

Beef consumption and selection bias in Thailand

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ABSTRACT: The objective of this study was to determine the frequency of beef consumption and consumer attitudes towards marbling, and perceived health characteristics of beef in Thailand. Following a structured survey and Chi-squared analysis consumers were broadly categorized into four groups based on beef consumption frequency and preference for, or against increased marbling including: Low frequency prefer marbling (LFPM), low frequency prefer lean (LFPL), high frequency prefer marbling (HFPM), and high frequency prefer lean (HFPL). Data from interviews showed that 8.5% were LFPM (predominately male). The LFPM segment placed strong values on beef odor and marbling score. Twenty seven percent of respondents were categorized as LFPL and consisted primarily of females 41-80 yr of age. The LFPL segment placed primary importance on cholesterol content, and were less concerned with marbling and beef odor. Additionally, the LFPL segment placed greater importance towards Thai native cattle when purchasing beef. Approximately 23.3% of respondents were categorized as HFPM and like LFPM were predominately male. The HFPM segment was less concerned with cholesterol content, more interested in trying new products, and typically chose beef from Charolais cattle. The HFPL group made up 41.2% of respondents and was equally proportioned between males and females. The HFPL segment preferred beef from Thai native cattle for its perceived health benefits. The results of this study will help the growing Thai beef industry to better understand their consumer and market specific products to meet consumer preferences.

Keywords: beef, consumer preference, marbling, cattle

Introduction

Beef consumption in Thailand is increasing and this trend is expected to continue as the population expands and economic status improves. Beef ranks highly in consumer acceptance due to flavor and nutritive value (Mateescu et al., 2013). Beef is good source of essential amino acids, and dietary fatty acids including omega-3 fatty acids (ω -3), omega-6 (ω -6) fatty acids, and conjugated linoleic acid (CLA) which may have health benefits (Leheska et al., 2008) such as anti-carcinogenic (Aldai

et al., 2010) and anti-obesity (Kennedy et al., 2010) properties. Presently, consumers place a strong value on the health attributes of beef which provides incentive to emphasize these characteristics (O'Neil et al., 2011). Healthy beef has been defined as being lean, high in essential amino acids, vitamins, and minerals; but low in caloric and saturated fatty acid (SFA) which can be obtained when beef is finished on forage-based diets (Nicklas et al., 2012). Although beef leanness is a favorable trait for perceived health benefits, tenderness, which is highly correlated

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with marbling (O'Quinn et al., 2012), has been shown to be the main attribute impacting consumer eating satisfaction (Schönfeldt and Strydom, 2011).

Cattle diet and production system (forage- or concentrate-based finishing) have a large impact on beef fatty acid profiles, leanness, and overall quality (Elswyk and McNeill, 2014). Cattle raised and finished on forages tend to produce leaner carcasses with a greater percentage of essential fatty acids and CLA content per unit of total lipid (Wood et al., 2008). Additionally, beef from forage-based systems resulted lower SFA, greater monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids, and more favorable PUFA/SFA (Bressan et al., 2011) compared to concentrate-finished beef which had lower proportions of CLA and n-3 PUFA (Schmidt et al., 2013). Currently in Thailand most Thai native cattle are finished utilizing forages while most Holstein, Holstein cross bred cattle, and imported beef breeds (such as Charolais) are finished utilizing concentrate based rations.

Cattle breed can also influence beef nutritional profile and quality (Giusti et al., 2013). Beef from *Bos indicus* cattle is leaner and less tender than beef from *Bos taurus* cattle (Cuvelier et al., 2006). Thai native cattle (*Bos indicus*) are currently the primary source of beef in Thailand due to their environmental tolerance and fertility, however, they are later maturing and lighter weight than most improved breeds (Samootkwam et al., 2015). Overall, Thai native beef quality is lower than other beef due to their typical production system and advanced age at slaughter (Jaturasitha et al., 2009). The meat from

Bos indicus cattle has been shown to have less fat and a greater proportion of PUFA compared to *Bos taurus* breeds which makes it a favorable option for health-conscious consumers (Nfor et al., 2014). Contrarily, *Bos taurus* breeds have a greater percentage of fat in the carcass, including intramuscular fat (marbling; Duarte et al., 2013) and have been shown to be more tender than *Bos indicus* derived beef (Riley et al., 2005) making beef from *Bos taurus* more ideally suited for consumers seeking quality and palatability traits.

A major challenge to the beef industry is to produce products that match specific consumer demand for both health and palatability traits. Consumer preferences have been broadly used as the basis for evaluating target markets, especially the segmentation technique (Verbeke et al., 2011). Therefore, the objectives of this study were to classify consumer segments in Thailand for beef consumption based on breed preference, production system, perceived nutritional status, sensory characteristics, safety characteristics, and value.

Materials and methods

Population and sampling method

Survey data was collected through individual interviews (n = 400) using a structured questionnaire at butcher shops and beef centric restaurants (e.g.: steakhouses and barbecue restaurants) in Thailand in June, 2014. Consumer interviews were conducted in a random fashion following the equation of Yamane (1973) providing for a confidence level of 95% for an infinite

population where the population ratio = 0.5 and has an error of $\pm 5\%$. The methodology for questionnaire preparation and survey data collection was based on those outlined by Gracia and de-Magistris (2013). The target consumer selected was between 18-80 years old. The interviewers asked the consumers screening questions to ensure they were representative of beef consumers.

Questionnaire and measurements

A master questionnaire was improved by interviewing a pretest of 30 beef consumers to make sure of linguistic accuracy and eliminate probable errors. After the pretest the questionnaires were re-evaluated for validity and reliability and the final draft was created (Tavakol and Dennick, 2011). The final questionnaire contained four parts: 1) socio-demographic variables including: gender, age group, education status, occupation, monthly income; 2) beef consumption frequency; 3) consumer attitude on beef attributes and label information including: sensory characteristics, perceived safety characteristics, nutritional characteristics, production system, and beef price; and 4) expected price if labeled with attributes of interest, purchase decision if attribute labeled beef price was more than commercial beef price, primary reason for purchasing beef, and consumer attitude on the source of the beef from those that indicated a willingness to purchase attribute labeled product at a higher price ($n = 344$). Variables in parts three and four of the questionnaire were measured on a 5-point hedonic scale where 1 = dislike very much,

2 = dislike moderately, 3 = neither like nor dislike, 4 = like moderately and 5 = like very much, adapted from Meilgaard et al. (1991).

Segment characterization and statistical analysis

Beef consumption frequency data was collapsed from the 8-point categorical scale to a 2-point categorical scale including low frequency and high frequency consumption. After that beef consumers were arranged in a two-step cluster analysis by using frequency of beef consumption (low frequency or high frequency) and preference for lean or marbled beef as segmentation variables. All data were analyzed using SPSS 17.0 (SPSS, 2008, IBM Corporation, Armonk, NY, USA). The socio-demographic data of the segment parts were analyzed by bivariate cross-tabulation with chi square statistics and multivariate logistic regression analysis. A model of variables was produced and the segments were coded 1 to specify positive segment association and 0 to specify negative segment association. The newly coded segment associations were then utilized as categorical dependent variables in logistic regression analysis. Categorical independent variables including gender, age, education, occupation, and monthly income were analyzed. The Hosmer & Lemeshow goodness-of-fit test was used to determine if the observed rates matched the expected rates of segment association ($P > 0.05$). Segmentation data categorized by hedonic liking scores were analyzed by one-way ANOVA and post-hoc analysis was carried out by using Duncan's multiple range tests for segment differences at $\alpha < 0.05$.

Results and discussion

Consumer segmentation

The consumer in Thailand can be classified into 4 segments. The first segment was classified to low frequency beef consumption (less than one time per month) with a preference for greater marbling (LFPM) and was composed of 8.5% of the surveyed population. The second segment (27% of sampled populations) was classified as low frequency consumption with a preference for lean beef (LFPL). Consumers that prefer lean beef typically do as for health-conscious reasons (Olmedilla-Alonso et al., 2013). The third segment (23.3% of all participants) were high frequency of beef consumers (more than one time per month, up to everyday) and preferred marbling (HFPM). The fourth segment was made of consumers that indicated a high frequency of consumption and preferred lean beef (HFPL). The HFPL segment contained the largest proportion of consumers sampled at 41.2%.

Profiling of the segments

Segment membership was not significantly associated with socio-demographic variables ($P > 0.05$), except gender ($P < 0.05$). The results indicate that males tend to prefer marbling while females tended to prefer lean when purchasing beef. Women preferring lean beef compared to men is an indication that they were more concerned with characteristics that indicate the foods they are purchasing are part of healthy diet that is low in fat and cholesterol. Similar results were shown in a survey conducted in the United States (Hanagriff et al., 2009) where women

showed preference for beef products labeled as lean and meeting the American Heart Association guidelines. The results from the Hosmer-Lemeshow goodness-of-fit test are presented in **Table 1** and show that the recorded demographic segmentation was not by chance ($P \geq 0.29$). Highlights from the Hosmer-Lemeshow analysis showed that the LFPL segment tended to be females (odds=1.66) between 41-80 years of age (odds=3.04) with a monthly income below \$937 or above \$1,248 (odds=0.16). Conversely the HFPM segment tended to be males (odds=0.49) that were self-employed (odds=1.92) with a monthly income between \$937-1248 (odds=2.66). The multivariate logistic regression results confirmed the previous bi-variate analyses results, which also indicated that female consumers tended to prefer lean beef while male consumers preferred marbling.

Consumers' preference for beef attributes by segment

Overall, the Thai consumers surveyed ranked most attributes between "Like Moderately" and "Like Very Much". Therefore, there were not many attributes with statistical differences between the segments indicating that the Thai consumer would like to have as much information about the beef they are purchasing as possible. Interestingly, the LFPM segment placed a greater importance on odor and marbling score ($P < 0.05$) than LFPL and HFPL. However, the HFPM segment was similar to all segments for marbling score. These data indicate that the LFPM consumers may be more selective when deciding to purchase beef than the HFPM group when evaluating marbling

scores. Marbling has been shown to impact palatability (Pannier et al., 2014) and perceived tenderness (Price, 2010). Additionally, factors that influence taste (tenderness, flavor, and juiciness) are of greatest concern to most beef consumers Tatum (2015). In contrast, Font-i-Furnols et al. (2012) reported that health conscious consumers preferred lean beef and that marbling was negatively correlated to purchasing decision for these consumers. Likewise, in the current survey, information about cholesterol content received a more favorable rating from the LFPL segment than HFPM segment ($P < 0.05$) which agrees with previous reports of health conscious consumers preferring lean beef and being concerned with cholesterol intake (Kallas et al., 2014).

Primary reason for purchasing beef and attribute pricing expectations

To gain a better understanding of what labeling attributes might be of concern to beef

consumers they were asked to identify their primarily reason for purchasing beef. Chi square analysis showed that when consumers were asked their primary intent for purchasing beef the actual outcome was different from the expected ($P < 0.05$; **Figure 1**). As expected most consumers that were in the prefer lean segments (80.2% and 66.2% of the LFPL and HFPL segments, respectively) indicated they purchased beef as part of a healthy diet (avoid obesity or for health reasons). It would be expected that consumers concerned about health would also be associated with the prefer lean segments since a major concern for the health consciousness consumer is fat content (Van Wezemael et al., 2010). For consumers in the prefer marbling segment 60.7% of the LFPM group also cited health reasons for purchasing beef, while the majority of the HFPM segment indicated they select beef out of interest in testing new products.

Table 1 Socio-demographic profile of the beef consumer segments, logistic regression results (n = 400)

Item	Consumer segment ¹															
	LFPM				LFPL				HFPM				HFPL			
	Hosmer & Lemeshow goodness of fit P = 0.75				Hosmer & Lemeshow goodness of fit P = 0.49				Hosmer & Lemeshow goodness of fit P = 0.29				Hosmer & Lemeshow goodness of fit P = 0.61			
	Exp (B)	Lower	Upper	P-value												
Male gender (REF)																
Female gender	0.70	0.33	1.49	0.36	1.66	1.03	2.68	0.04	0.49	0.30	0.81	0.01	1.29	0.84	1.97	0.25
18-25 years (REF)																
26-40 years	0.57	0.17	1.92	0.37	2.18	0.89	5.35	0.09	0.91	0.39	2.09	0.82	0.67	0.32	1.40	0.29
41-80 years	0.46	0.10	2.10	0.32	3.04	1.09	8.49	0.03	0.45	0.16	1.25	0.13	0.95	0.41	2.22	0.91
Primary school (REF)																
Secondary school	1.24	0.10	16.07	0.87	0.50	0.14	1.78	0.28	1.86	0.41	8.39	0.42	1.22	0.41	3.63	0.73
Vocational diploma	1.01	0.05	19.10	0.99	1.55	0.41	5.82	0.52	2.05	0.42	10.11	0.38	0.48	0.14	1.66	0.25
Bachelor's degree	2.98	0.31	28.93	0.35	0.76	0.24	2.41	0.64	2.13	0.54	8.49	0.28	0.62	0.23	1.71	0.36
Postgraduate degree	3.22	0.29	35.95	0.34	0.94	0.26	3.30	0.92	3.19	0.72	14.07	0.12	0.42	0.13	1.29	0.13

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	Hosmer & Lemeshow goodness of fit P = 0.75				Hosmer & Lemeshow goodness of fit P = 0.49				Hosmer & Lemeshow goodness of fit P = 0.29				Hosmer & Lemeshow goodness of fit P = 0.61			
	Exp	Lower	Upper	P-value												
	(B)				(B)				(B)				(B)			
Government officer (REF)																
Business employee	1.23	0.39	3.88	0.72	0.69	0.35	1.36	0.28	1.58	0.76	3.27	0.22	0.92	0.50	1.69	0.79
Self-employed business	1.70	0.57	5.03	0.34	0.63	0.32	1.25	0.18	1.92	0.94	3.92	0.07	0.75	0.41	1.39	0.36
Housewife	3.80	0.30	48.37	0.30	0.76	0.17	3.47	0.72	1.89	0.31	11.39	0.49	0.52	0.13	2.10	0.36
Student	1.93	0.33	11.40	0.47	1.63	0.50	5.32	0.42	1.37	0.41	4.59	0.61	0.45	0.16	1.28	0.13
Other	0.00	0.00	0.00	1.00	0.54	0.05	5.86	0.61	0.00	0.00	0.00	1.00	2.81	0.28	27.97	0.38
Below \$312 (REF) ²																
\$313-624	1.37	0.31	6.05	0.68	1.06	0.44	2.56	0.89	1.09	0.42	2.83	0.86	0.82	0.36	1.85	0.63
\$625-936	1.55	0.29	8.25	0.61	0.77	0.28	2.08	0.61	0.74	0.25	2.20	0.59	1.36	0.55	3.38	0.50
\$937-1248	2.75	0.49	15.35	0.25	0.16	0.04	0.61	0.01	2.66	0.85	8.28	0.09	1.09	0.39	3.00	0.87
\$1,249-1,560	4.08	0.66	25.21	0.13	0.72	0.20	2.57	0.61	1.60	0.43	5.93	0.48	0.50	0.15	1.68	0.26
Over \$1,560	0.73	0.09	5.89	0.77	0.47	0.15	1.46	0.19	1.06	0.33	3.44	0.92	1.80	0.67	4.88	0.25

¹LFPM = low frequency consumption preferred marbling, LFPL = low frequency consumption preferred lean, HFPM = high frequency consumption preferred marbling, and HFPL = high frequency consumption preferred lean, ² 1 US Dollar = 35 Thai Baht.

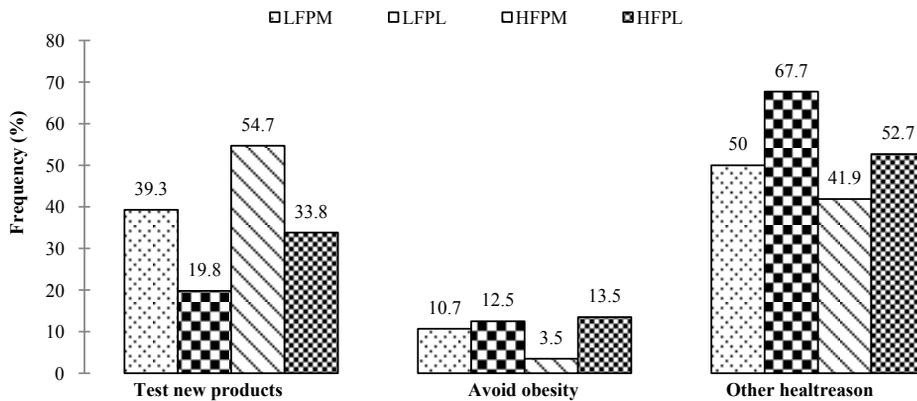


Figure 1 Primary reason why consumers purchase beef

(n = 400; $\chi^2 = 27.24$; $P < 0.05$); LFPM = low frequency consumption preferred marbling, LFPL = low frequency consumption preferred lean, HFPM = high frequency consumption preferred marbling, and HFPL = high frequency consumption preferred lean.

Chi square analysis showed no difference ($P = 0.84$) among the consumer segments for their expected price of beef products containing information relating to attributes of concern. Interestingly, approximately half of the consumers

in each segment expected beef with additional information to be the same price as beef without attribute labels while 28.7-35.5% of consumers in each segment would expect to pay a greater price. However, when asked if they would still

purchase beef when labeled with attributes of importance if it cost more than non-labeled beef, 82.4-89.2% of consumers indicated they would still purchase.

Consumer attitudes to beef source on healthy beef purchasing decision

The breed of cattle or source of the beef may also have an impact on consumer perceptions and willingness to purchase. Therefore, the consumers that indicated a willingness to purchase attribute labeled beef, even if priced greater than non-attribute labeled beef, were asked to record their liking of beef from various sources available in Thailand (Table 2). Beef originating from male Holsteins, cull cows, and beef that was imported (non-descript origin) had similar liking scores ($P = 0.20$) across all segments and were rated between “neither like nor dislike” and “like moderately”. Beef from Thai native cattle was viewed more favorably ($P < 0.05$) by LFPL,

HFPL, and HFPM segments than the LFPM segment. Beef from Charolais cattle had a more favorable ($P < 0.05$) liking score from HFPM than either of the prefer lean segments. Beef from Thai native cattle was utilized to represent lean beef. A recent study reported that beef from *Bos indicus* cattle had lower total fat content than beef from *Bos taurus* cattle (Rodrigues et al., 2017). Therefore, it was expected that the prefer lean segments would prefer beef from Thai native cattle. Beef from Charolais cattle was utilized to represent beef with a greater degree of marbling and tenderness. Waritthitham et al. (2010) reported that Charolais x Thai native cattle had greater marbling scores than Brahman x Thai native cattle. Additionally, beef from *Bos taurus* cattle has been shown to be more tender than beef from *Bos indicus* cattle (Riley et al., 2005), which among other things was positively correlated to marbling score (Albrecht et al., 2006).

Table 2 Consumer perception of known beef source when willing to purchase beef with desired attributes at a greater price than commercial beef (n = 344)

Beef source /Liking score ²	Consumer segment ¹				P-value
	LFPM	LFPL	HFPM	HFPL	
Thai native beef	3.50 ^b	4.17 ^a	3.93 ^a	4.16 ^a	<0.01
Male Holstein beef	3.29	3.65	3.69	3.66	0.20
Culling cow beef	3.14	3.25	3.46	3.37	0.35
Charolais beef	3.79 ^{ab}	3.44 ^b	4.02 ^a	3.64 ^b	<0.01
Imported beef ³	3.11	3.06	3.18	2.95	0.57

¹LFPM = low frequency consumption preferred marbling, LFPL = low frequency consumption preferred lean, HFPM = high frequency consumption preferred marbling, and HFPL = high frequency consumption preferred lean, ² Liking score 1= Dislike very much to 5 = Like very much (Meilgaard et al., 1991), ³ Imported beef = beef imported from other *Bos taurus* breed, ^{a,b,c} Means within rows with different superscripts differ ($P < 0.05$).

Conclusions

This survey found that consumers in Thailand can be broadly segregated into 4 segments concerning their beef purchasing decisions including high and low frequency and their preference for beef that is lean or has more intramuscular fat (marbling). From the study, most of the consumers preferred lean beef with the largest segment being high frequency preferred lean followed by low frequency preferred lean, high frequency preferred marbling, and finally low frequency preferred marbling. Although the high frequency preferred lean segment contained an equal percentage of males to females, females predominantly preferred lean products (low and high frequency preferred lean segments together), while the preferred marbling classification had a greater proportion of males. Additionally, a greater proportion of consumers were considered high frequency than low frequency purchasers of beef products. Although most beef attributes scored highly in all segments the low frequency preferred marbling segment placed a greater emphasis on beef odor and marbling scores, while the low frequency preferred lean segment place greater emphasis on cholesterol content. For the high frequency beef consumers, those that preferred marbling were less concerned about cholesterol content, were more interested in trying new products and preferred beef from imported *Bos taurus* cattle (Charolais). In contrast high frequency beef consumers that preferred lean products also preferred beef from Thai native cattle due to perceived health benefits. The results from this study will help the expanding Thai and Southeast

Asian beef industry to understand their target consumers and enhance targeted marketing practices.

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