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Consumer preferences for pork safety characteristics in Thailand

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Abstract

The rapidly growing public concern over the safety of pork products in Thailand presents an opportunity for the industry to rearrange its hog farming practices in line with high safety standards to attract a premium. Studies have shown that labelling of safety attributes, including certification for food safety, animal welfare, ractopamine-free production, and country of origin, influences consumers' food safety or quality perception and willingness to pay a premium. This study estimated the preferences and willingness of Thai consumers to pay for pork products labelled with safety attributes using a choice experiment with a mixed logit model. Of the food safety attributes tested, consumers were most willing to pay a higher premium for ractopamine-free certified pork products, followed by labels on the country of origin, food safety certification, and animal welfare certification.

Introduction

Food safety and animal welfare concerns are on a rapid rise globally, which calls into question the sustainability of current production and processing systems and the adequacy of existing legislative and regulatory frameworks. As demand is increasingly dependent on the quality and safety standards of products as perceived by consumers (Loureiro & Umberger, 2007), producers and firms have a responsibility to ensure that food products are safe for consumption and are equally perceived as such. Safety labels with information on the traceability, country of origin, nutritive value, environmental friendliness, and presence/absence of chemical residues are used to assure consumers of the product quality (McCluskey & Loureiro, 2003).

The pork industry has had its share of the food safety challenges. At an average 1.34 percent growth in consumption annually and an average annual consumption of 12.3 kilograms/capital/year, pork is the second most sourced meat after poultry, which has an average consumption of 14.2 kilograms/capital/year (Organisation for Economic Co-operation and Development [OECD], 2020). Diseases like foot and mouth disease, classical swine fever, African swine fever, etc., have threatened hog farming and trade in pork products over the years. At the same time, globally, there is growing pressure on governments to tackle food safety issues and protect consumers by the implementation of policies on product

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labeling and certification (Lai, Wang, Ortega, & Olynk Widmar, 2018; Muringai, Goddard, Bruce, Plastow, & Ma, 2017; Wu et al., 2017). Also, there is a need for the pork industry to develop high-quality products that address consumers' safety concerns (Drescher, de Jonge, Goddard, & Herzfeld, 2012).

In Thailand, pork is the second common source of protein next to poultry. The Thai pork industry has witnessed significant changes in growth, doubling production in response to increasing consumer demand. Pork safety concerns in Thailand have lingered for over a decade, the implementation of policies on food safety monitoring and controlling in the pork supply chain notwithstanding. The Ministry of Public Health's Food Act (No. 269) B.E. 2546 (Ministry of Public Health [MOPH], 2003) prescribes standards for the contamination of foods with beta-agonist chemicals to protect consumers from any potential hazards. Aligned with the 2004 food safety policy, the Ministry of Public Health, in coordination with the Ministry of Agriculture and Cooperatives, has implemented regulations for food quality and safety control according to international standards.

Thai consumers' pork safety awareness has increasingly focused on food safety certification, beta-agonist residue, and pork color (Department of Livestock Development [DLD], 2019), and the government has implemented policies to address these issues. Recently, country-of-origin and animal welfare labeling of pork products was introduced in Thailand but in limited markets and scope. The increase in safety consciousness and low demand for products might make pork safety investments seem unprofitable considering the associated costs, e.g. costs of testing, labeling, safety audits, etc., so consumers' willingness to pay price premiums is crucial to the project's success. Thus, this study examines consumers' preferences and willingness to pay (WTP) for attributes reflecting food safety of pork products.

This article is organized as follows: first, we presented a description of the safety characteristics and a brief overview of the existing literature on pork safety attributes. Then, the methodology section first describes the mixed logit model and then the CE survey design. Finally, we presented the results of the analyses, discussion, conclusions, and policy implications.

Literature Review

Different studies have analyzed pork safety characteristics, focusing on various attributes and consumer willingness to pay. Balcombe, Bradley, Fraser, and Hussein (2016) used a discrete choice experiment to examine the willingness of 490 UK consumers to pay for the country-of-origin labels on multiple meat products. They found that the UK was the most preferred country of origin followed by EU countries, for all meat products, with WTP estimates of 0.84 pound for pork sausages originating from the UK, -0.27 pound for those from the EU, and -0.73 pound for sausages from outside the EU. Klain, Lusk, Tonsor, and Schroeder (2014) elicited the WTP for the mandatory country-of-origin labeling in the USA from 526 respondents and showed a mean WTP of $0.016–$1.08 per pound of steak/chop purchased, depending on the valuation method used and assumptions about labeling knowledge and average volume purchased per choice. Other studies have also shown a positive effect of country of origin labeling on consumer preferences, including Lai et al. (2018); Lusk, Schroeder, and Tonsor (2013); Mørkbak, Christensen, and Gyrd-Hansen (2010); Loureiro and Umberger (2007). Besides disclosing the origin of products, information on the country of origin is one of many clues upon which consumers' perceptions of food safety relies (Lewis, Grebitus, Colson, & Hu, 2017; Becker, Benner, and Glitsch, 2000).

Food safety concerns have been found to have a strong influence on consumer willingness to pay a premium. Lai et al. (2018) found that consumers were most willing to pay a premium for pork safety certification labels compared to the country of origin labeling, ecolabeling, and animal welfare labeling. The food safety attribute had more than twice the value of other attributes in the study. Similarly, Lewis et al. (2017) found a positive WTP for food standard assurance, hormone-free, and gourmet or premium quality beef labels. Consistently, British and German consumers showed the highest WTP for hormone-free beef. Loureiro and Umberger (2007) examined US consumers' relative preferences and WTP for beef attributes and found that the USDA food safety certification labels carried the highest premium of $8.068 per pound of steak among food safety attributes, including country of origin, traceability, and tenderness.

Perceptions and attitudes of consumers toward animal welfare have been investigated in many studies. For example, Clark, Stewart, Panzone, Kyriazakis, and Frewer (2016) showed that the more informed consumers are regarding animal welfare, the greater their concern and WTP for farm animal welfare labeling. Consumers with limited disposable income, however, may not have the financial resources to pay for more expensive welfare-friendly products (WFP). Lagerkvist and Hess (2010)

indicated a positive relationship between WTP and consumer income, and a negative relationship with age. Moreover, French and German consumers exhibited a higher WTP for farm animal welfare labeling than consumers from UK, USA, Sweden, and Ireland analyzed, while Danish consumers showed a lower WTP. Other literature on WTP for farm animal welfare include Ortega and Wolf (2018); Kehlbacher, Bennett, and Balcombe (2012); Tonsor, Olynk, and Wolf (2009); Mørkbak et al. (2010); Moran and McVittie (2008); McVittie, Moran, and Nevison (2006) and (Lagerkvist & Hess, 2010). Most of these studies focused on the safety characteristics and quality preferences for meat, mainly with regard to the country of origin, food safety certification, animal welfare, hormones-free, and traceability labeling.

This study considers Thai consumers' willingness to pay a premium for pork product labels indicating the country of origin, food safety certification, animal welfare certification, and ractopamine residue–free certification. Although the country-of-origin labeling is not yet mandatory in Thailand, it was included in this study to gauge the response of consumers. Consumer confidence in product safety and chemical control standards is reflected in their valuation of the food safety certification labels (Liu, Gao, Snell, & Ma, 2020; Lewis et al, 2017). Animal welfare attributes were used to measure consumers' valuation of the production process and quality associated with the animal welfare standard (Sonoda, Oishi, Chomei, & Hirooka, 2018). In this study, we also included the ractopamine residue-free labeling as a ban on the use of ractopamine in swine production has been in place in Thailand since 2003 (Ministry of Public Health [MOPH], 2003). Moreover, the country is under pressure to make exceptions for pork products from the US, which allows the use of ractopamine under the codex standard.

Methodology

Mixed Logit Model

A discrete choice model (DCM) was used to estimate consumers' preference for pork safety characteristics. The DCM is based primarily on Lancaster's theory of demand supported by random utility theory. DCMs are derived under the assumption of utility-maximizing behavior by a decision maker (Train, 2009). Therefore, the probability P_{ni} that consumer n chooses alternative i is represented by Equation (1).

$$P_{ni} = Pr(U_{ni}>U_{nj}, \forall j \neq i) = Pr(V_{ni}+\varepsilon_{ni}>V_{nj}+\varepsilon_{nj}, \forall j \neq i) = \int_{\varepsilon} I(\varepsilon_{ni}-\varepsilon_{nj}<V_{ni}-V_{nj}, \forall j \neq i) f(\varepsilon_n) d\varepsilon_n \quad (1)$$

where U_{ni} is the utility that the consumer obtains from the alternative, V_{ni} is the representative utility that depends on parameters that are observed, ε_{ni} is a disturbance term that captures the factors that affect utility but are not included in V_{ni}, and $I(.)$ is the indicator function.

Among different specifications of the density of discrete choice models, mixed logit is a highly flexible model that can approximate any random utility model, and it is not restricted to normal distributions (Train, 2009). Mixed logit captures the heterogeneous preferences of individuals by assuming coefficient β_n as a random probability distribution with the density function $f(\beta)$. In this study, consumers' preferences for pork safety characteristics were derived from the utility-maximizing behavior using a mixed logit model. The utility U_{ni} that the consumer n obtained from the attributes of each choice i was estimated (Equation (2)) using the maximum likelihood method as follows:

$$U_{ni} = \beta_1 COOL_{ni} + \beta_2 Food\ safety_{ni} + \beta_3 Ractopamine\ residue_{ni} + \beta_4 Animal\ welfare_{ni} + \beta_5 color_{ni} + \beta_6 Price_{ni} + \varepsilon_{ni} \quad (2)$$

where U_{ni} is the latent unobservable utility level that the n^{th} consumer obtains from choosing the i th pork product types; price, COOL (country of origin), food safety, ractopamine residue, animal welfare, and color are the pork products attributes considered; β_n is a vector of coefficients of attributes representing the n^{th} consumer's preference, and ε_{ni} is a random term that is iid extreme value. The choice probability P_{ni} (Equation (3)) was estimated according to Train (2009).

$$P_{ni} = \int \left(\frac{e^{\beta' X_{ni}}}{\sum_j e^{\beta' X_{nj}}}\right) f(\beta) d\beta, \quad (3)$$

The parameters were estimated through simulation of the log likelihood function, as shown in Equation (4) below.

$$LL = \prod_{n=1}^{N} \prod_{i=1}^{j} \left[\frac{e^{\beta' X_{ni}}}{\sum_j e^{\beta' X_{nj}}}\right] = \sum_{n=1}^{N} \sum_{i=1}^{j} \ln \left[\frac{e^{\beta' X_{ni}}}{\sum_j e^{\beta' X_{nj}}}\right] \quad (4)$$

In order to calculate the mean willingness to pay for each attribute, the MWTP for the attributes was calculated using Equation (5).

$$MWTP_k = -\frac{\widehat{\beta_k}}{\widehat{\beta_6}} \quad (5)$$

where $\hat{\beta}_k$ is the coefficient of attribute k and $\hat{\beta}_6$ is the coefficient of price change. The WTP ratio is a price change associated with a unit increase in a given attribute.

Choice Experiment Survey Design

The attribute design started with a pilot survey, during which data on the purchasing behavior, pork product preferences, safety concerns for pork products, food safety attitudes and knowledge, socio-demographic profiles, and food safety characteristics were obtained from a small group of consumers ($n = 30$) in a supermarket. One kilogram of pork chop was used as a reference portion in this experiment since it was the most commonly purchased pork product. Details of the attributes (Table 1) were designed based on literature reviews, expert opinions and the pre-survey results. All attributes, except price, have two levels. The country of origin attribute was designed as with (yes) and without (no) labeling as consumers were mostly unfamiliar with it. The food safety labeling was according to the chemical contamination inspection standards and certification by Thailand Food and Drug Administration. For the ractopamine residue attribute, products were considered as ractopamine free or containing traces of ractopamine not exceeding the CODEX standard for ractopamine hydrochloride maximum residue levels (MRLs), which are 10 ppb in pork and beef meat, 40 ppb in livers and 90 ppb in kidneys (Centner, Alvey, & Alvey, 2014). The animal welfare attribute was designed as with or without certification, whether the production has met animal welfare standards. Pork colors considered were pink (light) and red (dark). Color is an important indicator of meat quality for consumers (Ngapo, Fortin, Aalhus, & Martin, 2010). The price attribute was based on the market price of pork in Thailand and comprised four levels ranging from THB 110 to THB 170 per kg of pork chop. This range covers the lowest price found in local market and highest price level in urban supermarket.

The study used a factorial experimental design for the five two-level attributes and the four-level price attribute, yielding a full factorial design of 128 difference combination ($2^5 \times 4$). An orthogonal factorial design for alternative of CE design was reducing combination using statistical software to 16. The sixteen-choice set were divided into two blocks, resulting in a total of 8 choice sets. Each choice set consisted of two choices and a status quo choice, resulting in a total of 8 choice sets. The status quo was defined as a pork product without any labeling, with a pink color and a price of THB 130 per kg, considered common in supermarkets. An example of the choice sets is shown in Table 2.

Table 2 Example of a choice set (originally in Thai)

Attributes	Choice 1	Choice 2	Choice 3 (Status quo)
Country of Origin Labeling	No	Yes	No
Food Safety Certification	Yes	No	No
Ractopamine Residues	Yes	Yes	No
Animal Welfare Certification	Yes	Yes	No
Color	Red	Pink	Pink
Price (THB/ kg)	150	170	130

Data Collection

The data were collected in Bangkok, the capital city of Thailand and several selected provinces in the Central region of Thailand, including Ayutthaya, Ang Thong, Chainat, Chonburi, Nakhon Pathom, Nonthaburi, Pathum Thani, Prachup Kiri Khan, Phetchaburi, Samutprakan, Singburi and Suphanburi to reflect differences in terms of the level of economic development, and consumption behaviors. Face-to-face interviews with consumers were conducted by trained enumerators during March and

Table 1 Attribute description in choice experiment

Attribute	Levels	Description
Country of Origin Labeling	Yes, No	Yes indicates a declaration of the country of origin "Product of Country X"
Food Safety Certification	Yes, No	Yes indicates product certification according to domestic safety criteria under the scheme on Safety of agricultural commodities and food
Ractopamine Residues	Yes, No	Yes indicates ractopamine residues detected but less than the CODEX standard for ractopamine hydrochloride maximum residue level (MRLs) No indicates ractopamine-free products
Animal Welfare Certification	Yes, No	Yes indicates official certification by an animal welfare agency guaranteeing that the product meets animal welfare standards
Color	Red, Pink	Consumer preferences and considerations for the pork purchase
Price (THB/kg)	110, 130, 150, 170	Price in THB per kilogram of pork loin

April 2019, with a total of 850 respondents, of which 400 respondents were from Bangkok. The consumers were randomly intercepted near local market, large fresh market, butcher's shop, supermarket and grocery stores and invited to participate in the survey. The question concerning whether the respondent is responsible for pork purchasing in the household was used to screen respondents in this study.

Results

Characteristics and Socioeconomic Profile of Respondents

Socio-economic profiles of respondents are shown in Table 3. There were 272 (32%) male and 578 (68%) female respondents in total. The average age of the respondents was 42.2 years. More than half of the respondents completed higher education. The average household size was 3.5 members per household. The mean household monthly income was THB 58,792, In 2019 Census by National Statistics Thailand, about 51 percent of the population who were female, the average age of population who were at least 15 years old was 44.2 years, most population had secondary school education, average household size was 2.98, and average household income was THB 26,018. There were more females, higher education and income in the current sample as compared to Census. The reason was that the survey targeted the person who did most of responsible for pork purchasing for the household and most respondents were had a bachelor's degree resulted in higher average household income. The household average weekly pork consumption was THB 389. (26,018). The important characteristics that were considered when purchasing pork were sanitation (36.7%), convenience (36.7%), service (13.4%), store trustworthiness (11.9%), and certification (7.4%).

Table 3 Characteristics of survey respondents

(n = 850)

Characteristics	Description	Total	Percent
Gender	Male	272	32.0
	Female	578	68.0
Age	Less than or equal 30 years old	178	20.9
(Average = 42.2, STD = 12.52)	31–40 years old	237	27.9
	41–50 years old	213	25.1
	51–60 years old	163	19.2
	More than 60 years old	59	6.9
Education level	Primary school	208	24.5
	Secondary school and college	168	19.7
	Bachelor degree	349	41.1
	Graduate degree	125	14.7
Number of household members	1–2	244	28.7
(Average = 3.5, STD = 1.64)	3–4	372	43.8
	5–7	221	26.0
	8 and more	13	1.5
Annual household income	≤ 20,000	166	19.5
(THB/month)	20,001–30,000	163	19.2
(Average= 58,792, STD = 49,902)	30,001–50,000	198	23.3
	50,001–80,000	122	14.4
	> 80,000	201	23.6
House hold weekly pork consumption	≤ 100	102	12.0
(THB/week)	101–250	239	28.1
(Average = 389, STD = 359.7)	251–450	225	26.5
	451–600	187	22.0
	> 600	97	11.4
Important characteristics of pork purchasing	Sanitary	1,871	36.7
	convenience	1,562	30.6
	Service	681	13.4
	Store trustworthy	607	11.9
	Certification	379	7.4

Estimation Results

Results obtained from the empirical specification of Eq. (2) are reported in Table 4. The estimated mean coefficients for the country of origin labeling, food safety certification, ractopamine residues certification, animal welfare certification, and price were statistically significant at p-value < 0.01, while the coefficient for color was significant at p-value < 0.05. The estimated mean coefficient relationships with the utility function were as expected. The estimated coefficients for the country of origin labeling, food safety certification, and animal welfare certification were positive, while price, ractopamine residue, and color were negative. Therefore, the country of origin labeling, food safety certification, and animal welfare certification attributes increase the utility of pork consumers, whereas ractopamine residue and red pork color decrease the utility. Also, an increase in pork price decreases the utility level. The highest utility increase was caused by the country of origin labeling, followed by food safety certification and animal welfare certification. Meanwhile, the presence of ractopamine residue caused the highest decrease in utility.

The estimated MWTP for each attribute, the change in price associated with a unit increase in a given attribute (Equation (5)), is reported in Table 5. The country of origin labeling had the highest MWTP of all the attributes. Consumers were willing to pay an average of THB 47.78 per kilogram of pork chop with the country of origin labeling on the packaging.

The MWTP for food safety certification and animal welfare certification were estimated at THB 31.68 and 22.49 per kilogram, respectively. This implied that consumers were less concerned about animal welfare and food safety than for the country of origin. Ractopamine residue had the highest negative MWTP. This negative MWTP indicated that consumer negative willing to pay to pork containing ractopamine residue THB 129.57 per kilogram and reflected consumers' perception of ractopamine-free pork products. Also, the MWTP for color was negative, which showed that the consumers willing to pay was negative with THB 17.85 per kilogram of red-colored pork. In Thailand, most consumers think red-colored pork products signal unsafe or they perceived pink colored pork generally healthier.

Table 5 Derived mean willingness to pay estimates

Attribute	Mean WTP (THB/kg)	*SE*	*p*
Country of Origin Labeling	47.781596	12.78964	0.00000
Food Safety Certification	31.677127	13.73426	0.02100
Ractopamine Residue	-129.57513	24.90241	0.00000
Animal Welfare Certification	22.491072	7.528684	0.00300
Color	-17.858804	8.014039	0.02600

Table 4 The estimation results

Attribute	Coefficient	Standard Error	*z*	*p*
Mean				
Country of Origin Labeling	0.381624	0.055399	6.890	.0000
Food Safety Certification	0.253000	0.082050	3.080	.0020
Ractopamine Residues	-1.034895	0.072308	-14.310	.0000
Animal Welfare Certification	0.179632	0.058977	3.050	.0020
Color	-0.142635	0.070071	-2.040	.0420
Price (THB/kg)	-0.007987	0.001426	-5.600	.0000
Standard Deviation				
Country of Origin Labeling	-0.398652	0.125405	-3.180	.0010
Food Safety Certification	0.054800	0.276083	0.200	.8430
Ractopamine Residues	1.137479	0.088332	12.880	.0000
Animal Welfare Certification	0.160375	0.207185	0.770	.4390
Color	-0.313366	0.192403	-1.630	.1030
Price (THB/kg)	0.001098	0.005765	0.190	.8490
Number of obs. =	10,200	LR chi2(6) =	120.37	
Log likelihood =	-3360.328	Prob > chi^2 =	0.0000	

The MWTP for the country of origin labeling, food safety certification, and animal welfare certification indicated a price premium of 36.75–17.30 percent of the average regular price of pork products at THB 130 per kilogram in Thailand. Similar results have been reported in other studies (Pouta et al., 2010; Thi Nguyen et al., 2018; Yang & Renwick, 2019). Raun Mørkbak et al. (2010) also showed that the country of origin labeling had the highest WTP among all attributes. In other studies, however, food safety certification attracted the highest premium (Lai et al., 2018; Loureiro & Umberger, 2007), while animal welfare certification attracted the lowest positive premium elsewhere (Lai et al., 2018; Xu et al., 2019).

The Thai Food Act (No. 269) of 2003, in essence, prohibited the use of beta-agonist chemicals and their detection in foods (Ministry of Public Health [MOPH], 2003). In can be assumed that Thai consumers understand that beta agonists, including ractopamine, are unsafe for consumption, whether or not the detection level meets the CODEX standard. Our findings show that Thai consumers generally prefer pink-colored pork. Similarly, Ngapo (2017) reported that Canadian consumers showed a 1.5–fold preference for light-colored pork compared to the darker shade.

Conclusion and Recommendation

Our findings have implications for pork safety investments and policies in Thailand. Pork safety certification and labeling, though currently not mandatory in Thailand, could attract higher premiums to the benefit of producers. In this study, Thai consumers' willingness to pay more for pork products with safety cues like the country of origin labeling, food safety certification, ractopamine-free certification, and animal welfare certification labels was estimated using a choice experiment. The country of origin attribute attracted the highest premium, perhaps because consumers could most relate to it as a safety cue. The safety and quality perceptions of local versus imported pork have a strong influence on consumers' decision-making and willingness to pay. The implementation of a mandatory country of origin labeling would bring clarity and enhance utility, among other benefits.

The pork safety certification attracted the second highest premium. In Thailand, safety certification is generally more popular in food items like vegetables and rice. This finding sends a clear signal for producers to consider the potential of food safety labeling of pork products to benefit from associated premiums. To date, there are no animal welfare certification programs in Thailand. Consumers, however, are increasingly associating animal welfare with meat quality as indicated by the positive willingness to pay, third among the attributes in the choice set. Thus, the certification could serve to encourage best hog farming practices while enhancing utility and profit. Thai consumers indicated their disapproval of ractopamine-contaminated pork. The negative willingness to pay suggests that consumers may be more willing to purchase ractopamine-free pork. Also, consumers were in favor of pink-colored pork as they perceived it as natural and generally healthier.

Conflict of Interest

There is no conflict of interest.

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