Food Quality and Preference 123 (2025) 105317

Contents lists available at ScienceDirect

Food Quality and Preference

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

Personality matters in consumer preferences for cultured meat in China

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ARTICLE INFO

Keywords:
China
Chicken breast
Consumer preferences
Choice experiment
Cultured meat
Personality traits

ABSTRACT

This study extends our current knowledge of consumer preferences for cultured meat. We explored if personality traits have a role in affecting Chinese urban consumer choice behavior for cultured meat. We performed a choice experiment (CE) and used cultured chicken breast as a case study. The results indicate that personality traits (i.e., agreeableness, neuroticism, and conscientiousness) influence consumer preference for cultured meat. Our findings provide valuable insights into the psychology of consumer preferences and attitudes that can help to effectively communicate the nature of cultured meat to the public. They also have relevant implications for cultured-meat producers, and policy makers.

1. Introduction

China is the world's largest meat-consuming country; indeed, its meat consumption has risen to 93.39 million tons in 2023 (OECD/FAO, 2023), and this trend is expected to increase over the next decades (Wang, 2022). However, conventional farm-raised meat production and consumption lead to a series of negative externalities related to climate, natural environment, human health, and animal welfare (Godfray et al., 2018; Tuomisto, 2019; Zhang et al., 2020a). This has led to an emergency for policy makers to make food production and consumption more sustainable, as well as reduce conventional meat production and consumption (Post et al., 2020). In 2021, the Chinese government released a five-year plan that includes the development of meat alternatives, including cultured meat (Ministry of Agriculture and Rural Affairs of China, 2021). Cultured meat has substantial potential to address the problems posed by conventional meat because its production can be more efficient than conventional meat in terms of greenhouse gas emissions,[1] water consumption, and land use (Post, 2012; Post et al., 2020).

However, a challenge for the widespread adoption of cultured meat technology is consumer acceptance (Post, 2020). Indeed, most consumers are unwilling to buy cultured meat (e.g., Gómez-Luciano et al., 2019; Bryant et al., 2019; Siegrist and Hartmann, 2020a,b; Dupont et al., 2020; Weinrich et al., 2020; Zhang et al., 2020b, Asioli et al., 2022). Even though Chinese consumers have a greater willingness to buy (WTB) cultured meat compared to European countries (Bryant et al., 2019; Siegrist and Hartmann, 2020a), their willingness to pay for cultured meat remains negative (Zhang et al., 2020; Wang, 2022; Ortega et al., 2022; Yuan et al., 2022; Chen et al., 2023). Several factors have been identified as possible determinants for negative attitudes toward cultured meat. Among them, food neophobia, perception of unnaturalness, distrust of biotechnology, evoked disgust, safety concerns, nutrition concerns, ethical concerns, as well as individual characteristics and cultural factors, play a relevant role (Siegrist et al., 2018; Bryant and Barnett, 2020; Siegrist and Hartmann, 2020a; Siegrist and Hartmann, 2020b; Asioli et al., 2022).

Personality, defined as the relatively enduring patterns of people thinking, feeling, and behaving (Hofstee, 1994), consistently emerges as

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[1] Recent research has been inconclusive about the carbon footprint advantages of cultured over conventional meat (Sinke et al., 2023; Lynch and Pierrehumbert, 2019), which depends on the availability of decarbonized-energy generation and the specific production systems that are realized. Indeed, initially, cultured-meat production results in less warming compared to conventional meat, but this gap narrows in the long term, and in some cases the latter causes far less warming. This is because CH_4 (methane) emissions from conventional meat production do not accumulate, unlike CO_2, which is the type of GHG mainly produced by cultured meat (Lynch and Pierrehumbert, 2019).

https://doi.org/10.1016/j.foodqual.2024.105317
Received 1 December 2023; Received in revised form 27 July 2024; Accepted 5 September 2024
Available online 12 September 2024

a stable and influential predictor for consumer choice. Despite not being fixed over an individual's life cycle, personalities tend to exhibit stability, particularly among adults (Heckman, 2011). Changes in personality among adults are generally small and have negligible effects on their economic and social decisions (Cobb-Clark and Schurer, 2012). Furthermore, personalities have significant explanatory power in explaining economic preferences compared to other attitude and value variables (Lin et al., 2019). In addition, personality traits have been found to significantly influence consumer food-purchasing behavior. For example, prior studies have identified that personality traits can influence individual choice behavior in different contexts, including health issues, lifestyle, and economic decisions (e.g., Almlund et al., 2011; Ferguson et al., 2011; Keller and Siegrist, 2015; Spinelli et al., 2018). Personality traits also have a significant influence on consumers' choices for food products. Prior literature revealed that personality traits impact consumers' choice of organic food (Grebitus and Dumortier, 2016; Bazzani et al., 2017), local food (Bazzani et al., 2017), genetically modified (GM) foods (DeLong and Grebitus, 2018; Lin et al., 2019), specialty coffee (Ufer et al., 2019), and apples and wines (Grebitus et al., 2013). To illustrate, consumers exhibiting higher levels of openness, conscientiousness, and neuroticism are more willing to accept GM foods (DeLong and Grebitus, 2018; Lin et al., 2019). On the other hand, individuals with higher levels of agreeableness are less willing to accept GM foods (Ardebili and Rickertsen, 2020).

On the basis of prior studies (DeLong and Grebitus, 2018; Lin et al., 2019; Ardebili and Rickertsen, 2020; Ufer et al., 2019) on the relationship between personality traits and food technology, we hypothesize that individuals who exhibit greater levels of openness, conscientiousness, or neuroticism will have a higher valuation for cultured meat, while those who exhibit greater levels of agreeableness will have a lower valuation for cultured meat. Furthermore, we hypothesize that individuals who exhibit higher levels of agency would show a higher valuation for cultured meat. First, Ufer et al. (2019) found that consumers with higher levels of agency tend to have a greater tolerance for risk. Since previous research has found that consumers perceive cultured meat to be risky (Pakseresht et al., 2022), its purchase may involve a certain level of risk. Therefore, consumers with higher levels of risk tolerance are more likely to be willing to pay a premium price for cultured meat. In addition, dominant consumers, because of their self-confidence and willingness to embrace new experiences (Utkarsh et al., 2019), they may be more likely to accept cultured meat as a new product and demonstrate a higher WTP for it. Second, agency is also linked to social influence and the desire to maintain or enhance one's status (Cheng et al, 2010; Louvet et al., 2019). Thus, consumers with higher level of agency may perceive cultured meat as a novel and high-status product, aligning with their self-image and social aspirations. Such perception can drive consumers to be willing to pay a premium price to secure cultured meat and reinforce their status. Third, since higher agency levels correlate with assertiveness in decision-making (Cheng et al, 2010), dominant consumers may tend to be more decisive and proactive in their choices, which may lead them to be willing to pay a premium price to ensure they obtain the product (i.e., cultured meat) they desire.

Despite the important role of personality traits in consumer food choice, to the best of our knowledge, no study has explored the role of personality traits in consumer preference for cultured meat. To fill this void, we tested, for the first time, whether and how personality traits affect Chinese consumer preferences for cultured fresh skinless boneless chicken breast products by using a hypothetical choice experiment (CE). The innovative aspect of this work is that it is the first study that provides evidence on whether personality traits are related to consumer preference toward cultured meat, which can provide useful information for producers, policy makers, and academia. Specifically, if personality traits explain consumer preference heterogeneity for cultured meat, then there could be relevant implications for producers of cultured meat to better position and communicate to targeted groups who have a positive attitude for cultured meat. For instance, if our study reveals that individuals with specific personality traits, such as openness or conscientiousness, are more inclined toward cultured meat, producers can tailor their marketing messages accordingly. This might involve identifying these target groups by analyzing their behavior, for example, through social platforms. The results of this study can also provide insights for policy makers to develop effective communication strategies and education campaigns specifically targeted at consumers with particular personality traits with the aim of promoting cultured-meat technology. For instance, if certain personality traits are identified as positively related to acceptance of cultured meat, policymakers can design campaigns that speak directly to consumers who have these traits. This might involve emphasizing the sustainable and innovative aspects of cultured meat for individuals with high openness, addressing health and safety concerns for those high in conscientiousness, or highlighting the social and ethical dimensions for individuals with heightened agreeableness. Moreover, recognizing the role of personality traits in shaping attitudes toward cultured meat can guide the development of educational programs that address specific concerns or misconceptions associated with different traits. For example, if neuroticism is found to be a factor influencing skepticism about cultured meat, then educational campaigns can provide accurate information to alleviate these concerns and promote a more positive perception.

This study is structured as follows. First, an extensive literature review of personality traits and cultured meat preference is provided. Second, a description of the applied methodology and econometric analysis used in this study is illustrated. Third, the results of this study are presented and discussed. Finally, conclusions, policy implications, and future research avenues are provided.

2. Literature review on personality traits

Personality traits of an individual describe a relatively stable pattern of behavior, thoughts, and emotions (Roberts, 2009). A variety of personality trait models and scales have been developed to capture and organize individual differences among people (Lin et al., 2019). One of the main models is the Five Factor Model or the "'Big Five" (John and Srivastava, 1999). The Big Five personality traits include openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (McCrae and Costa, 1999). For example, openness to experience characterizes someone who is intellectually curious and tends to seek new experiences and explore novel ideas (Zhao and Seibert, 2006). Someone with a high level of extraversion enjoys social activities and prefers to be with others than being alone (LePine and Van Dyne, 2001), while individuals who score high on neuroticism tend to be nervous and often express negative attitudes (LePine and Van Dyne, 2001). These personality traits work together to describe broad behavioral tendencies associated with future behavior and behavioral outcomes (Baumert et al., 2017). Lachman and Waver (1997) subsequently added "agency" to the Big Five traits to address dominance and assertiveness and created the so-called "Big Six" personality traits. People with high agency are likely to satisfy themselves and ensure control over their decisions (Grebitus et al., 2013). The Big Six personality traits scale has been applied in different fields such as studies on consumer food preference over the past decades (e.g., DeLong and Grebitus, 2018).

Big Five and Big Six personality traits scales have been largely used in several studies to investigate consumer food choices, product labeling, and consumer attitudes toward new and unfamiliar food. For example, Conner et al. (2017) discovered that plant-based food consumption is positively linked to openness, extraversion, and conscientiousness. In terms of product labeling, DeLong and Grebitus (2018) found that consumers who scored high in conscientiousness prefer labeled GM animal products, while Ardebili and Rickertsen (2020) found that conscientiousness and agreeableness are negatively related to consumer acceptance of GMO salmon. Peschel et al. (2019), using the 'Big Six' model to investigate US consumer preference for dried fruit,

found that neuroticism and agency were positively related to production method labeling. Nezlek and Forestell (2019) identified a negative relationship between food neophobia, openness, and extraversion, and that approach motive toward new foods was positively related to openness and agreeableness. Some authors found that the relationship between personality traits and food purchasing depends on the country as well as culture. For example, in a study on consumer preferences for GM pork in China, Italy, and the United States, Lin et al. (2019) found that openness was positively related to consumer acceptance of GM pork in all three countries, while conscientiousness was negatively related to consumer acceptance in the US and Italy but is unrelated in China.

3. Materials and methods

3.1. Data

We conducted an online survey in 2019 in the three first-tier cities of China; namely, Beijing, Shanghai, and Guangzhou. Consumers in these cities generally have a higher income and higher education level than in other areas and are thus more likely to consider high-quality and novel foods (Zhang et al., 2020b). Second, these top-tier cities attract people from all over China, especially young people, who tend to be more open-minded to new food products. This means that these cities have a larger market potential for cultured meat. Furthermore, an online survey approach can obtain a good representative sample of the Chinese urban population because most of Chinese citizens have access to the Internet. The penetration rate of Internet services in towns in China is 81.3 % (China Internet Development Statistics Report, 2022) and is much higher (95 %) in top-tier cities, e.g., Beijing, Shanghai, and Guangzhou. The number of Internet users in China was about 1.051 billion by the end of June 2022 (China Internet Development Statistics Report, 2022).

Fig. 1 depicts the procedures of the survey. Participants were recruited by the Baidu Group[2] in China and screened to ensure that they were over 18 years of age and were responsible for food purchasing in the household. The questionnaire consists of three parts. The first part includes the eight CE tasks. The second is personality trait scales, for which participants are required to complete thirty items. The third is sociodemographic characteristics, including age, gender, income, education and household size, and the number of children under 18. A total of 285 observations were used in the study. Several measures were taken to ensure the best possible data quality. First, following Alesina et al. (2018), before respondents started to respond to the questionnaire, we informed them about the importance of their honest responses. Second, after background questions and before the choice tasks, we showed an "attention check" question to nudge respondents to pay extra attention to the subsequent choice experiment (CE) tasks.

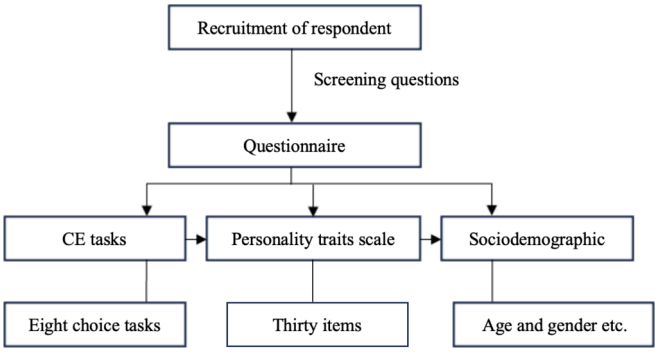

Fig. 1. Procedures of the questionnaire.

3.2. Experimental design

To elicit consumer preference for a cultured meat product, a hypothetical CE about chicken breast purchasing behavior was administered. Chicken breast was chosen as the product of interest given that China was the world's second-biggest market for chicken products, at about 14.945 million tons in 2022 (USDA,2023). Furthermore, cultured chicken was recently approved to be sold in the market in Singapore by the company Eat Just, Inc. and in the United States for the company Good Meat and Upside Foods (Arin Baker, 2023); thus, it is possible that other countries, including China, could soon follow.

In the CE, respondents are asked to indicate their preferred chicken breast product among several of experimentally designed sets of alternatives. Each alternative profile was thereby characterized by a specific combination of attribute levels and a no-purchase option. In this study, the CE was based on chicken breast characterized by the following attributes: production technology, carbon trust label, antibiotic use, and price (Table 1). Production technology was included because the main aim of the study is to elicit consumers' WTP for cultured meat in relation to different personality traits. Two levels, namely, conventional and cultured meat, were specified. Cultured meat technology is the subject of our study, while conventional meat production is the most common method of chicken production. Carbon trust label refers to the environmental impact of food production, transportation, and use of the food products in terms of CO_2 emissions. We included a carbon trust label because consumers are increasingly interested in food products with a lower carbon footprint. Indeed, carbon trust has been found to affect Chinese consumer food choices (Chen et al., 2018;Yang et al., 2021; Li et al., 2017; Rondoni and Grasso, 2021). Two levels corresponding to 'carbon trust label' or 'no label' were specified. We also included 'antibiotics use' given that antibiotics might be used during chicken production (Chriki and Hocquette, 2020), which is a concern that could affect consumer meat choices. In addition, there was a debate about the use of antibiotics in animal production, as this might pose potential health risks for consumers (Lusk et al., 2006; Boyer et al., 2017; Grunert et al. 2018). In China, consumers are concerned about food safety and pay much attention to food safety attributes (Zhou and Jin, 2013; Zhang et al., 2021; Yuan et al., 2024). Therefore, the attribute "antibiotics use" may play a key role in consumers' food decision making. The"antibiotics use" was specified with two levels: a claim stating ""no antibiotics ever" and no information reported. 'No antibiotics ever' means that antibiotics were never used during the production process. Finally, we included price because it is a significant determinant of consumer food choice, and it can be used to derive a monetary evaluation of WTP. Four price

Table 1
Attributes and attribute levels used in choice design.

Attributes	Levels
Production method	Conventional chicken Cultured chicken
Carbon Trust label	Carbon label No label is reported
Antibiotics use	No antibiotics ever No information is reported
Price (RMB/500 g)	8.9 13.9 18.9 23.9

[2] Baidu Group is a company that provides services for recruiting participants and collecting survey data. Website: https://mtc.baidu.com/product/qss.html.

levels, i.e., 8.9 RMB, 13.9 RMB, 18.9 RMB, and 23.9RMB, were set to reflect the average market price for 500 g chicken breast. The 500 g weight of chicken breast is the typical size sold in retail stores in China.

The attributes and attribute levels were first used to develop an orthogonal fractional design reducing the full factorial 256 (4^2*2^4) combinations of the attributes to 24. The D-efficiency score was 99.16 % for the chosen design, indicating a very minimal variance matrix (Britwum and Yiannaka, 2019). To limit the response time and consumer fatigue, and to increase the response rate, we split the 24 choice sets into three blocks of eight choice sets.[3] Each choice set included two chicken breast options and an 'opt-out' option. An example of a choice task is shown in Fig. 2. The 'opt-out' option was added to each choice task to present a more realistic market scenario where respondents could voluntarily opt out of a purchase, which avoided over-inflation of the estimates (Hensher et al., 2015). To avoid ordering effects, the choice sets were presented in random order as Savage and Waldman (2008) recommended. In addition, to mitigate the potential hypothetical bias, a cheap talk script (Cummings and Taylor, 1999) was provided before the series choice tasks.

Since cultured meat is novel for consumers, we provided them with a detailed explanation. Specifically, we explained and described all of the attributes and levels of the alternative products to consumers before the choice tasks, including the production method (i.e., cultured meat and conventional meat) as typical procedure in CE questionnaires (for example, Asioli et al., 2022; Slade, 2018; Ortega et al., 2022) (see the questionnaire in Appendix A).

3.3. Personality measurement

Upon completion of the choice tasks, consumers were asked to complete a questionnaire to collect information on their personality traits. To measure the personality traits, we used the Big Six personality scale, also called Midlife Development Inventory (MIDI) scale, which was developed by Lachman and Weaver (1997) to elicit a consumer personality profile.

The MIDI scale consists of six personality dimensions, including agency, agreeableness, openness, neuroticism, extraversion, and conscientiousness (Lachman and Weaver, 1997). Each dimension is measured by five items/adjectives that each corresponds to a series of individual characteristics (see Table 2). Each adjective is measured using a scale from 1 (not at all) to 4 (a lot) that indicates the degree to which each adjective on the scale describes the responder. Each personality trait was computed by calculating the mean scores of the adjectives (Lachman and Weaver, 1997).

We used the MIDI scale for four main reasons. First, the MIDI scale is able to capture personality in an economical and reliable way in a short time (Lachman and Weaver, 1997; Grebitus et al., 2013; Bazzani et al., 2017; Lin, et al., 2019). Second, the MIDI scale has been used previously to elicit consumer personality traits in the context of novel foods (e.g., Grebitus et al., 2013; DeLong and Grebitus, 2018), which show consistent and robust results. Third, the MIDI scale is simple to understand and use by respondents. Lastly, compared with the Big Five personality traits scale, the MIDI scale is more comprehensive since it adds an additional dimension (i.e., agency).

[3] The experimental design also allows conventional chicken breast with carbon trust label and cultured chicken breast with no carbon trust label, which is part of the experimental choice design. Actually, there is uncertainty if cultured meat could result in a smaller carbon footprint compared to conventional chicken breast (Lynch and Pierrehumbert, 2019). Thus, it is possible that conventional meat has a smaller carbon footprint compared to the cultured meat production.

4. Econometric analysis

To test the effect of personality traits on consumer WTP for cultured chicken, we used discrete choice models (DCMs), which are typically used to analyze choice data (Hensher et al., 2015). DCMs are based on modeling "utility", which is the net benefit a consumer obtains from selecting a specific product in a choice situation as a function of the attributes that are embedded in the product under consideration (Hensher et al., 2015). The utility of an individual n in choosing alternative j in the choice situation t can be expressed as follows:

$$U_{njt} = \beta_n' X_{njt} + \varepsilon_{njt} \quad (1)$$

where X_{njt} is the observable portion of utility function, which represents the individual n utility obtained from alternative j in choice situation t; β is the vector of taste parameters corresponding to the attributes; and ε_{njt} is the unobservable portion of the utility function, which is assumed to be independent of the vector β and x.

Within this framework, different DCMs can be derived depending on assumptions regarding the distribution of the unobserved portion of the utility and the functional form of the utility. There are different specifications of discrete models, from multinomial logit (MNL), which assumes homogeneity in individuals' tastes, to the random parameter logit (RPL) model, which accounts for preference heterogeneity. In the MNL, the unobserved portion of the utility (i.e., error terms) is assumed to be independently and identically distributed as a Gumbel distribution (extreme value type I). This assumption also implies that individuals' preferences are homogeneous. However, individuals may actually differ in terms of taste intensities (Train, 2009), which is the case in the context of cultured meat (Van Loo et al., 2020; Ortega et al., 2022). Thus, the assumption of homogeneous preference is likely to produce biased coefficient estimates. Thus, to account for individuals' heterogeneous preference, the RPL model was employed in our study. The RPL model allows for random taste variation and consideration of the panel structure of choice data (Train, 2009).

However, the basic RPL model does not consider the systematic difference between the opt-out option and alternative options. Because the alternative options are hypothetical and vary in every choice task, the opt-out option is actually experienced by respondents and is self-repeated in all the choice tasks. As such, the unobservable utilities of the two purchase options might have a higher variance in comparison to the unobservable utility of the opt-out option, and they might be more correlated amongst themselves than with the utility of the opt-out option (Bazzani and Canavari, 2017). To account for the correlation of the purchase alternative utilities in the estimation, the Random Parameter Logit–Error Component (RPL–EC) model (Scarpa and Alberini, 2005; Scarpa et al., 2007) has been employed. The RPL–EC model includes a standard RPL model with an additional error term with zero-mean, which was added to the utility function in Eq. (1) as follows:

$$U_{njt} = \beta_n' X_{njt} + \eta_{it} + \varepsilon_{njt} \quad (2)$$

where η_{it} is the error component (EC) that is associated with alternatives that portray purchasing options in the choice tasks and is absent in the utility of the opt-out alternative (Scarpa et al., 2005). In our choice context, the RPL–EC model can be specified as follows:

$$U_{njt} = ASC + \beta_1 Price_{njt} + \beta_{2n} Cultured_{njt} + \beta_{3n} Carbon_{njt} + \beta_{4n} Antibiotics_{njt} + \eta_{it} + \varepsilon_{njt} \quad (3)$$

where n represents the nth individual, t indicates the choice situation, and j refers to the alternatives. ASC is an alternative-specific constant dummy variable that assumes value 1 when the opt-out option is chosen and 0 otherwise. $Price_{njt}$ is a continuous variable expressing price for 500 g of chicken breast, which is represented by four price levels in the experiment design (i.e., 8.9 RMB, 13.9 RMB, 18.9 RMB, and 23.9 RMB). $Cultured_{njt}$ is the dummy variable equal to 1 if the chicken breast is

	Alternative A	Alternative B	Alternative C
Production process	Cultured meat	Cultured meat	
Antibiotics use	No information is reported	No antibiotics ever	I would not buy either option A or B
Carbon trust	With label	No label	
Price	8.90	18.90	
I would choose	A_____	B_____	C_____

Fig. 2. An example of a choice task.

Table 2
Big Six Personality Trait description in the MIDI scale.

Personality Trait	Adjectives
Agency	Self-confident, forceful, assertive, outspoken, dominant
Agreeableness	Helpful, warm, caring, softhearted, sympathetic
Openness	Creative, imaginative, intelligent, curious, broadminded, sophisticated, adventurous
Neuroticism	Moody, worrying, nervous, calm (−)
Extraversion	Outgoing, friendly, lively, active, talkative
Conscientiousness	Organized, responsible, hardworking, careless (−)

produced by cultured meat technology, and 0 otherwise. $Carbon_{njt}$ is the dummy variable equal to 1 if the chicken breast has been branded with the "carbon trust" label, and 0 otherwise. $Antibiotics_{njt}$ is the dummy variables equal to 1 if the chicken breast has been produced using the claim "no antibiotics ever", and 0 otherwise. The parameters corresponding to the three non-price attributes were modeled as random parameters assumed to follow a normal distribution, and the opt-out parameter was modeled as a fixed parameter. The attribute level coefficients were each specified as random and normally distributed with 500 Halton draws.

To test how personality traits impact consumers' WTP for the three attributes, namely, cultured meat, carbon trust label, and antibiotic use, three interaction effect models were estimated. Following prior research (Bazzani et al., 2017; Lin et al., 2019; Lim et al., 2013), the effect of personality traits was accounted for by means of interaction terms between the six personality traits (i.e. agency, openness, agreeableness, neuroticism, extraversion, and conscientiousness) and the three attributes (i.e., cultured, carbon, and antibiotics) in the design. The empirical equations are specified as follows:

$$U_{njt} = ASC + \alpha Price_{njt} + \beta_{in} X_{njt} + \gamma_i\left(Cultured_{njt} * Personality_n\right) + \eta_{it} + \varepsilon_{njt} \quad (4.1)$$

$$U_{njt} = ASC + \alpha Price_{njt} + \beta_{in} X_{njt} + \gamma_i\left(Carbon_{njt} * Personality_n\right) + \eta_{it} + \varepsilon_{njt} \quad (4.2)$$

$$U_{njt} = ASC + \alpha Price_{njt} + \beta_{in} X_{njt} + \gamma_i\left(Antibiotics_{njt} * Personality_n\right) + \eta_{it} + \varepsilon_{njt} \quad (4.3)$$

where:

X_{jt} = [Cultured, Carbon, Antibiotics]$_{jt}$,

$Personality_n$ = [Agency, Openness, Agreeableness, Neuroticism, Extraversion, Conscientiousness].

Eq. (4.1) represents the interaction between personality information and the "cultured" attribute, Eq. (4.2) represents the interaction between personality information and the "carbon" attribute, and Eq. (4.3) represents the interaction between personality information and the "antibiotics" attribute. In all three models, the total utility consists of six components. First, ASC is an alternative-specific constant dummy variable that assumes value 1 when the opt-out option is chosen, and 0 otherwise. Second is the price scalar ($Price_{njt}$) along with its fixed parameter α. Third, the3 × 1 vector X_{njt} represents the chicken breast attributes (i.e., Cultured, Carbon, and Antibiotics) with dummy variables. The three attributes have the same definitions as specified in Eq. (3). The random parameter β is assumed to be normally distributed. Fourth, the component $\gamma_i\left(Cultured_{njt} * Personality_n\right), \gamma_i\left(Carbon_{njt} * Personality_n\right)$ and $\gamma_i\left(Antibiotics_{njt} * Personality_n\right)$ captures the personality–interaction effects with the three attributes, namely, cultured (Eq. (4.1), carbon (Eq. (4.2), and antibiotics (Eq. (4.3), respectively. Specifically, the 1× 6 personality vector $Personality_n$ interacts with the dummy variables $Cultured_{njt}$, $Carbon_{njt}$, and $Antibiotics_{njt}$ to capture the co-variation between each personality trait (i.e., agency, openness, agreeableness, neuroticism, extraversion, and conscientiousness) and cultured-meat preference (i.e., Cultured for eq(4.1), Carbon for eq.(4.2), and Antibiotics for eq.(4.3)). Fifth, η_{it} is the error component (EC) that is associated with alternatives that portray purchasing options in the choice tasks and is absent in the utility of the opt-out alternative (Scarpa et al., 2005). Sixth, ε_{njt} is the unobservable portion of the utility function.

5. Results

5.1. Descriptive analysis

The respondents of our survey are all chicken breast purchasers. The frequency of consumption of chicken breast products revealed that about 40 % of respondents purchase chicken breast daily, about 50 % purchase it twice a week, and about 10 % purchase it once a week or less frequently. Table 3 reports the demographics of our sample. Generally, the demographics of our sample aligns with other studies that have targeted Chinese urban consumers (e.g., Zhang et al., 2022; Ortega et al., 2022; Lin et al., 2020; Chen et al., 2023). Approximately half of our sample was female (47.02 %). The average age was 33.28 years. The majority of the sample had a monthly family income higher than 20,000 RMB. Approximately 84 % of the sample had a bachelor's degree or higher, which is reasonable given our use of an online survey (Yang et al., 2020).

Table 4 reports the descriptive statistics of personality traits. The Cronbach's alpha parameters of each personality trait were greater than 0.50, which indicates that the MIDI scale used in our study is reliable and is internally a consistent tool in measuring personality traits (Bazzani et al., 2017). Individuals scored the lowest for Neuroticism (2.52) and the highest in Agreeableness (2.79), suggesting that consumers, on average, identified themselves more as helpful, warm and caring, and less moody, worrying, and nervous people. This finding was in line with prior studies (DeLong and Grebitus, 2018; Bazzani et al., 2017; Lin et al., 2019).

Table 3
Summary statistics for the survey respondents.

Variable	Description(n = 285)	Our sample
Gender	0 if female	47.02 %
	1 if male	52.98 %
Age	Years	38.28 (6.52)
Education	≤High school	11.58 %
	Associate or Bachelor Degree	84.21 %
	Master's Degree or above	4.21 %
Children under 18	0 if no	39.30 %
	1 if yes	60.70 %
Occupation	Student	0.35 %
	Independent worker	11.58 %
	Private-sector worker	66.32 %
	Public-sector worker	18.60 %
	Retired	0.35 %
	Unemployed	1.40 %
	Not in paid employment	1.40 %
Household income (RMB)	Under 10,000	21.05 %
	10001–20000	21.40 %
	20001–30000	20.35 %
	30001–40000	29.47 %
	40001–50000	6.32 %
	Above 50,000	1.40 %
City (%)	Beijing	32.98 %
	Guangzhou	34.39 %
	Shanghai	32.63 %
Chicken breast purchase frequency		Everyday 40 %
		Twice a week 50 %
		Once a week or less frequently 10 %

Table 4
Descriptive statistics of personality traits.

Trait(Cronbach's Alpha values)	Mean	Variable	Mean	SD
Agency(0.68)	2.76	Self-confident	3.05	0.73
		Forceful	2.85	0.77
		Assertive	2.57	0.95
		Outspoken	2.84	0.97
		Dominant	2.51	0.91
Agreeableness(0.71)	2.79	Helpful	2.77	0.96
		Warm	2.82	0.95
		Caring	2.75	0.92
		Softhearted	2.76	0.93
		Sympathetic	2.84	0.94
Openness(0.62)	2.69	Creative	2.66	0.91
		Imaginative	2.73	0.92
		Intelligent	2.65	0.89
		Curious	2.75	0.91
		Broadminded	2.82	0.88
		Sophisticated	2.65	0.94
		Adventurous	2.60	0.92
Neuroticism(0.70)	2.52	Moody	2.58	0.93
		Worrying	2.54	0.95
		Nervous	2.49	0.94
		Calm (−)	2.46	0.86
Extraversion(0.65)	2.65	Outgoing	2.59	0.96
		Friendly	2.78	0.93
		Lively	2.69	0.88
		Active	2.64	0.91
		Talkative	2.57	0.89
Conscientiousness(0.60)	2.69	Organized	2.65	0.89
		Responsible	2.83	0.91
		Hardworking	2.86	0.86
		Careless (−)	2.41	0.84

5.2. WTP estimates

The results of the estimation of the RPL-EC using Eq. (3) for the main effects are exhibited in Table 6. We reported the coefficients of the main effects for cultured, carbon, price, antibiotics, and ASC, as well as the corresponding standard errors (SEs), standard deviations (SDs), and significances for the attributes (*p* values). The distributions of the EC coefficients associated with the alternatives have a significant estimate for the SDs, suggesting that utility variance is much larger for utility of the alternatives as compared with the opt-out option. We found some interesting results. On average, consumers prefer conventional chicken (coefficient: −0.15, *p-value*: 0.03) labeled with the claim 'no antibiotics ever' (coefficient: 0.11, *p-value*: 0.001), and of low price (coefficient: −0.01, *p-value*: 0.03). In addition, the significant SDs for the attributes Cultured, Carbon, and Antibiotics indicate an interesting consumer heterogeneity preference for these three attributes.

Table 5 shows consumers' mean WTP (mWTP). Consumers mWTP for cultured chicken, carbon-labeled chicken, and chicken with the claim "no antibiotics ever" are 1.85 RMB/500 g, 4.92 RMB/500 g, and 14.08 RMB/500 g, respectively. The results reveal that consumers are willing to pay more for the chicken breast labeled with the claim "no antibiotics ever" rather than for the brand "Carbon Trust" label and "production technology".

Table 5
Results of WTP estimates.

	Cultured	Carbon	Antibiotics
WTP	1.85	4.92	14.08
95 % confidence intervals	[−5.35,9.72]	[-0.96, 16.96]	[6.94, 35.58]

5.3. The relationship between personality traits and WTP

The results of the RPL–EC using Eq. (4) for the interaction terms between the production technology (cultured) attribute and the personality traits are exhibited Table 6. We reported the coefficients of attributes and interaction terms, as well as the corresponding standard errors (SEs), standard deviations (SDs), and significances for the attributes (*p* values). We found some interesting relations between the attribute Cultured and three personality traits, namely, Agreeableness, Neuroticism, and Conscientiousness. Specifically, we found a negative relation (coefficient = − 0.40, p value = 0.00) between Cultured and Agreeableness, which suggests that respondents with a higher tendency of being helpful and agreeable tend to prefer more conventional meat. In addition, we found a positive relation (coefficient = 0.19, p value = 0.50) between Cultured and Neuroticism, which indicates that more worrying and nervous individuals tend to prefer cultured meat. We then found a negative relation (coefficient = − 0.35, p value = 0.03) between Cultured and Conscientiousness, which suggests that more organized, responsible, hardworking, and careless individuals are less likely to prefer cultured meat.

The results of the RPL–EC using Eqs. (5) and (6) for the interaction terms between Carbon attribute, Antibiotics, and the personality traits are also exhibited in Table 7. We found a positive relation (coefficient = 0.27, p value 0.05) between Carbon and Extraversion, which suggests that respondents with a higher tendency of being outgoing and friendly tend to prefer more carbon-labeled meat. We did not find any significant

Table 6
RPL–EC estimates: main effects and interaction effects.

Variables		Main effects	Main effects + interactions effect with cultured	Main effects + interactions effect with carbon	Main effects + interactions effect with antibiotics
Main effects					
Cultured	Mean	−0.15**	−0.15*	−0.15**	−0.15**
		(0.07)	(0.57)	(0.07)	(0.07)
	SD	0.53***	0.34***	0.50***	0.53***
		(0.09)	(0.10)	(0.09)	(0.09)
Carbon	Mean	0.05	0.06	−0.02	0.05
		(0.06)	(0.06)	(0.42)	(0.06)
	SD	0.33***	0.29**	0.28**	0.33***
		(0.12)	(0.13)	(0.14)	(0.12)
Antibiotics	Mean	0.11***	0.11*	0.11	−0.41
		(0.07)	(0.06)	(0.07)	(0.46)
	SD	0.50***	0.50***	0.50***	0.48***
		(0.11)	(0.11)	(0.11)	(0.12)
Price	Coef.	−0.01*	−0.01*	−0.01*	−0.02*
		(0.01)	(0.01)	(0.01)	(0.01)
Opt-out	Coef.	−0.74***	−0.73***	−0.74***	−0.73***
		(0.11)	(0.12)	(0.12)	(0.11)
Error component	Coef.	0.74***	0.81***	0.76***	0.72***
		(0.11)	(0.11)	(0.11)	(0.11)
Interaction effects					
Agency*Cultured	Coef.		0.24		
			(0.18)		
Agreeableness*Cultured	Coef.		−0.40***		
			(0.12)		
Openness*Cultured	Coef.		0.19		
			(0.19)		
Neuroticism*Cultured	Coef.		0.19*		
			(0.11)		
Extraversion*Cultured	Coef.		−0.04		
			(0.13)		
Conscientiousness*Cultured	Coef.		−0.35**		
			(0.14)		
Agency*Carbon	Coef.			−0.01	
				(0.16)	
Agreeableness*Carbon	Coef.			−0.16	
				(0.12)	
Openness*Carbon	Coef.			−0.12	
				(0.18)	
Neuroticism*Carbon	Coef.			0.18	
				(0.11)	
Extraversion*Carbon	Coef.			0.27*	
				(0.14)	
Conscientiousness*Carbon	Coef.			−0.04	
				(0.15)	
Agency*Antibiotics	Coef.				−0.10
					(0.17)
Agreeableness*Antibiotics	Coef.				0.23
					(0.15)
Openness*Antibiotics	Coef.				−0.01
					(0.20)
Neuroticism*Antibiotics	Coef.				−0.10
					(0.12)
Extraversion*Antibiotics	Coef.				0.06
					(0.16)
Conscientiousness*Antibiotics	Coef.				0.07
					(0.15)
Summary Statistics					
Number of observations		6840	6840	6840	6840
Log likelihood		−2395.96	−2381.88	−2425.43	−2392.16
AIC/N		2.11	2.10	2.14	2.11

Note: *, **, and *** denote variables significant at 10%, 5%, and 1%, respectively. Standard errors are presented in parentheses.

interaction terms among personality traits and Antibiotics. This suggests that the personality traits did not affect consumers' preference for chicken breast with the claim "no antibiotics ever". To enhance our estimation results, we also estimated a single model including all the interaction terms (Appendix A Table A1). The results are similar to the estimation results of Table 6.

Following Grebitus et al. (2013), we present figures illustrating the relationship between consumers' WTP for cultured meat and each personality trait. Individual WTP was calculated based on the coefficients of Eq. (3). Fig. 3 depicts the relationship between consumers' WTP for cultured meat and each corresponding personality trait. Consistent with the findings in Table 6, agreeableness and conscientiousness exhibit a

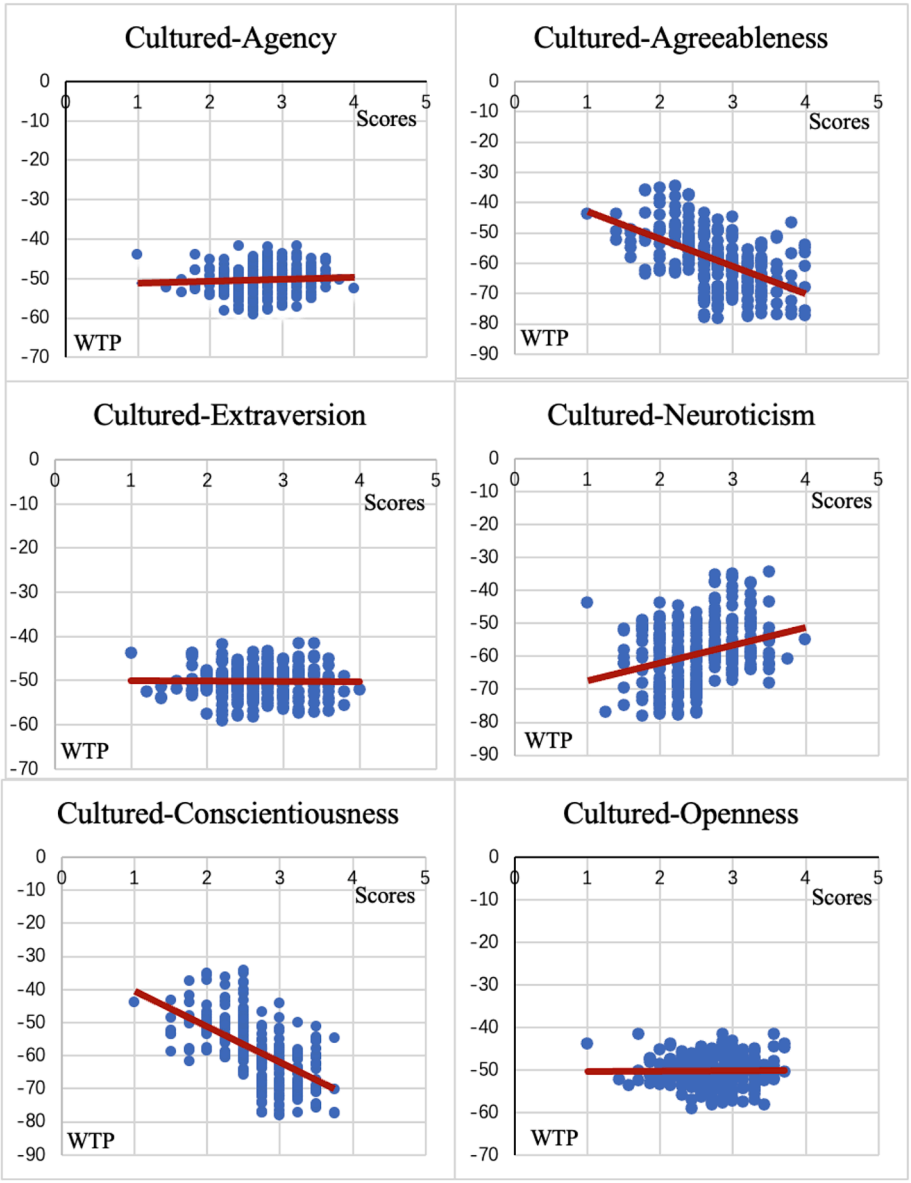

Fig. 3. Effect of personality traits on consumers' WTP for cultured meat. Note: The *y*-axis displays WTP, and the *x*-axis displays the scores of personality.

significantly negative effect on WTP. The relationship between agency and WTP is slightly positive but not significant at the level of 5 %, while the relationship between openness and WTP follows a similar trend. However, the relationship between agency and WTP is slightly negative but not significant.

6. Discussion

We investigated if and how personality traits affect Chinese urban consumer preferences for hypothetical cultured fresh skinless boneless chicken breast products by using a hypothetical choice experiment. Several main outcomes were identified. First, we found that, on average, consumers prefer conventional chicken labeled with the claim"no antibiotics ever" and at a low price. This finding is corroborated by Van Loo (2020) and Asioli et al. (2022). Second, we found a negative relationship between agreeableness and consumers' WTP for cultured meat. Individuals high in agreeableness are often characterized by their tendency to be cooperative, compassionate, and compliant (Lin et al., 2019). Such individuals may be more skeptical or cautious about novel or unconventional food technologies like cultured meat. Their preference for maintaining harmony and adhering to established norms might make them less open to adopting new and unfamiliar products, especially those involving significant technological intervention. This finding is corroborated by Lin et al. (2019), who found that more agreeable consumers are less likely to choose GMO foods. Third, we found a negative relationship between conscientiousness and consumers' WTP for cultured meat. Conscientious individuals are often more conservative and risk-averse, preferring stability, predictability, and adherence to traditional practices (Ufer et al., 2019). Cultured meat, as a novel and innovative food technology, may be perceived as risky or uncertain. Conscientious consumers might be less willing to deviate from traditional meat consumption patterns and therefore show a lower WTP for cultured meat. The similarity of these findings to those observed in the context of GMO foods (Lin et al., 2019) suggests a broader pattern where conscientious individuals are cautious about adopting foods produced with advanced scientific and technological interventions. Their conservative nature and preference for established norms make them less inclined to embrace novel food technologies, leading to a lower valuation of cultured meat.

Overall, our findings suggest that personality traits play a key role in affecting consumer valuation for cultured meat, which can provide valuable insights for both the cultured-meat industry and policymakers. Specifically, marketers can develop customized marketing campaigns tailored to specific personality traits, engaging consumers through personalized messaging and promotions. In the digital era, the personality-based marketing strategy has been proven to be effective (Hirsh et al., 2012). Consumer personality traits can be predicted, for example, by investigating their online experience and social profiles (Golbeck et al., 2011), which allows personality traits to be predicted from social media use and online consumer behavior. Therefore, marketers can employ consumers' use of social media to identify agreeableness, neuroticism, and conscientiousness of consumers and to optimize their outreach efforts through tailored content and advertisements. Policy makers can support educational initiatives aimed at enhancing consumer understanding of cultured meat, allocate resources to promote sustainable practices within the industry, and collaborate with stakeholders to establish transparent marketing guidelines. By addressing potential concerns associated with agreeable and conscientious personalities, policymakers can contribute to the broader acceptance of cultured meat products within diverse consumer segments.

7. Conclusions

Our study is the first to explore whether and how individuals' personality traits shape consumer preference for cultured meat. We find that personality traits play a role in explaining heterogeneous preferences for cultured meat. Our results provide useful insights that can be used by policymakers and by cultured-meat producers to develop and market cultured meat.

Several limitations can be identified from this study. First, consumers may still be unfamiliar with cultured meat, potentially leading to cognitive bias. This bias may result in consumers expressing a lower WTP for cultured meat. Although we provided detailed information on cultured meat to respondents before the choice tasks, we did not assess whether respondents had a clear understanding of what cultured meat is. Perhaps with the future availability of cultured meat in the market, future studies can potentially mitigate this bias by using samples of consumers with prior experience with cultured meat. Second, our study relied on hypothetical purchasing scenarios, which may not fully capture real-world purchasing behavior. Third, our sample size is limited and thus offers limited generalizability of our findings to the Chinese urban population.

Several future research avenues can be identified from this study. First, future studies should further investigate consumers' WTP by conducting non-hypothetical (real) experiments in store or labs using experimental auctions (Lusk and Shogren, 2009), multiple price lists (Asioli et al., 2022), or real CE combined with sensory evaluations (Asioli et al., 2017) of cultured meat when cultured meat will be available and approved for consumer tasting. Second, future research should conduct longitudinal studies that can provide insights into the stability and changes in consumer preferences for cultured meat over time. Finally, it would also be interesting to test the robustness of our results on personality traits on consumer valuations for other types of cultured meat (i.e., beef, pork, lamb), using larger sample sizes and testing in other countries, given the expected increase in meat demand in many countries around the world.

Ethical statements

The study was explained to consumers in the online questionnaire. They were informed that they would participate in the survey using their personal smartphone, that all data will be de-identified and only reported in the aggregate. All participants acknowledged an informed consent statement in order to participate in the study. They were financially compensated for their participation.

CRediT authorship contribution statement

Shaosheng Jin: Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Qianqian Zhai:** Writing – review & editing, Validation, Resources, Investigation, Conceptualization. **Rao Yuan:** Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation. **Daniele Asioli:** Writing – review & editing, Validation, Software, Methodology, Data curation, Conceptualization. **Rodolfo M. Nayga:** Writing – review & editing, Writing – original draft, Visualization, Resources, Methodology, Conceptualization.

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.

Acknowledgements

This research was funded by the National Science Foundation of China (grant number: 72273128).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2024.105317.

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