Is cultured meat a promising consumer alternative? Exploring key factors determining consumer's willingness to try, buy and pay a premium for cultured meat


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Is cultured meat a promising consumer alternative? Exploring key factors determining consumer’s willingness to try, buy and pay a premium for cultured meat

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ABSTRACT

Cultured meat is a relatively new product, enjoying consumer appreciation as a more sustainable meat option. The present study builds on a sample from a diverse set of countries and continents, including China, the US, the UK, France, Spain, Netherlands, New Zealand, Brazil, and the Dominican Republic and uses partial least square structural equation modelling. The proposed conceptual model identified key factors driving and inhibiting consumer willingness to try, buy, and pay a price premium for cultured meat. Results relate to the overall sample of 3091 respondents and two sub-sample comparisons based on gender and meat consumption behaviour. Food neophobia, having food allergies, being a locavore, and having concerns about food technology were found to be inhibiting factors towards willingness to try, buy and pay more. Food curiosity, meat importance, and a consumer’s perception of cultured meat as a realistic alternative to regular meat were found to be important drivers that positively impacted consumers’ willingness to try, buy and pay more. Best practice recommendations address issues facing marketing managers in food retail and gastronomy.

1. Introduction

In the past decade, the world population has seen vast growth. It is anticipated that by 2050, agricultural production systems will need to accommodate the needs of over nine billion people, accounting for an increase in food production of 70% (Bene et al., 2015; Bir, Davis, et al., 2019). Feeding the world is only one of many consumer concerns in western societies, which demand affordable, ethical, and environmental-friendly produced food. Consumer awareness and lifestyle changes toward vegetarian, vegan, and flexitarian diets (Kemper & White, 2021; Kerslake et al., 2022; Kwasny et al., 2022), alongside public debates on meat production, consumption, and animal welfare, that outline the negative externalities associated with livestock production (Bonnet et al., 2020; Mathur et al., 2021; De Boer & Aiking, 2022).

These externalities include water depletion, climate change, disruption of nutrient cycles, and adverse effects on biodiversity (Michel et al., 2021). The recent body of literature emphasizes that consumers are well informed about animal cruelty and issues of welfare and perceive in particularly factory farming and slaughtering unethically and unjustified. However, they are not to the same extent knowledgeable about the environmental externalities (Michel et al., 2021; Siegrist Hartmann &., 2020). Regardless, a desire to counteract animal cruelty and environmental externalities are often cited as examples of pro-social consumer motivation toward meat-reduced lifestyle changes (Onwezen et al., 2021). Pro-social refers to motivations that extend beyond a...
consumer’s self-interests and focus on the interests of others, which may
be animals, society, or the world (Rosenfeld & Burrow, 2017). Motiva-
tions can also arise from personal or moral grounds (Rosenfeld & Burrow, 2017). Personal motivations, such as improved health or lifestyle,
can lead to a meat-reduced or meat-free diet and moral motivations
turn from belief systems and norms that attach a right or wrong aspect
to consumer choices (Rosenfeld & Burrow, 2017).

Across most countries, changes related to meat alternatives can be
found in consumer motivation, increased demand, and publicity, as well
case production technological and legislative developments (Bir,
Davis, et al., 2019; Gravely & Fraser, 2018; Michel et al., 2021; Morton
et al., 2018; Mawesen et al., 2021; Van Loo et al., 2020).

One of the most technological advantages in food production is
cellular agriculture and the development of cultured meat (Asche-
mann-Witzel et al., 2019; Seh et al., 2022; Slade, 2018; Treich, 2021).
Cultured meat is procured through a muscle biopsy where starter cells are
taken from a living animal (Post, 2014; Pakseresht et al., 2022).
Starter cells are undifferentiated cells that can be seen as an organism’s
raw material from which all other cells with specialized functions are
generated (Allan et al., 2019; Bedou et al., 2020; Seh et al., 2022).
In-vitro, these starter cells begin a growing and dividing process (cell
proliferation) and subsequently differentiate into the desired skeletal
muscle cells. The skeletal muscle cells are preserved until they reach
maturity and are afterwards harvested and assembled to obtain cultured
meat products (Seh et al., 2022).

In many countries, the specific technology to produce cultured meat
is primarily used for research purposes, given that production is in its
earlier stages and is prohibitively costly (Mancini & Antonioli, 2019; 
Pakseresht et al., 2022). However, the market and availability of meat
alternatives are steadily increasing. Supermarkets and restaurants are
offering a wider variety of plant-based and fungal-based meat alterna-
tives. According to Baum et al. (2021), the standout leader is Singapore,
where various new startups and well-established businesses are striving
for market leadership in the alternative protein market. The startup
“Just Foods” obtained legal permission to serve their cultured meat
chicken nuggets for $50 at a popular restaurant in Singapore, making
Singapore the first country to have commercially available cultured
meat (Baum et al., 2021).

This development provides clear evidence that consumers are
interested in cultured meat and various studies have explored consumer
acceptance of cultured meat or willingness to try it (Verbeke, Sans, & Van
Loo, 2015; Bryant & Dillard, 2019; Bryant et al., 2020; Rolland
et al., 2020; Weinrich et al., 2020; Boerboon et al., 2022; Motoki et
al., 2022). Only a few studies have been dedicated to consumer willingness
to pay for cultured meat (Asioli et al., 2018; Aorola et al., 2020; Kantor
& Kantor, 2021, Asioli, Bazzani, & Naya, 2021). Thus, the key factors
driving willingness to try, buy and pay a price premium for cultured
meat deserve further attention. While some factors such as food neu-
phobia, and concerns about biotechnology, food quality aspects, as well
as environmental benefits, are well explored and validated (De Koning
et al., 2020), concepts such as food curiosity, importance dedicated to
meat in a cultural context, local food consumption and dietary re-
quirements such as food allergies and sensitivities, could complement
the more widely explored factors. The present paper addresses these
research gaps and proposes a conceptual model to generate a more
complete picture of the driving forces of consumers’ willingness to try,
buy and pay a price premium. Therefore, the relevant factors are pre-

dented in the following section of the paper.

2. Conceptual review and hypotheses

2.1. Food curiosity

A food-curious consumer is one with keen interest in food and
wants to explore all aspects of food production, processing, and con-
sumption (Hwang et al., 2020; Stone et al., 2022). Respectively, food
curiosity is motivated by feelings that trigger a need to seek information
to fill knowledge gaps related to food. Per se, curiosity is an important
driver of any exploratory behaviour such as trying and buying cultured
meat (House et al., 2016; Piochi et al., 2022). To satisfy their curiosity,
consumers are willing to obtain information, even if this incurs costs or
produces adverse effects. Following Van der Weele and Driessen (2013),
genuine interest or a wow effect are the initial reactions of consumers
towards cultured meat. Other studies emphasize disgust as a common
negative consumer reaction, which often counteracts positive consumer
reactions like willingness to try new products. However, curiosity and
interest in product and production processes are often able to overcome
disgust reactions (Stone et al., 2022). Overall, various consumer studies
on products like cultured meat, namely plant-based and insect-based
meat alternatives, have found that food curiosity and the influence of
social circles are the most important drivers of the purchase and con-
sumption of new meat alternatives (Estelle et al., 2021; Liu et al., 2021;
Sogari, 2015). Hence, the following hypothesis is proposed:

Hypothesis H1. Food curiosity will positively affect willingness to a)
try b) buy and c) pay a price premium for cultured meat.

2.2. Concerns about food technology

Cultured meat is a form of cellular agriculture, where meat is pro-
duced in vitro, with the assistance of a culture medium and a bioreactor
(Aschermann-Witzel et al., 2019; Seh et al., 2022). The food technology involved in
the process assists in imitating the natural processes inside an animal’s
body in terms of cell development (Aschermann-Witzel et al., 2019). However,
consumers are not necessarily familiar with the processes and technol-
gies, and they may have reservations about biotechnology as a part of
modern food production (De Koning et al., 2020). Risks to human health,
adverse environmental effects, and unknown long-term effects are
common consumer concerns (Hwang et al., 2020). Similarly, tissue
engineering and in-vitro production are often subject to ethical discus-
sion. The technology involved in cultured meat production could be
considered desirable and morally superior because tissue engineering
closely follows natural processes and avoids slaughter and animal
crueity (Mancini & Antonioli, 2019; Chriki & Hocquette, 2020; Weinrich
et al., 2020). In turn, the technology could be considered questionable
because it may be seen as artificial and unnatural, as the meat is con-
structed in a laboratory (Varela et al., 2022). Since various consumer
studies have shown distrust and concerns toward biotechnology the
following hypotheses are proposed:

Hypothesis H2. Concern for food technology will negatively affect willingness to a) try b) buy and c) pay a price premium for cultured meat.

2.3. Food neophobia

Food neophobia is defined as a reluctance to eat new food items or
avoidance due to the fear of an unpleasant sensory experience (Guio0
t Nai Fovino, 2019; Siegrist & Hartmann, 2020; Verbeke, Sans, & Van
Loo, 2015; Faccio &). It is a consumer personality trait, rooted in consumer
values, with the intent to avoid the risk associated with unfamiliar food
products (Siegrist & Hartmann, 2020; Elzerman et al., 2021; Onwezen
et al., 2021). Familiarity and the extent of consumption impact the de-
gree of food neophobia. Consumers who have never eaten any form of
alternative meat tend to have higher levels of food neophobia compared
with consumers who have consumption experience (De Koning et al.,
2020; Hwang et al., 2020; Siegrist & Hartmann, 2020). Age is also
positively associated with food neophobia (Siegrist & Hartmann, 2020).
Studies report older consumers are more likely to experience food
neophobia than younger consumers, especially those living in bigger
cities (Hwang et al., 2020; Siegrist & Hartmann, 2020). Food neophobia
in older consumers is often associated with dental or gastrointestinal
problems (Faccio & Guio0 Nai Fovino, 2019). Concerning gender and
food neophobia, there is no consensus in the recent body of literature. While some studies suggest that men are more neophobic than women, other studies find no significant differences. It is suggested that women tend to be less food neophobic as they are often involved in food purchase and preparation (Meiselman, King, & Gillette, 2020; Siegrist et al., 2013; Faccio & Guiotto Nai Fovino, 2019). This may not apply to cultured meat as it is a new meat product and not available in many food retail outlets. (Hwang et al., 2020; Pakseresht et al., 2022). Respectively the following hypotheses are proposed:

**Hypothesis 3** H3. Food neophobia negatively affects consumers’ willingness to a) try, b) buy, and c) pay a price premium for cultured meat.

### 2.4. Meat importance and the suitability of cultured meat as an alternative to regular meat

Cardiovascular disease, high cholesterol, cancer, and other illnesses are associated with meat over-consumption. (Schweiggert-Weisz et al., 2020). However, when eaten in moderation, meat is a valuable source of protein. The value of meat for the human body stems from its amino-acid composition and digestibility. In addition, some meat types provide the human body with iron, zinc, vitamin A and vitamin B (Schweiggert-Weisz et al., 2020). Many consumers in western societies consider meat consumption to be an important part of their food culture and dietary acculturation in line with their self-identity (Boguera et al., 2022; Bonnie et al., 2007; Lueders et al., 2022). Personal values, religion, and ethics often determine whether consumers perceive cultured meat as a suitable alternative to regular meat (Treich, 2021). When buying or eating meat, consumers consider intrinsic meat attributes such as freshness, tenderness, leanness, flavour/taste, texture, and smell (Mancini & Antonioli, 2019; Slade, 2018). Taste, texture, and smell are essential to the sensory consumption experience of meat products including meat alternatives and consumer willingness to try cultured meat. (Siegrist & Sütterlin, 2017; Wilks et al., 2021). Some plant-based meat products try to imitate the taste and texture of meat, creating analogs to these sensory characteristics of regular meat, but cultured meat is an identical substitute where such imitation is not required (Pakseresht et al., 2022). An example of such imitation is a burger Patty made of plant-based proteins, mostly beets and peas, which imitate bleeding (Slade, 2018; Wilks et al., 2021). Thus, the following hypotheses are proposed:

**Hypothesis 4.** (H4). Meat importance positively affects consumers’ willingness to a) try, b) buy, and c) pay a price premium for cultured meat

**Hypothesis 5.** (H5). Meat importance positively affects the consumer’s perception of cultured meat as a suitable alternative to regular meat

**Hypothesis 6.** (H6). The consumer’s perception of cultured meat as a suitable alternative to regular meat positively affects consumers’ willingness to a) try, b) buy, and c) pay a price premium for cultured meat.

### 2.5. Food allergies

Many consumers suffer from food allergies or sensitivities which require them to follow strict diets (Handral et al., 2022). These consumers rely on food substitutes and are attentive to ingredients (Lipton, 2017). Various plant, fungal and insect-based foods contain allergens (Sadler, 2004), however, whether this is the case for cultured meat is yet to be explored (Hadi & Brightwell, 2021). The recent body of literature lacks information about food allergies and assessments concerning food safety risks related to cultured meat (Hadi & Brightwell, 2021). Amidst this background, the following hypotheses are proposed.

**Hypothesis 7.** (H7). Food allergies affect consumers’ willingness to a) try, b) buy, and c) pay a price premium for cultured meat.

### 2.6. Locavore

Following Bir, Lai, et al. (2019) the term locavore refers to a person whose diet consists only of locally grown or produced food. Locavoring requires rather traditional buying such as from farmers’ markets, at the farm gate, from community-supported agriculture, and nearby shops, as it is assumed that food procured from these distribution channels has been produced nearby (Bir, Lai, et al., 2019). Some consumer associations with local food are superior quality, organically or more sustainably produced, and livestock for meat being raised in an area within a certain radius measured in km or driving hours (Bailey et al., 2022; Hempel & Hamm, 2016; Witzling & Shaw, 2019). Naturalness, transparency, insights into food production systems, trust, and a more personal relationship with farmers are other drivers that make local food attractive to consumers (Feldmann & Hamm, 2015; De Boer et al., 2016). Given that cultured meat and how it is produced is unlikely to be viewed as traditional or local food, the following hypothesis is proposed:

**Hypothesis 8.** (H8). Being a locavore negatively affects consumers’ willingness to a) try, b) buy, and c) pay a price premium for cultured meat.

### 2.7. Conceptual model

A conceptual model suggesting that consumers’ willingness to try, buy and pay a price premium for cultured meat is the result of a combination of different predictors is proposed (see Fig. 1). This includes attitudinal factors such as food curiosity, food neophobia, concerns towards food technology, factors related to lifestyle, e.g., importance dedicated to local food and meat, the perception of cultured meat as a realistic alternative to regular meat, as well as factors referring to a consumers’ background, such as suffering from food allergies. In addition, views and empirical findings have suggested that attitudes towards cultured meat are not universal, and likely to be varied by gender or meat consumption. For example, some research suggests that cultured meat has a greater appeal for men (Bryant & Barnett, 2020; Gomez-Luciano et al., 2019; Slade, 2018) while other findings conclude that the appeal is greater for women (Bryant et al., 2019; Heidemann et al., 2020; Hocquette et al., 2015). Likewise, some researchers consider cultured meat to be a vegetarian product (Chriki & Hocquette, 2020) and suggest that cultured meat could have widespread appeal for no-meat eaters (Caldwell, 2015; Hicks et al., 2018), while others conclude that cultured meat will be more appealing to meat eaters (Franckeovic et al., 2021; Bryant & Barnett, 2020; Bryant et al., 2019; Valente et al., 2019). Therefore, once the proposed model is examined, the relationships found in the global sample will be examined to see whether they apply to both males and females, as well as the no-meat and meat-eating sub-groups (see Fig. 2).

### 3. Materials and methods

#### 3.1. Survey instrument and data collection

A globally distributed online survey about plant-based meat alternatives and cultured meat was conducted in nine different countries, spanning all the continents except Africa, in 2018/2019. The survey was distributed via social media and email, but upon request survey participants also had the option to fill out a printed version. Given budget constraints and the diversity within meat-reduced or meat-free diets, and the controversial nature of discussions related to cultured meat and meat/non-meat consumption, sampling via social media platforms were considered suitable for the present study. Social media platforms are cost-effective and allow researchers to access personal contacts, which are directly linked to them, and members of special interest groups that connect with other users throughout the social media networks (Schneider & Harknett, 2022). Such groups are classified as online
communities connecting members with shared interests, attitudes, and in the case of this study’s context, consumption habits. Such a multi-referral sampling approach somewhat overcomes the risk of one-dimensional information (Schneider & Harknett, 2022).

A total of 3091 responses were complete and appropriate for data analysis. The sample included 571 respondents from China, 539 from the USA, 231 from the Netherlands, 216 from Brazil, 210 from Spain, and 206 from the Dominican Republic. All participants had to be of legal age to take part in the survey, to make sure they could give informed consent themselves (Singer, 2004). Given the cultural diversity of the investigation, the survey was initially designed in English and then translated into other languages. The translation work included grammatical and colloquial adjustments for the English-speaking countries, and for other countries, the respective co-authors translated the survey. All researchers involved in the translation are fluent in English with advanced language proficiency, and native speakers in their respective mother tongues. This way of proceeding assured cultural appropriateness of the translation and translation accuracy (Lee et al., 1999). The corresponding author facilitated a centralized data collection ensuring data safety and consistency. The Human Ethics Committee at Harper Adams University (HAU) in the United Kingdom approved the research design and survey instrument. The survey instrument required all survey participants to provide their informed consent. The survey included closed-end questions related to meat consumption behaviour, willingness to try, buy and pay a price premium for novel food products such as cultured meat, as well as attitudes dedicated to local food and food technology. The study further explored socio-demographic information and personality traits such as food neophobia and food curiosity and included various multi-item scales that were constructed following the extant literature (see Table 2). The two items related to food neophobia and four items related to food curiosity were adapted from Pliner and Hobden (1992), and the items related to food technology concerns (4 items) stem from Cox and Evans (2008). The five items related to meat

![Fig. 1. Proposed conceptual model.](image1)

![Fig. 2. Conceptual model results.](image2)
5

importance followed Roininen et al. (1999). All of these statements presented in the survey asked respondents to indicate their agreement on a five-point Likert scale ranging from “strongly disagree (1)” to “strongly agree (5)”. Their meat consumption was measured using a single item where they reported either “I consume a moderate amount of meat”, “I consume large amounts of meat”, or “I do not consume meat.”

Two methods were employed to analyze the data. Descriptive analyses were performed, using SPSS, to describe the sample, and PLS-SEM was employed, using SmartPLS, to examine the research model and test the proposed hypotheses. PLS-SEM is suitable for estimating complex causal dependencies between latent variables within explorative models (Chin, 1998; Henseler et al., 2015). It was especially appropriate in the current research as it does not require data to be normally distributed because of religious beliefs or otherwise disapprove due to animal husbandry, animal cruelty, or other ethical reasons. Given that cultured meat could overcome these issues, it may provide these consumers with the option of non-meat eaters in the sample builds on the following assumption. Some non-meat eaters would enjoy eating meat but choose not to eat meat or to consume small amounts of meat due to ethical reasons (Hair et al., 2022). Once both steps have been successful, the model is appropriate for hypothesis testing.

3.2. Data analysis

Table 1 provides insight into the demographics of the survey. Frequencies are also reported for gender and meat-eating habit sub-groups. The sample consisted of 59.3% women and 38.9% men, with the remaining 1.2% preferring not to reveal their gender identity. The mean age of the sample was 34 years old. While 10.4% of the survey participants indicated they eat no meat, 72.3% stated they eat meat in moderation, and 17.3% classified themselves as heavy meat eaters. Overall, Spain, Brazil, and the Dominican Republic had the highest percentage of heavy meat eaters, whereas the UK, the US, and the Netherlands had the highest percentage of non-meat eaters. The inclusion of non-meat eaters in the sample builds on the following assumption. Some non-meat eaters would enjoy eating meat but choose not to because of religious beliefs or otherwise disapprove due to animal husbandry, animal cruelty, or other ethical reasons. Given that cultured meat could overcome these issues, it may provide these consumers with an authentic and ethical meat alternative (Chiriki & Hocquette, 2020; Van der Weele & Driessen, 2013). Table 2 reports the means, minima, maxima, and standard deviations for the single-item measures in the model.
3.3. Measurement model

Following Hair et al. (2022), the assessment of the model’s measurement was conducted to check for reliability and validity. Table 3 shows that the Cronbach Alpha indicators were above 0.7 except for Food Neophobia. This low Cronbach Alpha is somewhat mitigated by satisfactory composite reliability indicators for all scales (>0.7). Support for scale convergent validity was found with average variance extracted (AVE) scores above 0.5 and item factor loadings above 0.6. With all but one indicator within appropriate ranges, the requirements of construct reliability and convergent validity were deemed to have been satisfied (Hair et al., 2011, 2022).

After accessing construct reliability and validity, evaluating the discriminant validity of the constructs via Fornell–Larcker criterion and Heterotrait-Multitrait (HTMT) ratio was performed. As displayed in Table 4, the discriminant validity requirements were fulfilled for all constructs. All HTMT ratios are below 0.90 and for the Fornell-Larcker criterion, the cross-loadings are less than the diagonal values (Fornell & Larcker, 1981; Hair et al., 2022; Henseler et al., 2015). Finally, tests for the presence of collinearity were performed. The averaged variance inflation factor (VIF) score was used to determine if collinearity occurred among the constructs (Hair et al., 2019). The VIF scores ranged from 1.000 to 1.155 with an average VIF score of 1.085, indicating that collinearity was not an issue within the proposed model. Hair et al. (2019) suggest that VIF scores should not be greater than 5, and ideal values are below 3.

### Table 3

<table>
<thead>
<tr>
<th>Scale</th>
<th>Items</th>
<th>Factor Loadings</th>
<th>Cronbach’s Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Curiosity</td>
<td>1 – Strongly Disagree to 5 – Strongly Agree</td>
<td>0.740</td>
<td>0.837</td>
<td>0.563</td>
<td></td>
</tr>
<tr>
<td>Meat Importance</td>
<td>1 – Strongly Disagree to 5 – Strongly Agree</td>
<td>0.909</td>
<td>0.933</td>
<td>0.737</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4

<table>
<thead>
<tr>
<th>Fornell-Larcker Criterion</th>
<th>Concerns about Food Technology</th>
<th>Food Curiosity</th>
<th>Food Neophobia</th>
<th>Meat Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerns about Food Technology</td>
<td>0.752</td>
<td>-0.178</td>
<td>0.750</td>
<td></td>
</tr>
<tr>
<td>Food Curiosity</td>
<td>-0.200</td>
<td>-0.302</td>
<td>0.768</td>
<td></td>
</tr>
<tr>
<td>Food Neophobia</td>
<td>0.038</td>
<td>-0.017</td>
<td>-0.044</td>
<td>0.859</td>
</tr>
<tr>
<td>Meat Importance</td>
<td>-0.017</td>
<td>-0.044</td>
<td>-0.048</td>
<td>0.311</td>
</tr>
</tbody>
</table>

3.4. Structural model

The proposed structural model was tested resulting in a goodness of fit (GoF) of 0.370, a normal fit index (NFI) of 0.805, and a standardized root mean square residual (SRMR) of 0.063 for the overall sample. This indicates adequate model fit, considering a satisfactory SRMR less than 0.08 and greater than 0.10 is considered problematic, as suggested by Hair et al. (2022).

The model fit scores for all the analyzed sub-samples were also adequate, with 0.381 (GoF), 0.777 (NFI), and 0.668 (SRMR) for the female sub-sample and 0.378 (GoF), 0.723 (NFI), 0.069 (SRMR) for the male sub-sample. The no-meat eating sub-sample was 0.466 (GoF), 0.740 (NFI), and 0.088 (SRMR) and the heavy meat eating sub-sample was 0.391 (GoF), 0.597 (NFI), and 0.081 (SRMR).

For explanatory power, the model’s constructs contributed to an R² for willingness to try cultured meat of 0.223, for willingness to buy cultured meat of 0.202, and willingness to pay a price premium of 0.111. The R² for cultured meat as a realistic alternative to regular meat of 0.013, but meat importance was the only predictor. Deducing from the R² values, it is clear that the model’s constructs are better suited to explain future behaviour that represents a lower level of commitment.

3.5. Multigroup analysis

To examine the generality of the model, its structure was tested on sub-groups of the sample. Two sets of sub-groups were chosen: male vs. female, and no-meat vs. heavy meat eaters. The choice of no-meat vs heavy meat eaters was predicated on the fact that over 70% of the sample were moderate meat eaters and the model tests were unlikely to differ from the overall sample. Thus, a model comparison of extremes (no-meat vs heavy meat eaters) was the most likely to yield differences. The first step of the model comparisons was to test the structural model for each of the sub-groups and examine any variations from the
complete sample. This was followed by a partial least squares multi-
group analysis, which tested whether the observed sub-group differ-
ences were statistically significant. Following Hair et al. (2018) and
Henseler et al. (2009), this type of analysis relies on non-parametric
significance testing for the difference of group-specific results that,
lke hypotheses testing, rely on a bootstrapping technique. Hair et al.
(2018) state that results are significant at the 5% level if the p-value
is less than 0.05. When the MGA approach is employed while comparing
sub-group models, it can confirm the significance of sub-group
variations.

4. Results

The results from hypothesis testing are presented in Table 5. This
includes the overall sample as well as the sub-samples. Results from the
multigroup analysis are displayed in Table 6.

In the overall sample, food curiosity positively influenced willing-
ness to try and buy cultured meat, supporting hypotheses H1a/b. However,
no significance was found for hypothesis H1c, where food
curiosity was used as a predictor of consumers’ willingness to pay a price
premium for cultured meat (see Table 5). Comparisons between sub-
groups (see Table 5) and the multi-group analyses (see Table 6)
confirmed two differences in the sub-groups, namely that H1a and H1b
were supported in the male sub-group but not supported in the female
sub-group. While the meat subgroups did not support H1a or H1b, the
MGA did not find significant differences between them.

Concerns about food technology seem to have a negative effect on consumers’ willingness to try, buy and pay a price premium for cultured
meat, supporting hypotheses H2a/b/c in the overall sample (see Table 5). In male-female sub-samples, H2a/b/c was supported for both
men and women, although the relationship towards willingness to buy
was significantly stronger for men (see Table 6). Across the heavy meat
no meat sub-samples, H2a/b were supported and H2c was supported for
no-meat eaters. The relationship between technology and willing-
ness to pay a price premium was not significant for heavy meat eaters
and this difference was confirmed in the MGA. (see Table 6).

Food neophobia negatively affected consumers’ willingness to try
and buy cultured meat, therefore supporting H3a/b in the overall
sample (see Table 5). H3c was not supported as food neophobia was not
found to be a significant predictor of willingness to pay a price premium
for cultured meat. In the male-female sub-sample comparisons, the only
significant difference was that the path between food neophobia and
willingness to try was stronger for men (Table 6). No significant dif-
ferences in path relationships were found in the no-meat - heavy meat
sub-samples (see Table 6).

In the overall sample, meat importance positively affects consumer
willingness to try & buy, but negatively affects willingness to pay a price
premium and negatively impacts the perception of cultured meat as a
realistic alternative to regular meat products including cultured meat (Hwang et al., 2020).

5. Discussion

The results related to food curiosity and consumers’ willingness to
try and buy cultured meat confirm recent studies. Food curiosity is a
strong predictor, positively impacting consumers’ willingness to try
alternative meat products including cultured meat (Hwang et al., 2020).

The non-significant relationship between food curiosity and willingness
to pay a price premium can be explained as follows: According to
Gomez-Luciano et al. (2019) and Kantor and Kantor (2021), cultured
meat is already more widely known in various countries e.g., the UK,
Spain, Brazil, and the Dominican Republic, through media coverage.
Hence, societal familiarity with cultured meat may have dampened food
curiosity. In addition, cultured meat is not yet widely commercially
available in food retail and gastronomy (Pakseresh et al., 2022), which
can be attributed to the nature and production process of cultured meat
and distrust and disgust is one of the strongest
attitudinal predictors inhibiting consumers’ willingness to accept meat
alternatives and their willingness to pay for cultured meat. (Bryant et al.,
2019a; b; Wilks et al., 2019; Siegrist & Hartmann, 2020; Hwang,2020;
Onwezen et al., 2021). In the context of cultured meat, food neophobia
and concerns about food technology seem to be closely linked, and this
can be attributed to the nature and production process of cultured meat.
### Table 5
Path coefficients.

<table>
<thead>
<tr>
<th>Hypothesised Path Relationship</th>
<th>Complete Sample</th>
<th>Female Sub-group</th>
<th>Male Sub-group</th>
<th>No Meat Sub-group</th>
<th>Heavy Meat Sub-group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef- t-Stat P</td>
<td>Coef- t-Stat P</td>
<td>Coef- t-Stat P</td>
<td>Coef- t-Stat P</td>
<td>Coef- t-Stat P</td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
</tr>
<tr>
<td>H1a Food Curiosity - &gt; WTB</td>
<td>0.067 3.990 0.000 0.035 1.659 0.097 0.133 4.574 0.000 0.078 0.804 0.422 0.075 1.762 0.078</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>H1b Food Curiosity - &gt; WTB</td>
<td>0.045 2.678 0.007 0.010 0.482 0.630 0.101 3.647 0.000 0.056 0.524 0.6 0.057 1.348 0.178</td>
<td></td>
<td></td>
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<tr>
<td>H1c Food Curiosity - &gt; WTPM</td>
<td>0.028 1.548 0.122 0.007 0.300 0.764 0.069 2.473 0.013 0.043 0.543 0.587 0.062 1.301 0.193</td>
<td></td>
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<tr>
<td>H2a Concerns about_Food Technology - &gt; WTB</td>
<td>-0.214 13.097 0.000 -0.194 9.286 0.000 -0.233 8.369 0.000 -0.185 3.495 0 -0.256 6.676 0</td>
<td></td>
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<tr>
<td>H2b Concerns about_Food Technology - &gt; WTB</td>
<td>-0.222 13.473 0.000 -0.188 8.773 0.000 -0.258 9.813 0.000 -0.205 4.247 0 -0.205 5.445 0</td>
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<tr>
<td>H2c Concerns about_Food Technology - &gt; WTPM</td>
<td>-0.128 7.088 0.000 -0.118 4.985 0.000 -0.127 4.512 0.000 -0.207 4.314 0 -0.024 0.61 0.542</td>
<td></td>
<td></td>
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<tr>
<td>H3a Food Neophobia - &gt; WTB</td>
<td>-0.146 8.763 0.000 -0.176 8.242 0.000 -0.106 3.720 0.000 -0.17 3.433 0.001 -0.178 4.451 0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>H3b Food Neophobia - &gt; WTB</td>
<td>-0.079 4.752 0.000 -0.101 4.762 0.000 -0.064 2.264 0.024 -0.123 2.386 0.017 -0.671 1.681 0.093</td>
<td></td>
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<tr>
<td>H3c Food Neophobia - &gt; WTPM</td>
<td>0.003 0.163 0.871 -0.002 0.071 0.944 0.005 0.158 0.874 -0.064 1.245 0.213 0.024 0.475 0.634</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>H4a Meat Importance - &gt; WTB</td>
<td>0.141 7.719 0.000 0.175 8.285 0.000 0.014 0.422 0.673 0.312 6.271 0 0 0.01 0.992</td>
<td></td>
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</tr>
<tr>
<td>H4b Meat Importance - &gt; WTB</td>
<td>0.082 4.464 0.000 0.113 5.062 0.000 -0.031 1.020 0.308 0.27 4.837 0 -0.055 1.246 0.213</td>
<td></td>
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</tr>
<tr>
<td>H4c Meat Importance - &gt; WTPM</td>
<td>-0.050 2.715 0.007 -0.017 0.713 0.476 -0.165 5.691 0.000 0.218 4.163 0 -0.12 2.431 0.015</td>
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</tr>
<tr>
<td>H5 Meat Importance - &gt; Realist Alternative to Meat</td>
<td>-0.115 5.455 0.000 -0.155 6.166 0.000 -0.130 4.676 0.000 0.204 3.981 0 -0.168 3.413 0.001</td>
<td></td>
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<tr>
<td>H6a Realist Alternative to Meat</td>
<td>0.268 16.174 0.000 0.302 14.110 0.000 0.223 8.071 0.000 0.194 3.997 0 0.296 7.754 0</td>
<td></td>
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</tr>
<tr>
<td>H6b Realist Alternative to Meat</td>
<td>0.296 18.643 0.000 0.341 16.724 0.000 0.232 8.826 0.000 0.227 5.052 0 0.324 8.444 0</td>
<td></td>
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<tr>
<td>H6c Realist Alternative to Meat</td>
<td>0.262 16.415 0.000 0.282 13.699 0.000 0.229 8.895 0.000 0.234 5.407 0 0.253 5.877 0</td>
<td></td>
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</tr>
<tr>
<td>H7a Food Allergies - &gt; WTB</td>
<td>-0.057 3.502 0.000 -0.018 0.840 0.401 -0.103 3.941 0.000 -0.089 1.892 0.058 -0.062 1.666 0.096</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H7b Food Allergies - &gt; WTB</td>
<td>-0.088 5.241 0.000 -0.044 2.050 0.040 -0.140 5.321 0.000 -0.129 2.742 0.006 -0.051 1.289 0.198</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H7c Food Allergies - &gt; WTPM</td>
<td>-0.084 4.938 0.000 -0.059 2.715 0.007 -0.105 3.955 0.000 -0.169 3.954 0 -0.027 0.665 0.506</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>H8a Locavore - &gt; WTB</td>
<td>-0.110 6.728 0.000 -0.113 5.312 0.000 -0.110 4.163 0.000 -0.066 1.244 0.214 -0.128 3.619 0</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>H8b Locavore - &gt; WTPM</td>
<td>-0.082 4.961 0.000 -0.097 4.427 0.000 -0.057 2.144 0.032 -0.06 1.13 0.259 -0.087 2.303 0.021</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>H8c Locavore - &gt; WTPM</td>
<td>-0.030 1.603 0.109 -0.051 2.136 0.033 0.014 0.483 0.629 -0.096 1.792 0.073 0.009 0.208 0.835</td>
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</tbody>
</table>

(continued on next page)
A consumer’s willingness to try new food products stems from their system of norms and values, which often relates to both the product itself and the associated technology involved in the production (De Koning et al., 2020). The differences between the male and female sub-sample are consistent with some research reporting that men tend to be more food neophobic than women (Faccio & Guiotto Nai Fovino, 2019; Siegrist et al., 2013).

Meat importance refers to intrinsic attributes such as meat taste, texture, smell and nutritional importance, which are essential product characteristics for consumers when it comes to meat purchase and consumption (Schouteten et al., 2016; Meiselman, King, & Gillette, 2020). In contrast to other plant-based meat alternate natives, the sensory and nutritional features are the same as regular meat (Pakseresht et al., 2022). The insignificant or opposite results for the sub-sample of heavy meat eaters may be due to their eating behaviour. Changing meat-eating behaviour involves self-regulation and executive function, and overcoming pre-existing habits (Tomiyama et al., 2020) or believing that cultured meat may not be as healthy as regular meat (Bryant & Barnett, 2020).

The significant findings for the non-meat eaters may appear, at first glance, surprising. However, the reasons for not eating meat and the motivations to consume meat are quite diverse. Rosenbaum and Burrow (2017) report that motivations, aversions, and constraints are the major reasons why consumers follow a meat-reduced or meat-free diet. While meat aversion is not a likely explanation for these findings, motivations and social reasons may explain these results. Cultured meat alleviates some of the negatively viewed practices associated with meat production, such as factory farming and animal cruelty, which are among the pro-social and moral motivations for people choosing not to eat meat. In addition, consumers who are restrained from meat consumption by their social circles, including family and friends, may view cultured meat as an acceptable food choice. A posthoc analysis highlighting the diversity of possible motivations for the non-meat eaters in the sample can be found in Table A1 (appendix). The frequencies of a selection of questionnaire items indicate agreement with pro-social ideas such as locavorism (63% agreement) and sustainability concerns (81.3%). Evidence of personal motivations is also present with the importance of personal health (76.2% agreement) and disagreement with the nutritional necessity of meat (91.9% disagreement) and affinity towards the sensory experience of meat-eating (79.7% disagreement). Tomiyama (2020) also explains some of the significant differences between the male and female sub-samples, claiming that men are less inclined to eat a plant-based diet but are more willing to try and buy cultured meat.

Overall, cultured meat appears to be a realistic alternative to traditional meat, and is very appealing to socially conscious consumers. These types of consumers are aware of the problems associated with...
meat production and consumption. Cultured meat allows consumers to continue eating meat without supporting the negative externalities or being worried about food safety as the meat stems from a sterile environment (Verbeke, Marcu, et al., 2015; Gómez-Luciano et al., 2019; Van Der Weele & Driesen, 2019; Weinrich et al., 2019). The potentially high price-point of cultured meat could be a factor contributing to consumers’ evaluation of whether it is a realistic alternative to traditional meat, and this deserves critical attention. The existing body of literature shows that other meat substitutes products targeting consumers following a meat-free or meat-reduced diet are often more expensive than traditional meat products (Apostolidis & McLeay, 2016), which could explain why consumers are willing to pay a price premium. In the long term, the price point needs to be reduced for cultured meat to be accessible to consumers at all income levels.

Food allergies influence the food consumption habits and purchase decisions of many consumers. While various plant and fungal-based proteins contain allergens, whether or not cultured meat contains allergens remains unclear (Hadi & Brightwell, 2021). The negative relationships suggest that consumers with food allergies are less willing to consume cultured meat, or perhaps their allergies temper their willingness to try, buy and pay a price premium for any new foods with the potential to cause allergic reactions.

The findings concerning locavores may be because the beliefs and values underpinning locavorism conflict with the notion of cultured meat. Local food is often associated with traditional farming methods, affordability and community (Caspi et al., 2012), which is inconsistent with laboratory-grown meat, even if the laboratory is nearby.

6. Managerial implications

The present study focused on key factors driving consumer willingness to try, buy, and pay a price premium for cultured meat. The study highlighted food neophobia, having food allergies, being a locavore, and having concerns about food technology as inhibiting factors towards willingness to try, buy and pay a price premium for this meat alternative. Food curiosity, meat importance, and a consumer’s perception of cultured meat as a realistic alternative to regular meat were important drivers that positively impacted consumers’ willingness to try, buy and pay more. These findings are of relevance to marketing managers in food retail and gastronomy. Once cultured meat is more widely commercially available, and offered at commercially viable prices, familiarizing consumers with the products and making production processes transparent and understandable will be crucial to wider acceptance. The use of appropriate terminology is also key, and avoiding terminology related to the technical process and association with laboratory conditions is best avoided. Instead, marketing campaigns should focus on the benefits of cultured meat for the environment, animal welfare, and any hypoallergenic characteristics. In addition, marketers and policymakers need to price cultured meat at a level that is commensurate with its benefits. While novelty may command unrealistic prices in the short term, it is hoped that the price point will settle to a reasonable level so it has a chance to be a viable alternative to meat and other meat substitutes. Often there is a price premium for meat substitutes, which may be morally justifiable, but fair access including consumers with low income should be considered. Concerns about food technology can be mitigated through trustworthy food system actors. Food retailers and regulators should be called to assess, assure, and communicate the safety of the products and the technology employed in the production of all meat alternatives.

To foster food curiosity towards cultured meat as a new product, the sensory product attributes of cultured meat should be highlighted and adjusted to the needs, wants, and price systems of different consumer groups. To generate consumer acceptance for cultured meat, targeting meat lovers and socially conscious consumers who enjoy the taste of meat but have refrained from meat consumption due to the adverse effects on the environment and animals are likely to be beneficial, as cultured meat corresponds to their lifestyle and values.

7. Suggestions for future research

Future research could examine consumer attitudes in Singapore where cultured meat, in the form of “Just Food’s Good Meat Chicken Nuggets”, is already commercially available. Research at the point of sale could overcome any discrepancies between behavioural intention and actual consumer behaviour. The study would uncover whether cultured meat is a realistic opportunity for Asian consumers. With the potential of more countries following the example of Singapore, future research should focus on how to target consumers, following the work of Asioli, Bazzani, and Naya (2021) and Baum et al. (2022). In addition, employing a best-worst methodology could be a suitable approach to studying consumer preferences towards product attributes. The approach allows understanding the underlying trade-offs when consumers consider the bundle of cultured meat attributes.

Empirical studies dedicated to cultured meat should target vegan and vegetarian consumers and build on the work of Rosenbaum and Burrow (2017). Such work would add to the extant literature and could distinguish pro-social, personal, and moral motivations alongside aversion and constraints as important predictors in PLS-SEM studies. Lastly, in a culturally meat consumption context, the relationship between food neophobia and disgust could be extended. Aversion of uncleanliness and micro-organisms could be included as mediators in the model.

8. Limitation

In terms of limitations, a few methodological aspects deserve critical attention. In the present study, respondents self-reported their meat consumption habits and classified themselves as non-meat eaters, moderate meat eaters, or heavy meat eaters. The survey participants had no numerical references for this classification which could have led to socially desirable answers and underreporting of consumption. In future investigations, the authors aim to address this issue by measuring portion sizes and frequencies of consumption as well as incorporating cheap talk (from game theory) to experimental designs to overcome this potential problem. A further limitation concerns the non-meat eaters specifically. Their reasons for abstaining from meat consumption did not consider reasons such as aversions, motivations, and constraints. In upcoming investigations, the authors will consider these aspects and aim to contribute a finer-grained analysis of why consumers avoid meat, are opposed to cultured meat, and are willing to try and buy cultured meat. Lastly, the sampling approach of the present study is likely to have affected the sample. The perspective of elderly consumers may have been under-represented given the investigation through social media. Recruitment through dietary organizations or opt-panel providers in the future could overcome this drawback.

Author contribution

David Dean: data analysis and interpretation; editing manuscript; Meike Rombach: writing manuscript and data interpretation; Frank Vrieseskoep: project manager, research design, research supervision, data curation, Wim de Koning: research design and research supervision; Luis Kluwe Aguia: researcher; Martin Anderson: researcher supervision; Philippe Mongondry: researcher supervision; Mark Oppong-Gyamfi: researcher; Beatrix Urbano: researcher; Cristino Alberto Gómez Luciano: researcher; Bin Jiang: researcher; Wendy Hao: researcher; Emma Eastwick: researcher; Zheng (Virgil) Jiang: researcher; Anouk Boereboom: researcher.

Funding

No specific funding has been attributed to the project.
Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Human Ethics Committee at HAU, United Kingdom.

Informed consent

All participants gave their informed consent for inclusion before they participated in the study.

Appendix

Table A1

Selected Item Frequencies for No Meat Sub-group

<table>
<thead>
<tr>
<th>Individual Questionnaire Items (No meat: N = 320)</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locavore: I often get my food from traditional and/or local sources</td>
<td>2.2%</td>
<td>13.2%</td>
<td>21.0%</td>
<td>48.6%</td>
<td>15.0%</td>
<td>100%</td>
</tr>
<tr>
<td>Health: I am very particular about the healthiness of the food I eat</td>
<td>0.7%</td>
<td>5.9%</td>
<td>17.2%</td>
<td>40.9%</td>
<td>35.3%</td>
<td>100%</td>
</tr>
<tr>
<td>Sustainability: I am worried about human kind’s ability to provide the nutritional needs for all people living on earth now</td>
<td>2.1%</td>
<td>5.3%</td>
<td>11.3%</td>
<td>36.9%</td>
<td>44.4%</td>
<td>100%</td>
</tr>
<tr>
<td>Meat Nutrition: Meat is an important part of a healthy and balanced diet</td>
<td>71.3%</td>
<td>20.6%</td>
<td>5.9%</td>
<td>0.9%</td>
<td>1.3%</td>
<td>100%</td>
</tr>
<tr>
<td>Meat Appreciation: The taste of meat is important to me</td>
<td>65.9%</td>
<td>13.8%</td>
<td>11.3%</td>
<td>6.9%</td>
<td>2.1%</td>
<td>100%</td>
</tr>
</tbody>
</table>

References


Data will be made available on request.


