Meat Science 212 (2024) 109475

Contents lists available at ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

Chinese consumer preference for beef with geographical indications and other attributes

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ARTICLE INFO

Keywords:
Beef preference
Quality labeling
Geographical indications
Consumer behavior
Choice experiment

ABSTRACT

As the demand for beef products grows in the Chinese market, understanding consumer preferences for beef, especially those related to quality labelling, is essential. The recent agreement between China and the European Union to promote Geographical Indications (GIs) provides a new insight into preferences for beef with quality labelling. This paper assesses consumer preferences for beef products with GIs and other attributes. A nationwide survey is conducted including 1210 respondents in China by a choice experiment attributing GI label, 'green', 'hazard-free', and 'organic' labels, feeding regimes (grain-fed, grass-fed), country of origin (China, Ireland, Australia, Brazil), and price (30, 40, 80, 100 ¥/500 g). The random parameter logit model with error component reveals that Chinese consumers have a significant preference for grain-fed beef and domestic beef, and they are willing to pay a premium price for GI-labelled beef compared with other attributes. The interaction between GIs and country of origin is included to indicate the positive price impact of GIs on imported beef products. Demographic factors such as place of residence and occupation are found to affect consumer preferences for GIs.

1. Introduction

The growing concern about climate change and healthy eating habits is leading to reduced beef consumption in many countries (Magalhaes et al., 2023; Niva & Vainio, 2021). While along with the change in the food demand patterns, beef consumption in China has a 58% increase from 2000 to 2021 according to the OECD-FAO (Organization for Economic Co-operation and Development and the Food and Agriculture Organization of the United Nations) suggesting a sustained rise (OECD-FAO, 2023). China was a large beef importer, in 2021, with total beef imports of 2.36 million tons, valued at $12.63 billion (China Customs, 2022). And China's beef consumption is expected to have a large growth prospect in the future, as the per capita beef consumption in China is <16% of that in the United States and Australia (Zhu, Chen, Zhao, & Wu, 2021). Gaining insights into the preferences of Chinese beef consumers is essential to exploring this vast potential market.

The increasing demand for beef is accompanied by rising concerns about food safety issues (Ortez, Widmar, Thompson, & Brad Kim, 2022; Ramos et al., 2024). Chinese consumers are focusing on beef quality, including its tenderness, juiciness, and flavor, which are highly correlated to their overall liking (Lang et al., 2015; Mao, Hopkins, Zhang, & Luo, 2016; Wang et al., 2020). They are willing to pay for quality attributes of beef, such as safety claims, animal welfare information, and organic food certifications (Ortega, Hong, Wang, & Wu, 2016). Specifically, Chinese consumers have expressed greater intentions to buy traced beef, suggesting the significance of information regarding the place of production (Jin, Cao, Jones, Li, & Frewer, 2023; Lin, Ortega, Ufer, Caputo, & Awokuse, 2022). They show substantial preferences for beef sourced from distinct geographical regions, but there is no clear consensus. Some research suggests that Chinese consumers prefer Australian beef products to domestic (Chinese) beef (Ortega et al., 2016), while another estimation implies that local beef is more favourable due to its perceived higher quality compared to importing beef (Wang, Shen, Cai, Liu, & Gai, 2022).

On September 2020, the Government of the People's Republic of China and the European Union (EU) signed an agreement to ensure mutual protection for origin labelling, Geographical Indications (GIs), in both markets and to promote GI as an official quality label in China

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https://doi.org/10.1016/j.meatsci.2024.109475
Received 3 November 2023; Received in revised form 27 January 2024; Accepted 28 February 2024
Available online 1 March 2024

(European Union, E., 2020; Ministry of Commerce of China, 2021). Because of the varying ways in which the protection of GI has evolved under national laws, the international standard of GI protection is accepted in Article 22.1 of Trade-Related Aspects of Intellectual Property Rights (TRIPS) as "Indications which identify a good as originating in the territory of a member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good" (China National Intellectual Property Administration, 2019; Kizos et al., 2017; Portes, Venâncio, & Gonçalves, 2021; Van Caenegem & Cleary, 2017). GI offers an effective way to identify the origin of a product and differentiate between similar products, preventing consumer misinformation about agri-food quality and origin (Agostino & Trivieri, 2014; Kireeva, 2009; Menapace & Moschini, 2014). Today, legislative frameworks have been established to manage Chinese GI system (Zhao, Finlay, & Kneafsey, 2014). A total of 2475 GI products had been approved in China by the end of April 2021 (China National Intellectual Property Administration, 2021). In the context of the Chinese beef market, GI could act as an effective strategy to provide consumers with certified origin information and assurance of beef quality.

Specific beef products can obtain GIs if they originate from a designated geographical area and adhere to stringent production specifications. For instance, Orkney Beef, a Protected Designation of Origin (PDO) within the EU GI scheme, requires beef from cattle born and reared in the Orkney Isles and slaughtered and dressed in Orkney. Third party butchery outlets use the GI logotype to identify joints of Orkney Beef (Department for Environment, F. R. A, 2021). Moreover, some GI-labelled beef, such as Irish Grass Fed beef, is certified for beef products produced in Ireland using specific production techniques. This Protected Geographical Indication (PGI) certifies beef from cattle that derive at least 90% of their feed intake from grass (Department of Agriculture, F. a. t. M, 2020). GIs can serve as indispensable mechanisms in preserving the authenticity and quality of beef products by certifying their origin and production methods, ensuring consumers receive products that meet specific regional standards and requirements.

GIs were estimated to increase consumer preference and the level of Willingness to Pay (WTP) for GI-labelled olive oil (Aprile, Caputo, & Nayga Jr, 2012; Menapace, Colson, Grebitus, & Facendola, 2011), wine (Boatto, Defrancesco, & Trestini, 2011; Čačić, Tratnik, Gajdoš Kljusurić, Čačić, & Kovačević, 2011), cheese (Duvaleix, Emlinger, Gaigné, & Latouche, 2021), and beef (Bardají, Iráizoz, & Rapún, 2009). To our knowledge, there is a deficient study about consumer attitudes to GI in China, but Chinese consumers display a significant preference for some quality labels such as 'green food' label, 'organic' label, original label, or 'No Additives' labels (Wang, 2022). They are willing to pay premium prices for government certification information compared to farm information or comprehensive traceability information (Lu, Wang, Wu, & Chen, 2020; Wu et al., 2017).

Overall, this research aims to address the following research questions: (1) What is Chinese consumers' preference for beef products? (2) Are they willing to pay a premium price for GI-labelled beef compared with other attributes? (3) What demographic factors affect Chinese consumers' preference for GIs? By conducting a choice experiment in China and analyzing consumers' WTP for certified GI labels, this study contributes to existing research on consumer preference and GI. It expands the scope of the beef preferences study by providing insights into consumer preference for GI-labelled beef. And it enriches GI research within the context of China. Comparative analyses with other labels and attributes can help identify the specific aspects of consumer preference.

2. Materials and methods

The choice experiment was designed to include seven attributes, including GI label, green food certification, hazard-free food certification, organic food certification, feeding regime, country of origin (COO), and price.

2.1. Attribute selection

To compare GIs with other beef certifications, we selected three well-known food quality labels: green food certification, hazard-free food certification, and organic food certification. 'Green food' requires the reasonable application of inputs to prevent pollution of toxic and harmful substances during food processing. The number of certified green products was 4112 in 2021 (China Green Food Development Center, 2021). The 'hazard-free food' standard is not as stringent as 'green food' and can be adopted more widely to restrict pesticide residues and other substances. 'Organic food' complies with the specifications for organic products and meets international demand. There were >16,000 organic food enterprises in 2022 (State Administration for Market Regulation, 2023). There is no documentation or evidence to indicate that these four labels (including GIs,) are related. Hence, these four labels are considered individual attributes. For 'green', 'organic' and 'hazard-free' labels, pictures of their logos were used in survey to inform the respondents. Since the logos of GI labels differ from country to country, no specific picture of GI labels was displayed for GI attribute.

Normally, a GI label refers to a combination of a geographic region and a production method. Therefore, the production system needs to be considered to measure the interaction between GIs and production methods. Grain-fed cattle are typically fed an unnatural diet based on corn and soy. Grass-fed beef guidelines stipulate key criteria for the standards of an animal's diet, which must be based on grass or grass-based forage (Bord Bia, 2021). Due to the difference in feeding regimes for cattle, grain-fed and grass-fed beef differ in flavor and nutrition (Daley, Abbott, Doyle, Nader, & Larson, 2010; Maughan, Tansawat, Cornforth, Ward, & Martini, 2012). The choice experiment includes grass-fed and grain-fed as a feeding regime attribute to investigate whether consumers have a diverse preference for feeding regimes or GIs.

GI is an indication identifying the territory of a good (WTO, 2002), so it is usually named after places or regions. In general, the COO is widely used to inform consumers of the country of production. These two attributes overlap to some extent. However, COO is not a certified label compared with GIs. And the place information of GIs could be more specific than COO. Thus, we consider including COO to measure the interaction and difference between them. Imported products are estimated to be more favored by Chinese consumers (Ortega, Chen, Wang, & Shimokawa, 2017). This assumption is examined by comparing China with other countries as the COO attributes. While Brazil owns the largest share of Chinese beef imports, Australia enjoys the highest reputation for beef among Chinese consumers (Kantono, Hamid, Ma, Chadha, & Oey, 2021). Irish beef represents EU beef. Therefore, China, Ireland, Australia, and Brazil are the four levels of COO attribute.

Lastly, price is a fundamental attribute for WTP analysis. This price range was selected to encompass the average prices of beef from China as well as the lowest and the highest prices in actual beef markets. Based on this, we selected four levels of price to apply during the choice experiment, that is ¥30, ¥40, ¥80, and ¥100 per 500 g. Pictures of beef were provided during the choice experiment to homogenize basic impressions of beef for each respondent. Table 1 lists the attributes and corresponding levels used in the choice experiment.

2.2. The choice experiment design

The whole questionnaire was written in Chinese. Before the choice experiment, respondents were informed of the research in an introductory text, including a description of the choice experiment. This was important for respondents to make their choices and to ensure that their decision in each choice made was independent of other choices. Given GI is new to Chinese consumers, a brief background information about GI was provided for respondents. Furthermore, respondents were told that the beef products only differed in price, GI, 'green', 'hazard-free', and 'organic' labels, feeding regime, and COO.

The SAS software was used to generate choice sets with ChoicEff

Table 1
Attributes and levels in choice experiment.

Attribute	Level
GI label	Certified GI label
	No certified GI label (base)
Green food certification	Certified 'Green' food
	No certified 'Green' food label (base)
Hazard-free certification	Certified 'Hazard-free' label
	No certified 'Hazard-free' label (base)
Organic certification	Certified 'Organic' label
	No certified 'Organic' label (base)
Feeding regime	Grass-fed
	Grain-fed (base)
COO	China (base)
	Ireland
	Australia
	Brazil
Price (Yuan/500 g)	¥30
	¥40
	¥80
	¥100

Macro procedures. The optimal generic choice design, which is adapted from the orthogonal design, is implemented. The candidate set was searched for an efficient design with the assumption $\beta = 0$. This approach is based on the work of Huber and Zwerina (1996), who proposed constructing efficient experimental designs for choice experiments under an assumed model and value for β. The design comprised two four-level factors and five two-level factors. The interaction between GI and COO was also included. Considering respondents cannot tolerate too many questions, which may impair the quality of the responses, 16 choice sets were used with three alternatives and an opt-out alternative per choice set. The opt-out option refers to choosing 'none of them', indicating a more realistic situation in which some respondents are not satisfied with any of the products. The 16 choice sets were presented to respondents in a random order, which helps to avoid bias due to the order in which the choice sets were presented. Fig. 1 displays an example of a choice set in English.

2.3. Data collection

Data were collected in China through an online platform, Qualtrics, which is a popular survey platform among researchers who design non-interactive online experiments (Molnar, 2019). Qualtrics owns global online panels to target beef consumers in China. It leveraged online, non-probability-based sampling. First, a pilot study was conducted in three large Chinese cities during November 2021. The main nationwide study began in December 2021, comprising a sample size of 1210 respondents. Data were collected from respondents at random geographic locations in China. To target beef consumers, only respondents who had purchased or consumed beef in the previous three months were allowed to continue with the survey. Respondents were required to be adults, i.e., at least 18 years old. To have qualified data, we performed data scrubbing, including checking for and eliminating straight lining, deleting bad verbatim responses, and eliminating speeders (Gao, House, & Bi, 2016; Jones, House, & Gao, 2015)

2.4. Analysis methods

During the decision-making process, respondents differ in terms of their preferences towards products. The utility is combined with a systematic component and a random component. The random utility model assumes that in each choice scenario individuals choose the alternatives that they perceive to have the highest utility (Raghavarao, Wiley, & Chitturi, 2010). According to this utility function, the component of consumer utility in this paper is specified as:

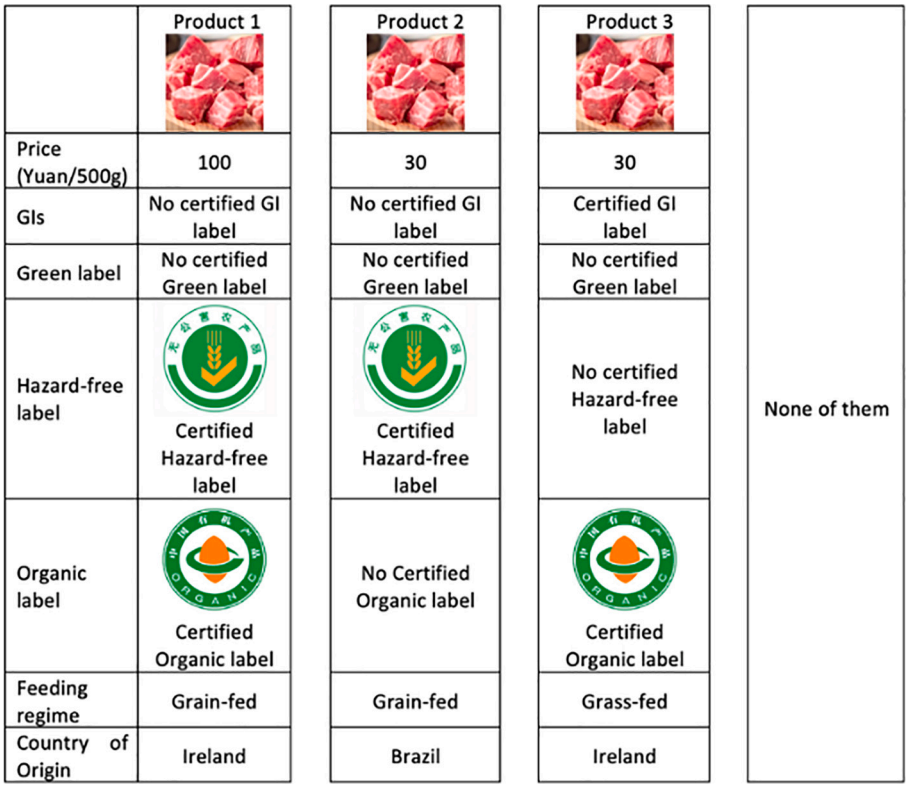

Fig. 1. Example of a choice set.
The choice sets in questionnaire were written in Chinese.

$$u_{ijs} = \beta_1 GI_{ijs} + \beta_2 Green_{ijs} + \beta_3 Hazard - free_{ijs} + \beta_4 Organic_{ijs} + \beta_5 Grass - fed_{ijs} + \beta_6 Brazil_{ijs} + \beta_7 Ireland_{ijs} + \beta_8 Australia_{ijs} + \beta_9 Price_{ijs} + \varepsilon_{ijs} \quad (1)$$

where the u_{ij} is the utility of respondent i for choice set S with j alternatives. The utility consists of the vectors of the attributes and the related preference parameters β. All attributes, including the certified GI and quality labels, the COO, and the feeding regimes are dummy variables, while only the price attribute is a continuous variable. It is generally assumed that respondents have the same preferences for price, such that a higher price will decrease utility. Therefore, in this paper, the price is assumed to have a fixed parameter, while other variables have random parameters with normal distributions (Carlsson, Kataria, Lampi, Nyberg, & Sterner, 2021; Train & Weeks, 2005).

Furthermore, considering that consumers may not perceive high utility for every choice scenario, choice scenarios include a 'none' option, which is also known as the opt-out option. Following Yang, Raper, and Lusk (2020), the opt-out variable is associated with an alternative-specific constant (ASC). The consumer utility of an opt-out option is denoted by:

$$u_{opt-out} = ASC_{opt-out} + \varepsilon_{opt-out} \quad (2)$$

The random parameter logit model (RPL) is used to estimate the choice probability. The RPL is also referred to as the mixed logit model, a commonly used model that can approximate any random utility model (McFadden & Train, 2000). RPL allows for random taste variation, unrestricted substitution patterns, and correlation in unobserved factors over time (Train, 2003). It is usually specified to allow for the study of heterogeneity on the impact of independent variables on the dependent variable (Glasgow, 2001). Assuming that all individuals have the same preferences regarding price but that preferences with respect to the other variables are heterogeneous, these preferences are modelled with random coefficients. For RPL the probabilities are approximated via simulation techniques following Train (2003). R draws of values of β are drawn from $f(\beta_i/\theta)$ (Van Loo, Caputo, Nayga, Meullenet, & Ricke, 2011). Usually, the Halton draws are applied as they provide more efficient distributions of draws (Bhat, 2003). The choice-specific constants and the elements of β_i are distributed randomly across individuals and allow the parameter distributions to be heterogeneous with observed data.

The unobserved heterogeneity can also be brought into the model by alternative-specific random effects, which are related to the choices rather than the parameters. The error component (EC) E_{ij} may vary by the alternatives in the choice experiment. The random parameter allows the coefficient to vary, while the error component specifies variables that can induce correlation among alternatives. The identified preference heterogeneity has a restriction on the selection of the random parameters. The additional alternative-specific unobserved variation can be captured by adding groups of error components (Greene & Hensher, 2007). Therefore, considering the relationship between alternatives, the RPL model with error components (RPL-EC) is added as the second model. The error components are assumed to be normally distributed. The utility function with error component takes the form:

$$U_{ij} = \boldsymbol{\beta}_i \boldsymbol{X}_{ij} + \sum_{m \in M} \delta^m E_i^m + \varepsilon_{ij} \quad (3)$$

where E_i^m $(m = 1, \ldots M)$ are random error terms, M is the number of error components, δ^m is the parameter of error component. This study assumes two error components. E_i^1 is the grouped error components for alternatives 1, 2, 3, and E_i^2 is for the opt-out option.

WTP is the amount of money consumers are willing to pay to obtain a good. In a corresponding choice model, WTP can be obtained as the ratio of attribute and cost coefficients. The WTP for product attributes is given by:

$$WTP = -\frac{\beta_f}{\beta_p} \quad (4)$$

where the β_f is the coefficient of the attribute f and β_p is the coefficient of the attribute price (Gao, Yu, Li, & McFadden, 2019).

3. Results

3.1. Demographics

In total, 1210 respondents were surveyed and asked to indicate the following: age, gender, household composition, income, education level, occupation, place of residence, geographic location, and beef consumption experience. The characteristics of the data sample are listed in Table 2. Overall, referring to national population statistics, the distribution of the sample was similar in the Chinese population by gender and age. According to the Seventh National Population Census in 2020, there were 723.3 million males accounting for 51.2%, and 688.4 million females, accounting for 48.8% of the population (National Bureau of Statistics of China, 2021). However, the sample in this study was slightly younger, more educated, and with a higher level of income, which is common in Internet-based surveys (Yang, Hobbs, & Natcher, 2020).

Table 2
The characteristics of the sample.

Variables	Options	Percentage of the total sample (n = 1210)
Gender	Female	52.7
	Male	47.3
Age	18–29	19.7
	30–39	21.3
	40–49	20.8
	50–59	20.0
	Over 60	18.2
Household composition	Single	11.6
	Married with no children	13.3
	Married with one child	66.1
	Married with more than one child	7.4
	Other multi-person household	1.7
Education level	Primary school education or lower	1.6
	Senior high school education	3.6
	High school education (including secondary specialized school)	29.0
	Bachelor's degree (including College degree)	62.4
	Master education or higher	3.5
Occupation	Student	18.4
	Working full-time	72.0
	Working part-time	1.1
	Self-employed	1.2
	Unemployed	2.4
	Retired	3.5
	Freelance	1.6
Income per capita	<¥3000	7.4
	¥3000 - ¥4999	16.0
	¥5000 - ¥9999	34.6
	¥10,000 - ¥19,999	26.9
	¥20,000 ¥29,999	8.5
	Over ¥30,000	6.5
Place of residence	First-tier cities (Beijing, Shanghai, Guangzhou, and Shenzhen)	45.5
	Other cities except first tier	54.5
COO of consumed beef	Australia	29.6
	Europe Union	21.1
	China	66.7
	Brazil	18.6

Note: Data were from the consumer survey conducted in China in 2021.

Table 3
Coefficients of the Random Parameter Logit Model and Random Parameter Logit with Error Component Model.

Attribute	RPL		RPL-EC	
	Mean	Standard deviation	Mean	Standard deviation
GI label	0.710*** (0.038)	1.028*** (0.037)	0.695*** (0.048)	1.027*** (0.034)
'Green' label	1.301*** (0.041)	1.059*** (0.036)	1.267*** (0.055)	1.101*** (0.041)
'Hazard-free' label	1.185*** (0.042)	1.096*** (0.041)	1.146*** (0.059)	1.138*** (0.054)
'Organic' label	1.241*** (0.042)	1.110*** (0.043)	1.231*** (0.054)	1.081*** (0.047)
Grass-fed (base = grain-fed)	−0.127*** (0.022)	0.097 (0.075)	−0.133*** (0.023)	0.118* (0.070)
COO (base = China)				
Brazil	−0.272*** (0.035)	0.368*** (0.047)	−0.264*** (0.033)	0.339*** (0.049)
Ireland	−0.330*** (0.037)	0.447*** (0.047)	−0.322*** (0.037)	0.518*** (0.048)
Australia	−0.256*** (0.037)	0.419*** (0.048)	−0.271*** (0.034)	0.506*** (0.037)
Price	−0.009*** (0.000)		−0.009*** (0.000)	
Opt-out	−2.729*** (0.165)	3.313*** (0.124)	−2.530*** (0.181)	2.030*** (0.129)
SignaE01				−2.405*** (0.155)
SigmaE02				2.2666*** (0.153)
Number of obs.	19,360		19,360	
McFadden Pseudo R^2	0.331		0.332	
Log-Likelihood	−17,945.390		−17,934.022	
AIC/N	1.856		1.856	

Note: *** indicate statistical significance at the 1% level. Standard errors in parentheses.

3.2. Consumer preferences for beef attributes

All model estimations were developed using the maximum simulated likelihood method in NLOGIT software. Halton draws were used, with the number of Halton draws set to 1500 draws for both models. Table 3 presents the results of two choice model specifications. The left column represents the RPL model, and the right column displays the RPL-EC model. The log-likelihood ratio and Pseudo R2 tests indicate that the RPL-EC model provided more efficient estimates than the RPL model because the RPL-EC model has a better goodness-of-fit value. Adding error components for alternatives allows for additional sources of preference heterogeneity that are not accounted for by random parameters. The significance of the standard deviation for the error components confirms the heterogeneity between choices 1, 2, 3, and 4 and suggests that it is necessary to include an opt-out option. For these reasons, the discussion is based on the estimates of the RPL-EC model specification.

Standard deviations for random parameters were significant, implying unobserved preference heterogeneity. Both attributes had a highly significant influence on consumer utility ($P < .001$). The positive coefficient of GIs indicated that containing GIs is considered to be of higher utility ($\beta = 0.695$). The level of the coefficients diverged from quality labelling showing the highest overall relative marginal utility for the 'green' label ($\beta = 1.267$), followed by the 'organic' label ($\beta = 1.231$), the 'hazard-free' label ($\beta = 1.146$), and the GI label. In addition, the effect of grass-fed beef on the utility function was statistically negative ($\beta = -0.133$). With regard to the COO, marginal utility for Brazil ($\beta = -0.264$), Ireland ($\beta = -0.322$), and Australia ($\beta = -0.271$) relates to the base level China. The significantly negative coefficients for beef originating from Brazil, Australia, and Ireland suggested Chinese consumers' preference for domestically produced beef over imports.

According to random utility theory, the opt-out parameter captures the average effect of factors influencing opt-out choices that are not included in the utility specification. The negative and significant estimation on opt-out choice ($\beta = -2.530$, $P < .001$) implied that respondents prefer to consume a beef product rather than choosing the "none of them to buy" option. The standard deviation estimates for all attributes were significant which means that there is considerable heterogeneity present in their responses across the board.

From the initial design stage, the study incorporated an interaction between GI labels and COO. The choice set design ensured estimation to contain the model interactions between the alternative-specific variables of interest and the indicator variables that control for the presence of the COO in the choice set (Kuhfeld, 2010). The number of choice sets was enlarged to guarantee measurement. The interaction terms between GI attributes and COO were added to the RPL -EC model (Table 4). Mean coefficients of interaction terms were highly significant ($P < .001$), implying the effect of GI is highly associated with origin attributes. The value of interaction terms suggested that the marginal utility for beef from Brazil ($\beta = 0.215$), Ireland ($\beta = 0.221$), and Australia ($\beta = 0.087$) with GIs was positive. However, the effect for Chinese beef products with a GI label was negative ($\beta = -0.036$), on the basis that Chinese beef products without GI labels ($\beta = 0$).

3.3. Willingness to pay for attributes of beef

In order to further assess the impact of GI and quality labels among several countries, the RPL-EC model with interaction terms was conducted to calculate the WTP values, depending on the equation listed in eq. (4). WTP values signal the relative importance of the attribute instead of the actual market prices (Schulze, Spiller, & Risius, 2021). We present the WTP by attributes (Table 5). The low price coefficient results in a high level of WTP for specific features. Respondents are willing to pay a premium price for products labelled 'green', 'hazard-free', and 'organic', compared with negative WTP for the GI-labelled Chinese beef, grass-fed beef and beef from Ireland, Australia, and Brazil. The positive WTP for interaction terms aligns with the regression results. Consumers

Table 4
Coefficients of the RPL-EC model with interaction terms.

Attribute	Mean	Standard deviation
GI label	−0.036*** (0.070)	1.054*** (0.037)
'Green' label	1.224*** (0.052)	1.027*** (0.040)
'Hazard-free' label	1.231*** (0.057)	1.105*** (0.049)
'Organic' label	1.139*** (0.053)	1.091*** (0.047)
Grass-feed	−0.139*** (0.023)	0.080 (0.068)
GI label x Brazil	1.124*** (0.077)	0.414*** (0.097)
GI label x Ireland	1.154*** (0.090)	0.602*** (0.070)
GI label x Australia	0.527*** (0.073)	0.046 (0.153)
COO (base = China)		
Brazil	−0.873*** (0.053)	0.340*** (0.056)
Ireland	−0.898*** (0.054)	0.391*** (0.067)
Australia	−0.404*** (0.048)	0.511*** (0.037)
Opt-out	−2.950*** (0.171)	1.126*** (0.110)
Price	−0.004*** (0.000)	

Note: *** indicate statistical significance at the 1% level. Standard errors in parentheses.

Table 5
WTP estimates.

Attribute	WTP (¥/500 g)
GI label	−9.621 [−25.396, 6.154]
'Green' label	324.581 [309.212, 339.950]
'Hazard-free' label	326.422 [309.887, 342.956]
'Organic' label	302.051 [285.719, 318.383]
Grass-feed	−36.962 [−38.1540, −35.771]
GI label x Brazil	298.187 [291.995, 304.379]
GI label x Ireland	305.986 [296.975, 314.997]
GI label x Australia	139.753 [139.055, 140.451]
Brazil	−231.639 [−236.720, −226.557]
Ireland	−238.211 [−244.057, −232.365]
Australia	−107.150 [−114.806, −99.495]

Note: 95% confidence intervals appear in squared brackets.

are willing to pay more for beef with the GI label from Brazil (WTP = 56.92), Ireland (WTP = 58.15), and Australia (WTP = 22.98). This suggest that GIs have the most substantial impact on the perceived value of imported beef compared with domestic beef.

3.4. Factors influencing respondents' buying decisions

Consumers' WTP might be influenced by several factors. In order to measure deterministic factors that affect consumer WTP for a given food attribute, an OLS regression was used. The independent variables include the demographic characteristics of respondents: age, gender (female = 1), income per person in the household, education level, household composition, occupation, residence (Beijing, Shanghai, Shenzhen, Guangzhou, and other cities), as well as the countries of origin for consumed beef based on previous experience (China, Brazil, EU, Australia, and others). The WTP results are based on the RPL-EC model with interaction terms which are classified into different COO.

Place of residence had a highly significant impact on consumer purchasing behavior ($\beta > 0$, $P < .001$). Respondents who are living in first-tier cities (Beijing, Shanghai, Guangzhou, Shenzhen) were more likely to pay a premium for beef with a GI label. Income had significantly negative coefficients among four countries ($\beta = -0.170$, $\beta = -0.207$, $\beta = -0.212$, $\beta = -0.192$; $P < .005$, $P < .001$, $P < .001$, $P < .001$), indicating that the income was inversely correlated with the WTP for GI labels. In terms of household composition, married respondents without children suggested a positive preference for GI beef ($\beta = 1.506$, $\beta = 1.664$, $\beta = 1.653$, $\beta = 1.660$, $P < .001$). In addition, students showed the highest relative WTP among different levels of occupation ($\beta = 1.506$, $\beta = 1.568$, $\beta = 1.475$, $\beta = 1.715$, $P < .001$). Age and education do not have an influence on consumers' WTP for GI beef from all countries. The determinants of WTP for GI-labelled beef are similar across different beef origins, apart from gender and some occupations. The detailed results are shown in Table 6.

4. Discussion

The rapid boost in beef consumption in China has sparked significant interest in beef preferences among researchers and industry (Liu et al., 2023; Zhang et al., 2021). Motivated by growing food safety concerns, Chinese consumers have become increasingly attentive to quality certifications. This study assessed Chinese consumer preference for beef and beef products with various quality labels, particularly GI labels.

Table 6
Factors affecting consumers' WTP for GI labels on beef products.

Variables	Coefficients for GI labels on beef products from			
	China	Brazil	Ireland	Australia
Age	0.001 (0. 006)	0.004 (0.006)	0.004 (0.006)	0.001 (0.006)
Gender (base = male)	−0. 157 (0. 128)	−0.246* (0.131)	−0.23* (0.131)	- 0.216* (0. 130)
Education	−0.089 (0.106)	0.008 (0.109)	0.007 (0.109)	−0.037 (0. 108)
Income	−0.170** (0.071)	−0.207*** (0.072)	−0.212*** (0.072)	−0.192*** (0.071)
Household composition (base = Other multi-person household)				
Single	0.426 (0.570)	0.496 (0.574)	0. 479 (0. 573)	0. 443 (0. 572)
Married with no children	1.506*** (0. 564)	1.664*** (0.569)	1.653*** (0.568)	1.660*** (0. 566)
Married with one child	0. 743 (0. 543)	0.643 (0.548)	0. 622 (0. 547)	0.661 (0. 545)
Married with more than one child	0. 680 (0. 581)	0.803 (0.585)	0. 738 (0. 584)	0. 738 (0. 583)
Occupation (base = Unemployed)				
Working full-time	1.179** (0.501)	0.843* (0. 485)	0. 852* (0. 485)	1.110** (0. 506)
Working part-time	0.615 (0. 791)	0.698 (0. 760)	0. 714 (0. 761)	0. 944 (0. 774)
Freelance	1.404** (0.683)	1.156* (0. 675)	1.179* (0. 676)	1.385** (0. 690)
Self-employed	1.340* (0.765)	1.456** (0.742)	1.491** (0. 742)	1.698** (0. 755)
Retired	1.095** (0.511)	0.652 (0.496)	0. 651 (0. 497)	0.974* (0. 516)
Student	1.564*** (0.606)	1.568*** (0. 592)	1.475*** (0. 592)	1.715*** (0. 609)
COO of consumed beef				
Australia	0.002 (0.166)	0. 040 (0. 151)	0. 039 (0. 152)	0. 052 (0. 151)
Europe Union	0.144 (0.170)	0. 205 (0. 175)	0. 229 (0. 175)	0. 213 (0. 174)
China	0.294** (0.145)	0. 220 (0. 148)	0. 249* (0. 149)	0. 259* (0. 148)
Brazil	−0.290 (0.175)	−0. 337 (0. 179)	−0. 356 (0. 180)	−0.325 (0. 178)
Place of residence (base = other cities except Beijing, Shanghai, Guangzhou, and Shenzhen in China)				
Beijing	0.528** (0.211)	0. 846*** (0. 215)	0. 821*** (0. 215)	0. 702*** (0. 214)
Shanghai	0.515*** (0.181)	0. 688*** (0. 187)	0. 675*** (0. 188)	0. 583*** (0. 186)
Guangzhou	0.656*** (0.203)	0. 752*** (0. 209)	0. 756*** (0. 209)	0. 667*** (0. 208)
Shenzhen	0.752*** (0.238)	0. 811*** (0. 244)	0. 813*** (0. 244)	0. 749*** (0. 242)

Note: *, **, *** indicate statistical significance at the 10%, 5% and 1% level separately. Standard errors in parentheses.

4.1. The effect of beef attributes on consumer choices

The output reveals a significant preference for grain-fed beef over grass-fed beef, which is particularly relevant in the context of China, where grain-fed beef enjoys higher popularity compared to grass-fed varieties (Reader, 2021). China's culinary traditions, taste preferences, and the influence of Western dietary habits may contribute to the higher preference for grain-fed beef in the country. Consumer preference for beef may be influenced by variations in nutritional knowledge and health considerations, as the functional fatty acids composition of grass-

fed or grain-fed cattle differs (Nogoy et al., 2022). Economic factors, such as the availability and affordability of grass-fed beef, could also be influencing this trend. Understanding the consumer preference for grain-fed beef allows for the development of targeted and effective marketing approaches.

Origin is the most highly ranked credence attribute for beef products (Henchion, McCarthy, & Resconi, 2017), and it also matters to Chinese beef consumers, who suggest a preference for domestically produced beef over imports (Brazil, Australia, and Ireland). This finding aligns with previous research highlighting this specific consumer trend (Wang, Chen, Bai, & Lai, 2018). Chinese consumers prefer domestic meat over imported meat, largely driven by price and convenience (Wang, Gao, & Chen, 2022). And their nationalistic attitudes and regard for the foreign country may explain their taste heterogeneity for domestic over imported beef (Ortega et al., 2017).

Chinese consumers value food safety information most and show a higher preference for 'green' labels, which was testified by this paper (Liu, Yan, & Zhou, 2017). Chinese beef consumers have a positive attitude towards 'hazard-free', 'organic' labels, and GI, but prefer 'green' labels more than other labels. Considering the growing awareness of consumers about food safety, it is important to signify safety from the perspective of marketing strategy. The various quality labels play an essential role in building consumer trust. Demand for improved management and regulation of food quality labels is significant. Notably, labels are the most valued by consumers, and their importance in the Chinese beef market should not be underestimated.

GIs have been introduced as a novel quality labelling scheme that reinforces food quality certification from a unique perspective. This paper confirms GIs are attractive to respondents and likely to facilitate their purchase intention. As Chinese consumers have been proven to value food quality certifications, this result corresponds with earlier research assumptions (Wang, Gao, & Chen, 2022). Compared to 'green', 'organic', and 'hazard-free' labels, the estimated impact of the GI label is the lowest. One possible reason is that Chinese consumers are more familiar with the other three quality labels and lack awareness and knowledge of GI labels. Low awareness leads to a low WTP level for GIs (Teuber, 2011). However, there is no doubt that consumers have encouraging attitudes and favorability towards GIs.

The influence of GI is associated with the COO of beef. Chinese consumers have a stronger preference for imported beef products with GIs, as they perceive these products to be of higher quality and more authentic. Given consumers' perception of quality benefits towards GI products (Chen, 2021), it is likely that GIs are related to specific breeds of cattle, feeding practices, and other production methods that consumers associate with high-quality beef. However, the impact of GIs on domestic beef products is deficient. One reason why GIs may have a weaker impact on domestic beef products is that Chinese consumers are less familiar with GIs for domestic products. GIs are a relatively new concept in China, and there is less awareness of domestic GIs among consumers. It might be some concern about the credibility of GIs for domestic products.

4.2. Implications

Imported beef products benefit more from GI labelling over domestic beef products. On the one hand, as GI is an indicator for places or regions, its effect relates to the COO attribute. It is important to address the issue of the credibility of using GIs, and this requires a series of practical implementations and regulations by a government agency to differentiate certified GIs from just places of production. On the other hand, the interaction between GIs and COO indicates that the GI label strongly relates to a particular foreign country. The GI label is not conducive to developing consumer preferences for domestic beef. This finding attaches great importance to GIs for product imports in the Chinese market. The low purchasing intention and trustworthiness of imported beef caused by a lack of awareness could be improved by consumer belief in quality labelling.

This paper showed that WTP is affected by gender, income, occupation, and place of residence. Students are the most likely group to pay a premium for GI-labelled beef products. This may be because students are more concerned about food quality and safety (Cheng, Zhang, Ma, & Zhan, 2017). The place of residence is an important indicator for respondents in deciding whether to pay a premium price for GI products. Urban and rural residents have different beef consumption preferences (Mao et al., 2016). Chinese urban consumers in large cities care more about issues such as food security. The heterogeneity in consumption behavior and food cognition among cities accounts for the differences in attitudes towards GIs. Females and higher-income respondents are less likely to pay a premium for GI-labelled beef products. Marketers should focus their efforts on targeting male consumers, low-income consumers, students, and consumers who live in first-tier cities. It's important to educate consumers about the benefits of GIs and how they can help to ensure the quality and safety of beef by developing marketing campaigns that appeal to the specific needs and interests of their target consumers.

The EU-China GI Agreement is a significant step forward in the protection of GIs (Ferrante, 2021). This paper confirms that policymakers should continue to focus on promoting and protecting GIs by increasing market access, raising the awareness of GIs among consumers, and strengthening enforcement of GI regulations. Given the limited research on GI estimation in China, and the huge potential for GI's further development, this paper contributes to the literature and empirical research on beef consumer preferences based on GI labels. This analysis builds upon previous studies on consumer beef preferences by incorporating GI labelling, thus enriching the field of Chinese consumer research.

4.3. Limitations and future research needs

At the initial stage of GI estimation in China, this research could inspire and provide a reference point for further studies. For instance, future research could classify respondents by knowledge and awareness of GI labels to estimate the preference differences. Additionally, the sample used in this paper is more highly educated and city-oriented than the general population. Further studies could focus on a larger sample of rural consumers. In China, some consumers take price as a signal for good quality which leads to insensitive responses to price changes (Wang, Gao, Heng, & Shi, 2019). This study's broad GI scope allows for a deeper investigation of specific labels in the future. The integration effect of GI with grass-fed and grain-fed could be also evaluated. Due to the regulation that Irish Grass Fed Beef can be produced in both the Republic of Ireland and Northern Ireland, a deeper exploration of this aspect is necessary to fully understand its impact on consumer perceptions. Respondents undertaking hypothetical responses during choice experiment rather than real responses in a real market could emerge bias, as they might provide a higher WTP than what they actually pay using their own money (Hensher, 2010; Loomis, 2011). The design could be further improved to mitigate the bias, for instance, by using an experimental auction or non-hypothetical choice experiment (Shi, Xie, & Gao, 2018).

5. Conclusions

Collectively, the results highlight a positive consumer preference for GI labelling as well as 'green', 'hazard-free', and 'organic' labels, which underscores the growing importance of quality attributes in the Chinese beef market. While GI labelling remains relatively new in China, its positive reception suggests significant potential for the future market. Notably, the impact of GIs significantly interacts with COO, exhibiting greater value for imported beef. Therefore, future GI promotion and policy initiatives in China should carefully consider the interplay between these factors.

Statement of informed consent

Written informed consent was obtained from the participants for their anonymized information to be published in this article.

Authorship contribution statement

Rao Fu: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data Curation, Writing-Original draft, Writing – review & editing.

Chenguang Li: Conceptualization, Writing - Review & Editing, Supervision.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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