Consumer segmentation and motives for choice of cultured meat in two Chinese cities: Shanghai and Chengdu

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Article Title Page

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Emerald

Consumer segmentation and motives for choice of cultured meat in two Chinese cities: Shanghai and Chengdu

Structured Abstract:

Purpose: The widespread dietary adoption of cultured meat could provide important benefits to animal welfare, the environment, food safety and security. This study examines consumer segmentation and consumer motives for choice of cultured meat in China.

Design/methodology/approach: The data were collected by means of a web-based questionnaire (n=608) distributed in the two cites of Shanghai and Chengdu. Factor analysis, cluster analysis and path analysis were employed for data analysis.

Findings: Three consumer segments were identified with regard to the acceptance of cultured meat in China: Conservatives (25.7%), Acceptors (41.9%) and Pioneers (32.4%). Significant differences were recognised in age, household income, education and household size between the three consumer segments. The following meat choice motives have significant influences on Chinese participants' attitudes and/or purchase intentions towards cultured meat: Usually eat, Environmental concern, Societal concern, Mood, Purchase convenience and Price.

Originality/value: This is the first study to develop a factorial construct of meat choice motives (MCMs) based on a previous theoretical model of food choice motives (FCMs) in China. The study contributes understanding of choice motives for cultured meat in a non-Western setting, particularly in China - the country consuming the largest quantity of pork. Further, this is the first study to recognise segments that are directly based on consumer attitudes and purchase intentions towards cultured meat. The findings of this study will help global producers and policymakers to create effective promotion strategies and policies for this innovative product in developing countries, particularly in China.

Keywords

Consumer segmentation; socio-demographics; motives; cultured meat; China.

1. Introduction

The production of cultured meat is an emerging solution to the increased demand for meat caused by the growth of both population and wealth in developing countries and the rising demand for meat substitutes related to meat safety crises and the health, environmental and animal welfare issues with meat consumption in developed countries (Bryant and Barnett, 2020; Verbeke, Marcu et al., 2015; Verbeke, Sans et al., 2015). Although cultured meat is currently produced at a high cost in laboratories, it will come into the public market with an acceptable price due to the quick development of relevant technologies, for example, the further commercialisation of *in vitro* technologies and the participation of artificial intelligence in production (Lee et al., 2020; Zhang, Zhao et al., 2020). Therefore, cultured meat will be commercially produced and enter consumer markets.

Since 2015, scholars have published a number of empirical and review studies related to consumer behaviour towards cultured meat. Most of them are descriptive or exploratory in nature and provide findings that are related to consumer perceptions (i.e., unnatural, artificial, disgusting and creating benefits or risks to society, safety, environment and animal welfare); information influences (i.e., consumer change in attitudes and intentions when exposed to different descriptive information about cultured meat); purchase intentions (i.e., most consumers are willing to try cultured meat, but few are willing to pay more for cultured meat than animal-raised meat); socio-demographic influences (i.e., significant influences of gender, age and income on consumer choice of cultured meat); and the impact of food neophobia on cultured meat acceptance (e.g., Bryant and Barnett, 2020; Dupont and Fiebelkorn, 2020; Hocquette et al., 2015; Siegrist and Sütterlin, 2017; Siegrist and Hartmann, 2020; Verbeke, Marcu et al., 2015; Verbeke, Sans et al., 2015; Van Loo et al., 2020; Wilks and Phillips, 2017). What is lacking are studies to systematically explore consumers' motives for choice of cultured meat.

Most of these empirical studies have been conducted with samples of consumers in Western developed countries (Bryant and Barnett, 2018, 2020). There is a lack of understanding of consumer behaviour towards cultured meat in Asian developing countries, particularly in China which has different dietary patterns from those of Western developed countries and is the largest country for pork consumption in total volume (OECD, 2020). There are currently only a few published journal articles which have used Chinese consumers as samples in their studies; which explored Chinese consumers' perceptions, perceived naturalness, disgust, trust and food neophobia, attitudes or purchase intentions towards cultured meat (Bekker et al., 2017; Bryant et al., 2019; Liu et al., 2021; Siegrist and Hartmann, 2020; Zhang et al., 2020). Further, Siegrist and Hartmann (2020) indicated obvious differences in the cultured meat acceptance across China, South Africa, Mexico and seven Western developed countries. As such, consumer adoption of cultured meat can vary depending on their cultural origins (e.g. East vs. West). As such, it is urgent that more studies be conducted to systematically understand consumer choice of cultured meat and its influencing factors in a non-Western setting, particularly in China- a large Asian developing country with high levels of pork consumption.

At present there is a lack of understanding of consumer segmentation related to the choice of cultured meat. As far as the authors know, only two studies have conducted a cluster analysis and recognised consumer segments based on perceptions towards different meat substitutes including cultured meat (de Oliveira Padilha et al., 2021; Possidónio et al., 2020). Therefore, a need exists to recognise and profile consumer segments specifically based on their choices with regard to cultured meat.

The current study aims at contributing knowledge to address the aforementioned gaps. The research objective is twofold: 1) recognise and profile consumer segments in China based on consumer attitudes and purchase intentions towards cultured meat; and 2) develop and test a theoretical model which associates Chinese consumers' meat choice motives with their attitudes and purchase intentions towards cultured meat.

2. Theoretical background and research framework

Figure 1 presents a framework that contextualizes the research approaches involved in this study. It was developed based on a literature review that recognised segmentation and significant factors which influenced consumer choices of cultured meat. The following subsections will introduce the theoretical and empirical background of this framework.

>>>>>>>>>Insert Figure 1

2.1. Consumer segmentation and profiling for cultured meat

Consumer segmentation analysis is increasingly conducted in food and ecological consumer studies, often followed by segmentation profiling in order to systematically understand the impacts of socio-demographics on different consumer segments (Jaeger et al., 2020). There have been a number of empirical studies that have recognised consumer segments based on consumer perceptions; attitudes and behaviour/behavioural intentions towards meat consumption; reduced meat consumption or plant-based eating; and adoption of meat substitutes (e.g., Graça et al., 2015; Van Loo et al., 2017; Verbeke and Vackier, 2004).

However, no empirical study has been found which reveals consumer segments directly based on consumer attitudes, behaviour or behaviour intentions towards cultured meat. This study fills the gap by conducting a cluster analysis based on Chinese consumers' attitudes and purchase intentions towards cultured meat. Attitude is a consumer's general evaluation or feelings (positive or negative) towards cultured meat and has a positive influence on their purchase intention for it (Bryant and Barnett, 2018; Possidónio et al., 2020; Verbeke, Marcu et al., 2015; Wilks et al., 2020). Regarding purchase intention, it represents a consumer's willingness to try, purchase or pay more for cultured meat (Bryant and Barnett, 2018; Verbeke, Marcu et al., 2015; Verbeke, Sans et al., 2015; Zhang, Li et al., 2020). Since cultured meat is currently a conceptual product from the standpoint of an average consumer, consumer studies have mainly explored purchase intention instead of real consumption experiences.

The current study profiles the consumer segments based on socio-demographics, including age, gender, marital status, household income, educational level, residential place, household size and occupation, in order to examine similarities and differences in the socio-demographic distributions between different consumer segments for cultured meat (Jaeger et al., 2020). Previous studies have indicated that gender, age, income and educational level are significant socio-demographics for consumer acceptance of cultured meat (Bryant and Barnett, 2018; Bryant and Dillard, 2019; Mancini and Antonioli, 2019; Palmieri et al., 2020; Rolland et al., 2020; Slade, 2018; Zhang, Li et al., 2020).

2.2. Association between meat choice motives and attitude and purchase intention towards cultured meat

This study associates Chinese consumers' meat choice motives (MCMs) with their attitudes and purchase intentions towards cultured meat. This aims at recognising significant motives for their choices of cultured meat. The concept of MCM is extended from a theoretical model of food choice

motives (FCMs) originally developed by Steptoe et al. (1995) in which consumers choose daily food based on nine motives, namely *sensory appeal, health concern, mood, convenience, natural content, price, weight control, familiarity* and *ethical concerns*. Researchers have extended the original model and added extra FCMs such as *food safety concerns, processed convenience, purchase convenience (availability), environmental/ecological concerns, political values* and *religion* (Honkanen and Frewer, 2009; Lindeman and Väänänen, 2000). It is a common approach to recognise significant motives for consumer acceptance of specific food products/services and sustainable eating patterns (e.g., traditional food, healthy-claimed food) through associating consumers' FCMs with their attitudes and purchase intentions towards those specific food products/services (Pieniak et al., 2009; Žeželj et al., 2012). The current study has developed the concept and model of MCMs with the adjustment of FCMs into text expressions specifically for meat consumption.

A total of twelve MCMs are used in this study: *health concern, familiarity, price, sensory appeal, processed convenience, purchase convenience, mood, naturalness concern, safety concern, animal welfare concern, societal concern* and *environmental concern*. Following the previous approach in association between FCMs and the acceptance of specific food product/services (e.g., Pieniak et al., 2009), only the most appropriate and relevant MCMs for the case of cultured meat are included. The selection of the MCMs is based on a literature review of the significant factors which influence consumer acceptance of cultured meat. *Animal* and *environmental friendliness* are two main advantages of cultured meat which can persuade consumers to try it (Bryant et al., 2020; Palmieri et al., 2020; Shaw and Iomaire, 2019; Siegrist and Sütterlin, 2017; Van Loo et al., 2020; Verbeke, Sans et al., 2015). Consumers worry about cultured meat based on the following aspects: the *health* and *safety* risks of eating it; its affordability, that is, a high *price* and current unaffordability; the *sensory* characteristics, that is, whether it has the same taste, texture and appearance as animal-raised meat; *convenience,* that is, if available or feasible in the market; and the *societal* influences of its consumption related to the local economy, traditional meat industry and meat consumption customs (Bogueva and Marinova, 2020; Bryant and Barnett, 2018, 2019; Bryant and Dillard, 2019; Bryant et al., 2020; Gómez-Luciano et al., 2019; Hocquette et al., 2015; Mancini and Antonioli, 2019; Mancini and Antonioli, 2020; Possidónio et al., 2020; Rolland et al., 2020; Shaw and Iomaire, 2019; Siegrist and Sütterlin, 2017; Verbeke, Marcu et al., 2015; Verbeke, Sans et al., 2015). Further, consumers with a higher *familiarity* with cultured meat, for example, relevant knowledge and information, are more likely to accept it (Bryant, Szejda et al., 2019; Mancini and Antonioli, 2019). In addition, some consumers perceive cultured meat as *unnatural/artificial* and disgusting, which results in negative attitudes towards it (Bryant, Anderson et al., 2019; Dupont and Fiebelkorn, 2020; Hwang et al., 2020; Ruzgys and Pickering, 2020; Siegrist and Hartmann, 2020, Siegrist and Sütterlin, 2017; Siegrist et al., 2018; Verbeke, Marcu et al., 2015; Wilks et al., 2020). Disgust is the induction of a negative *mood* related to an unfamiliar product, such as cultured meat (Bekker et al., 2017; Marzillier and Davey, 2005).

3. Methods and materials

3.1. Participants and procedures

The data for this study were collected by means of an online survey conducted from August to October 2020. A questionnaire was developed in English and translated into Chinese. The term 'cultured meat' was translated into '培养肉', rather than '人造肉 (artificial meat)', a term representing both cultured meat and vegetarian meat in China (Zhang, Li et al., 2020). The

questionnaire was distributed among registered members of the consumer sample panel owned by a Chinese research agency. A soft launch was conducted with 55 consumers from Shanghai. Due to the acceptable scale reliabilities of the soft-launch dataset, the questionnaire was not revised further and the soft-launch dataset was finally combined into the main dataset of the study. The questionnaire was randomly distributed based on a quota sampling method using gender (male and female), age (below and above 40 years of age) and place of residence (Shanghai and Chengdu) as dimensions for quota stratification (Fabinyi et al., 2016). The selection strategy of survey locations was based on the uneven developments in the economy, education and other social sectors between China's first-tier cities, for example, Shanghai, and other-tiered cities, for example, Chengdu (Liu et al., 2011).

Participants were first shown the MCM questions and then the questions related to cultured meat. Prior to the cultured meat questions, they were asked to read a description about cultured meat summarised from previous studies (Bryant and Dillard, 2019; Rolland et al., 2020; Siegrist et al., 2018; Tuomisto et al., 2011; Zhang, Li et al., 2020).

Following the description, a response validation question was used to examine if respondents fully understood the concept of cultured meat: '*Which one of the products described by the following statements is cultured meat?'*, with five answer categories: *1. the burger made of soy protein; 2. the pork obtained from slaughtering a hog; 3. the beef grown from a cattle cell in an university lab; 4. the mutton obtained from slaughtering a clone sheep in an university; 5. the vegetarian chicken meat made of flour protein*. Only those participants who fully understood the concept and selected the correct answer category—number 3—could continue the survey and were retained as valid participants of this study.

A total of 608 valid participants were obtained with 305 from Shanghai and 303 from Chengdu. All valid participants received a monetary incentive from the Chinese research agency. Table 1 shows the socio-demographic distributions of the sample, including residential place, marital status, age, household size, monthly household income, education, occupation, gender and age.

>>>>>>>>>Insert Table 1

3.2. Measures

Table 2 shows the measures and items for the twelve MCMs involved in this study. The items were developed from the survey questions used in previous FCM-related studies and the studies of consumer behaviour towards meat (Graça, Calheiros et al., 2015; Graça, Oliveira et al., 2015; Lindeman and Väänänen, 2000; Pieniak et al., 2009; Steptoe et al., 1995). A seven-point Likert agreement scale was used to give response categories for each of the measurement items, ranging from 1=totally disagree to 7=totally agree.

>>>>>>>>>Insert Table 2

Table 2 indicates the measures and items for consumer attitudes and purchase intentions towards cultured meat. The attitudes were measured by two items using a seven-point semantic differential scale with bipolar adjectives from 1= unpleasant/dull to 7= happy/ pleasant. The items were developed from previous studies which explored consumer attitudes towards cultured meat (Bryant and Dillard, 2019; Bryant, Anderson et al., 2019).

The purchase intentions were measured by three items using the seven-point Likert agreement scale as response categories. The items were derived from a previous study by Verbeke, Sans et al. (2015) that examined consumers' willingness to try, purchase and pay more for cultured meat.

3.3. Data analysis

Data was analysed using the SPSS and AMOS 25.0 statistical software packages. First, descriptive analyses (with mean values) were determined for the attitude and purchase intention variables. Cronbach's α tests were used to examine internal reliabilities for their factorial constructs (Žeželj et al., 2012). Second, a two-step hierarchical cluster analysis (with the distance measure of log likelihood and the clustering criterion of Schwarzsches Bayes) was conducted to reveal consumer segments by using the variables of attitude and purchase intention towards cultured meat as segmentation variables (Chamhuri and Batt, 2013). Cross-tabulation with $\chi 2$ tests and one-way ANOVA tests were conducted for segmentation profiling in order to reveal significant differences in socio-demographic distributions across the consumer segments. Third, a confirmatory factor analysis and an exploratory factor analysis (with a maximum likelihood estimation method with varimax rotation) were used to explore and confirm the appropriateness of the MCM factorial construct for the Chinese sample (Jones et al., 2002; Milošević et al., 2012; Pieniak et al., 2009). Fourth, a structural equation model (SEM) was built to associate consumer MCMs with their attitudes and purchase intentions towards cultured meat. Path analysis was conducted to recognize the significant MCMs that influenced consumer attitudes and purchase intentions towards cultured meat in China (Pieniak et al., 2009; Žeželj et al., 2012).

4. Results and discussion

4.1. Descriptive analysis

In general, participants had positive attitudes towards cultured meat, with the mean values scored on the positive answer anchor (higher than 4). The attitude variables had good internal reliability as the high Cronbach's α was above 0.95.

Regarding purchase intentions, participants were willing to try and purchase cultured meat. The mean values of the relevant two variables WTCC1 and WTCC2 scored on the positive answer anchor. By contrast, they were not willing to pay more for cultured meat than conventional animal-raised meat. The mean value of the relevant variable WTPM scored on the negative answer anchor (lower than 4). The purchase intention variables had a high Cronbach's α value of 0.898, while the statistics of Cronbach's α test indicated a large increase of the value to 0.946 if the variable WTPM was deleted from the purchase intention factorial construct. Therefore, WTPM was treated as a separate variable representing participants' willingness to pay more for cultured than traditional meat. Only WTCC1 and WTCC2 were kept in the purchase intention factorial construct in this study to represent participants' willingness to consume cultured meat.

In general, this is in line with previous findings with Western consumers who have generally positive attitudes towards cultured meat and are more willing to try or buy than to pay more for cultured meat than traditional meat (Bryant and Barnett, 2018; Dupont and Fiebelkorn, 2020; Mancini and Antonioli, 2019; Rolland et al., 2020; Verbeke, Sans et al., 2015).

4.2. Segmentation analysis

The two-step hierarchical cluster analysis was conducted by using the attitude and purchase intention variables as segmentation variables. Due to the high internal reliability, the segmentation variables of the attitude towards and willingness to consume cultured meat were obtained on the basis of the mean values of their item variables (see Table 2).

>>>>>>>>>Insert Table 3

The segmentation analysis resulted in a three-segment solution. Table 3 shows the segmentation analysis results with the size and mean value per segmentation variable and F-test statistics. Segment 1 accounted for 25.7% of the total sample. Participants in this segment had strongly negative attitudes and purchase intentions towards cultured meat due to the mean values of all the segmentation variables scored on the negative answer anchor and lower than 3. Therefore, this segment was named as the *Conservative*. Segment 2 was the largest segment with 41.9% of the total sample. Participants in this segment had slightly positive attitudes and willingness to consume cultured meat as the mean values of attitudes and willingness to consume variables scored higher than 4 but lower than 5. As such, this segment was labelled as *Acceptor*. Segment 3 accounted for 32.4% of the total sample. Participants in this segment had strongly positive attitudes and purchase intentions towards cultured meat as the mean values of all the attitudes and purchase intention variables scored higher than 5. Thus, the segment was named as *Pioneer*.

Most Chinese participants—around 75%—were acceptors or pioneers with regard to cultured meat who have positive attitudes and are willing to consume and/or pay more for it. Only a small percentage—about 25% of Chinese participants—were conservatives who have very negative attitudes and purchase intentions towards cultured meat. This is in line with the descriptive findings from a recent study by Zhang, Li et al. (2020) that most Chinese participants were willing to taste or purchase cultured meat. As such, China—the largest country for pork consumption—has the potential for huge demand for cultured meat in the future due to this positive consumer base (OECD, 2020). From that perspective, producing cultured pork might be a solution to deal with the high levels of pork demand and the current food safety issues in the animal-raised pork supply, for example, African swine fever in China (Vilanova et al., 2019).

Table 3 indicates the segmentation profiling results. Cross-tabulation with $\chi 2$ tests and one-way ANOVA tests identified significant differences across the three segments with respect to the socio-demographic characteristics of age, monthly household income, education and household size. No such significant differences were recognised for gender, marital status, occupation and residential place. Compared to the other segments, the *Conservative* segment was typified by the oldest mean age, the highest percent of participants with a middle level of household income (10001-20000 RMB) and a low educational level as well as the lowest percentage of participants with a household size above four. The *Acceptor* segment was characterised by the youngest mean age and the highest percentage of participants who had a low household income (0-10000 RMB). The *Pioneer* segment was typified by the highest percentage of participants who had a high household income (≥20001 RMB), a high educational level and a household size of three as well as the lowest percentage of participants who had a household size between 1 and 2.

The *Acceptor* and *Pioneer* segments have a younger mean age and a larger percentage of participants with a high educational level than the *Conservative* segment. This confirms the previous findings that young and highly-educated people are more willing to accept cultured meat than are old and less-educated people (Bryant and Dillard, 2019; Bryant and Sanctorum, 2021; Fernandes et al., 2021; Mancini and Antonioli, 2019; Palmieri et al., 2020; Slade, 2018; Van Loo et al., 2020; Zhang, Li et al., 2020).

Regarding income, previous studies have provided contradictory findings. Bryant, Szejda et al. (2019) indicated a positive influence of income level on consumer acceptance of cultured meat, while Wilks and Phillips (2017) provided the opposite result. Meanwhile, Zhang, Li et al. (2020) found a non-significant influence of income level on the cultured meat acceptance in China. Our findings from the segmentation analysis recognise a non-linear significant influence of income level on cultured meat acceptance in China. Although the most positive acceptors of cultured meat

(the *Pioneer* segment) contain the largest percentage of high-income consumers, the least positive acceptors (the *Conservative* segment) do not have the largest percentage of low-income consumers. Instead, the mid-level acceptors of cultured meat (the *Acceptor* segment) own the largest percentage of low-income consumers.

This is the first study to recognise the significant influence of household size on consumer acceptance of cultured meat. In contrast to income level, a relatively linear influence is identified for household size; the more acceptable cultured meat is in the segment, the larger is the household size. Nayga (1995) indicated that household size is positively linked to household meat consumption. This may explain the findings from our study about the relationship between household size and cultured meat acceptance; those Chinese participants with a larger household size have a greater need for meat-related products, such as cultured meat, than do their counterparts with a smaller household size.

Previous studies have indicated that male consumers are more willing to accept cultured meat than are their female counterparts (Baum et al., 2022; Bryant and Barnett, 2018; Van Loo et al., 2020; Verbeke et al., 2021; Zhang, Li et al., 2020). This significant influence of gender on cultured meat acceptance is not found in our study. In addition, Bryant and Dillard (2019) indicated no-difference in consumer acceptance of cultured meat between different regions in the United States. Our study also indicates no-difference in cultured meat acceptance between China's first-tier and other-tiered cities.

4.3. Confirmatory factory analysis

Table 4 indicates results of the confirmatory factor analysis for the original twelve-factorial construct of MCMs. The value of goodness of fit indices RMSEA was within the acceptable limit—lower than 0.08—while that for CFI was outside the acceptable limit—higher than 0.9 (Pieniak et al., 2009). Furthermore, the AVE values of five MCM factors, namely *Health concern, Familiarity, Sensory appeal, Naturalness concern* and *Safety concern* were lower than one or several squared correlation coefficients (see Table 4) as compared with other MCMs. There was also severe multi-collinearity between the MCM factors of *Safety concern* and *Naturalness concern*, with their high correlation coefficient above 0.85. As such, the original MCM factorial construct in this study did not fit well with the data from China (Milošević et al., 2012; Pieniak et al., 2009).

>>>>>>>>>Insert Table 4

4.4. Exploratory factory analysis

Table 5 indicates results of the exploratory factor analysis that explored an adjusted MCM factorial construct. A new ten-factorial construct was recognised. The values of standardised factor loading (SFL) for most of the items were within the acceptable limit—higher than 0.4 for the exploratory factor analysis with a maximum likelihood estimation method with varimax rotation (Haszard et al., 2013; Milošević et al., 2012). Internal reliabilities of the new MCM factors were acceptable, with all the Cronbach's α values higher than 0.6 (Milošević et al., 2012; Žeželj et al., 2012). The MCM factors of *Price, Sensory appeal, Processed convenience, Purchase convenience, Mood, Animal welfare concern* and *Societal concern* contained the same items as that of the original factorial construct.

Two items from the original MCM factor of *Familiarity*—F1 and F2—did not load well and had SFL values lower than 0.4 for any factor in the new construct. These two items were

treated as separate observed variables in the SEM of Section 4.5, namely 'Usually eat (F1)' and 'Familiarity (F2)' based on their semantic meanings (see Table 2).

The third *Familiarity* item—F3—loaded on a new factor with the five items from the original MCM factor of *Health concern*. The new factor was labelled as *Health benefits concern* due to semantic meanings of the *Health concern* items and that of the item F3 related to 'benefit concern'.

One item from the original *Naturalness concern* factor—NC3—loaded on a new MCM factor with the four items of the original *Environmental concern* factor. This new factor remained labelled as *Environmental concern* as the semantic meaning of NC3 was related to 'environmental and natural friendliness'.

Two other original *Naturalness concern* items—NC1 and NC2—loaded on a new MCM factor together with the three items from the original *Safety concern* factor. The new factor was labelled as *Safety and additives concern* in the adjusted MCM construct as the semantic meanings of NC1 and NC2 were related to 'food additives concern'. This is in line with the previous findings by Zhang et al. (2013) and Tang (2012) that food safety events in China are largely related to issues of additives or artificial ingredients.

Four items—SA5, M4, HC1 and AC2—were deleted in the SEM of Section 4.5 due to a low SFL (lower than 0.4) or a high level of cross-loadings (higher than 0.35) on multiple factors in the adjusted MCM construct, while the item SA4 was kept in the SEM as it had an SFL close to 0.4 on the *Sensory appeal* factor and no cross-loading on other MCM factors. This decision was also based on the previous findings that appearance (the semantic meaning of SA4) was a significant sensory attribute of concern to consumers for their acceptance of cultured meat (Bryant and Barnett, 2018).

>>>>>>>>>Insert Table 5

4.5. Structural equation modelling

A SEM was developed to associate consumers' MCMs with their attitudes and purchase intentions towards cultured meat, with twelve latent variables and three observed variables. There was no severe multicollinearity among the independent variables in the path analysis, as shown in Table 5.

>>>>>>>>>Insert Table 6

A path analysis performed well based on the SEM, as the goodness-of-fit indices RMSEA and CFI were within acceptance limits (Pieniak et al., 2009). Table 6 indicates the statistically significant paths from the path analysis. Participants' attitudes had significantly strong positive influences on their willingness to consume and willingness to pay more for cultured meat. This finding is similar to that of a recent study by Dupont and Fiebelkorn (2020) that attitude is a strong predictor of consumers' willingness to purchase a cultured meat burger. Further, Attitudes had a higher value of coefficient estimates on the willingness to consume than on the willingness to pay more for cultured meat. In other words, attitudes had a more significant influence on the willingness to consume than on the willingness to pay more for cultured meat. This finding indicates that it is harder for a positive attitude to influence consumers' willingness to pay more for cultured meat than it is to influence their willingness to consume cultured meat.

Regarding MCMs, the attitudes towards cultured meat were significantly and negatively linked to *Usually eat (F1)*. In other words, those participants who attached 'usually eating' as a more important factor to their daily meat choices had less-positive attitudes towards cultured meat.

This corresponds with previous findings that have shown familiarity with cultured meat is an important driving factor for consumer acceptance of it (Bekker et al., 2017; Bryant, Szejda et al., 2019; Mancini and Antonioli, 2019; Onwezen et al., 2021; Van Loo et al., 2020). Cultured meat is now only a conceptual product to average consumers, including our study participants who didn't have any real consumption or eating experiences with it. As such, it is reasonable that those Chinese participants who consider 'usually eating' as a more important factor for their daily meat choice have less positive attitudes towards cultured meat.

The willingness to consume cultured meat was significantly and positively associated with *Societal concern.* Despite the environmental benefits of cultured meat production, such as less resource usage and greenhouse gas emission, it is entirely based on a lab-grown approach which is totally different from consumers' perceptions about the relatively natural and environmentally-related production approach of traditional animal-raised meat (Siegrist and Sütterlin, 2017; Tuomisto and Teixeira de Mattos, 2011; Verbeke, Marcu et al., 2015). This might be the reason that those Chinese participants who consider environment as a more important factor for their daily meat choice are less willing to consume cultured meat. It also corresponds with previous findings that have shown perceived unnaturalness is a main barrier to consumer acceptance of cultured meat (Hwang et al., 2020; Possidónio et al., 2020; Siegrist and Hartmann, 2020; Siegrist and Sütterlin, 2017; Siegrist et al., 2018).

The willingness to consume cultured meat was significantly and negatively linked to *Mood*. Many studies point out that consumers perceive cultured meat as disgusting, which results in their opposition to it (Boereboom et al., 2022; Siegrist et al., 2018; Verbeke, Marcu et al., 2015; Wilks et al., 2019). From that perspective, it is reasonable that those Chinese participants who seek mood enhancement through their daily meat consumption are less willing to consume cultured meat which they view as disgusting.

The willingness to pay more for cultured meat was significantly and positively associated with *Price*. This confirms previous studies that found that an affordable or lower price can significantly increase consumers' willingness to accept cultured meat (Gómez-Luciano et al., 2019; Verbeke, Sans et al., 2015). Previous studies have also indicated a weak willingness by consumers to pay a price premium (a higher price than for animal-raised meat) for cultured meat (Rolland et al., 2020; Slade, 2018; Van Loo et al., 2020). As such, controlling the price is crucial for the success in promoting cultured meat in the future market.

Purchase convenience has a significantly negative influence on Chinese participants' willingness to pay more for cultured meat than traditional meat. This is in line with the previous findings of Verbeke, Sans et al., (2015) which showed that consumer doubts about the availability of cultured meat negatively influence their acceptance of it. Gómez-Luciano et al. (2019) also pointed out that in comparison to cultured meat, consumers are more willing to accept plant-based meat substitutes due to their wide availability in the current market.

Societal concern has a positive influence on both Chinese participants' willingness to consume and their willingness to pay more for cultured meat than for traditional meat. Previous studies have indicated consumer concern about potential societal risks of cultured meat consumption, such as hurting local animal husbandry and the loss of eating traditions (Bryant and Barnett, 2018; Paloviita, 2021; Verbeke, Marcu et al., 2015; Wilks and Phillips, 2017). However, our study does not recognise societal risk concerns from Chinese participants. In contrast, those Chinese participants who attach societal friendliness as a more important factor to their daily meat choices are more willing to consume and pay more for cultured meat. This reflects their expectations about the potential societal benefits from cultured meat consumption in the future.

Thus, the creation, exploration and promotion of the societal values of cultured meat is particularly important to increase consumer demand.

4.6. Limitations and recommendations

Firstly, given the nature of the quota sampling method and the web survey approach in our study, the sample did not fully represent the demographic distribution in either China or the two Chinese cities. Hence readers should be careful not over generalise the applicability of these results. Secondly, our study only involved a Chinese sample. This did not allow an empirical comparison of the choice motives and consumer segmentation for cultured meat between China and Western countries. Future relevant studies involving both Western and non-Western samples are strongly recommended. It is also encouraged that the further studies beyond the West and China are conducted building on the findings in our study.

5. Conclusion and implications

This is the first study to develop a factorial construct of meat choice motives (MCMs) based on an existing theoretical model of food choice motives (FCMs) in China. The study fills a gap in the literature contributing understanding and insights regarding choice motives for cultured meat in a non-Western setting, China - the world's largest consumer of pork. Six MCMs—*Usually eat, Environmental concern, Societal concern, Mood, Purchase convenience* and *Price*—are found to have statistically significant influences on Chinese participants' attitudes, willingness to consume and/or willingness to pay more for cultured meat than for animal-raised meat. In general, environmental and societal concerns, as well as price, are among the strongest and direct drivers towards (or against) the adoption of cultured meat by participants in these two Chinese cities. This is similar with their Western counterparts in previous relevant studies. As such, it provides evidence of no significant differences in the choice motives for cultured meat between these Chinese participants and Western consumers.

This is the first study to recognise segments that are directly based on consumer attitudes and purchase intentions towards cultured meat. Chinese participants can be clearly classified into three segments: Conservative, Acceptor and Pioneer. The study provides direct evidence of the lack of understanding of consumer acceptance of cultured meat in developing countries in a confirmatory and more reliable way.

Apart from the important academic implications mentioned above, this study has significant policy and managerial implications as well. Although cultured meat is currently a conceptual product to consumers, it will play a vital role in addressing the rising global demand for meat, particularly in developing countries such as China. Our findings confirm the positive attitudes and willingness of Chinese participants to consume cultured meat. This further demonstrates the potential of cultured meat to succeed in this huge market with a rising demand for meat products.

Further, the findings of this study will help global producers and policymakers to create effective promotion strategies and policies for this innovative product in developing countries, particularly in China. Given our findings, they can, for the first time, easily utilise different Chinese consumer segments for cultured meat based on their specific socio-demographic distributions, for example, the *Conservative* segment (old, middle income, low education level and with a household size between 1 and 2), the *Acceptor* segment (young and low income) and the *Pioneer* segment

(young, high income, high educational level and a household size above 2). This will be helpful for the development of promotion policies specifically for these different consumer groups.

In addition, our findings enlighten stakeholders of the need to take a staged strategy for the promotion of cultured meat. Consumer decisions are composed of two stages: first, making the decision of whether or not to buy; and then deciding the price they are willing to pay (Verbeke et al., 2013). A two-stage strategy should thus be used for cultured meat promotion: first, the policies should inform consumers' willingness to consume it and, second, inform their willingness to pay for it. Our findings provide clear strategic guidelines in each of these stages: improving consumers' impressions about environmental, mood and societal benefits for cultured meat in the first promotion stage and satisfying their expectations about price, availability and societal values in the second stage.

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688

Table 1 Socio-demographics of the sample

	Total sample	(n= 608)	
Place of residence		**Monthly household income**	
Shanghai	50.2%	0-10000 RMB (0-1528.3 USD)	32.4%
Chengdu	49.8%	10001-20000 RMB (1528.5-3056.3 USD)	41.1%
Marital status		⩾20001 RMB (⩾3056.5 USD)	26.5%
Married	73.7%	**Education**	
No, but has a partner	9.2%	Low (College degree, high school or below)	25.8%
Single	17.1%	High (Bachelor degree or above)	74.2%
Age		**Occupation**	
Mean value	36.06	Managing employee	33.1%
Range	18- 73	Salaried employee	47.7%
< 40	57.2%	Student	10.4%
≥ 40	42.8%	Other ((Unemployed, Retired, Farmer, Housewife/houseman, on leave, self-employed or worker)	8.9%
Household size		**Gender**	
1-2	11%	Male	49.7%
3	58.7%	Female	50.3%
≥4	30.3%		

Table 2 Measurements of MCMs and the attitudes and purchase intentions towards meat and cultured meat

Code	Factor and measurement items (It is important to me that the fresh meat, meat product or meat meal I eat or purchased on a typical day…)
HC	**Health concern**
HC1	Keeps me healthy.
HC2	Contains a lot of vitamins and minerals.
HC3	Is nutritious.
HC4	Is high in protein.
HC5	Is good for my skin/teeth/hair/nails etc.
F	**Familiarity**
F1	Is what I usually eat.
F2	Is familiar.
F3	Is what I know its benefits.
P	**Price**
P1	Is not expensive.
P2	Is cheap.
P3	Does not beyond my budget for food purchase.
SA	**Sensory appeal**
SA1	Has a pleasant texture.
SA2	Tastes good.
SA3	Is delicious.
SA4	Looks nice.
SA5	Has a good appearance.
PRC	**Processed convenience**
PRC1	Is easy to prepare.
PRC2	Can be cooked very simply.
PRC3	Takes no time to prepare.
PUC	**Purchase convenience**
PUC1	Can be bought in supermarkets, restaurants or wet markets close to where I live or work.
PUC2	Is easily available in supermarkets, restaurants and wet markets.
M	**Mood**
M1	Helps me cope with stress.
M2	Helps me relax.
M3	Cheers me up.
M4	Makes me feel good.
NC	**Naturalness concern**
NC1	Contains no additives.
NC2	Contains no artificial ingredients.
NC3	Is produced in an environment as natural as possible.
S	**Safety concern**
S1	Is safety-assured.
S2	Has no risk to cause food-safety issues (e.g. food poisoning and foodborne illness).
S3	Is prepared and handled in good hygienic conditions.
AC	**Animal welfare concern**
AC1	Has been produced in a way that livestock have not experienced pain.
AC2	Has been produced in a way that livestock's rights have been respected.
AC3	Has been produced in a way that avoid livestock being tortured.
SC	**Societal concern**
SC1	Supports the local economy.
SC2	Has the contribution of livestock sector development in order to boost the rural employment and livelihood.
SC3	Contributes to protect local dietary cultures, traditions and customs.
EC	**Environmental concern**
EC1	Has been produced in an environmentally friendly way.
EC2	Has been produced in a way which has not disrupted ecological balance.
EC3	Has been produced in a way which supports environmental sustainability.
EC4	Has been produced in a way which contributes to the reduction of global greenhouse gas emission.
WTCC	**Willingness to consume cultured meat**
WTCC1	I am willing to try cultured meat.
WTCC2	I am willing to purchase cultured meat.
WTPM	**Willingness to pay more for cultured meat than traditional meat**
	I am willing to pay more for cultured meat than for conventional animal-raised meat.
ATC	**Attitude towards cultured meat**
ATC1	Unhappy/happy
ATC2	Unpleasant/Pleasant

Table 3 Sizes and mean scores of the attitudes or willingness to purchase towards cultured meat (see Table 3) and socio-demographic distributions among consumer segments

	Segment 1	Segment 2	Segment 3
	Conservative	Acceptor	Pioneer
Segment size	(n=156)	(n=255)	(n=197)
Share of the total sample (n=608)	25.7%	41.9%	32.4%
Willingness to purchase cultured meat (Mean/Median)* **	2.69/3.00[a]	4.86/5.00[b]	6.32/6.50[c]
Willingness to pay more for cultured meat than traditional meat(Mean/Median) * **	1.49/1.00[a]	3.28/3.00[b]	5.14/5.00[c]
Attitude towards cultured meat(Mean/Median) * **	2.44/2.50[a]	4.27/4.00[b]	5.94/6.00[c]
Gender			
Male	51.3%	47.8%	50.8%
Female	48.7%	52.2%	49.2%
Marital status			
Married	75.6%	68.6%	78.7%
No, but has a partner	7.7%	11.4%	7.6%
Single	16.7%	20.0%	13.7%
Age*	38.00[a]	35.16[b]	35.68[ab]
Monthly household income*			
0-10000 RMB	31.4%	37.3%	26.9%
10001-20000 RMB	46.2%	39.6%	39.1%
≥20001 RMB	22.4%	23.1%	34.0%
Education***			
Low	37.2%	25.5%	17.3%
High	62.8%	74.5%	82.7%
Household size**			
1-2	15.4%	13.7%	4.1%
3	55.8%	56.1%	64.5%
≥4	28.8%	30.2%	31.5%
Occupation			
Managing employee	34.6%	28.6%	37.6%
Salaried employee	47.4%	48.2%	47.2%
Student	6.4%	12.5%	10.7%
Other	11.5%	10.6%	4.6%
Residential place			
Shanghai	48.1%	49.4%	52.8%
Chengdu	51.9%	50.6%	47.2%

*Note: ***= p<0.001; **= p<0.01; *= p<0.05; a-b indicate significantly different frequency or means from Cross-tabulation with χ2 tests or one-way ANOVA tests; a - c indicate significantly different means from* one-way ANOVA test

Table 4 Results of the confirmatory factor analysis and the correlation matrix of the MCM for MCMs (n=608)

Factor and item	SFL	CR	AVE	Factor and item	SFL	CR	AVE
Health concern		0.698	0.319	**Mood**		0.813	0.524
HC1	0.594			M1	0.662		
HC2	0.473			M2	0.783		
HC3	0.672			M3	0.790		
HC4	0.558			M4	0.649		
HC5	0.508			**Naturalness concern**		0.661	0.399
Familiarity		0.542	0.283	NC1	0.749		
F1	0.526			NC2	0.534		
F2	0.537			NC3	0.594		
F3	0.533			**Safety concern**		0.788	0.554
Price		0.827	0.632	S1	0.771		
P1	0.894			S2	0.734		
P2	0.938			S3	0.728		
P3	0.468			**Animal welfare concern**		0.836	0.631
Sensory appeal		0.731	0.358	AC1	0.727		
SA1	0.579			AC2	0.848		
SA2	0.704			AC3	0.804		
SA3	0.695			**Societal concern**		0.655	0.390
SA4	0.511			SC1	0.568		
SA5	0.466			SC2	0.695		
Processed convenience		0.700	0.437	SC3	0.604		
PRC1	0.669			**Environmental concern**		0.777	0.466
PRC2	0.686			EC1	0.654		
PRC3	0.629			EC2	0.717		
Purchase convenience		0.752	0.603	EC3	0.710		
PUC1	0.771			EC4	0.648		
PUC2	0.783						

Factor	1	2	3	4	5	6	7	8	9	10	11	12
1. Sensory appeal	1											
2. Purchase convenience	0.334	1										
3. Processed convenience	0.319	0.180	1									
4. Societal concern	0.261	0.237	0.119	1								
5. Environmental concern	0.346	-0.093	0.220	0.495	1							
6. Animal welfare concern	0.239	-0.139	0.282	0.248	0.725	1						
7. Naturalness concern	0.455	-0.088	0.412	0.095	0.690	0.645	1					
8. Safety concern	0.511	-0.025	0.324	-0.083	0.588	0.547	0.915	1				
9. Mood	0.614	0.115	0.284	0.450	0.375	0.285	0.266	0.219	1			

10. Price	0.284	-0.111	0.441	-0.125	0.284	0.285	0.551	0.540	0.188	1		
11. Familiarity	0.639	0.509	0.437	0.515	0.235	0.113	0.139	0.166	0.594	0.084	1	
12. Health concern	0.668	0.200	0.293	0.458	0.491	0.369	0.573	0.539	0.561	0.249	0.690	1

Note: Regarding the variable codes, please see Table 2; CR= Composite reliability; AVE= Average variance extracted; SFL= Standardized factor loading; Goodness-of-fit indices: RMSEA=0.046, CFI=0.897, Chi-square= 1635.608, DF= 713, p=0.000.

Table 5 Results of the exploratory factor analysis and the Correlation matrix for MCMs (n=608)

Factor and item	SFL	Cronbach's α	Factor and item	SFL	Cronbach's α
Safety and additives concern (SAC)		0.821	**Mood**		0.806
S1	0.678		M2	0.758	
NC1	0.639		M1	0.675	
S2	0.623		M3	0.670	
S3	0.587		M4	0.435	
NC2	0.521		**Health benefits concern (HBC)**		0.735
Price		0.803	F3	0.556	
P2	0.858		HC3	0.508	
P1	0.795		HC5	0.489	
P3	0.452		HC4	0.485	
Sensory appeal		0.721	HC2	0.482	
SA3	0.653		HC1	0.443	
SA2	0.623		**Animal welfare concern**		0.833
SA1	0.479		AC2	0.706	
SA4	0.396		AC3	0.666	
SA5	0.336		AC1	0.648	
Processed convenience		0.694	**Societal concern**		0.647
PRC1	0.674		SC2	0.618	
PRC2	0.607		SC3	0.448	
PRC3	0.593		SC1	0.430	
Purchase convenience		0.753	**Environmental concern**		0.799
PUC2	0.779		EC3	0.643	
PUC1	0.708		EC1	0.589	
		-	EC4	0.568	
Usually eat (F1)	-		EC2	0.563	
Familiarity (F2)	-		NC3	0.441	

Factor (code)	1	2	3	4	5	6	7	8	9	10	11	12
1. Usually eat (F1)	1											
2. Familiarity (F2)	0.38	1										
3. Societal concern	0.241	0.268	1									
4. Animal welfare concern	0.027	0.061	0.261	1								
5. Mood	0.307	0.259	0.453	0.28	1							
6. Purchase convenience	0.326	0.32	0.238	-0.167	0.086	1						
7. Processed convenience	0.224	0.306	0.124	0.308	0.259	0.178	1					
8. Environmental concern	0.136	0.067	0.467	0.743	0.345	-0.109	0.242	1				
9. Health benefits concern	0.282	0.265	0.541	0.32	0.503	0.263	0.273	0.434	1			
10. Sensory appeal	0.315	0.366	0.228	0.227	0.535	0.334	0.283	0.36	0.6	1		

11. Price	0.058	0.042	-0.124	0.269	0.171	-0.111	0.442	0.32	0.141	0.278	1	
12. Safety and additives concern	0.093	0.044	-0.049	0.579	0.195	-0.037	0.366	0.642	0.396	0.485	0.557	1

Note: Regarding the variable codes, please see Table 2; SFL= Standardized factor loading; Kaiser–Meyer–Olkin (KMO) value=0.886; Results of Bartlett's test of sphericity (Approx. $\chi 2$=9520.640, p=0.000).

Table 6 Significant paths of the path analysis based on the SEM (see Figure 2): standardized regression weights

Factor (code)	Path	Factor (code)	Total sample (n=608)
Usually eat (F1)	→	Attitude towards cultured meat	-0.157**
Environmental concern	→	Willingness to consume cultured meat	-0.244*
Societal concern	→	Willingness to consume cultured meat	0.233**
Mood	→	Willingness to consume cultured meat	-0.15***
Societal concern	→	Willingness to pay more for cultured meat than for traditional meat	0.211*
Purchase convenience	→	Willingness to pay more for cultured meat than for traditional meat	-0.101*
Price	→	Willingness to pay more for cultured meat than for traditional meat	0.124**
Attitude towards cultured meat	→	Willingness to consume cultured meat	0.941***
Attitude towards cultured meat	→	Willingness to pay more for cultured meat than for traditional meat	0.727***

*Note: ***= p<0.001; **= p<0.01; *= p<0.05; ns = no significant; Goodness-of-fit indices: RMSEA=0.040, CFI=0.937, Chi-square=1425.762, Degrees of freedom=718, p=0.0000; regarding the variable codes, please see Table 2.*

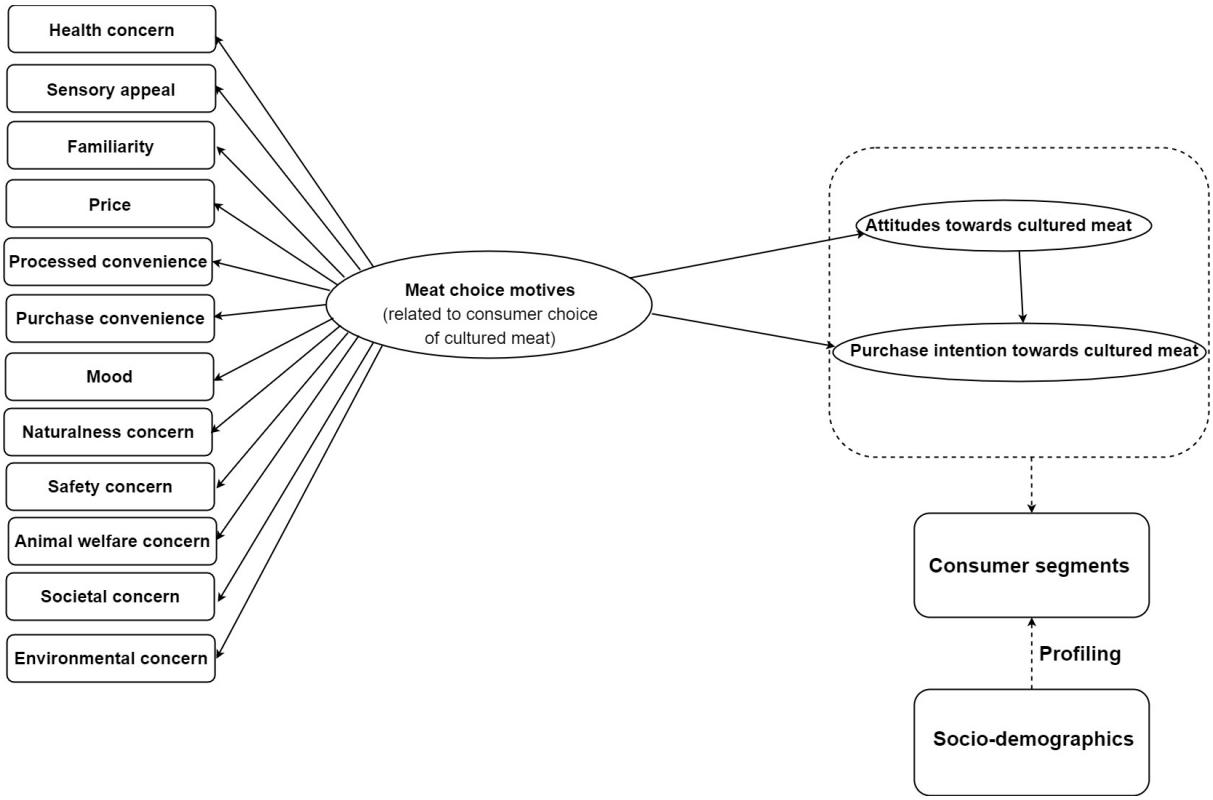

Figure 1 Research framework in the study