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Economic Benefit of Highly Pathogenic Porcine Reproductive and Respiratory Syndrome (HP-PRRS) Vaccination: From Meat Purchasers' Perspective

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Abstract: China is the largest pork producing country in the world, but China's pork industry is threatened by the pig disease Highly Pathogenic Porcine Reproductive and Respiratory Syndrome (HP-PRRS). Although vaccination is the most practical method of choice for HP-PRRS control, due to the high cost of the vaccines, producers are reluctant to vaccinate their pigs. If pork producers could pass along the cost of HP-PRRS vaccination to consumers, it would help cover the HP-PRRS vaccination costs, and ultimately, reduce HP-PRRS occurrence in China. To help inform HP-PRRS vaccine development and policy, our research employed the contingent valuation method to assess consumers' attitudes toward and willingness to pay (WTP) for PRRS vaccinated pork products. The results found a high positive WTP value for the HP-PRRS vaccinated pork production program in China. This study provides insight into the possibility of increasing the HP-PRRS vaccination percentages.
Keywords: Consumer survey, Contingent Valuation, HP-PRRS vaccinated pork, Willingness to pay.

INTRODUCTION

China is the largest pork producing and consuming country in the world, producing and consuming almost half of the pork produced in the world. Because pork is the major animal protein source for Chinese citizens, outbreaks of swine diseases will have a great impact on the meat market.

Since 2006, the China swine industry has been challenged by a new virus, which is called 'highly pathogenic porcine reproductive and respiratory syndrome (HP-PRRS)'. The virus affected almost 3.8 million pigs with a mortality rate of 20% to 100% and caused the death of 992,000 pigs. This HP-PRRS disease had spread quickly throughout the country, resulting in significant economic losses [1].

The highly pathogenic porcine reproductive and respiratory syndrome, also known as "blue-ear pig disease" in China, is a highly contagious disease in pigs. Since HP-PRRS could destroy the immune system of infected pigs, it was considered the AIDS (Acquired Immune Deficiency Syndrome) in pigs [2]. Because too many pigs were infected and died during HP-PRRS outbreak from Jun 2006 to the end of 2007, pork market price increased rapidly during this period. The China's average market price of pork was 6.26 yuan per kg on Jun 2006, however, the price increased to 14.95 yuan per kg on December 2007. The price more than doubled during HP-PRRS outbreak period. A previous study by Zhang *et al*., [3] also indicated that HP-PRRS outbreak negatively affected pork price in China's meat market.

In order to control the spread of HP-PRRS, Zhang et al., [4] demonstrated that vaccinating pigs with HP-PRRS vaccination was the most economically efficient and epidemiologically effective measure, compared with other control strategies. However, due to the high cost of HP-PRRS vaccines, producers were reluctant to vaccinate their pigs. If pork producers could pass along the cost of HP-PRRS vaccination to consumers, it would help cover the HP-PRRS vaccination costs, and ultimately, reduce HP-PRRS occurrence in China. Therefore, pork producers may want to know how much consumers are willing to pay a price premium for the pork from HP-PRRS vaccinated pigs (HP-PRRS vaccinated pork). The purpose of this study was to estimate consumers' willingness to pay (WTP) for HP-PRRS vaccinated pork, and to examine factors that affect consumers' perception of this pork. The findings of this study will help policy makers regulate HP-PRRS vaccination in China.

METHODS

Contingent valuation

The above-mentioned HP-PRRS vaccinated pork product is not available in the Chinese pork market. Therefore, methods suited to measure the value of a commodity not yet available in the market need to be applied. Stated preference approaches have been widely used for this purpose. Contingent Valuation (CV) in particular was become popular [5].

Contingent Valuation was well applied for evaluating food safety control managements. However, there are relatively few CV studies relating to livestock disease control. Articles that reported the use of CV for evaluating livestock farmers' preferences in relation to livestock disease control include Bennett and Balcombe [6], who applied CV to estimate farmers' WTP for a tuberculosis cattle vaccine in England and Wales, and Kairu-Wanyoike et al [7] who used CV to calculate farmers' WTP for contagious bovine pleuropneumonia vaccination in Kenya. However, to the best of authors' knowledge, there is no scientific research published to date about consumers' preference or WTP for vaccination of animals, especially for HP-PRRS vaccinated pork. Therefore, to help form HP-PRRS vaccination policy, this study employed CV to assess consumers' attitudes toward and WTP for HP-PRRS vaccinated pork.

Survey

A survey was conducted in Guangzhou city. Guangzhou is the capital city of Guang Dong province, a province that has the largest population in China, and is the financial and manufacturing center in Southern China. The economy and culture of Guangzhou have an enormous influence on South East Asian countries.

Following Bennett and Balcombe [6], a consumer survey with support from a professional telephone consumer survey institution (Intelligence Agency of Guang Dong Province) was conducted. To develop the survey questionnaires, we first identified the policies regarding vaccination of meat producing animals in Guangzhou, conducted in-depth interviews of key officials from the Department of Agriculture (Guangzhou Government), and the Guangzhou Food and Drug Administration. Before a pilot survey according to the guidelines of Bateman *et al*., [8] was conducted, we held discussions with local government officials, economic experts from the Guang Dong Academy of Social Sciences, and consumer survey experts from the Intelligence Agency of Guang Dong Province. Based on these discussions, we developed a questionnaire used in the telephone survey. Following pre-testing of the questionnaire, a pilot survey was carried out before the main survey was conducted in November 2014. Consumers were selected randomly from a 'Mobile phone owner list' provided by the Guangzhou government. In order to ensure a balanced sampling, a set of criteria was developed. These criteria included consumers' age, address, length of residence in Guangzhou, as well as their concerns and interests in pork purchasing.

The sample size needed was estimated using the method of Mitchell and Carson [5] formulated for contingent valuation. The sampling was not strictly stratified as the population in Guangzhou because the main objective of this study was to evaluate consumers' WTP for HP-PRRS vaccinated pork, so only the pork purchasers were selected for the survey. Guangzhou has the biggest immigrant population in China, with some people living in Guangzhou occasionally. We only included respondents who lived in Guangzhou for more than one year to survey.

Empirical models

Based on the recommendation from Carson [9], the questionnaire consisted of three parts. The first part gathered consumers' demographic information on gender, age, education, household size, household income, etc. (Table 1). The second part collected information about consumer's awareness of pork safety and quality, and frequency of buying pork at supermarkets. The third part focused on consumers' preference and WTP for HP-PRRS vaccinated pork. To receive reliable responses, we used dichotomous choice questions (Table 2) in the survey. With respect to question 4, 4-1, 4-2, in Table 2, all respondents were asked whether or not they prefer to purchase HP-PRRS vaccinated pork (Table 2). For the dependent variables (Y_i = 0, where i = 1,2,3) a "yes" answer is coded as 1 and a "no" answer is coded as 0. Binomial logit model was run three times for analysis [1)]. In the first analysis, all respondents were asked to choose whether or not they want to purchase HP-PRRS vaccinated pork if the pork price is 12 yuan per 500g (question 4 in Table 2). In the second analysis, for consumers who answered "yes" (552 samples), they were asked to respond to question 4-1 (if the price is 14 yuan per 500g) in Table 2. In the third analysis, for consumers who answered "no" (107 samples), they were asked to respond to question 4-2 (if the price is 9 yuan per 500g).

For the i^{th} respondent, the following discrete outcomes of the bidding process were observable:

$$Y_i = 0 \quad 0 \leqq \text{WTP} < B_p \qquad (1)$$
$$\text{Yi=1} \quad B_p \leqq \text{WTP}$$

The individual i's WTP for the PRRS vaccinated pork is represented as:

$$WTP_i = \alpha + \beta' Z_i + \varepsilon_i \qquad (2)$$
$$Zi = \{X_1, X_2, X_3, \ldots\ldots X_{19}\}$$

where WTP_i is consumer i's unobservable true willingness to pay, B_p is the price that respondent face to choose (presented as 9,12, or 14 Chinese Yuan;

Table 2) in the questionnaire; *Zi* is a column vector of observable socio-demographic variables of the respondents; ε_i is the stochastic part that is representing the unobservable influence on the individual WTP. Unknown parameters to be estimated are α, and β.

RESULTS AND DISCUSSIONS

About one third of consumers who received the survey agreed to participate in the survey and completed the telephone interview. In total, six hundred and fifty nine complete questionnaires were obtained from the survey. Because of the telemarketing fraud problem in Guangzhou, some respondents did not trust phone calls from strangers, which partly explained the high "failure to complete" rate in this study.

Table-1: Demographic statistics and variable definitions in binomial logit model

		Y_1; P_i = 12				Y_2; P_i = 14				Y_3; P_i = 9				Total	
		Yes		No		Yes		No		Yes		No			
Classification	**Variable**	No.	(%)	No	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
1.Gender															
Male	$X_1 = 1$	223	40.4	42	39.3	172	38.7	51	47.7	9	34.6	33	40.7	265	40.2
Female	$X_1 = 0$	329	59.6	65	60.7	273	61.3	56	52.3	17	65.4	48	59.3	394	59.8
2.Age															
16-19	X_2- X_7=0	95	17.2	18	16.8	83	18.7	12	11.2	3	11.5	15	18.5	113	17.1
20-29	X_2=1;(X_3- X_7=0)	202	36.6	53	49.5	153	34.4	49	45.8	18	69.2	35	43.2	255	38.7
30-39	X_3=1;(X_2, X_4- X_7=0)	109	19.7	10	9.3	89	20.0	20	18.7	1	3.8	9	11.1	119	18.0
40-49	X_4=1;(X_2,X_3,X_5- X_7=0)	72	13.0	12	11.2	59	13.3	13	12.1	3	11.5	9	11.1	84	12.8
50-59	X_5=1;(X_2- X_4,X_6,X_7=0)	43	7.8	6	5.6	38	8.5	5	4.7	0	0.0	6	7.4	49	7.4
61-70	X_6=1;(X_2- X_5,X_7=0)	23	4.2	7	6.5	16	3.6	7	6.5	0	0.0	7	8.6	30	4.5
≥70	X_7=1;(X_2- X_6=0)	8	1.4	1	0.9	7	1.6	1	0.9	1	3.8	0	0.0	9	1.4
3. Education															
Elementary	$X_8 = 1$	26	4.7	9	8.4	22	4.9	4	3.7	3	11.5	6	7.4	35	5.3
Junior high	$X_8 = 2$	72	13.0	13	12.1	63	14.2	9	8.4	1	3.8	12	14.8	85	12.9
High sch.	$X_8 = 3$	185	33.5	36	33.6	146	32.8	39	36.4	11	42.3	25	30.9	221	33.5
Junior college	$X_8 = 4$	126	22.8	31	29.0	105	23.6	21	19.6	9	34.6	22	27.2	157	23.8
College	$X_8 = 5$	123	22.3	11	10.3	95	21.3	28	26.2	1	3.8	10	12.3	134	20.3
Graduate sch.	$X_8 = 6$	20	3.6	7	6.5	14	3.1	6	5.6	1	3.8	6	7.4	27	4.1
4. Have child															
Yes	$X_9 = 1$	319	57.8	50	46.7	270	60.7	49	45.8	10	38.5	40	49.4	369	56.0
No	$X_9 = 0$	233	42.2	57	53.3	175	39.3	58	54.2	16	61.5	41	50.6	290	44.1
5. Have aged people															
Yes	$X_{10} = 1$	234	42.4	40	37.4	189	42.5	45	42.1	7	26.9	33	40.7	274	41.6
No	$X_{10} = 0$	318	57.6	67	62.6	256	57.5	62	57.9	19	73.1	48	59.3	385	58.4
6. Household size															
1	$X_{11} = 1$	15	2.7	3	2.8	12	2.7	3	2.8	2	7.7	1	1.2	18	2.8
2	$X_{11} = 2$	55	10.0	21	19.6	43	9.7	12	11.2	8	30.8	13	16.0	76	11.5
3	$X_{11} = 3$	160	29.0	29	27.1	126	28.3	34	31.8	4	15.4	25	30.9	189	28.7
4	$X_{11} = 4$	126	22.8	15	14.0	105	23.6	21	19.6	5	19.2	10	12.3	141	21.4
5 or more	$X_{11} = 5$	196	35.5	39	36.4	159	35.7	37	34.6	7	26.9	32	39.5	235	35.9
7. Household income (Unit: thousand Yuan/ year)															
≤30	$X_{12} = 1$	106	19.2	23	21.5	77	17.3	29	27.1	2	7.7	21	25.9	129	19.6
30-60	$X_{12} = 2$	97	17.6	28	26.2	79	17.8	18	16.8	10	38.5	18	22.2	125	19.0
60-90	$X_{12} = 3$	73	13.2	19	17.8	55	12.4	18	16.8	5	19.2	14	17.3	92	14.0
90-120	$X_{12} = 4$	79	14.3	11	10.3	67	15.1	12	11.2	2	7.7	9	11.1	90	13.7
120-150	$X_{12} = 5$	34	6.2	2	1.9	31	7.0	3	2.8	1	3.8	1	1.2	36	5.5
150-180	$X_{12} = 6$	38	6.9	1	0.9	31	7.0	7	6.5	0	0.0	1	1.2	39	5.9
180-210	$X_{12} = 7$	38	6.9	6	5.6	29	6.5	9	8.4	1	3.8	5	6.2	44	6.7
≥210	$X_{12} = 8$	87	15.8	17	15.9	76	17.1	11	10.3	5	19.2	12	14.8	104	15.8
Sample size		**552**		**107**		**445**		**107**		**26**		**81**		**659**	

Overall, Guangzhou consumers had relatively high preference for HP-PRRS vaccinated pork**.** Among the respondents who completed the survey, 87.7% ([552+26]/659) expressed the acceptance of HP-PRRS vaccinated pork (WTP ≥ 9 yuan), 83.8% (552/659) said they were willing to pay the price premium of 2 yuan (12-10 yuan; the price premium is 20% of regular pork price for this pork), and 67.5% (445/659) were willing to pay a price premium of 4 yuan (Table 1). It was possible that some respondents might be willing to pay a much higher price for this kind of pork. Therefore, low price might not be a good promotion strategy for HP-PRRS vaccinated pork in China. On the other hand, even the price decreased from 12 yuan to 9 yuan, the proportions of acceptance for HP-PRRS vaccinated pork did not increase significantly (from 83.8% to 87.7%).

European Commission conducted a similar consumer survey in 2006. The results (European Commission, 2006) indicated that over half of the respondents were against the meat from chicken vaccinated with H5N1, a highly pathogenic avian influenza (HPAI). Compared with the EU, Chinese consumers had relatively higher acceptance of meat from vaccinated food-producing animals.

Results of demographic statistics are presented in Table-1. From the sample collection, 59.8% of the respondents were female. In the case of Y_2 (Column 'Y_2; P_i = 14' in Table 1), the proportion of female who wanted to buy HP-PRRS vaccinated pork at 14 yuan per 500g (price premium 4 yuan; 65.4%, in Table 1), was much higher than male consumers. Females were the main pork purchaser, and they had a higher likelihood than males of purchasing HP-PRRS vaccinated pork with price premium.

Table-2: Statistics of responses to basic questions and variable definitions

		Y_1; P_i = 12				Y_2; P_i = 14				Y_3; P_i = 9				Total	
		Yes		No		Yes		No		Yes		No			
Classification	**Variable**	No.	(%)	No	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
1. How much pork do you purchase per week?															
Unit:500g	X_{13} Mean value	5.8550		4.7850		5.9752		5.3551		5.8654		4.4383		5.6813	
2. The first thing that you (mostly) care about, when you are buying pork.															
Food safety	$X_{14} = 1$; (X_{15},$X_{16} = 0$)	318	57.6	64	59.8	263	59.1	55	51.4	15	57.7	49	60.5	382	58.0
Freshness	$X_{15} = 1$; (X_{14},$X_{16} = 0$)	187	33.9	28	26.2	150	33.7	37	34.6	8	30.8	20	24.7	215	32.6
Price	$X_{16} = 1$; (X_{14},$X_{15} = 0$)	17	3.1	7	6.5	9	2.0	8	7.5	1	3.8	6	7.4	24	3.6
Others	X_{14}- X_{16}=0	30	5.4	8	7.5	23	5.2	7	6.5	2	7.7	6	7.4	38	5.8
3. Frequency of buying pork at supermarket															
Seldom	$X_{17} = 1$	390	70.7	75	70.1	309	69.4	81	75.7	19	73.1	56	69.1	465	70.6
Sometimes	$X_{17} = 2$	74	13.4	14	13.1	61	13.7	13	12.1	4	15.4	10	12.3	88	13.4
Often	$X_{17} = 3$	88	15.9	18	16.8	75	16.9	13	12.1	3	11.5	15	18.5	106	16.1
4. Asking consumers who purchase pork from supermarket (Sometimes or Often), what kind of pork do you purchase from supermarket (Branded or non-branded)?															
Branded	$X_{18} = 1$	71	12.9	10	9.3	65	14.6	6	5.6	2	7.7	8	9.9	81	12.3
Non-branded[2]	$X_{18} = 0$	481	87.1	97	90.7	380	85.4	101	94.4	24	92.3	73	90.1	578	87.7
Sample size		552		107		445		107		26		81		659	
4. If the price of normal pork is 10 yuan per 500g, on the other hand, the pork from the pigs which are PRRS-vaccinated and free of PRRS infection, is 12 yuan per 500g, do you want to purchase this PRRS-vaccinated pork?															
Yes	$Y_1 = 1$; P_i = 12	552	83.8												
No	$Y_1 = 0$; P_i = 12			107	16.3										
4-1. (If they answered 'Yes' in question 4), if the price of PRRS-vaccinated pork is 14 yuan per 500g, do you want to purchase?															
Yes	$Y_2 = 1$; P_i = 14					445	80.6								
No	$Y_2 = 0$; P_i = 14							107	19.4						
4-2. (If they answered 'No' in question 4), if the price of PRRS-vaccinated pork is 9 yuan per 500g, do you want to purchase?															
Yes	$Y_3 = 1$; P_i = 9									26	24.3				
No	$Y_3 = 0$; P_i = 9											81	75.7		

Notes: 1) Proportion of total samples (659).
2) In the model estimation, other samples who answered purchase pork from supermarket seldom, was considered as $X_{18} = 0$

The age group of 30 to 39 years old (Age 30-39) had a higher acceptant rate for HP-PRRS vaccinated pork. In the case of 'Y_1; P_i = 12' (Table 1), 91.6% (109/119) of the age group 30-39 accepted to pay a price premium of 2 yuan for HP-PRRS vaccinated pork. Among them, 81.7% (89/109) even expressed the willingness to pay a price premium of 4 yuan for this pork. This result corresponded to the result of X_9 (Table 1, Table 3). Further analysis (data not shown) indicated that 71.4% (85/119) of respondents in age 30-39 have children. The results from the logit analysis indicated that respondents with children had relatively higher WTP for HP-PRRS vaccinated pork than respondents without children (Table 3; Column 'Y_1; P_i = 14', the parameter of X_9 was positive and statistically significant).

These results suggested that there is a potential demand for HP-PRRS vaccinated pork among urban consumers of 30 to 39 years old. On average, approximately 15% of China's population was in the age category of 30 to 39 years, with 60% of this population living in urban areas [10]. Multiplying by China's total population, it could be roughly estimated that there are 122 million people (1350 million × 15% × 60%) who might have great interests and WTP for HP-PRRS vaccinated pork. These urban citizens in their 30s represented significant potential HP-PRRS vaccinated pork consumers, conceivably having huge benefits for the pork producers who adopt HP-PRRS vaccination.

Table-3: Estimation results from binomial logit model

Dependent variable				Y_1; P_i = 12		Y_2; P_i = 14		Y_3; P_i = 9		
Variable	Coefficient			Odd ratio	Coefficient		Odd ratio	Coefficient		Odd ratio
Constant	α	0.1185		1.1258	2.2484	***	9.4725	1.0613		2.8900
X_1	β_1	0.0671		1.0694	-0.3624		0.6960	-0.6997		0.4967
X_2	β_2	-0.4722		0.6236	-0.8423	**	0.4307	1.4021	*	4.0635
X_3	β_3	0.5278		1.6952	-0.8183	*	0.4412	-0.3169		0.7284
X_4	β_4	0.2417		1.2733	-0.7336		0.4802	0.4191		1.5206
X_5	β_5	0.4155		1.5152	-0.1020		0.9030	--------		--------
X_6	β_6	-0.3354		0.7150	-1.2627	**	0.2829	--------		--------
X_7	β_7	0.4164		1.5164	-0.2881		0.7497	--------		--------
X_8	β_8	0.1614		1.1752	-0.2790	**	0.7565	-0.4499		0.6377
X_9	β_9	0.3428		1.4089	0.7679	***	2.1552	-0.1215		0.8856
X_{10}	β_{10}	0.1795		1.1966	0.0059		1.0059	-0.4208		0.6565
X_{11}	β_{11}	0.0169		1.0170	-0.1516		0.8593	-0.4504		0.6373
X_{12}	β_{12}	0.0449		1.0459	0.1697	***	1.1850	0.0931		1.0976
X_{13}	β_{13}	0.0455	*	1.0466	0.0196		1.0197	0.1463	*	1.1576
X_{14}	β_{14}	0.4240		1.5280	0.6456		1.9072	-0.1315		0.8768
X_{15}	β_{15}	0.7460		2.1085	0.3968		1.4870	0.0473		1.0485
X_{16}	β_{16}	-0.2715		0.7622	-0.7724		0.4619	-0.5794		0.5602
X_{17}	β_{17}	-0.1332		0.8753	-0.1046		0.9007	-0.2982		0.7421
X_{18}	β_{18}	0.3075		1.3600	1.0569	**	2.8775	0.1657		1.1802
Number of obs			659			552			107	
LR chi2(19)			30.37			47.87			17.44	
Prob＞ chi2			0.034			0.0002			0.2933	
Log Likelihood			-277.1315			-247.5074			-45.4136	

Note: In the case of *Y3;* P_i = *9*, independent variable X_5,X_6,X_7, and constant are collinear. It happens when multiple dummy variables included in logit model (Hosmer and Lemeshow, 2000) [12]. Therefore, this study deleted those three variables for the analysis of question 4-2 (Column *Y3;* P_i = *9*).

Among respondents with children who had strong preference for HP-PRRS vaccinated pork, 89.2% ([319+10]/369) accepted HP-PRRS vaccinated pork. Moreover, 86.4% (319/369) of them accepted a price premium of 2 yuan/500g, and 73.2% (270/369) accepted a higher price premium of 4 yuan/500g. In the case of 'Y_2; P_i = 14' in Table 3, the odd ratio of X_9 was 2.2, suggesting that consumers with children were 2.2 times more likely purchase HP-PRRS vaccinated pork than consumers without children.

Unsurprisingly, respondents with higher household income had relatively better preference for HP-PRRS vaccinated pork. Among the respondents who had annual household income over 210,000 yuan, 95.2% ([87+12]/104) accepted HP-PRRS vaccinated pork, 83.7% (87/104) accepted 2 yuan/500g of price premium of HP-PRRS vaccinated pork, and 73.1% (76/104) accepted price premium of 4 yuan/500g for this pork.

Table-2 summarized pork consumption patterns, purchasing behavior, and purchasing channels. The quantity of pork purchased by respondents who accepted HP-PRRS vaccinated pork was significantly higher than the quantity of respondents who did not accept HP-PRRS vaccinated pork.

Most consumers considered food safety as the most important factor when they purchase pork, as indicated by the answers to question 2 in Table-2. This result was different from a previous survey in that most consumers considered price was the most important factor in purchasing pork in Beijing [11]. The discrepancy between these two studies could be due to pork safety problems (*e.g.* selling dead diseased pigs) that occurred in Guangzhou and Guangzhou consumers care about pork safety more than consumers in other regions.

Most consumers mainly purchased pork from wet markets and seldom from supermarkets. Only 16.1% (88/659) of the respondents mainly purchased pork at supermarkets. In addition, most consumers rarely purchased the pork with brand name (usually in high price). Consumers' pork purchasing channel did not affect their acceptance for HP-PRRS vaccinated pork. On the other hand, in Table 3 Column 'Y_2; P_i = 14', the parameter of X_{18} was positive with an odd ratio of 2.9, suggesting that consumers who purchased branded pork will be 2.9 times more likely to purchase HP-PRRS vaccinated pork by paying high price premiums than consumers who did not purchase the pork brand name. These results indicated that HP-PRRS vaccinated pork should be sold in supermarkets in a brand name.

On the other hand, the results of logit model analysis in this study showed that education level did not statistically affect consumers' acceptance for HP-PRRS vaccinated pork statistically (Column 'Y_1; P_i = 12' in Table 1 and Table 3). However, in the case of choosing high price premium (4 yuan) for HP-PRRS vaccinated pork, the education level affected consumers' WTP negatively (parameter β_8 in Table 3, column 'Y_2; P_i = 14'). This result implied highly educated consumers perceived HP-PRRS vaccinated pork as reasonable, because the price premium of 2 yuan can include the HP-PRRS vaccination cost significantly.

CONCLUSIONS

Major findings

To mitigate the burden of HP-PRRS vaccination cost on pork producers in China, the findings of this study suggested that it is possible to sell HP-PRRS vaccinated pork with a price premium, and pass along some of HP-PRRS vaccination cost to consumers. Results of this study indicated that most consumers (83.8%) accepted to pay the price premium of 2 yuan for HP-PRRS vaccinated pork. 67.5% of the consumers also could pay a price premium of 4 yuan. It could be considered there will be a considerable amount of consumers that would be willing to pay more price premium for this kind of pork.

Furthermore, based on the analysis of results in this study, this HP-PRRS vaccinated pork should be introduced at the supermarket and with a brand name. This study also identified that the main HP-PRRS vaccinated pork purchasers are urban consumers in the age of 30-39 years with children. To make this kind of pork more attractive to this particular consumer group, product differentiation strategy should be applied. This kind of pork should be promoted with a brand name. Pricing strategy is important. This study suggested that setting the price premium for this pork around 2 yuan per 500g is reasonable. On the other hand, the results of this study also indicated that decreasing the price of HP-PRRS vaccinated pork lower than normal pork price is not an appropriate pricing strategy for promoting HP-PRRS vaccinated pork. Even if the price of this pork decreased from 12 yuan (2 yuan of price premium) to 9 yuan (1 yuan cheaper than the normal pork price), the proportions of acceptance for this pork was not increased significantly. Selling HP-PRRS vaccinated pork with a cheaper price will not increase the market share of this pork, instead, it will force pork producers to bear the burden of high HP-PRRS vaccination cost.

Limitations

This study was conducted in the urban area in Guangzhou, where the average income level is top in China. Further comparative studies should be conducted in other areas of China, and even in other countries in Southeast Asian, such as Vietnam where HP-PRRS outbreaks are more severe than China. Furthermore, based on the result of consumers' willingness to pay high premium for vaccinated pork, further research regarding Cost Benefit Analysis of HP-PRRS vaccination in swine production should be investigated in the future.

On the other hand, to promote full coverage of HP-PRRS vaccination in China, it is important to educate consumers on the severity of HP-PRRS. Pork is the traditional meat in China, and Guangzhou dwellers prefer pork more than people in other part of China. HP-PRRS severely caused death of pigs, and pork safety problems of selling dead diseased pigs were severe in Guangzhou. Guangzhou consumers do not know where they can buy safe pork. Therefore, to restore consumer confidence in the safety of pork in Guangzhou, further research related to governmental pork safety inspection design, and consumer preference for pork safety control measures are needed.

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