FACTORS INFLUENCING POTENTIAL CONSUMPTION OF BIOSAFETY PORK IN URBAN AREAS OF THE NORTHERN DELTA, VIETNAM

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ABSTRACT

The paper examined factors influencing the potential consumption of pork produced using biosafety breeding practices (BBP) in urban areas of the Northern Delta region, Vietnam. The primary data were collected from a sample of 402 consumers in 2020 by the stratified convenient method in 11 provinces belonging to the region using structured questionnaires. Two kinds of models were applied e.g., (i) binary logit was employed to estimate the factors affecting the consumers purchase intention for BBP pork; (ii) ordered logit was developed to estimate the factors affecting the willingness to pay (WTP) for BBP pork. The factors affecting purchase intention for BBP pork consisted of consumer's knowledge, household characteristics, and income. Regarding WTP for BBP, three principles of BBP i.e., waste treatment, infectious disease control, and input material management had positive effects on WTP. Moreover, household income, availability, origin, and certification of the BBP pork were factors playing important roles for supporting the acceptance probability of the higher price premium. Meanwhile, the pork consumption quantity and purchase intention negatively influenced WTP. Based on the findings, the study proposed some appropriate solutions and policy implication to improve biosafety pork consumption as well as expand the BBP pork distribution in Vietnam.

Key words: binary choice, consumer behavior, ordered logit, purchase intention, willingness to pay

INTRODUCTION

The Northern Delta is a historical region of Vietnam with over four thousand years of history and is the origin of Vietnamese culture. The region has a high population density, sharing 22% of the total population but only 5% of total land area of the country. In the region, the urban population occupies for 34% of the total population. This is a dynamic economic region, accounting for 35.8% of the country's GDP. The average monthly expenditure per capita in the Northern Delta is about 3,296 million VND[1], and for income, the figure is approximately 5,085 million VND (VGSO 2020), ranking in the top two regions among the seven economic regions of the country. In Vietnam, the share of food expenditures in a household is about 53.3% of the total expenditures of a household, which is approximately 1.3 million VND per person per month, this figure in urban area is about 1.5 million VND, accounting for 48.2% of the total expenditures of a household (Vu 2009). In recent years, the monthly average expenditure per capita for foods in the Northern Delta urban areas has increased rapidly due to the performance of remarkable economic growth. Such a large potential consumption in this area can make it become an important market for BBP pork.

Pig farming is one of the most important agricultural sectors in the Northern Delta, Vietnam. At the beginning of 2020, the number of pigs in the Northern Delta was 3,497 thousand heads,

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[1] 1USD ~ 23.000 VND

accounting for about 20% of the total number of pigs of the whole country (VGSO 2020). However, in this area, agricultural production that does not take biosafety into account has led to the threat of disease transmission as well as food safety. Some issues related to inorganic waste treatment in livestock, sales, and butchery have been increasing in parallel with the growth of the pig breeding scale in the Northern Delta (Pho et al. 2018). Biological hazards are the source of many foodborne illnesses nationally. Thus, the epidemic has recently become more and more complicated, and has caused serious consequences for pig farming in Vietnam (Cook and Phuc 2019). As such, biosafety breeding practices (BBP) should be developed to ensure that production prevents the entry of diseases and as tools to limit the effects of infectious diseases (Jaffee and Henson 2005). Utilizing the BBPs in agriculture production could create a potential market for agricultural products and make a difference in the value chain of agricultural products, including clear identification of the responsibility specifications of producers in the food value chain (Elbakidze 2003).

Recently, the Government of Vietnam issued the National Technical Regulation QCVN 01-14: 2010/BNNPTNT about BBP principles in pig farms in order to control the problems related to bio-security in pig farming and biosafety in pork (MARD 2010). In which, three main principles outline the management of inputs, the control of infectious diseases, and the procedures for waste treatment in pig farms. The BBPs will be able to model consumption trends because consumers pay more attention to products that are healthy and environmentally friendly. Many consumers have an intention to pay more for environment-friendly products (Laroche et al. 2001) because this consumption behavior not only shows personal responsibility for one's health, but it also displays the role of individualism for social development and environment protection (Briceno and Stagl 2006). In addition, issues such as environmental protection, health consciousness and infectious disease control can be listed as some main goals of BBP livestock in Vietnam (VNA 2010). The middle-income class in urban areas started becoming concerned about consumption for health-beneficial purposes and environmental protection (De Koning et al. 2015). Urban consumers have better knowledge about safe foods than rural consumers. From this point of view, the probability of WTP for BBP food of urban residents tends to be higher than that of rural residents.
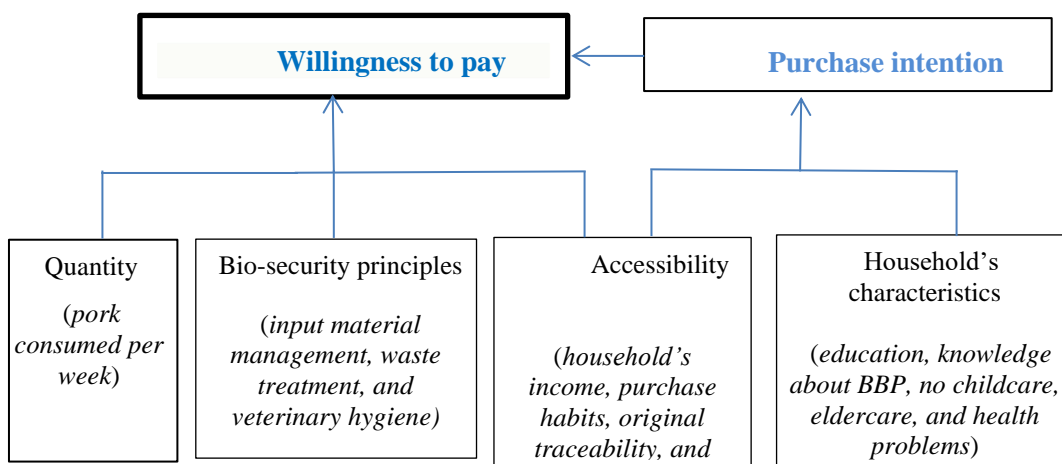
The linkage between the BBP principles and consumer attitudes for food include management of flock, control of incoming animals, control of inputs and outgoing materials, and control of other animals (Aila and Oima 2013). Bio-security objectives were bio-exclusion or external bio-security; bio-management or internal bio-security; and bio-containment (CSHB 2010). In a social cost-benefit analysis, the BBP principles can bring out the different quantities for the product but those also take extra cost, which should be smaller than the estimated benefits (Trewin 2001). Thus, the BBP principles should be conducted to reach the consumer intention, the WTP premium price for BBP pork can bring more return for manufacturers to cover their production costs, which can lead to their survival. Complicating the issue is the fact that the majority of Vietnamese pig farms are small in size (from 1 to 9 pigs per farm) and the large size farms (over 300 pigs) only account for a small proportion (VGSO 2020). Since the investments of large facilities and techniques in pig farms for ensuring the biosafety standards lead to a rise in the product cost with high investment and tech. The level BBP application of pig farm stayed in low, and BBP pork have not yet met the consumer demand, especially small-scale pig farms (Cuc et al. 2020). Despite the increase of demand for bio-safe pork, small-scale pig farms have a disadvantage in finding buyers because the pork quality and biosafety have not yet met consumer expectation. Thus, improving consumer intention to purchase BBP pork was suggested to improve BBP pork consumption.

Under these circumstances, it is necessary to ascertain the answers to the following questions: Do consumers have an intention to buy BBP pork? How much are they willing to pay for BBP pork? What are the main factors affecting these consumer's intention and willingness to pay for BBP pork? By answering these questions, we can propose reasonable solutions to improve BBP pork accessibility to target consumers. From these points of view, the study sought to examine the potential consumption

habits of consumers through their intention to buy BBP pork and the prices they are WTP for BBP pork in the urban areas of the Northern Delta, Vietnam.

MATERIALS AND METHODS

Analytical framework. An analytical framework was designed to examine the potential consumption of households for BBP pork in urban areas in the Northern Delta of Vietnam and to estimate the factors affecting the consumers' decisions of WTP (Fig. 1). Potential consumption for BBP pork was approached on the evaluation of purchase intention and willingness to pay. The influences of factors on purchase intention, including consumer's knowledge, household characteristics, the origin, availability and certification, and purchase habit were examined. Then, the factors affecting willingness to pay, including household income, consumer's knowledge, household characteristics quantity of pork consumed, bio-security principles, the origin, availability and certification, purchase habit were also further evaluated.

Source: Diagram developed by the authors 2020

Fig 1. Analytical framework of the research

Site selection. The data were collected from the Northern Delta of Vietnam which is an alluvial area made up of two rivers, the Red River and the Thai Binh River, located in Northern Vietnam. Based on the convenient sampling method, the survey was carried out in urban areas of four provinces, namely Hanoi, Vinh Phuc, Hai Duong, and Quang Ninh in the Northern Delta. The selected provinces are located in the key economic zone in the Northern Vietnam with high speed of urbanization. The customer surveys for BBP pork were conducted at supermarkets and grocery stores in the selected sites. The respondents were housewives who were responsible for the food purchases in their households. Housewives are responsible mainly for food consumption decision-making and food purchasing behaviors and cooking for all family members. The survey was carried out from September to November in 2020. The allocation of the sample was based on the urban population proportion of each selected province in the total urban population in the Northern Delta region. In our study, 429 urban customers were selected as respondents for the survey (Table 1). After refining the surveyed data, 402 respondents of the customer survey were used for analysis.

Table 1. Distribution of respondents in the four provinces of the Northern Delta region, Vietnam

| No. | Province | Urban areas population | | Number of samples |
		Population (1000 people)	Proportion (%)	
1	Hanoi	4,000.3	69.65	299
2	Vinh Phuc	295.2	5.14	22
3	Hai Duong	594.2	10.35	44
4	Quang Ninh	853.7	14.86	64
	Total	**5,743.4**	**100**	**429**

Source: Survey (2020)

Sample selection. For multivariate regression analysis, the minimum sample size needed was calculated using the formula: $n = 50 + 8 \times m$; *where*: n is the number of samples to be investigated, and m is the number of independent factors. The study intended to include 20 variables in the regression analysis model; therefore, the minimum number of survey samples was 210 (Tabachnick et al. 2007). According to Scheaffer et al. (2006), the size of the sample is defined by following function:

$$n = \frac{N}{(N-1)\,\delta^2 + 1},$$

where N is the urban population count in the Northern Delta and δ is the chosen error. In the economic field, the generally accepted level of confidence is 95% corresponding to an accepted error of 0.05. At an accepted error of 0.05, the minimum number of survey samples was n = 399.

The choice experience methods. In the study, choice experience method was employed to design the questionnaire to investigate the consumers' purchase intention of BBP pork. Consumers were introduced to BBP pork, alternative choice of characteristics of BBP product were presented as well as premium prices. They were asked for their optimal choice. The questionnaire included three main parts: (i) Information about the respondents' socio-economic characteristics and household characteristics; (ii) The purchase intention for BBP pork, i.e., the frequency of purchasing and the purchasing place; and (iii) The willingness to pay. Respondents were asked to find the highest price premium they would be willing to pay for BBP pork instead of conventional ones. Respondents were presented the highest premium price, if they accept that price, the WTP would be decided, if not, they were continuously presented lower premium price, then the WTP would be decided when they said "yes". The third part was designed to discover information about the independent variables. The respondents were introduced to the BBP principles and then asked how they agreed with a set of given statements. The answers demonstrated how respondents believed in BBP principles such as what they expected and how they evaluated the traceability, availability, and certification of BBP pork.

Data analysis. The study applied basic methods of data analysis such as descriptive statistics and comparison, and also used quantitative method to analyze data on independent variables presented as categories. The ordinal regression model was employed to explain the effects of factors on the potential consumption. Factors affecting purchase intention and willingness to pay for BBP pork i.e., household income, consumer's knowledge, household characteristics, quantity of pork, bio-security principles, the origin, availability and certification, and purchase habit were included in the models.

Binary logistic model. First, the binary logistic model was utilized to estimate the explanation variables for consumer purchase intention. The dependent variable, purchase intention, was measured

by a dummy variable, taking the value of 1 if the households intended to buy often and zero if not. The binary logistic regression model is specified as follows:

$$g(\pi) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \beta_n x_n.$$
$$g(\pi) = \log\left[\frac{\pi}{1-\pi}\right]$$

in which, π is the probability that consumers choose between [0, 1], while $x_1 \ldots x_n$ are explanation variables influencing the probability of the purchase intention for BBP pork.

The ordinal logit regression model. This model was selected to evaluate the price premium that consumers were WTP for BBP pork. WTP was measured by the percentage of increase in price that consumers were WTP higher than the original price (the original price was the price for conventional pork). The WTP was measured by using ordinal variables to ask the respondents about what price they were willing to pay for BBP pork as compared to conventional pork (Ghorbani and Hamraz 2009 and Haghjou et al. 2013).

The estimation functions of WTP (y) can be specified as follows:

$$y* = \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + \varepsilon = x\beta + \varepsilon$$
$y*$ is the estimation of the probability of given price premium for BBP pork.
$$y* = \log\left[\frac{y}{1-y}\right]$$

The constant (cut-off) was the threshold, which was estimated in the model. The probability that the consumer is WTP at given price premium was defined by:

$$P(y=1|x) = P(y* \le \alpha_1|\ x) = P(\alpha_1 - \beta'x < \varepsilon\ |x)$$
$$P(y=2|x) = P(\alpha_1 < y* \le \alpha_2|\ x) = P(\alpha_1 - \beta'x < \varepsilon \le \alpha_2 - \beta'x|x)$$
$$\ldots$$
$$P(y=n|x) = P(\alpha_{n-1} < y*|\ x) = P(\ \varepsilon \le \alpha_{n-1} - \beta'x|x)$$

The dependent variables. Based on the developed analytical framework and the review of relevant research literature, the study used a number of explanation variables to examine the impacts of the variables on the purchase intentions and the WTP for BBP pork. The dependent variable representing purchase intension (PI) was employed in form of the binary logit model, while the willingness to pay (WTP) was applied in the form of ordinal logit model. The 5-point Likert scale from 1 for totally disagree to 5 for totally agree was applied to represent some independent variables i.e., *Inp, Waste, Inf, Org, Lab, Cer and Habit* (Table 2).

Table 2. Descriptions of the variables in the potential consumption model

Variable name	Code	Description	Expected sign
		The dependent variables	
Purchase intention	*PI*	Does the customer intend to buy BBP pork?	n/a
		(Dummy variable, taking value of 1 if the customers intend to buy and zero if not)	
Willing to pay	*WTP*	Which level of price is the consumer willing to pay for BBP pork?	n/a
		(0) the same as conventional pork	
		(1) 10% higher than conventional pork	

Variable name	Code	Description	Expected sign
		(2) 20% higher than conventional pork	
		(3) 30% higher than conventional pork	
		(4) 40% higher than conventional pork	
The independent variables			
Education	*Edu*	What is the level of the consumer's education?	+
		(1) Under high school	
		(2) High school	
		(3) University or college	
		(4) Post graduate	
Knowledge about BBP	*Kno*	How much does the consumer know about BBP?	+
		(0) Never heard	
		(1) Sometimes hear about	
		(2) Quite clear	
No childcare	*Child*	Does the consumer's household have any children?	+
		(0) No	
		(1) Yes	
Eldercare	*Old*	Does the consumer's household have any elderly persons over 60 years old?	+
		(0) No	
		(1) Yes	
Household's income	*Inco*	Which is the level of the customer's household monthly income per person (MI)?	+
		(3) MI ≥ 10 million VND	
		(2) 5 ≤ MI < 10 million VND	
		(1) 3 ≤ MI < 5 million VND	
		(0) MI < 3 million VND	
Quantity	*Qua*	What is the amount of conventional pork that the customer's household consumes per week (kg)?	-
Input material management	*Inp*	Were the respondents presented the "Input material management" principles of BBP and how did they agree that those principles can efficiently reduce contaminants, banned weight gain hormone and antibiotics in pork?	+
Waste treatment	*Waste*	Were the respondents presented the "Waste treatment" principles of BBP and how did they agree that those principles can efficiently protect the environment from pig farm wastes?	+
Veterinary hygiene	*Inf*	Were the respondents presented the "Veterinary hygiene" principles of BBP and how did they agree that those principles can efficiently reduce infectious disease in pork?	+
Original traceability	*Org*	Has it packaging information about the manufacturer to easily trace the origin?	+
Availability	*Lab*	Is it easy to find and to buy BBP pork in the market?	+

Variable name	Code	Description	Expected sign
Certification	*Cer*	Is it very safe and reliable because it is given the certification of BBP?	+
Purchase habits	*Habit*	How often does the consumer purchase BBP pork at a supermarket or safe-food store? (1) Never (2) 1-2 times/week (3) 3-4 times/week (4) 5-6 times/week (5) Over 6 times/week	+

RESULTS AND DICUSSIONS

Consumer household profile. Table 3 shows some characteristics of the surveyed consumer households for BBP pork. About 38% of the surveyed households had children under 10 years of age, 6.5% of the total households had members with health problem, and 26.1% of the households had elders. The education level of the consumers was quite high, where 73.9% of the respondents had a university or college background, a great majority of the respondents (82.6%) heard about BBP, but only 8% of the respondents had a clear understanding about BBP, indicating low level knew clearly about BBP. Majority of the income of the consumer's households ranged from 3 to 10 million VND/person/month (67.9%), in which, 31.3% of the households had an income of 3-5 million VND/person/month and 36.8% of households had an income of 5-10 million VND/person/month.

Table 3. Consumer household profile

Variable name	Situation	Frequency	Percent
Childcare	No	249	61.9
	Yes	153	38.1
Health problems	No	376	93.5
	Yes	26	6.5
Eldercare	No	297	73.9
	Yes	105	26.1
Education of consumer	Under high school	16	4.0
	High school	44	10.9
	University or college	297	73.9
	Post graduate	45	11.2
Knowledge about BBP	Never heard about BBP	38	9.5
	Sometimes heard about BBP	332	82.6
	Clearly understand BBP	32	8.0
Household income	≥10 million VND	70	17.4
	From 5 to < 10 million VND	148	36.8
	From 3 to < 5 million VND	125	31.1
	<3 million VND	59	14.7
Total		402	100

Source: Survey (2020)

The consumers in the Northern Delta urban areas purchased pork mainly from wet markets. The frequency of purchasing pork at wet markets are from five to six times per week which accounted for 45.5% of the total respondents. The majority of the consumers in the study areas had a tendency to frequently purchase at wet markets. On the other hand, under the development of retail markets in urban areas in the Northern Delta, a small number of consumers had a tendency to purchase in supermarkets. However, they still purchased pork in supermarkets less frequently than at wet markets, as nearly 22.6% of the respondents purchased pork in supermarkets or safe–food stores at the rate of 3-4 times per week (Table 4).

Purchasing at wet markets was the consumption habit and it is believed that they could get the expected bargain price there, which they could not get in the supermarkets. Otherwise, the supermarkets often offer higher prices than wet markets. In addition, wet markets are usually located nearer to the consumer's houses than supermarkets, so it is more convenient for consumers to buy pork from wet markets.

Table 4. Consumer's behavior regarding place and frequency of purchasing pork

Frequency	Place of purchase			
	Wet market		Supermarket/ Safe-food store	
	Number	%	Number	%
Less than 1 time/ week	21	5.22	41	10.2
1-2 times/week	19	4.73	188	46.8
3-4 times/week	113	28.11	91	22.6
5-6 times/week	183	45.52	55	13.7
Over 6 times/week	66	16.42	27	6.7
Total	**402**	**100**	**402**	**100**

Source: Survey (2020)

Table 5 shows the descriptive statistics on some of the explanation variables, i.e., the principles of BBP on the consumer's expectations and evaluation about the product's origin, availability, and certification of BBP. The variables of input material management, waste treatment, and veterinary hygiene reflected the expectation levels of how consumers perceived the BBP principles, i.e., reducing contaminants; banning weight gain hormones compounds and antibiotics in pork; protecting the environment; and limiting infectious diseases in pork product. The score for the principles of input material management (Inp) was highest with a score of 3.63 out of 5, while the score for environment (Envi) was lowest at 3.42 out of 5.

The evaluations of consumers about the traceability/origin, availability, and certification of BBP were from 2.89 to 3.47. In the surveyed market, a large amount of pork was sold with a brand name, with no information of the livestock farm, manufacture, or awarded certifications, even if it was sold in supermarkets and safe-food stores. The consumers' trust about certification was not very high and BBP pork is often found in supermarkets or safe-food stores, which are sometimes quite far from the consumers' residence.

Table 5. Consumer evaluation of BBP principles, the origin, availability, and certification

Variable code		Variable name	Min.	Max.	Total (n=402)		Purchase intention (n=303)	
					Mean	Standard deviation	Mean	Standard deviation
np	I	Input material management	1.00	5.00	3.63	0.988	3.71	0.923
aste	W	Waste treatment	1.00	5.00	3.42	1.129	3.56	1.128
nf	I	Veterinary hygiene	1.00	5.00	3.44	0.974	3.59	0.937
er	C	Certification	1.00	5.00	3.42	1.083	3.46	1.114
rg	O	Original traceability	1.00	5.00	2.89	1.038	2.90	1.073
va	A	Availability	1.00	5.00	3.47	0.888	3.48	0.916

Source: Survey 2020

Intention to consume BBP pork. The average quantity of pork consumption was about 1.85 kg/week/household (Table 6). This is lower than the average quantity of pork consumption in Vietnam (nearly 2 kg/week/household) (VGSO 2020). The average price of conventional pork in the retail market was about 117 thousand VND/kg. The purchase intention for BBP pork accounted for 75% of the total respondents. A majority of the households (61.4% of the total observations) were WTP for BBP pork at the premium price of 20% higher than that of conventional pork, and at the price of 30% higher than that of conventional pork, it was about 24.6% of the total observations.

Table 6. Consumption of quality pork and purchase intention for BBP pork

Variable code	Variable name	Minimum	Maximum	Mean	Std. deviation
Qua	Quantity of pork	0.12	10.08	1.85	1.39
PI	Purchase intention	0.00	1.00	0.75	0.431
WTP	Willing to pay	0.00	4.00	2.22	0.80
Pla	Habit	1.00	5.00	2.59	1.06

Source: Survey 2020

The influence of the factors on the intention to purchase BBP pork. The estimates of the factors affecting the intention to buy BBP pork in the Northern Delta urban areas are shown in Table 7. The likelihood ratio (LRχ^2=276.86) had a significance level of 1%, which meant that the whole the model was fit, the R square was 53.4%, which was suitable for the estimation of the binary logistic model (Gracia and Magistris 2008), and the chi-square ratio was 178.734 at the significance level of 1%. Education, knowledge, childcare, eldercare, and household income were significant factors influencing the customer's purchase intention for BBP pork. The correct prediction rate was quite high at 88.1%.

Table 7. The binary logit regression estimation of factors affecting purchase intention for BBP pork

Variable codes	Variables	Coefficient estimation	Standard error	Significance	Marginal effect
Edu	Education	***0.973	0.274	0.000	2.647
Kno	Knowledge about BBP	***3.594	0.579	0.000	36.368
Child	Childcare	***1.313	0.380	0.001	3.719
Ill	Health problem	1.382	1.024	0.177	3.982
Old	Eldercare	**0.965	0.410	0.019	2.625
Inco	Household income	***1.025	0.190	0.000	2.786
Cer	Certification	-0.107	0.162	0.511	0.899
Org	Original traceability	-0.204	0.167	0.221	0.815
Ava	Availability	0.030	0.187	0.874	1.030
Habit	Purchase habits	**0.401	0.164	0.015	1.493
Constant		***-6.941	1.287	0.000	0.001
Model fit	Likelihood ratio = ***270.058				
	The correct prediction rate = 88.10%				
	Nagelkerke R Square = 0.534				
	Chi-square= *** 178.734				

*Note: *, **, *** are significant levels at 10%, 5% and 1%, respectively.*
Source: Data collection and analysis (2020)

Consumer knowledge is a significant determinant factor for purchase intention (Haghjou et al. 2013). Results of the logistics regression would show which of the characteristics of the consumers in terms of their knowledge whether the information is quite clear for them, sometimes heard about it or never heard. If knowledge about BBP change from never heard to sometimes heard, the probability of purchase intention would increase 36 times. The estimates also indicated that education was one of the most important factors affecting the purchase intention with a marginal effect of 2.647, meaning that, on average, if the education level of the customers change from high school to university or college, it could motivate the probability of purchase intention, or an increase of 2.647 times. This finding is consistent with earlier studies that revealed education plays an important role in food purchase determination (Trung et al. 2014).

Households with children had the probability of purchase intention 3.7 times higher than households without children. For households with elders, the probability of purchase intention was 2.6 times that of household without elders. Children and elderly persons are commonly sensitive to contaminated foods, so customers with children and elders in their households usually cared about safe food consumption. This was the reason why households with childcare and eldercare had higher health consciousness (Prakash et al. 2018), and higher tendencies of purchase intention for BBP. The results stayed in line with previous researches that showed children can increase the safe food demand (Thompson and Kidwell 1998) and households that had seniors had stronger intention for purchase safe food (Haghjou et al. 2013).

As showed in Table 7, the household income also played an important role in purchase intention. The estimate of the household income effect was 0.1025 at the 1% level of significance, indicating that if the income of the household increase to over 3 million VND, 5 million VND and 10 million VND, respectively, the probability of their purchase intention for BBP pork tended to be 2.786 times in increase. Findings in the study were consistent with those in previous studies, e.g., high-income households preferred to purchase safe pork with full information about certifications, traceability, and no additive labels, and consumers' understanding about the certifications and food standards were able to create the purchase intention (Wang et al. 2018). The estimated coefficient of purchase habit was 0.401 at the significance level of 5%, meaning that when the consumer had a purchase habit at supermarkets and safe-food stores increase each 2 times per week, the probability of the purchase intention for BBP was 1,49 times in increase. These results agree with prior findings that revealed buying habits in super markets can determine the consumer's intention for buying safe food (Fleșeriu et al. 2020).

Factors influencing WTP for BBP pork. The model fitness test results proved the appropriateness of the estimated model, as shown in the scaled R-square of 47.9% and the likelihood ratio (LRχ^2=637.185) at the 1% level of statistical significance (Table 8). The estimated coefficient of income was significant at the 1% level, which showed that income was one of the key explanations for WTP for BBP. The household's income drove an important impact on the acceptance of higher prices, and if the household income was range from 5 million VND to 10 million VND or over 10 million VND, the probability of acceptance of the higher price is greater than that of lower income household. Our results were consistent with the reported highest positive determinant of WTP for safe pork that was monthly household income (Hao et al. 2019; Kataria et al. 2019) and income can positively effect on WTP because increasing income mean increase household's economic power for purchasing BBP (Oni et al. 2005). Meanwhile, the quantity of pork consumption and purchase intention were displayed as having a negative impact on WTP. If the household consumed higher quantities of pork, their WTP was reduced. Furthermore, the opposite relationship between purchase intention and WTP was found with the coefficient estimated of -1.024 at the significance level of 1%.

The estimated coefficients of input material management, waste treatment, and veterinary hygiene were all significant at 5%, 10% and 5%, respectively. Thus, the expectation and perception of

consumers about the influences of BBP could positively impact WTP. These findings were consistent with earlier report that consumer's expectation and perception on BBP principles can affect the preference for agriculture products (Aila and Oima 2013). Production principles aimed at satisfying consumers' concerns with food safety, disease safety and environmental protection could be preferred by consumers (Koklic et al. 2019; Zhang et al. 2019).

Table 8. Ordinal logit regression estimates of price WTP for BBP pork

	Variable codes	Variable names	Coefficient estimation	Standard error	Significance
Dependent variable	[WTP = 0.00]		***3.934	0.793	0.000
	[WTP = 1.00]		***5.022	0.775	0.000
	[WTP = 2.00]		***9.814	0.894	0.000
	[WTP = 3.00]		***12.523	1.007	0.000
Independent variable	*Inco*	Income	**0.259	0.125	0.038
	Qua	Quantity	***-0.526	0.057	0.000
	Inp	Input material management	**0.253	0.123	0.040
	Waste	Waste treatment	*0.189	0.106	0.074
	Inf	Veterinary hygiene	**0.299	0.140	0.033
	Cer	Certification	***0.505	0.112	0.000
	Org	Original traceability	***0.369	0.117	0.002
	Ava	Availability	***0.911	0.152	0.000
	Pla	Purchase habit	***0.520	0.115	0.000
	PI	Purchase intention	***-1.024	0.297	0.001
Model fit	Likelihood ratio = ***637.185				
	Chi-square = ***220.582				
	R square = 0.479				

Note: *, **, *** are significant levels at 10%, 5% and 1%, respectively.
Source: Data collection and analysis (2020)

The estimated coefficient of the certification, origin, and availability were significant at the 1% level, which indicated the significantly positive relationships between the certification, origin, and availability and WTP for BBP pork. It revealed that the perception of consumer about packaging with full information about manufactures and certifications can increase the WTP for BBP pork. Additionally, the availability of BBP presented a positive impact on the WTP for BBP. Certification was one of the promotors of WTP for BBP pork because it can raise the trust of consumers on livestock farmers. Practically, consumers do not know how to assess pork safety; pork is purchased with the expectation that livestock farmers are honest, keep their promises, and follow government regulations (Yee et al. 2005). The perception of consumers about certifications and traceability of origin are one of the most important types of information for ensuring the biosafety of products.

CONCLUSION

The factors influencing potential consumption of BBP pork in urban areas of the Northern Delta in Vietnam can be modeled using two kinds of model i.e., purchase intention and willingness to pay. In the study area, there is significant potential consumption for BBP pork through high proportion of consumers who intend to purchase BBP pork and high level of price premium that consumers are

willing to pay for BBP. Empirical evidence suggested that the increase in the consumer's knowledge, the household characteristics, and income could lead to the increase in the purchase intention for BBP pork. Purchasing habit in super markets could support for WTP. Similarly, the increase in income, bio-security principles preference and production identification played an important role for WTP improvement. However, the higher quantity of consumption for BBP pork could lead to the lower WTP.

The following policy recommendations are proposed to develop big production oriented biosafety practices: (1) motivate and expand the production and distribution of BBP pork in order to meet the potential consumption demands for BBP pork; (2) continue to improve the BBP principles to meet the consumers' expectations for some objectives such as environment protection, people's health, and infectious disease control; (3) improve the distribution of BBP, and establish a close linkage between farms and final consumers in order to reduce the price; and (4) provide detailed information about the availability, origin and certification related to BBP pork to ensure necessary information is on the packaging, which can increase the reliability of BBP pork in terms of consumers.

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