clear and realistic. In-person survey interview was conducted from January to Februarys of year 2001 in South Korea. Respondents were asked to choose from choices A, B and C that provide different profiles of beef products in terms of the specified attributes (Figure 1).

The interviewer met 105 respondents including retailers, wholesalers and importers in the Korean beef industry. This sample includes: senior purchasing managers in major Korean supermarket chains (including senior traders and buyers in top fifteen Korean supermarket chains and department stores) and senior buyers and traders in medium to large scale beef import and wholesale companies. The selected retailers, wholesalers and importers are beef merchandisers who are interested in marketing specialized and differentiated beef products under an effective food safety and quality assurance system in order to enhance their private brand image or business reputation. Therefore, these buyers are potential target market that is likely to purchase beef products that incorporate certain food safety enhancing attributes and to pay premium. In general our survey respondents can be considered as a representative of the characteristics of the Korean beef merchandising industries as it covers relatively large number of major players in the business. The Canadian Beef Export Federation (CBEF) facilitated the sample selection process and the interviews were conducted in the Korean language.

Ⅳ. Results and Discussions

The empirical results are presented in Table 1. The model has a reasonably good fit (Pseudo R^2 = 0.16) and the parameters that are statistically significant had signs consistent with our expectations. Estimates of the coefficients indicate the relative effects of attributes on the probability of a buyer choosing either alterative A or B based on the specified attribute level.

The coefficients on price variable indicate that the beef merchandisers tend to prefer a price range between 5500 won to 5352 won for chuck eyeroll (116D). The results reveal that bio-preservative packaging of imported chilled beef has a significant positive effect on merchandisers' utility. Treatment of imported beef with the steam pasteurization, however, has a negative effect on the merchandisers' utility, indicating that there is market resistance toward application of this food safety technology to beef products in South Korea.

Willingness to Pay for Food Safety-Enhancing Technologies

The results of estimated coefficients of the MNL model were used to simulate probabilities of product choice and used to estimate the Korean beef buyers' willingness to pay for food safety technologies.

Table 2 presented three scenarios that are simulated, using the value of significant coefficient estimates of the MNL. The first scenario compares two beef products that have identical attribute profiles except the bio-preservative packaging. Our results suggest that the respondents were more likely (20%) to choose a beef product packaged with bio-preservative (choice A) than alternative that had no (choice B). Consequently, the Korean beef merchandisers appear to be willing to pay 10% premium for imported chilled beef that has bio-preservative treatment. Korean beef merchandisers' willingness to pay for this particular food safety measure can be considered as a surrogate for their intent to adopt this technology in the Korean chilled beef marketing.

TABLE 2. Simulation Analysis: Effect of Beef Quality and Safety Attributes on Probability of Purchasing Beef by Korean Merchandisers

Scenario 1: Effect of Bio-Preservatives on Buyers' Choices

	Choice A	Choice B
Price	5352 won	5352 won
Bio-Preservatives Treatment	Yes	No
Steam Pasteurization Treatment	No	No
Meat Color	Good	Good
Probability of Choice	60%	40%
Price Change Required for Indifference between choices A & B	10 %	

Scenario 2: Effect of Steam-Pasteurization on Buyers' Choices

	Choice A	Choice B
Price	5352 won	5352 won
Treatment of Bio-Preservatives	Yes	Yes
Steam Pasteurization Treatment	Yes	No
Meat Color	Good	Good
Probability of Choice	42%	58%
Price Change Required for Indifference between choices A & B	-8.6%	

Scenario 3: Effect of Meat Color on Buyers' Choices

	Choice A	Choice B
Price	5352 won	5352 won
Treatment of Bio-Preservatives	Yes	Yes
Steam Pasteurization Treatment	No	No
Meat Color	Good	Average
Probability of Choice	66%	34%
Price Change Required for Indifference between choices A & B	17 %	

The second scenario compares two beef products that are differentiated by treatment of steam pasteurization. In other words, choice A in scenario 2 was priced at 5352 won and have both bio-preservative and steam pasteurization and good meat color. Choice B in scenario 2 was identical to choice A except that it had no steam pasteurization. Scenario 2 illustrates that the probability of choosing a steam pasteurized beef product is found to be 16% lower than that of a product without the steam pasteurization treatment. The third scenario assesses the importance of meat color in the imported chilled beef product. The beef merchandisers appear to be willing to pay 17% premium for a beef product that has good color compared to a product with average color condition.

Ⅴ. Marketing Implications and Conclusion

The Korean beef merchandisers' positive response toward bio-preservative treatment implies that imported chilled beef with bio-preservative may be perceived by the Korean beef merchandisers as a differentiated product with additional quality and safety control measures. Adoption of this food safety technology may significantly improve management of imported chilled beef associated with food safety and quality in the Korean beef import market.

Findings from this study suggest that the Korean beef merchandisers appear to be willing to pay 10 % premium on beef products that are packaged with bio-preservatives. Since packaging beef products with bio-preservative cost more to process than comparable products without the treatment, beef processors and exporters are inclined to pass on the additional costs of this treatment to the Korean buyers. Thus, it is important for beef processors and exporter that the Korean buyers are willing to pay a premium for such treatment in order to have this value adding process to be economically feasible.

Despite scientific evidence of the effectiveness and safety of steam pasteurization and regulatory approval of the process for application on meat products, the beef merchandisers in South

Korea are not willing to pay a premium for steam-pasteurized beef products. Although steam pasteurization systems have relatively low operating costs as expenses include only those for power to generate steam and to dispose of the small amount of waste water (Majchrowicz 1999), viable adoption of this technology by the beef processors in export countries will ultimately hinge on sufficient demand by beef merchandisers and consumers in the Korean market.

Study findings suggest that any marketing programs and product development that promote food safety features may need to be carefully designed for the Korean beef import market since the level of acceptance for specific food safety technologies (i.e. steam pasteurization) by the beef merchandisers may not be positive despite evident benefits of food safety and quality assurance. In order for beef exporters to capitalize on the advantages of food safety technologies, careful market study and examination of buyer preference for the food safety technologies should be conducted prior to introduction of these technologies.

This study provides some useful information to beef processing firms and exporters by examining Korean beef buyers' interest in food safety enhancing treatments. The econometric models applied in this study include four important factors that are crucial to beef buyers' purchasing decision. In order to have more comprehensive picture of Korean beef industry's preference for quality and safety of imported beef, future study should extend this model by including additional variables such traceability or quality assurance certificate.

In addition, demand for imported chilled beef may be ultimately determined by Korean consumers' preference and perception towards imported beef. Therefore, future study may need to have considerable focus on assessment of Korean consumer acceptance for imported beef with additional food safety features such as bio-preservatives and steam pasteurization.

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