Chinese consumers' willingness-to-pay for nutrition claims on processed meat products, using functional sausages as a food medium

Received 29 June 2020
Revised 10 October 2020
Accepted 5 January 2021

Xinyi Hong and Chenguang Li
School of Agriculture and Food Science, University College Dublin, Dublin, Ireland
Junfei Bai
Beijing Food Safety Policy and Strategy Research Base, China Agricultural University, Beijing, China
Zhifeng Gao
Department Food and Resource Economics, University of Florida, Gainesville, Florida, USA, and
Liming Wang
School of Economics and Management, Beijing University of Technology, Beijing, China and
Irish Institute for Chinese Studies, University College Dublin, Dublin, Ireland

Abstract

Purpose – Following the standard practice of using nutrition claims to denote food functionality, this study empirically explores Chinese consumers' willingness-to-pay for functional processed meat products by using three nutrition claims (namely "increased calcium," "containing omega-3", and "reduced salt") made on pork sausages. It also aims to outline the typical characteristics of Chinese consumer segments based on preferences.

Design/methodology/approach – A choice-based choice experiment is utilized to investigate Chinese consumers' valuation on attributes of interest regarding functional sausage products. First-hand data was collected in the two cities of Xi'an and Beijing.

Findings – There are market potentials for domestic and/or imported functional processed meat products among Chinese consumers. Nutrition claims made on pork sausages are appealing to Chinese consumers, and therefore, monetarily rewarded by them. Being imported from a more developed country of origin could both positively and negatively impact consumers' WTP for nutrition claims made on pork sausages. Furthermore, specific functional modification strategies should be taken into account when addressing different segments of the Chinese market. In addition, regional impacts between Xi'an and Beijing are implied in terms of consumers' valuation for functional pork sausages.

Research limitations/implications – Limitations in the current study are mainly two folds. First, the WTP estimation magnitudes are subject to a hypothetical bias by using a stated preference approach. Second, this

The authors thank the School of Agriculture and Food Science, University College Dublin and Beijing Food Safety Policy and Strategy Research Base, China Agricultural University for financial support for the data collection.

China Agricultural Economic Review
Vol. 13 No. 2, 2021
pp. 495-518
Emerald Publishing Limited
1756-137X
DOI 10.1108/CAER-06-2020-0160

study only focuses on pork sausages to explore consumers' perceptions and selects three nutrition claims among many other relevant options.

Practical implications – Implications are provided for meat marketers and for Chinese official food policymakers, such that promoting meat products with a nutrition claim is an attractive marketing strategy for foreign food manufacturers in China, and more reformulated meat products with better nutritional compositions should be allowed in the Chinese market.

Originality/value – To the best of the author's knowledge, this research is the first to fill in the literature blank on investigating the consumers' valuation for functional meat in the emerging market of China. Because when taking Chinese consumers as a target market and evaluating their perceptions of food quality-related labeling and certifications, the existing literature is mainly limited to topics of product safety, organic/green products, and geographical origins. However, nutrition claims, as marketable credence attributes that associate closely to the main characteristics of the functional food products, have been explored to a much lesser extent among Chinese consumers.

Keywords Chinese market, Choice-based conjoint experiment, Functional processed meat products, Willingness-to-pay

Paper type Research paper

1. Introduction

Being developed via scientific modification to achieve perceived health-benefited rewards, functional food [1] could be considered as a "pharma-nutrition interface," an in-between position to conventional food and medicines (Eussen *et al.*, 2011). In China, the market of functional food is thriving and is expected to be prosperous in the long term (European Commission, 2019). An online survey, carried out by Bord Bia (Irish Food Board) among a representative sample of Chinese adults, finds that Chinese consumers have a very high awareness of functional food (85%), which surpasses other food types such as fair-trade products (46%), ethical products (53%), and glycemic indexed food (71%), and correspondingly, a proportion as high as 83% of respondents expressed their willingness to buy food with functionality, either as "very likely" or "fairly likely" (Bord Bia, 2015).

In contrast to the growing interest in, and demand for, functional food among Chinese consumers, an investigation into consumers' perception of nutrition and/or health claims made on food products is much neglected. One possible reason for the lack of research could be the complications of definitions and regulations on functional food. Hitherto, a globally recognized criterion to define functional food is still not reached. Moreover, with regard to regulatory differences, the European Food Safety Authority legislation allows far more authorized nutrition and health claims on food upon a successful application compared to the 27 health functional claims approved by the former Chinese Food and Drug Administration (Patel *et al.*, 2008; Yang, 2008; Verhagen and van Loveren, 2016).

Nutrition and/or health claims are widely included as labeling indicators of functional food in consumer studies, which contains information on the nutritional value and the health functionality of food products (Ares *et al.*, 2009; Krystallis and Chrysochou, 2012; Van Wezemael *et al.*, 2014; Shan *et al.*, 2017b; Wortmann *et al.*, 2018; Schnettler *et al.*, 2019). Nutrition and health-related claims differ from other marketable credence attributes (e.g. country of origin, organic certificates, and traceability) in its thorough evidence-based scientific assessment to justify the stated nutrients and/or functionalities of health maintenance in food choices, although these other credence attributes also need to be assessed by food regulatory authorities via application to be labeled on the food package.

Therefore, this research aims to address a gap in the literature and explore Chinese consumers' acceptance of and willingness-to-pay (WTP) for functional food. We use nutrition claims in this study to represent the main characteristics of functional food while circumventing the regulatory complications on health claim labeling. A nutrition claim, distinguished from a health claim, states the nutrient content *(such as "contain," "source of," "free of" "reduced" and "increased")* without mentioning a health-beneficial outcome (Arvanitoyannis and van Houwelingen-Koukaliaroglou, 2005; Kaur *et al.*, 2017).

Given the fact that the functional food industry is a multibillion dollar business and comprises many food categories (Siegrist *et al.*, 2015), it is hard for any research to reach a valid conclusion without considering the vast differences among the distinctive categories of food. Therefore, a subsector of functional food, namely, the functional processed meat sector, and a representative product, namely, pork sausages, were selected as the focus for this research.

Processed meat products have been a nondismissible part of the daily consumption to many consumers and a strongly growing sector in China (Euromonitor.com, 2019), although they are often associated with a negative health perception and considered to be carcinogenic to humans (Tobin *et al.*, 2014; Shan *et al.*, 2017a). Reformulating them to incorporate more healthy properties provides possible directions to countereffect nutritional defects (Schnettler *et al.*, 2019). Sausages, as heavily processed meat products with a generally negative health reputation, are frequently chosen as a suitable food carrier for modifications. Food scientists have published successful examples of sausages with better nutritional value without compromising on their sensory satisfaction (Krickmeier and Schnackel, 2008; García-Íñiguez de Ciriano *et al.*, 2010; Berasategi *et al.*, 2014; Zajac *et al.*, 2017; Neville *et al.*, 2017; Díaz-Vela *et al.*, 2017). Evidence from the food markets concretes the role of sausages as innovation pioneers in the area of functional processed meat, with offerings, including calcium-enriched pork sausages from well-known Chinese brands such as *Shuanghui* and *Jinluo*; imported codfish sausages from a Korean brand *Jinju*; and other sausage products with no added food flavor, coloring agents, or starch. Therefore, this study empirically explores Chinese consumers' preferences and valuation for functional processed meat products by using pork sausages as a medium and aims to answer the following questions:

(1) Is there market potential for domestic and/or imported functional pork sausages among Chinese consumers?

(2) What are nutrition claims monetarily rewarded by Chinese consumers, and how much in terms of WTP?

(3) What are the typical characteristics of Chinese consumer segments based on preferences and WTP, and accordingly, how large is the market share of each consumer segment?

Aside from filling in the literature gap by providing further understanding of Chinese consumers' preferences for nutrition claims on functional processed meat, the answers to these questions will yield useful information for international marketers, particularly in the area of processed meat products and their marketing strategies, and for national food policymakers with regard to administrating the functional food market.

2. Literature review

Existing literature investigating Chinese consumers' perception and preferences for food quality-related labeling and certifications covers topics of product safety, organic/green produce, and geographical origins (Ehmke *et al.*, 2008; Ortega *et al.*, 2011, 2016; Wu *et al.*, 2011; Zhang *et al.*, 2012; Wu *et al.*, 2014, 2015b; Yu *et al.*, 2014; Wu, Wang and Zhu, 2015a; Li *et al.*, 2017). Using pork products as research interests, Ortega *et al.* (2011) survey consumers from seven cities in China and suggest the highest WTP for governmental safety assurance. Wu *et al.* (2015a) support the conclusion on attractiveness from certifications handed out by official authorities. Results find a price premium for traceable pork than the nontraceable counterparts, where government information is most valuable (2.11 RMB per 500 g), followed by farming information (2.02 RMB per 500 g). On a larger-scale sample of 1,489 consumers across seven cities, Wu *et al.* (2015b) further explore consumers' preferences for pork with varying levels of safety and other attributes, and observe high WTP for government-issued

quality certification. Another research involving a massive sample size of 1,757 Chinese consumers also verifies more monetary value for certified traceable food, including traceable pork products (Wu *et al.*, 2011), which is similar to Zhang *et al.*'s (2012) investigation on pork, milk, and cooking oil with traceability. Moreover, Yu *et al.* (2014) focus on the unique quality certification of "Green Food" in China and discover that a producer could charge at most 40% more for Green pork on top of the normal price of conventional pork meat.

However, nutrition and health claims, as marketable credence attributes that associate closely to the main characteristics of the functional food products, have been explored to a much lesser extent among Chinese consumers. One exception is Xu *et al.*'s (2020) study on dairy products. The authors have used Shanghai consumers to study their preferences for imported milk with nutrition claims and find that Chinese consumers are willing to pay higher prices for milk carrying a nutrition claim of containing vitamins or minerals, and the country of origin (COO) is also an influential factor on preferences.

In this study, three nutrition claims are selected (detailed reasons for this selection are explained in section 3.1). From the above literature, a hypothesis is proposed that *(Hypothesis 1) a Chinese consumer is willing to pay higher* prices *for improved nutritional attributes of pork sausages, which is certified by:*

H1a. A nutrition claim of "increased calcium"

H1b. A nutrition claim of "containing omega-3"

H1c. A reduced nutrition claim of "reduced salt"

When using a geographical origin of food as a quality indicator, Ehmke *et al.* (2008) use samples from four countries (namely, China, France, Niger, and the United States) to explore WTP for COO labels. They conclude that Chinese consumers are willing to pay more for domestic white onions, and the product's origin is in a middle position of relative importance, which is considered more important than "no genetical modification" but less valuable than "pesticide-free production." Somewhat similarly, Ortega *et al.* (2016) indicate that Austrian beef is perceived as being worth a higher price than Chinese or US beef and that Chinese consumers particularly value information on measures to enhance food safety. Another research by the same authors consolidates the importance of food safety reassurance by studying fresh-chilled pork loins, which highlights that consumers in mainland China favor their own-country over a US origin, but this situation is completely changed when US pork is awarded a food safety claim (Ortega *et al.*, 2017). Nevertheless, contradictory conclusions are drawn when dairy products (Wu *et al.*, 2014; Li *et al.*, 2017) and wines (Wang and McCluskey, 2010; Xu and Zeng, 2014) are researched. Although mixed results are presented, a general impression is that Chinese consumers tend to prefer food (e.g. pork) originating in China, especially when no foreign food prestige or product reputation is successfully built in the domestic market. However, ethnocentric tendencies are subject to alteration when imported food is certified. For this research, it is hypothesized that *(hypothesis 2) Chinese consumers prefer domestically produced and branded pork sausages to imported counterparts, but when sausages are labeled with a nutrition claim, the complementary effects between a more developed country of origin and certified nutritional improvement result in increased preferences for imported functional pork sausages.*

3. Material and methods

3.1 Choice-based conjoint (CBC) experiment

Following a large quantity of literature, which uses CBC experiments to estimate WTP for credence attributes of food (Ehmke *et al.*, 2008; Barreiro-Hurle, Gracia and de-Magistris, 2010; Ortega *et al.*, 2011; Wu *et al.*, 2015b; Wu *et al.*, 2015a; Ortega *et al.*, 2016; Arenna *et al.*, 2019), this methodology is utilized to investigate Chinese consumers' valuation on attributes of

interest regarding functional sausage products. The product profile of pork sausages in the current study is described by four attributes (one in the country of origin domain and three in the nutrition claim domain), in addition to the price factor (Table 1). The decisions on attributes and levels are based on preliminary results from pretests (Appendix 1), information from real-life supermarkets in China, and extensive consultation with relevant publications.

The price levels approximated retail prices to assure relevance for participants when making choices and enabled a reasonable coverage of price variation based on product features.

The EU was China's largest source of foreign pork, comprising 63 percent of China's pork imports in 2018 (United States Department of Agriculture, 2019). Therefore, imported EU pork sausages were set as an alternative to assess Chinese consumers' preferences on COO. This study only compared two scenarios of domestically produced and Chinese branded pork sausages versus EU produced and branded pork sausages. In order to avoid the intricacies of brand value, brand knowledge, and brand preferences (Zhuang *et al.*, 2008; Gao *et al.*, 2019), in the decision-making process, the brand names of either China or EU sausages were not specified.

Three pertinent claims of "increased calcium," "containing omega-3," and "reduced salt" were specified, which all varied at two levels (i.e. either the sausage product was qualified for the nutrition claim or there was no claim). These nutrition claims were considered most relevant to the Chinese market context to fulfill the research objectives, based on market observations and findings from existing research: (1) Field trips in supermarkets observed that the Chinese market already offered some innovatively functional sausage products, such as codfish sausages rich in DHA [2] and pork sausages enriched with calcium [3]; (2) Pretest pretest results suggested that fortification with omega-3 fatty acids could be the appropriate added nutrient that met consumers' health expectations for process meat products (see Appendix 1). (3) Sufficient evidence stresses that dietary intake of salt is excessive among Chinese families in Beijing (Zhao *et al.*, 2015), and the idea of reducing salt in processed meat is accepted by western consumers, with multiple low-salt meat products being marketed (Zhang *et al.*, 2010; Lalor *et al.*, 2010; Lee and Chin, 2010; Shan *et al.*, 2017a, b). (4) Multiple scientific papers suggest that meat products being enriched with omega-3 (Berasategi *et al.*, 2014; García-Íñiguez de Ciriano *et al.*, 2010; Zajac *et al.*, 2017), and calcium (Khan *et al.*, 2011) do not cause compromises on sensory characteristics. Therefore, these three nutrition claims were selected to reflect existing market offerings and research outcomes, as well as potential application to a wider range of meat products apart from sausages.

Attribute	Attribute levels	Description
Price (RMB[1]/400 g[2])	15, 20,25,30	The price was expressed in RMB, which represented the WTP for 400 g of chosen pork sausages, as prepacked sausages were often sold with 400 g based on real-world market offerings
Country of origin (COO)	China produced, Chinese brand, EU imported, EU brand	The pork sausages were either produced domestically in China and under a Chinese brand, or imported from the EU under an EU brand, where the brand name was not specified
Nutrition claim	Increased calcium None	If present, the pork sausages were enriched with enough calcium to carry an eligible nutrition claim of "increased calcium"
	Containing omega-3 None	If present, the pork sausages were enriched with enough omega-3 to carry an eligible nutrition claim of "containing omega-3"
	Reduced salt None	If present, the pork sausages reduced the use of salt ingredient to carry an eligible nutrition claim of "reduced salt"

Note(s): [1]: RBM is the initial abbreviation for renminbi, China's local currency unit; [2]: To closely simulate real-world situations where pork sausages were often sold in a pack of 400 g according to supermarket-level observations, this study set the retailing unit as "RMB/400 g" instead of a more commonly seen choice of "RMB/jin (500 g)"

Table 1.
Choice experiment attribute, associated levels, and description

A full-factorial set of attribute level combinations produced 64 alternatives (4*2*2*2*2) (Table 1). Then, alternatives were halved through an efficiently designed modified Fedorov algorithm that maximized the D-efficiency index (Kuhfeld *et al.*, 1994; Carlsson and Martinsson, 2003). The D-optimal design enabled the estimation of both main effects and specific two-way interaction effects between the brand/production origin and a nutrition claim (Ortega *et al.*, 2016). As a result, 32 different sausage profiles with differing attribute level combinations were produced and were further divided into 16 choice sets. A no-purchasing decision was included in each choice set to better replicate the actual shopping experience. All participants were shown 16 choice tasks one by one in the same order, and in each choice set, they were instructed to state their preferred alternative between the two competing packs of pork sausages (option 1 and option 2), or to choose "neither."" Figure 1 shows an example of a choice task.

3.2 Participants and survey instrument

Data was collected from two designated cities in China, namely Xi'an and Beijing, due to the coexistence of both similarities and differences between the two places. Both Xi'an and Beijing are popular tourist destinations with exposure to foreign cultures while maintaining locally authentic food cultures. Nevertheless, in terms of economic development and degree of affluence, Beijing is far ahead of Xi'an. Therefore, regional differences were also explored as an influence on consumers' preferences and WTP.

Surveys were carried out at either national supermarket chains with an imported food section or import supermarkets because supermarkets were considered as the most frequently shopping places for pork sausages according to pretest results (see Appendix 2). The logic was to conduct the survey at places where consumers had access to both domestic and imported food products and in a timely fashion after real grocery purchasing decisions were made, which is suggested by Ortega *et al.* (2011). The questionnaire was implicitly divided into three sections. The first part collected information about behavioral and attitudinal aspects of pork sausages and process meat in general, followed by the core section of a choice experiment. Prior to making decisions on the preferred hypothetical sausage product, a cheap talk strategy was adopted to counteract hypothetical bias (Lusk, 2003), and the experiment context was fully explained by the interviewer. For instance, the interviewer further emphasized that under the brand attributes, a Chinese brand denoted domestically produced pork sausages, and likewise, the EU brand represented EU originated and produced pork sausages. The last section mainly gathered standard sociodemographics and consumers' lifestyle information, where the interviewer let participants answer the questions independently and only offered help when requested, for the purpose of mitigating potential social desirability bias (Tourangeau and Yan, 2007).

After excluding incomplete surveys, the final Xi'an and Beijing effective samples consisted of 431 valid responses: 187 in Xi'an and 244 in Beijing. A statistical summary of characteristics for the overall sample and for the two samples of Xi'an and Beijing is reported in Table 2.

Scenario 1: if these were your only options, you would choose:			
Pork Sausages	Option 1	Option 2	Option 3
Price	20 RMB/400g	15 RMB/400g	Neither
COO	Domestically produced, Chinese brand	EU imported, EU brand	
Nutrition Claim	• Increased calcium	• Containing omega-3 • Reduced salt	
I will buy	□	□	□

Figure 1.
Example of a choice task

	Total	Subsample Xi'an	Subsample Beijing
Sample size (person)	431	187	244
Gender (%)			
Male	46.17	43.32	48.36
Female	53.83	56.68	51.64
Age (mean ± st.dev.)	32.74 (±10.86)	32.34 (±10.74)	33.06 (±10.96)
Family size based on family members who live together (%)			
1	7.89	6.42	9.02
2	15.31	13.90	16.39
3	41.30	39.04	43.03
4	22.97	26.20	20.49
5 and more	12.53	14.44	11.07
Having children aged 16 or under (%)			
Yes	32.25	36.9	28.69
No	67.29	63.1	70.49
Prefer not to answer	0.46		0.82
Highest education level (%)			
Elementary school or less	4.64	5.88	3.69
High school	15.31	14.97	15.57
College credit, no degree	17.63	26.74	10.66
Bachelor's degree	47.33	44.39	49.59
Master's degree or above	15.08	8.02	20.49
	Total	Subsample Xi'an	Subsample Beijing
Household monthly disposable income range (%)			
¥[1] 4,000 and below	7.19	8.02	6.56
¥ 4,001–¥ 8,000	20.88	19.25	22.13
¥ 8,001–¥ 12,000	25.52	35.83	17.62
¥ 12,001–¥ 16,000	19.49	20.86	18.44
¥ 16,001–¥ 20,000	8.35	5.35	10.66
¥ 20,001–¥ 24,000	10.21	3.74	15.16
¥ 24,001–¥ 28,000	2.32	2.14	2.46
¥ 28,000 and above	6.03	4.81	6.97
Individual consumption frequency of pork sausages (%)			
Less than 2 times in half year	22.97	19.79	25.41
3–5 times in half year	28.07	28.34	27.87
1–3 times per month	34.11	34.76	33.61
1–3 times a week	13.92	15.51	12.7
4–6 times a week	0.93	1.6	0.41
Everyday	0	0	
Individual monthly pork consumption (%)			
<250 g	45.24	43.32	46.72
250 g–500 g	21.81	24.06	20.08
500 g–1 kg	18.79	17.65	19.67
1 kg–1.5 kg	8.35	8.56	8.2
>1.5 kg	5.8	6.42	5.33
Individual monthly spending on purchasing pork sausages (RMB)			
mean (±st.dev)	78.52 (±110.93)	77.14 (±102.59)	79.58 (±117.12)

(*continued*)

Table 2.
A statistical overview of sample characteristics: total, Xi'an, and Beijing participants

	Total	Subsample Xi'an	Subsample Beijing
Market pork meat safety evaluation[2]			
Averaged score (±st.dev)	61 (±19)	62 (±19)	61 (±18)
Awareness of African Swine fever (%)[3]			
Have never heard of it	9.98	10.7	9.43
Have heard little of it	54.99	60.43	50.82
Have heard much of it	27.15	21.93	31.15
Have paid close attention on it	7.89	6.95	8.61

Note(s): [1]: ¥ is the currency symbol of Chinese renminbi; [2]: Pork meat safety evaluation was rated on a range of 1–100, where a larger number denoted a higher level of perceived safety; [3]: African Swine Fever (ASF) is a virulent disease, which is predicted to impose long-term effects on domestic supplies and import demand on pork products in China (United States Department of Agriculture, 2019). The survey period (July to early September of 2018) coincided with the incidence of the ASF disease hitting China's hog industry. This question regarding awareness of the ASF outbreak was added to account for the impact of the ASF incidence on consumers

Table 2.

The overall sample was almost gender balanced, with slightly more female participants (53.83%) than male counterparts (46.17%). This is a commonly observed phenomenon in surveys conducted around food outlets, probably owing to the reality that women are usually the primary food shoppers in a family (Ortega *et al.*, 2011, 2016, 2017; Wu *et al.*, 2015b). The age range was quite wide, from 18 to 77, and averaged at 33 years 41.3% of families comprised of three people, followed by four-person families (22.97%). Approximately one-third (32.25%) of the sample had children aged 16 or under. More than half of the respondents (62.41%) held a bachelor's degree or above. In terms of household monthly disposable income, around half (46.4%) of surveyed subjects reported a level between 8,000 RMB and 16,000 RMB. The two subsamples in Xi'an and Beijing exhibited many similarities in their sociodemographic characteristics, but with two apparent differences in education and household income. This was expected and reflected a city-level disparity in economic development between Xi'an and Beijing.

Table 2 also summarizes consumption information, where the majority of respondents (85.15%) consumed pork sausages one to three times a month or less. Accordingly, 67.05 % of respondents indicated an intake amount of fewer than 500 g. The average individual spending on pork sausages was 78.52 RMB per month, with a large standard deviation of 110.93 RMB, which indicated variation in expenditure. With regard to pork meat safety and consumers' awareness of the ASF disease outbreak, respondents rated 61 out of 100, suggesting a neutral or slightly positive attitude toward domestic pork safety. Additionally, around half of the sample (54.99%) had heard little about ASF and only 7.89% reported paying close attention to it, which implicitly reflected overall public confidence in the pork market. Comparisons of pork sausage consumption and pork safety concerns of the subsamples in two cities indicated congruence with each other.

3.3 Econometric specification and data analysis

With theoretical groundings from Lancaster consumer theory and random utility theory (Lancaster 1966; Train 2009), choices made by participants in the conjoint experiment manifest the utilities of each choice, which quantitatively measures consumer preferences on listed attributes. Assume all consumers, denoted N, respectively faced with J alternatives altogether from T choice sets. In accordance with Train's (2009) econometric deduction, the utility that an individual consumer n gets from the alternative j in the choice set t is specified as s function below:

$$U_{njt} = \beta_n^{'} x_{njt} + \varepsilon_{njt} \tag{1}$$

where U_{njt} denotes the overall utility; x_{njt} is a vector of constructed attributes that relate to the jth alternative and the nth consumer; β_n is a vector of individual-specific parameters representing marginal utility; ε_{njt} is an error term, independently and identically distributed across individuals and alternatives.

To fulfill the study's objectives, two versions of mixed logit models, namely a random parameter logit (RPL) model and a latent class model (LCM), were constructed.

Under the assumption that a consumer maximizes the utility obtained from the selected pork sausage products, the probabilistic specification takes the following form:

$$P_{nit} = \text{Prob}(U_{nit} > U_{njt} \forall j \neq i) \tag{2}$$

$$P_{nit} = \int \prod_{t=1}^{T} \left(\frac{e^{(\beta_n' x_{nit})}}{\sum_{j \in J} e^{(\beta_n' x_{njt})}} \right) f(\beta_n) d\beta \tag{3}$$

Where P_{nit} denotes the probability of the consumer n choosing the product profile of pork sausages i over J alternatives in the choice set t. $f(\beta)$ is the density function of random parameters β_n, deviating from the population distribution. Eqn (3) is unconditional, as the variance of random parameters β_n, causes correlation in unobserved utility across alternatives. This allows consumers to have heterogenous preferences for pork sausages, as suggested by various studies on pork-related products (Barreiro-Hurle *et al.*, 2010; Ortega *et al.*, 2011, 2017; Wu *et al.*, 2015b; Arenna *et al.*, 2019), and affords further consumer segmentation according to preferences. When consumers are classified into M latent classes of homogeneous subjects, preference heterogeneity is only present between classes but not within classes. Accordingly, in model construction, $f(\beta_n)$ is discrete, with fixed β within a segment of the population but random in-between segmentation, such that β takes a set of class-specific values, denoting $\beta_1, \beta_2, \ldots, \beta_m$. The choice probability of Eqn (3) in segment m is translated into:

$$P_{nit|m} = \sum_{m=1}^{M} \prod_{t=1}^{T} \left(\frac{e^{\beta_m' x_{nit}}}{\sum_{j \in J} e^{\beta_m' x_{njt}}} \right) S_{nm} \tag{4}$$

Where S_{nm} denotes the probability that consumer n belongs to the segment m. This probability of S_{nm} has the following function, described by (Ouma *et al.*, 2007):

$$S_{nm} = \frac{e^{\theta_m' Z_n}}{\sum_{m=1}^{M} e^{\theta_m' Z_n}} \tag{5}$$

where Z_n is a set of observable characteristics identified as impactful on the intrinsic taste preferences of a consumer n, and therefore, the class membership for the subject, and θ_m' is the parameter vector for homogeneous consumers in class m.

Derived from RPL models, WTP estimates can be calculated either by "estimation in preference space" or "estimation in WTP space" (Hole and Kolstad, 2012; Ortega *et al.*, 2016). The former approach is widely applied but is subject to drawbacks. In the standard utility function specification of parameters in linearity, WTP from the coefficient ratio of two random parameters may give rise to unrealistic, skewed estimation (Scarpa *et al.*, 2008; Balcombe *et al.*, 2009; Hole and Kolstad, 2012; Coffie *et al.*, 2016). If conveniently assuming a fixed monetary coefficient, this treatment compromises the economic meanings of WTP and is contrary to preference heterogeneity in food attributes by implying identical marginal utility of price across consumers (Meijer Erik, 2006). Otherwise, specifying a monetary coefficient to be lognormally distributed may lead to heavy skewness (e.g. exceedingly

large numbers) (Scarpa *et al.*, 2008). Alternatively, WTP space is advocated as a solution (Train K., 2005; Scarpa *et al.*, 2008; Balcombe *et al.*, 2009; Agnoli *et al.*, 2016; Coffie *et al.*, 2016), where essentially the mixed logit model is reformed in such a way that the coefficients directly represent payment estimates for attributes and the a priori assumptions of distribution are made with regard to WTP rather than attribute coefficients. The superiority of this approach is reflected in the ability to specify suitable WTP distribution, producing more realistic estimates and potentially providing better goodness of data fit in modeling payment for quality-related credence attributes for meat products (Ortega *et al.*, 2016, 2017). Referring to consumer studies on WTP for functional products, consumers are found to have heterogeneous preferences for functional ingredients in sausages and health-related information attributes, with mixed results on payment intentions (van Trijp and van der Lans, 2007; Lähteenmäki *et al.*, 2010; Annunziata and Vecchio, 2013; Van Wezemael *et al.*, 2014). Hence, normally distributed WTP coefficients are specified for all attributes in this study.

All model analysis was run by Stata 15.1 [4]. Estimation of parameters was computed through simulated log-likelihood of choice probabilities (Hole, 2007; Scarpa *et al.*, 2008; Train, 2009), using 1,000 Halton draws.

4. Results

4.1 RPL model results and WTP estimation

Table 3 contains RPL model results, calculated by estimation in preference space, as well as by estimation with these model variables re-parameterized in WTP space.

Considering the overall fit, both models are statistically significant (chi-square statistics of 2854.36 and 1267.44 respectively, with associated *p*-value being 0.000 and 0.000 respectively), proving joint impacts of attributes in the functions on respondents' utility. The log-likelihood ratio and AIC value are almost the same, with extremely marginal differences indicating the former model specification as a better fit. However, the latter model is advocated as a more advantageous payment intention measurement (Train , 2005; Scarpa *et al.*, 2008; Balcombe *et al.*, 2009; Agnoli *et al.*, 2016; Coffie *et al.*, 2016; Ortega *et al.*, 2017). Therefore, analytical outputs from the preference space model are used for interpretation of utility, while the monetary measurement is quoted from the WTP space model.

As expected, the negative sign of the price parameter implied decreasing utility due to higher pay. Considering the main effects of the origin and three nutrition claims, signs and statistical coefficients were positive, which indicated that more utility was obtained from the presence of an "increased calcium" claim, a "containing omega-3" claim, and a "reduced salt" claim. This result implicitly supports *hypothesis 1* that Chinese consumers are willing to accept increased prices given certified nutrition claims. Among the selected nutritional modifications, the estimated marginal utility coefficient magnitude was largest for calcium, followed by omega-3, and least for salt, which suggested that consumers in China placed more value on enrichment with calcium, and to a less extent on omega-3 fortification and salt reduction. The standard deviations of the calcium claim, omega-3 claim, and salt claim were also significant, showing that there were segments of consumers who had either positive or negative preferences for the three claims. The COO parameter was not significant, meaning that EU imported pork sausages were indifferent from these China-produced counterparts. However, the statistically significant standard deviation of the COO attribute and the significantly positive coefficient on the interaction term between the COO and the reduced salt claim highlighted that additional utility was derived when pork sausages with a reduced-salt claim were imported from the EU. These findings are similar in agreement with Ortega *et al.*'s (2017) observations that Chinese consumers in Hong Kong obtain statistically indistinguishable utility from Chinese fresh pork and US fresh pork, even accounting for

	PRL		WTP space	
	Coefficient	St.dev	Coefficient	St.dev
Price	−3.879***	1.583***	−2.833***	0.924***
	0.195	*0.104*	*0.099*	*0.063*
Country of origin	0.057	1.784***	8.436**	33.166***
(COO)	*0.223*	*0.095*	*3.608*	*2.680*
Calcium claim	0.637***	0.597***	17.331***	−12.160***
	0.124	*0.070*	*2.532*	*1.139*
Omega-3 claim	0.572***	1.238***	8.217***	24.234***
	0.137	*0.078*	*2.394*	*2.130*
Reduced salt claim	0.331***	0.843***	7.052***	−14.918***
	0.130	*0.090*	*2.073*	*1.570*
Constant (optout)	−4.672***	4.263***	−74.622***	−65.088***
	0.339	*0.236*	*6.739*	*6.065*
COO*Calcium	−0.090	−0.295	−14.213***	3.286**
	0.227	*0.215*	*3.737*	*1.551*
COO*Omega-3	−0.019	0.890***	0.296	−12.052***
	0.236	*0.168*	*3.353*	*2.525*
COO*Salt	0.865***	−0.556*	15.825***	−9.819***
	0.231	*0.337*	*3.873*	*2.109*
Log likelihood	−4785.516		−4837.912	
Chi-square statistics	2854.36		1267.44	
AIC	9607.031		9711.823	
BIC	9749.903		9854.695	
No. of observations	20,688		5,868	

Note(s): 1: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively; 2: St.dev., AIC, and BIC are short for standard deviation, Akaike information criterion and Bayesian information criterion, respectively; 3: Standard errors are reported in italic; 4: The sign of the estimated standard deviations is irrelevant: interpret them as being positive; 5: The coefficient of price parameters is assumed lognormally distributed in the preference space model

Table 3.
Results of the RPL model and WTP estimation

patriotism impacts, while in the geographically proximal city of Guangzhou, consumers significantly prefer local pork. Yet, a food safety claim on US pork elicits much monetary return and outperforms domestically produced pork products in both cities, whereas US pork carrying an animal welfare claim or an environmental claim is only positively valued in Hong Kong and negatively perceived in Guangzhou. In line with Ortega *et al.*'s (2016) other studies on US beef, the authors note that a US origin alone does not significantly make Chinese consumers differentiate it from domestic beef, but its popularity and accepted prices increase when US beef is marketed with an enhanced food safety label but not with animal welfare, green, or organic claim. Therefore, *hypothesis 2* is partly confirmed that Chinese consumers prefer imported EUbranded pork sausages with a reduced salt claim to domestically produced and branded counterparts with the same claim. However,

there are indifferent preferences in the COO attribute when considered alone and no nutrition claims are certified.

The right-hand side of Table 3 reports the estimation of WTP space, where the coefficients are directly interpreted as consumer payment for attributes. Significantly positive estimated means of coefficients for all three nutrition claims confirm *hypothesis 1*, *i.e.* that *a Chinese consumer is willing to pay higher* prices *for improved nutritional attributes in pork sausages which are certified in claims*, which is in line with Yang and Fang's (2020) and Xu *et al.*'s (2020) conclusion of Chinese consumers valuing health-benefited claims in pork and imported milk, respectively. More specifically, on average, a consumer was willing to pay an additional 17.3 RMB for an "*increased calcium*" claim (hypothesis 1a) on sausages, followed by 8.21 RMB for

a "*containing omega-3*" claim (hypothesis 1b), and 7.05 RMB for a "reduced salt" claim (hypothesis 1c). Overall, carrying a calcium-fortified nutrition claim attracted the highest financial reward from consumers, while the salt reduction claim elicited the lowest. At a significant level of 0.05, an EU origin also provided extra economic value for pork sausages with a maximum payment of 8.44 RMB. Yet, a notably negative WTP was found for the interaction between the COO and calcium. In other words, the joint presence of an EU origin and an "increased calcium" claim yielded lower utility and WTP than when each was provided separately. Therefore, provided that functional pork sausage products were imported from EU countries and were marketed under the original EU brand name, the maximum payment elicited from a Chinese consumer decreased to 11.56 RMB [5] for an "*increased calcium*" claim and increased considerably to 16.95 RMB for a "*containing omega-3*" claim and increased substantially to 31.31 RMB for a "reduced salt" claim. This corresponded with the discovery of significantly positive interaction effects between the EU brand and the reduced salt claim in the preference space model. Standard deviations for all estimated parameters were statistically significant at a 95% confidence level, indicating consistent rejection of preference homogeneity among Chinese consumers.

Respective estimation among the city-level samples of Beijing and Xi'an was also conducted (see Appendix 3), and the results implied that consumers in Beijing were willing to pay a larger amount for an EU origin, and consumers in Xi'an were more willing to pay higher prices for nutrition claims.

4.2 Consumer segments

Van Wezemael *et al.* (2014) note that research efforts are required to identify the claims for different products, which are most valued by consumer groups. This is supported by Ares *et al.* (2009), who states that different health claims might be attractive to different market segments. The RPL results (Table 3) asserts that Chinese consumers' perceived valuation for the origin and different claims made on functional sausages are heterogeneous.

As a result, an LCM is utilized to sort Chinese consumers into a number of classes based on their taste preferences. Four sociodemographic characteristics, namely household income, education, gender, and city, were selected to enter latent regression in Eqn (5) as covariate factors to select members of different classes. Education, income levels, and gender were identified as factors influencing consumers' pork meat preferences by Ortega *et al.* (2011) and Wu *et al.* (2015b). The city factor was worth investigating, given the economic and educational gaps between Xi'an and Beijing. In order to determine the optimal number of classes, LCMs with different numbers of consumer segments are estimated over a range of 2–11, and goodness-of-fit measures of the statistics are listed in Appendix 4.

Indicators of goodness-of-fit implied that the optimal class number was 10. Yet, existing literature normally splits consumers into classes of less than five. One possible inference is that the sophistication of specifying too many consumer groups in an overly segmented market might provide little research value, although a fraction may still contain a substantial size of Chinese consumers. Thus, the author argued that classifying consumers into 10 groups was not substantially more meaningful, in academic terms, compared to classifying them into five groups in revealing typical group features. As a result, a representative LCM with five classes was accordingly used, and estimated results were listed in Table 4.

Attribute coefficients of varying magnitudes and both signs verified heterogeneity among different classes. The price parameters were almost consistently negative (except for class 5) and statistically significant (except for class 1), which generally conformed to the economic expectations of higher utility as a result of lower prices. The estimated coefficients for the COO attribute were positive for classes 1, 2 and 4, but negative for classes 3 and 5, which indicated some evidence of ethnocentric tendencies in the latter two groups. With regard to

Table 4.
5-class regression results from latent class models

	Class 1		Class 2		Class 3		Class 4		Class 5	
	Coef	S.E.	Coef	S.E.	Coef	S.E.	Coef	S.E.	Coef	S.E.
Price	−0.004	0.024	−0.066***	0.009	−0.043***	0.005	−0.072***	0.022	0.047***	0.011
COO	19.572***	1.257	0.180	0.240	−0.389	0.777	0.620	1.278	−0.259	0.487
Calcium claim	−1.081	0.850	0.919***	0.152	0.447	0.387	−2.106**	0.924	−0.447	0.305
Omega-3 claim	1.105	0.841	0.455**	0.157	0.631	0.411	−0.506	0.819	−1.104***	0.305
Reduced salt claim	23.986***	0.263	−0.079	0.153	0.530	0.374	1.064*	0.644	0.312	0.291
COO* Calcium	2.949*	1.744	−0.817***	0.246	0.271	0.762	4.342**	1.780	0.924	0.575
COO* Omega-3	−2.356	1.729	−0.008	0.235	0.276	0.809	2.015	1.538	0.155	0.565
COO* Salt	−46.723		1.161***	0.238	0.499	0.739	−2.032*	1.210	−0.195	0.558
Opt-out	−3.90***	0.923	−0.32***	0.251	−3.60***	0.506	−4.386***	1.185	−1.216**	0.399
Age	0.025	0.019	−0.052**	0.020	−0.018	0.016	0.029	0.019		
Household income	0.086	0.160	0.274*	0.121	0.256**	0.111	0.361**	0.127		
Education level	−0.679**	0.231	−0.217	0.199	−0.146	0.175	0.174	0.234		
Gender	0.013	0.462	0.406	0.382	0.060	0.339	0.009	0.415		
City	−0.518	0.464	−0.004	0.379	−0.039	0.340	0.591	0.447		
Constant	0.785	1.182	1.722	1.078	1.458	0.953	−3.35**	1.275		
Class share	8.60%		21.00%		44.50%		13.20%		12.70%	
Log likelihood					−4915.7					
AIC					9969.4					
CAIC					10318.96					
BIC					10249.96					

Note(s): 1: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively; 2: Coef. and S.E., are short for coefficient and standard error; 3: Class 5 is computed as the reference class; 4: AIC, CAIC, and BIC are short for Akaike information criterion, Consistent Akaike information criterion and Bayesian information criterion, respectively

the three nutrition claims: consumers in class 1 disliked calcium enrichment, but not omega-3 fortification or salt reduction; consumers in class 2 consistently obtained higher value from nutrient enrichment but not from salt reduction; consumers in class 3 generally support all functional modifications in sausages, although none of the claim parameters were of statistical significance; the opposite occurred for their counterparts in classes 4 and 5, where the only welcomed functional modification in sausages was a salt reduction.

Previous studies normally divide consumers into four distinct groups based on their preference heterogeneities for quality-related attributes on pork (Ortega *et al.*, 2011; Wu *et al.*, 2015; Xu *et al.*, 2020). In this study of functional pork sausages, consumer segmentation conforms to observations in previous studies. Class 1 was featured as imported food supporters, which had a significantly negative relationship with an education level. Therefore, consumers with higher education compared to the base of class 5 were less likely to be classified into this class. Class 2 was specified as "addition" strategy supporters, where young consumers with relatively higher disposable income were likely to be incorporated. Class 3 included consumers who were satisfied with all functional claims and were typically younger, middle-income females. Class 4 was characterized as "reduced" strategy supporters, who were more likely to be well-educated, high-income older consumers. Class 5 was identified as indigenous food supporters due to negative coefficients of price and origin attributes. The breakdown of respondents among these five imperfectly homogeneous classes was 8.6%, 21.00%, 44.5%, 13.2%, and 12.7%, respectively. The findings provide suggestions for meat manufacturers. Meat companies are encouraged to launch functional meat products due to the reason that a major proportion of consumers (78.7%) have indicated demand (namely classes 2, 3, and 4). Moreover, consumers of middle and high income would be targeted, and young consumers are more inclined to accept the addition of nutrients in meat products. Senior consumers welcome more the idea of "less being more" in a healthier meat production process.

5. Conclusion

This research is the first to address the gap in the literature relating to consumers' perception of and WTP for meat products with nutrition claims in the emerging Chinese market. Findings conclude that there is the market potential for domestic and/or imported functional processed meat products among Chinese consumers. Nutrition claims made on pork sausages are appealing to Chinese consumers, and therefore, monetarily rewarded by them. Nevertheless, when interaction effects of origins and nutrition claims are considered, both complementary and substitutional effects on utilities and WTP are revealed. Being imported from a more developed country of origin could both positively and negatively impact consumers' WTP for nutrition claims made on pork sausages. Furthermore, specific functional modification strategies should be taken into account when addressing different segments of the Chinese market. In addition, regional impacts between Xi'an and Beijing are implied in terms of consumers' valuation for functional pork sausages.

These conclusions are of practical value to food administrators and international food marketers. There is a demand for healthier meat products with quality certification in China, such that a price premium can be expected from pork sausages with a nutrition claim. A reasonable implication is for Chinese official food policymakers to facilitate the certification process of nutrition claims made on meat products domestically and/or in other developed countries and allow better nutritionally reformulated meat products into the Chinese market. Moreover, a recommended marketing strategy for foreign food manufacturers in China is to promote their food products by using a nutrition claim. In the case of imported functional pork sausages, findings in this study imply that the "reduction" strategy (e.g. lowering salt) is valued substantially more than the "addition" strategy of enriching products with health-beneficial ingredients.

Several limitations in the current study are highlighted. First, the WTP estimation magnitudes are subject to a hypothetical bias by using a stated preference approach. Secondly, this study only focuses on pork sausages to explore consumer perception and selects three nutrition claims among many other relevant options. Accordingly, further studies might gain consumer insights into the Chinese market by using incentive-compatible mechanisms such as auctions or real choice experiments to incorporate real money transactions and products. These methods may help reduce the overly stated WTP for functional food products.

Notes

1. Common characteristics differentiating functional food from conventional food include: (1) beneficial effects on one or more functions of the human organism, by improving physical conditions and/or decreasing the risk of developing diseases; (2) providing some specific health benefit beyond basic nutrition; (3) modified by adding/concentrating one or more beneficial ingredient(s) or removing/replacing ineffective or harmful ingredients; (4) based on solid scientific evidence; (5) staying in the normal form of food.
2. Codfish sausages rich in DHA under a Korean brand of *Jinju* were available on the shelves of Chinese supermarkets.
3. Calcium enriched pork sausages under Chinese brands of *Shuanghui and Jinluo* were available on the shelves of Chinese supermarkets.
4. StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC.
5. WTP for each claim attribute is calculated as the sum of the direct and interaction WTP estimates in the monetary space model.

References

Agnoli, L., Capitello, R., De Salvo, M., Longo, A. and Boeri, M. (2016), "Food fraud and consumers' choices in the wake of the horsemeat scandal", *British Food Journal*, Vol. 118 No. 8, pp. 1878-1893.

Annunziata, A. and Vecchio, R. (2013), "Consumer perception of functional foods: a conjoint analysis with probiotics", *Food Quality and Preference*, Vol. 28 No. 1, pp. 348-355.

Arenna, Goddard, E. and Muringai, V. (2019), "Consumer purchase intentions for pork with enhanced carnosine-A functional food", *Canadian Journal of Agricultural Economics-Revue Canadienne D Agroeconomie*, Vol. 67 No. 2, pp. 151-169.

Ares, G., Gimenez, A. and Gambaro, A. (2009), "Consumer perceived healthiness and willingness to try functional milk desserts. Influence of ingredient, ingredient name and health claim", *Food Quality and Preference*, Vol. 20 No. 1, pp. 50-56.

Arvanitoyannis, I.S. and van Houwelingen-Koukaliaroglou, M. (2005), "Functional foods: a survey of health claims, pros and cons, and current legislation", *Critical Reviews in Food Science and Nutrition*, Vol. 45 No. 5, pp. 385-404.

Balcombe, K., Chalak, A. and Fraser, I. (2009), "Model selection for the mixed logit with Bayesian estimation", *Journal of Environmental Economics and Management*, Vol. 57 No. 2, pp. 226-237.

Barreiro-Hurle, J., Gracia, A. and de-Magistris, T. (2010), "The effects of multiple health and nutrition labels on consumer food choices", *Journal of Agricultural Economics*, Vol. 61 No. 2, pp. 426-443.

Berasategi, I., Navarro-Blasco, Í., Calvo, M., Cavero, R., Astiasarán, I. and Ansorena, D. (2014), "Healthy reduced-fat Bologna sausages enriched in ALA and DHA and stabilized with Melissa officinalis extract", *Meat Science*, Vol. 96 No. 3, pp. 1185-1190.

Bord Bia (2015), *Chinese Consumers and Their Food Full Report*, PERIscope, Dublin.

Carlsson, F. and Martinsson, P. (2003), "Design techniques for stated preference methods in health economics", *Health Economics*, Vol. 12 No. 4, pp. 281-294.

Coffie, R., Burton, M., Gibson, F. and Hailu, A. (2016), "Choice of rice production practices in Ghana: a comparison of willingness to pay and preference space estimates", *Journal of Agricultural Economics*, Vol. 67 No. 3, pp. 799-819.

Díaz-Vela, J., Totosaus, A., Escalona-Buendía, H. and Pérez-Chabela, M. (2017), "Influence of the fiber from agro-industrial co-products as functional food ingredient on the acceptance, neophobia and sensory characteristics of cooked sausages", *Journal of Food Science and Technology-Mysore*, Vol. 54 No. 2, pp. 379-385.

Ehmke, M.D., Lusk, J.L. and Tyner, W. (2008), "Measuring the relative importance of preferences for country of origin in China, France, Niger, and the USA", *Agricultural Economics*, Vol. 38 No. 3, pp. 277-285.

European Commission (2019), *China : Market Guide Functional Food and Consumer Trends*, New Frontiers in Food Fast Forward (NF4) project, available at: https://newfrontiersinfood.eu/wp-content/uploads/2019/12/NF4-China-Market-Study.pdf.

Euromonitor.com (2019), "Processed meat and seafood in China | market research report | Euromonitor", [online], available at: https://www.euromonitor.com/processed-meat-and-seafood-in-china/report (accessed 29 June 2020).

Eussen, S., Verhagen, H., Klungel, O., Garssen, J., van Loveren, H., van Kranen, H. and Rompelberg, C. (2011), "Functional foods and dietary supplements: products at the interface between pharma and nutrition", *European Journal of Pharmacology*, Vol. 668, pp. S2-S9.

Gao, Z., Yu, X., Li, C. and McFadden, B.R. (2019), "The interaction between country of origin and genetically modified orange juice in urban China", *Food Quality and Preference*, Vol. 71, pp. 475-484.

García-Íñiguez de Ciriano, M., Larequi, E., Rehecho, S., Calvo, M., Cavero, R., Navarro-Blasco, Í., Astiasarán, I. and Ansorena, D. (2010), "Selenium, iodine, omega-3 PUFA and natural antioxidant from Melissa officinalis L.: a combination of components from healthier dry fermented sausages formulation", *Meat Science*, Vol. 85 No. 2, pp. 274-279.

Hole, A.R. (2007), "Fitting mixed logit models by using maximum simulated likelihood", *Stata Journal*, Vol. 7 No. 3, pp. 388-401.

Hole, A.R. and Kolstad, J.R. (2012), "Mixed logit estimation of willingness to pay distributions: a comparison of models in preference and WTP space using data from a health-related choice experiment", *Empirical Economics*, Vol. 42 No. 2, pp. 445-469.

Kaur, A., Scarborough, P. and Rayner, M. (2017), "A systematic review, and meta-analyses, of the impact of health-related claims on dietary choices", *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 14.

Khan, M., Arshad, M., Anjum, F., Sameen, A., Aneeq-ur-Rehman and Gill, W. (2011), "Meat as a functional food with special reference to probiotic sausages", *Food Research International*, Vol. 44 No. 10, pp. 3125-3133.

Krickmeier, J. and Schnackel, W. (2008), "Customers acceptability of enhanced cooked sausages - Influences on technological and sensory quality of cooked sausages by functional ingredients", *Fleischwirtschaft*, Vol. 88 No. 3, pp. 110-114.

Krystallis, A. and Chrysochou, P. (2012), "Do health claims and prior awareness influence consumers' preferences for unhealthy foods? The case of functional children's snacks", *Agribusiness*, Vol. 28 No. 1, pp. 86-102.

Kuhfeld, W.F., Tobias, R.D. and Garratt, M. (1994), "Efficient experimental-design with marketing-research applications", *Journal of Marketing Research*, Vol. 31 No. 4, pp. 545-557.

Lähteenmäki, L., Lampila, P., Grunert, K., Boztug, Y., Ueland, Ø., Åström, A. and Martinsdóttir, E. (2010), "Impact of health-related claims on the perception of other product attributes", *Food Policy*, Vol. 35 No. 3, pp. 230-239.

Lalor, F., *et al.* (2010), "A study of nutrition and health claims - a snapshot of what's on the Irish market", *Public Health Nutrition*, Vol. 13 No. 5, pp. 704-711.

Lancaster, K.J. (1966), "New approach to consumer theory", *Journal of Political Economy*, Vol. 74 No. 2, pp. 132-157.

Lee, H.C. and Chin, K.B. (2010), "Application of microbial transglutaminase and functional ingredients for the healthier low-fat/salt meat products: a review", *Korean Journal for Food Science of Animal Resources*, Vol. 30 No. 6, pp. 886-895.

Li, C.G., *et al.* (2017), "Willingness to pay for 'taste of Europe': geographical origin labeling controversy in China", *British Food Journal*, Vol. 119 No. 8, pp. 1897-1914.

Lusk, J.L. (2003), "Effects of cheap talk on consumer willingness-to-pay for golden rice", *American Journal of Agricultural Economics*, Vol. 85 No. 4, pp. 840-856.

Meijer Erik, R.J. (2006), "Measuring welfare effects in models with random coefficients", *Journal of Applied Econometrics*, Vol. 2 No. 2, pp. 227-244.

Neville, M., Tarrega, A., Hewson, L. and Foster, T. (2017), "Consumer-orientated development of hybrid beef burger and sausage analogues", *Food Science and Nutrition*, Vol. 5 No. 4, pp. 852-864.

Ortega, D., Wang, H., Wu, L. and Olynk, N. (2011), "Modeling heterogeneity in consumer preferences for select food safety attributes in China", *Food Policy*, Vol. 36 No. 2, pp. 318-324.

Ortega, D., Hong, S., Wang, H. and Wu, L. (2016), "Emerging markets for imported beef in China: results from a consumer choice experiment in Beijing", *Meat Science*, Vol. 121, pp. 317-323.

Ortega, D., Chen, M., Wang, H.H. and Shimokawa, S. (2017), "Emerging markets for US pork in China: Experimental evidence from mainland and Hong Kong consumers", *Journal of Agricultural and Resource Economics*, Vol. 42 No. 2, pp. 275-290.

Ouma, E., Abdulai, A. and Drucker, A. (2007), "Measuring heterogeneous preferences for cattle traits among cattle-keeping households in East Africa", *American Journal of Agricultural Economics*, Vol. 89 No. 4, pp. 1005-1019.

Patel, D., Dufour, Y. and Domigan, N. (2008), "Functional food and nutraceutical registration process in Japan and China: similarities and differences", *Journal of Pharmacy and Pharmaceutical Sciences*, Vol. 11 No. 4, pp. 1-11.

Scarpa, R., Thiene, M. and Train, K. (2008), "Utility in willingness to pay space: a tool to address confounding random scale effects in destination choice to the Alps", *American Journal of Agricultural Economics*, Vol. 90 No. 4, pp. 994-1010.

Schnettler, B., Ares, G., Sepúlveda, N., Bravo, S., Villalobos, B., Hueche, C. and Lobos, G. (2019), "Are consumers willing to pay more for reformulated processed meat products in the context of the implementation of nutritional warnings? Case study with frankfurters in Chile", *Meat Science*, Vol. 152, pp. 104-108.

Shan, L., Regan, Á., Monahan, F., Li, C., Lalor, F., Murrin, C., Wall, P. and McConnon, Á. (2017a), "Consumer preferences towards healthier reformulation of a range of processed meat products A qualitative exploratory study", *British Food Journal*, Vol. 119 No. 9, pp. 2013-2026.

Shan, L., De Brún, A., Henchion, M., Li, C., Murrin, C., Wall, P. and Monahan, F. (2017b), "Consumer evaluations of processed meat products reformulated to be healthier - a conjoint analysis study", *Meat Science*, Vol. 131, pp. 82-89.

Siegrist, M., Shi, J., Giusto, A. and Hartmann, C. (2015), "Worlds apart. Consumer acceptance of functional foods and beverages in Germany and China", *Appetite*, Vol. 92, pp. 87-93.

Tobin, B., O'Sullivan, M., Hamill, R. and Kerry, J. (2014), "European consumer attitudes on the associated health benefits of neutraceutical-containing processed meats using Co-enzyme Q10 as a sample functional ingredient", *Meat Science*, Vol. 97 No. 2, pp. 207-213.

Tourangeau, R. and Yan, T. (2007), "Sensitive questions in surveys", *Psychological Bulletin*, Vol. 133 No. 5, pp. 859-883.

Train, K.W.M. (2005), "Discrete choice models in preference space and willingness-to-pay space", in Scarpa, R. and Alberini, A. (Eds), *Applications of Simulation Methods in Environmental and Resource Economics. The Economics of Non-market Goods and Resources*, Springer, Dordrecht, pp. 1-16.

Train, K.E. (2009), *Discrete Choice Methods with Simulation*, 2nd ed., Cambridge University Press, pp. 1-388, doi: 10.1017/CBO9780511805271.

United States Department of Agriculture, U (2019), *Livestock and Poultry:World Markets and Trade*.

van Trijp, H.C.M. and van der Lans, I.A. (2007), "Consumer perceptions of nutrition and health claims", *Appetite*, Vol. 48 No. 3, pp. 305-324.

Van Wezemael, L., Caputo, V., Nayga, R., Chryssochoidis, G. and Verbeke, W. (2014), "European consumer preferences for beef with nutrition and health claims: a multi-country investigation using discrete choice experiments", *Food Policy*, Vol. 44, pp. 167-176.

Verhagen, H. and van Loveren, H. (2016), "Status of nutrition and health claims in Europe by mid 2015", *Trends in Food Science and Technology*, Vol. 56, pp. 39-45.

Wang, H. and McCluskey, J.J. (2010), "Effects of information and country of origin on Chinese consumer preferences for wine: an experimental approach in the field", *2010 Annual Meeting*, July 25-27, 2010, Agricultural and Applied Economics Association, Denver, CO.

Wortmann, L., Enneking, U. and Daum, D. (2018), "German consumers' attitude towards selenium-biofortified apples and acceptance of related nutrition and health claims", *Nutrients*, Vol. 10 No. 2, p. 190.

Wu, L.H., Xu, L.L. and Gao, J. (2011), "The acceptability of certified traceable food among Chinese consumers'", *British Food Journal*, Vol. 113 Nos 4-5, pp. 519-534.

Wu, L., Yin, S., Xu, Y. and Zhu, D. (2014), "Effectiveness of China's organic food certification policy: consumer preferences for infant milk formula with different organic certification labels", *Canadian Journal of Agricultural Economics-Revue Canadienne D Agroeconomie*, Vol. 62 No. 4, pp. 545-568.

Wu, L.H., Wang, H.S. and Zhu, D. (2015a), "Analysis of consumer demand for traceable pork in China based on a real choice experiment", *China Agricultural Economic Review*, Vol. 7 No. 2, pp. 303-321.

Wu, L., Wang, S., Zhu, D., Hu, W. and Wang, H. (2015b), "Chinese consumers' preferences and willingness to pay for traceable food quality and safety attributes: the case of pork", *China Economic Review*, Vol. 35, pp. 121-136.

Xu, P. and Zeng, Y.C. (2014), "Factors that affect willingness to pay for red wines in China", *Journal of International Consumer Marketing*, Vol. 26 No. 5, pp. 426-439.

Xu, L., Yang, X. and Wu, L. (2020), "Consumers' willingness to pay for imported milk: based on Shanghai, China", *International Journal of Environmental Research and Public Health*, Vol. 17 No. 1, pp. 1-16, doi: 10.3390/ijerph17010244.

Yang, Y.X. (2008), "Scientific substantiation of functional food health claims in China", *Journal of Nutrition*, Vol. 138 No. 6, pp. 1199S-1205S.

Yang, W. and Fang, L. (2020), "Consumer willingness to pay for food safety attributes in China: a meta-analysis", *Journal of International Food and Agribusiness Marketing*, pp. 1-18, doi: 10.1080/08974438.2020.1754316, Routledge.

Yu, X.H., Gao, Z.F. and Zeng, Y.C. (2014), "Willingness to pay for the 'green food' in China", *Food Policy*, Vol. 45, pp. 80-87.

Zając, M., Kulawik, P., Tkaczewska, J., Migdał, W. and Pustkowiak, H. (2017), "Increasing meat product functionality by the addition of milled flaxseed Linum usitatissimum", *Journal of the Science of Food and Agriculture*, Vol. 97 No. 9, pp. 2865-2874.

Zhang, W., Xiao, S., Samaraweera, H., Lee, E. and Ahn, D. (2010), "Improving functional value of meat products", *Meat Science*, Vol. 86 No. 1, pp. 15-31.

Zhang, C.P., Bai, J.F. and Wahl, T.I. (2012), "Consumers' willingness to pay for traceable pork, milk, and cooking oil in Nanjing, China", *Food Control*, Vol. 27 No. 1, pp. 21-28.

Zhao, F., Zhang, P., Zhang, L., Niu, W., Gao, J., Lu, L., liu, C. and Gao, X. (2015), "Consumption and sources of dietary salt in family members in Beijing", *Nutrients*, Vol. 7 No. 4, pp. 2719-2730.

Zheng, S., Xu, P., Wang, Z. and Song, S. (2012), "Willingness to pay for traceable pork: evidence from Beijing, China", *China Agricultural Economic Review*, Vol. 4 No. 2, pp. 200-215.

Zhuang, G., Wang, X., Zhou, L. and Zhou, N. (2008), "Asymmetric effects of brand origin confusion Evidence from the emerging market of China", *International Marketing Review*, Vol. 25 No. 4, pp. 441-457.

Appendix 1

Pretest results on top-five desirable benefits from processed meat products

In China, the health (functional) food sector is administrated by the former China Food and Drug Administration (CFDA) (Yang, 2008). There are currently only 27 approved functional health claims to be made on foods by SFDA (see table below) subject to respective standard test procedures, requiring different test evidence on animals and/or on humans (Patel *et al.*, 2008). In order to preliminarily understand the health benefits that were preferred in the specific context of processed meat, a pretest was conducted during a presentation by the author at University College Dublin campus under the topic of "*consumer choice in economics and frontier of functional foods*" on April 4, 2018.

A two-page questionnaire was handed out to the audience, and 50 valid surveys were gathered. The question was stated as "*from your perspective, what are the most desirable five benefits you wish to see from processed meat products*?" The result is reported in the table below.

When later designing the most relevant health-related attributes to be evaluated, out of numerous nutrients, omega-3 fatty acids stood out as an appropriate candidate that met consumers' health expectations of "*enhance immunity*" and "*assist in memory*." Omega-3 fatty acids are proven nutrients that are beneficial for human health. These two types of fatty acids, namely the 20-carbon eicosapentaenoic acid (EPA) and the 22-carbon docosahexaenoic acid (DHA), contribute to the normal function of the heart and maintain normal vision and brain function, which are recognized by European Food Safety Authority and highlighted in the official regulation No. 432/2012 as permitted health claims made on foods.

The collected information was later referred to in the process of research design.

Health benefit	Count	Percentage
Enhance immunity	34	68%
Assist in memory	18	36%
Weight loss	18	36%
Improve sleep	17	34%
Improve child growth and development	16	32%
Alleviate eye fatigue	15	30%
Alleviate physical fatigue	15	30%
Facilitate digestion	15	30%
Regulate gastrointestinal tract flora	12	24%
Increase bone density	10	20%
Facilitate feces excretion	10	20%
Antioxidative	8	16%
Improve skin ability to retain water	7	14%
Assist in irradiation hazard protection	6	12%
Improve nutritional anemia	6	12%
Assist in protecting against chemical injury to the liver	6	12%
Assist in blood lipids reduction	5	10%
Moisten and clean throat	5	10%
Improve skin oil content function	5	10%
Assist in blood sugar reduction	4	8%
Assist in blood pressure reduction	4	8%
Enhance anoxia endurance	4	8%
Eliminate acne	3	6%
Assist in protecting against gastric mucosa damage	3	6%
Facilitate lead excretion	2	4%
Facilitate milk secretion	2	4%
Eliminate skin pigment	1	2%
Total Count	251	100%

Note(s): Among the 27 options, "*enhance immunity,*" "*assist in memory*" *and* "*weight loss*" are listed most desirable health rewards expected from processed meat products

Table A1.
Frequency of selection on top-five desirable benefits from processed meat products

Appendix 2

Pretest results on consumption and purchasing habits of pork sausages among Beijing consumers

As little was known about Chinese consumers' consumption and purchasing habits of pork sausages in the existing literature, a pretest was conducted to gather behavioral information in this regard. Questionnaire surveys were conducted via in-person interviews from July 27 to August 4, 2018. A total of 264 random consumers (54.5% female and 45.5% male) were interviewed in supermarkets located in the inner suburban districts (namely Haidian and Chaoyang) of Beijing, where retail food outlets were highest concentrated (Ortega *et al.*, 2016).

In the questionnaire, pork sausages were further classified into "ready-to-eat pork sausages" and "raw pork sausages to be cooked." Consumers' consumption and purchasing habits were asked regarding these two types of pork sausages, respectively. The questions and the results were provided in the table below.

Question 1: How often do you usually buy or eat pork sausages?

Sausage type	Less than once in a month	1–3 times per month	Once every week	2–4 times per week	More than 5 times per week	Prefer not to answer
Ready-to-eat	102 (38.64%)	81 (30.68%)	45 (17.05%)	29 (10.98%)	6 (2.27%)	1 (0.38%)
Raw	151 (57.2%)	47 (17.8%)	31 (11.74%)	21 (7.95%)	6 (2.27%)	8 (3.03%)

Overall, pork sausages were not frequently consumed by consumers in Beijing, where the majority of consumers had them no more than three times per month (69.32% for the ready-to-eat type and 75% for the raw type).

Question 2: On what occasions (time/place), do you usually eat pork sausages? (Multiple choice)

Sausage type	Breakfast	Morning in-between snack	Lunch	Afternoon in-between snack	Supper	Midnight snack	Travel food	I never eat	Prefer not to answer
Ready-to-eat	56 (21.21%)	22 (8.33%)	53 (20.08%)	58 (21.97%)	53 (20.08%)	63 (23.86%)	79 (29.92%)	21 (7.95%)	1 (0.38%)
Raw	9 (3.41%)	9 (3.41%)	55 (20.83%)	19 (7.2%)	90 (34.09%)	30 (11.36%)	19 (7.2%)	77 (29.17%)	11 (4.17%)

For the surveyed sample, the consumption occasions on ready-to-eat sausages were most often as travel food (29.92%) and almost evenly distributed among breakfast, lunch, in-between afternoon snack, supper and midnight snack, which indicated the characteristics of convenience and high compatibility with meals throughout the day. Furthermore, a low proportion of consumers (7.95%) stated themselves as "I never eat ready-to-eat sausages," whereas, raw sausages were most frequently had during supper, followed by lunch. Therefore, possibly due to the requirement of further cooking, raw pork sausages were usually had along with proper meals.

Question 3: Where do you often buy pork sausages? (Multiple choice)

Sausage type	Supermarkets	Community/ school convenience store	Chain stores, e.g. 7–11	Roadside booths or restaurants	Online channels	Others	Prefer not to answer
Ready-to-eat	162 (61.36%)	92 (34.85%)	75 (28.41%)	52 (19.7%)	56 (21.21%)	5 (1.89%)	6 (2.27%)
Raw	118 (44.7%)	29 (10.98%)	43 (16.29%)	48 (18.18%)	27 (10.23%)	16 (6.06%)	36 (13.64%)

Consumers mostly went to supermarkets to buy pork sausages, which coincided with (Zheng *et al.*'s 2012) finding on the the-most-frequently-used channel of pork purchase. As a result, our later research surveys were conducted in supermarkets.

Question 4: If there were genuine imported pork sausages on the market, which had been certified as functional sausages by the European Union, such that, pork sausages have added value linked to human health benefits through improvements on production techniques, how likely are you to buy the product?

Functional pork sausage type	1	2	3	4	5	6	7	8	9	Prefer not to answer
Ready-to-eat	23 (8.71%)	9 (3.41%)	8 (3.03%)	19 (7.2%)	124 (46.97%)	26 (9.85%)	34 (12.88%)	11 (4.17%)	8 (3.03%)	2 (0.76%)
Raw	41 (15.53%)	29 (10.98%)	16 (6.06%)	22 (8.33%)	95 (35.98%)	27 (10.23%)	13 (4.92%)	8 (3.03%)	6 (2.27%)	7 (2.65%)

A 9-point scale was employed to reflect consumers purchasing intention towards functional pork sausages with perceived health rewards, where 1 = very unlikely to buy, 5 = might buy, and 9 = very likely to buy. More than half of the sample had neutral or positive attitudes (scores of 5–9) on healthier pork sausage innovations (76.90% and 56.43%, respectively). In general, more consumers intended to buy functional ready-to-eat pork sausages than raw sausages.

Appendix 3
Results of RPL models and WTP estimation of the two-city samples

The RPL models and WTP space estimation were conducted among two sub-samples of Xi'an and Beijing, respectively (see Table A2 and Table A3 below).

	RPL		WTP space	
	Coefficient	St.dev	Coefficient	St.dev
Price	−4.216***	1.527***	−3.578***	1.190***
	0.316	*0.155*	*0.184*	*0.136*
Country of origin	−0.316	1.484***	−3.907	47.701***
(COO)	*0.316*	*0.135*	*11.983*	*7.618*
Calcium claim	0.565***	0.223	26.123***	12.301***
	0.173	*0.182*	*8.096*	*2.500*
Omega-3 claim	0.418**	1.115***	19.351***	38.308***
	0.190	*0.106*	*7.109*	*6.319*
Reduced salt claim	0.374**	0.682***	15.534**	11.428***
	0.181	*0.107*	*7.126*	*2.737*
Constant (optout)	−3.598***	2.847***	−149.218***	155.583***
	0.411	*0.271*	*28.750*	*29.654*
COO*Calcium	−0.194	0.818***	−19.480	2.606
	0.333	*0.171*	*13.502*	*4.350*
COO*Omega-3	0.107	−0.679	4.367	15.289**
	0.330	*0.240*	*12.452*	*6.513*
COO*Salt	0.643*	−0.773***	19.839	45.697***
	0.336	*0.201*	*14.005*	*7.629*
Log likelihood	−2180.2445		−2167.3389	
Chi-square statistics	1122.12		720.74	
AIC	4396.489		4370.678	
BIC	4524.331		4498.519	
No. of observations	8,976		8,976	

Table A2.
Results of the RPL model and WTP estimation of the Xi'an sample

Note(s): 1: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively; 2: St.dev., AIC, and BIC are short for standard deviation, Akaike information criterion, and Bayesian information criterion, respectively; 3: Standard errors are reported in italic; 4: The sign of the estimated standard deviations is irrelevant: interpret them as being positive; 5: The coefficient of price parameters is assumed lognormally distributed in the preference space model

	RPL		WTP space	
	Coefficient	St.dev	Coefficient	St.dev
Price	−3.262***	1.214***	−2.497***	0.982***
	0.262	*0.141*	*0.112*	*0.101*
Country of origin	0.453	1.924***	18.404***	22.416***
(COO)	*0.325*	*0.144*	*3.684*	*1.919*
Calcium claim	0.670***	0.754***	16.345***	−11.808***
	0.181	*0.088*	*2.491*	*1.479*
Omega-3 claim	0.640***	1.486***	9.609***	−19.831***
	0.203	*0.115*	*2.433*	*1.830*
Reduced salt claim	0.380*	0 0.919***	7.390***	12.491***
	0.189	*0.084*	*2.425*	*1.463*
Constant (optout)	−5.433***	5.30***	−56.336***	−26.972***
	0.488	*0.431*	*4.054*	*2.359*
	RPL		WTP space	
	Coefficient	St.dev	Coefficient	St.dev
COO*Calcium	0.039	0.413	−13.545***	4.420***
	0.333	*0.315*	*3.880*	*1.190*
COO*Omega-3	−0.326	1.030***	−0.424	22.167***
	0.339	*0.272*	*3.475*	*2.351*
COO*Salt	0 883***	0.550***	9.510**	−12.906***
	0.332	*0.186*	*4.180*	*1.718*
Log likelihood	−2579.5493		−2684.4393	
Chi-square statistics	1705.75		553.59	
AIC	5195.099		5404.879	
BIC	5327.729		5537.509	
No. of observations	11,712		11,712	

Note(s): 1: *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively; 2: St.dev., AIC, and BIC are short for standard deviation, Akaike information criterion, and Bayesian information criterion, respectively; 3: Standard errors are reported in italic; 4: The sign of the estimated standard deviations is irrelevant: interpret them as being positive; 5: The coefficient of price parameters is assumed lognormally distributed in the preference space model

Table A3. Results of the RPL model and WTP estimation of the Beijing sample

Regions impacted consumers' valuation for functional sausages, where consumers in Beijing were willing to pay a larger amount for an EU origin and consumers in Xi'an were more willing to pay higher prices for nutrition claims.

Appendix 4

Goodness-of-fit measures of LCMs of 2–11 classes

The optimal number of latent classes was determined based on goodness-of-fit measures. Indicators of both CAIC and BIC were minimized at 10 classes, while the smallest AIC was drawn at 11 segments. As a result, the market of functional sausages was heterogeneous and segmented in China. Yet, in fairness, even a small fraction of Chinese consumers could equal a considerably large consumer base for a lucrative food business when taking the size of the Chinese population into consideration.

Table A4. Goodness-of-fit measures of LCMs

No. of classes	No. of parameters	Log-likelihood	AIC	CAIC	BIC
2	24	−5728.91	11505.82	11627.41	11603.41
3	39	−5323.18	10724.36	10921.94	10882.94
4	54	−5100.29	10308.57	10582.14	10528.14
5	69	−4915.70	9969.40	10318.96	10249.96
6	84	−4807.17	9782.33	10207.88	10123.88
7	99	−4721.71	9641.41	10142.96	10043.96
8	114	−4634.92	9497.84	10075.38	9961.38
9	129	−4546.46	9350.92	10004.45	9875.45
10	144	−4489.51	9267.02	9996.54	9852.54
11	159	−4458.54	9235.07	10040.58	9881.58

Note(s): AIC, CAIC, and BIC are short for Akaike information criterion, Consistent Akaike information criterion, and Bayesian information criterion, respectively

Corresponding author
Xinyi Hong can be contacted at: xinyi.hong@ucdconnect.ie