

Framework for understanding consumer perceptions and attitudes to support decisions on cultured meat: A Theoretical Approach and Future Directions

Guoste Pivoraite ^{1*}, Shaofeng Liu ¹, Saeyeon Roh¹ and Guoqing Zhao ²

¹ Plymouth Business School, University of Plymouth, Plymouth, PL4 8AA, UK

² School of Management, Swansea University, Swansea, SA2 8PP, UK

Abstract. This paper investigated consumer perceptions and attitudes for decision making in Cultured Meat (CM), driven by the growing interest in innovative food products. The motivation stemmed from the anticipated challenges in consumer acceptance of CM, a novel alternative to traditional meat production. The research objective included to identify key factors influencing consumer behaviour in the context of the novel food product. The Systematic Literature Review methodically explored and synthesised existing research, giving insights to the factors affecting consumer perceptions and attitudes towards decisions on CM. Then, a tailored conceptual framework, the Cultured Meat Attitude and Perception Assessment (CAPA), has been developed to address the identified gaps and limitations in understanding consumer perceptions and attitudes. The results highlighted the complex and multidimensional nature of consumer attitudes, emphasising the role of knowledge (awareness, comprehension, familiarity), perception (disgust, neophobia, curiosity, fear, trust), and external factors (ethical issues, social factors, product attributes, information influence, perceived exclusivity, regulatory considerations) that could be used by decision makers such as food innovators and marketers. The CAPA framework integrated these factors to offer a holistic perspective on consumer behaviour, overcoming the limitations of existing work and offering insights to the decision makers in the industry.

Keywords: Consumer Behaviour, Decision Factors, Food Innovation, Cultured Meat

1 Introduction

The global landscape of food production, driven by many decision factors such as population growth and rising incomes, stands on the brink of significant transformation (María Ignacia Rodríguez et al., 2021). Over the past decade, heightened scrutiny of the environmental, ethical, and health implications of the global livestock industry has led to a critical re-evaluation of food value chain sectors (Stephens et al., 2018; Pakseresht, Ahmadi Kaliji & Canavari, 2022). Livestock production, contributing to approximately 80% of greenhouse gas emissions within food supply chains, poses a substantial risk to climate change mitigation (María Ignacia Rodríguez et al., 2021).

Responding to these challenges, a groundbreaking solution has emerged: Cultured Meat (CM). This transformative technology signifies a paradigm shift in meat production, enabling the cultivation of meat products outside live animals through the utilisation of animal stem cells and tissue engineering techniques (Rischer et al., 2020). CM technology facilitates the creation of biologically equivalent products to those derived from traditional livestock farming, with the potential to reduce or eliminate the need for live animals, which means that it offers a solution to reduce the environmental pressure caused by livestock farming, including deforestation, water pollution, and biodiversity loss, by significantly reducing the land and water requirements for meat production (Wilks & Phillips, 2017). Moreover, CM aims to replicate the sensory attributes of animal-sourced counterparts while matching their nutritional characteristics, therefore providing consumers with a sustainable and ethically viable alternative to conventionally produced meat (de Oliveira Padilha et al., 2022).

Despite its prospects, large-scale production and commercialisation of CM are still in their infancy (Pakseresht et al., 2022). Various barriers, including technological concerns such as the development of large-scale bioreactors and efficient growth media, hinder its industrial-scale production (Onwezen et al., 2021). The technological viability of CM products also faces challenges due to multiple decision criteria, for example, high production costs, impeding competitive pricing (Fernandes et al., 2022). Consumer perspectives represent another critical barrier to novel food acceptance, with studies indicating a wide spectrum of views, from low to high acceptance rates (Onwezen et al., 2021; Pakseresht et al., 2022; Siddiqui et al., 2022). This underscores the need for further exploration and understanding of decision factors such as consumer attitudes towards CM products (Ruzgys & Pickering, 2020; Tomiyama et al., 2020; Weinrich, Strack & Neugebauer, 2020).

This paper explores the intricacies of consumer decision-making for novel food products, specifically focusing on CM and various decision factors linked to CM to understand consumer perceptions and attitudes during the pre-commercialisation phase. The study aims to unravel relationships influencing these perceptions and attitudes, with the goal of establishing a conceptual framework to support food innovators and marketers for their decisions. Through a systematic literature review, the primary objective is to identify specific decision factors. Contributions encompass a comprehensive analysis of existing work on the factors impacting consumer perceptions and attitudes towards CM, providing insights into the current state of knowledge. The conceptual framework serves as a valuable tool for researchers, policymakers, industry stakeholders, and decision-makers looking to understand and enhance the consumer decision-making journey. Additionally, the study lays the foundation for future research, uncovering the complex interplay of decision factors influencing consumer attitudes toward pre-commercialized food innovations like CM.

2 Methodology - Systematic Literature Review

This paper employed the Systematic Literature Review (SLR) methodology, a comprehensive approach grounded in established literature and academic guidance (Denyer

& Tranfield, 2009; Booth et al., 2012). This methodology was chosen for its structured nature, offering advantages over traditional literature reviews by providing a systematic approach to synthesizing existing research.

Firstly, the SLR process involved formulating clear and well-defined research questions. In this case, the questions formulated were: 1) What are the internal and external decision factors that influence consumers' attitudes towards cultured meats and, subsequently, their intention to purchase these products? 2) How do these internal and external factors interact with consumers' attitudes, ultimately shaping their intention to purchase cultured meat?

Secondly, the identification of relevant research papers required a comprehensive search strategy. Reputable databases, including Scopus, Web of Science, and PubMed, were selected based on their relevance and reputation. The query, combining keywords reflecting the research objectives, guided the selection of databases. The overall query was composed by combining keywords, Boolean operators, special symbols, and grouping similar words: (cellular agriculture OR lab grown meat OR artificial meat OR cell cultured meat OR clean meat OR cultivated meat OR Cultured meat OR in vitro meat OR animal free meat OR cell based meat OR craft meat OR cruelty free meat OR factory grown meat OR fake meat OR meat 2.0 OR pure meat OR safe meat OR schmeat OR slaughter free meat OR synthetic meat) AND (View* OR attitude* OR intent* OR perce* OR opinion* OR willing* OR accept* OR adopt* OR behav*).

Then, the systematic approach to paper selection and evaluation was implemented, involving explicit inclusion and exclusion criteria (as shown in Table 1) aligned with research questions (Booth et al., 2012). These criteria encompassed the theoretical foundation, research methods, data collection, analysis, and overall paper quality. This rigorous selection process minimized biases and ensured the inclusion of the most relevant and methodologically sound studies.

Table 1. SLR inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Identification stage		
Availability	Full-text available	No full-text available
Peer- review	Peer- reviewed	Not peer- reviewed
Type of publication	Journal articles	Conference proceedings, book chapters, review articles, etc.
Timeframe	2008- 2023	Before 2008
Language	English Language	Non- English
Relevant subject area	Social Sciences	Hard Sciences (Biological Sciences, Medicine, Chemistry, etc.)
Screening stage		
Type of study	Empirical and Theoretical studies	discussion papers, overviews, opinion papers
Study Focus	Studies focused on consumer behaviour	Technical studies and papers not focusing on consumer behaviour
Relevance	Studies about cultured meat	- Studies focused on other meat alternatives (plant- based alternatives, insect- based substitutes, etc.) - Studies focused on other Cellular Agriculture products

Following this, the overall process of the literature selection is illustrated in Figure 1. After identifying papers using the mentioned queries from the relevant databases, the inclusion and exclusion criteria were applied, duplicates removed, the papers were screened by title and abstract, and then based on full-text. After adding additional relevant papers, 67 papers formed the final collection of literature and included in the analysis.

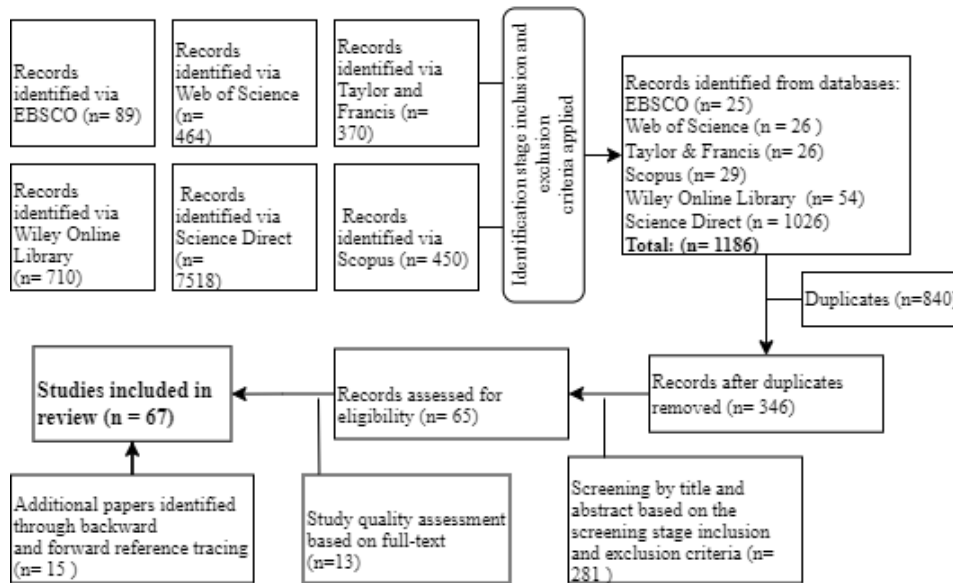


Fig. 1. Selection of papers flowchart

Following paper selection, the data extraction and synthesis stage systematically extracted key information from each paper, aiming to identify common themes, patterns, and discrepancies across the selected papers. Synthesis contributed to a nuanced understanding of the decision factors shaping consumer attitudes towards Cultured Meat.

The synthesis of findings addressed the research questions, offering insights into commonalities, contradictions, and gaps in the existing literature. The presentation of the last step, the development of the conceptual framework, will be detailed in the next section.

3 Key Findings from Systematic Literature Review

The findings from the SLR are organized into three key themes: internal decision factors (i.e. factors related to the consumers themselves), external decision factors (i.e. factors related to external environment), and links among different decision factors.

3.1 Internal decision factors

In exploring consumer decisions on CM, the SLR revealed that internal factors such as knowledge, perception, and personal elements play an important role in shaping consumer attitudes. As such, this section examines these internal aspects, providing insights into the dynamics influencing consumer decision-making regarding CM.

Knowledge. Consumer decision-making in terms of CM was significantly influenced by their own knowledge, comprising awareness, familiarity, and comprehension. Baum et al. (2022) found that prior knowledge had a limited impact on altering consumer acceptance, suggesting that awareness alone didn't drive attitude change. Hwang et al. (2020), however, reported a positive relationship between prior knowledge and consumer willingness to purchase CM, indicating that increased understanding enhances acceptance. Gousset et al. (2022), on the other hand, revealed that prior awareness did not significantly impact consumer overall feelings toward CM as well. It is notable, that these contrasting findings highlight the complexity of the relationship between prior knowledge and attitude.

Meanwhile familiarity, often intertwined with awareness, was recognised as a significant dimension of consumer knowledge too. Giacalone and Jaeger (2023) emphasised its importance however, Baum et al. (2022) reported that familiarity with meat substitutes did not significantly impact acceptance change, suggesting other factors like consumer effectiveness and message framing were more influential.

In term of comprehension, it pertained to consumers' understanding about CM and its production processes. Shan et al. (2022) found that higher levels of knowledge reduced susceptibility to framing effects, indicating comprehension acted as a safeguard. However, Li et al. (2023) found that comprehensive understanding alone may not positively influence attitudes, hinting at potential consumer resistance.

The nuanced relationship between these knowledge dimensions underscored the complexity of consumer understanding about CM, calling for further research to explore the interplay between different knowledge dimensions.

Perception. Perception, encompassing cognitive and emotional processes, played a role in shaping consumer attitudes towards novel food technologies like CM. Disgust consistently emerged as a crucial factor due to CM's perceived artificiality (Siegrist and Hartmann, 2020; Rosenfeld and Tomiyama, 2022). Food neophobia, fear of trying new foods, consistently influenced CM attitudes, impacting views on safety (Krings, Dhont & Hodson, 2022) while curiosity emerged as a significant driver for trying CM due to its innovative nature (Liu et al., 2021; Hocquette, 2022). In addition, the complexity of factors influencing consumer perception extended to fear, uncertainty, liking, and scepticism too. Some expressed liking driven by perceived advantages, while others expressed scepticism and concerns (Wilks et al., 2019; Hamlin, McNeill & Sim, 2022; Giacalone & Jaeger, 2023), highlighting the complex nature of consumer perceptions.

Personal Factors. Dietary preferences, age, gender, education, income, and cultural context played crucial roles in shaping consumer attitudes toward CM. For example, meat eaters showed higher intentions to try CM (Liu et al., 2021), and cultural background significantly influenced consumer attitudes, as seen in vegetarian preferences (Arora et al., 2020). Age and cultural context could influence openness and acceptance

as well (Dupont & Fiebelkorn, 2020; Liu et al., 2021). In terms of gender differences, they played an essential role, with men generally exhibiting greater willingness to try CM than women (Da Silva & da Cunha, 2022). Education correlated with positive attitudes (Zhang, Li, and Bai, 2020), but highly educated individuals expressed concerns related to economic disruptions (Tsvakirai, Nalley, and Makgopa, 2023). Looking at income levels, this factor impacted consumer attitudes, with higher income associated with a greater willingness to pay for cultured meat (Zhang, Shi, and Sheng, 2022). In addition, cultural context significantly shaped consumer attitudes too (Bekker, Tobi, and Fischer, 2017; Siegrist and Hartmann, 2020).

3.2 External decision factors

Shifting the focus outward, external factors, explored subsequently, contributed additional layers to the intricate framework shaping consumer attitudes and impacting decision-making in the context of CM. SLR findings indicated that the dynamics of consumer attitudes toward CM were connected to these external elements, reaching beyond individual cognitive processes.

Ethical Issues. Ethical concerns surrounding CM comprised environmental sustainability, animal welfare, food security, and social considerations, collectively shaping consumer attitudes. While sustainability consistently emerged as a driving force, nuanced findings revealed the complex interplay of factors influencing acceptance (Palmieri et al., 2020; Specht et al., 2020; da Silva & da Cunha, 2022). Ethical concerns for animal welfare remained strong across the literature, emphasising the enduring influence of more humane alternatives (Wilks & Phillips, 2017; Palmieri et al., 2020; Ruzgys & Pickering, 2020; Liu et al., 2021; Verbeke et al., 2021; Gousset et al., 2022). Food security also played a notable role, particularly in regions facing challenges. Additionally, social considerations highlighted mixed views on the impact of cultured meat, necessitating further exploration of its broader societal consequences (de Oliveira et al., 2022; Dean et al., 2023).

Product Attributes. Consumer perceptions of CM were influenced by healthiness, safety, nutrition, naturalness, sensory properties, and price. Healthiness was positively associated with acceptance (Gómez-Luciano, 2019; Specht et al., 2020; Zhang et al., 2020; de Oliveira et al., 2021; Da Silva & da Cunha, 2022). Safety was considered a critical factor, with controlled production environments enhancing perceived safety (Liu et al., 2021). Naturalness, a consistent barrier, required careful management of diverse perceptions (Ruzgys & Pickering, 2020; Giacalone & Jaeger, 2023). Sensory properties, particularly taste and texture, significantly influenced acceptance, emphasising the need to align CM with familiar expectations (Mancini & Antonioli, 2019; Zhang et al., 2020; Dean et al., 2023). Price sensitivity posed challenges, with concerns about high costs prevalent (Verbeke et al., 2015; Wilks & Phillips, 2017; de Oliveira et al., 2022).

Information Influence. Information, nomenclature, and labelling was another set of elements that impacted consumer perceptions of CM. Detailed information and visual imagery may not uniformly sway consumer evaluations (Baum et al., 2023) however, message framing positively influenced willingness to pay (Zhang et al., 2022).

Combining appeals and diverse information types showed to be effective as well (Septianto et al., 2023; Piochi et al., 2022). In addition, nomenclature significantly shaped consumer behaviour, with careful selection essential for positive responses (Califano et al., 2023; Li et al., 2023; Bryant & Barnett, 2019). Furthermore, labelling and packaging, such as green packaging and specific labels, influenced consumer preferences and behavioural intentions (Asioli et al., 2022; Dupont et al., 2022; Krings, Dhont & Hodson, 2022).

Social Influence. Limited research explored social factors influencing consumer perceptions of CM. Cultural factors, peer opinions on social media, and social settings played roles in shaping perceptions and acceptance (Chong et al., 2022; Leong, 2022; Motoki et al., 2022). Exposure to lab-grown meat information through social media influencers proved to not significantly impact acceptance while social image motivations varied (Chong et al., 2022). Peer opinions on social media shaped public perceptions and decisions, emphasising the importance of congruence between elite and lay perspectives (Leong, 2022). Additionally, social situations, such as dining with friends, influenced the expected acceptance of cultured meat (Motoki et al., 2022).

While research on social influence concerning cultured meat appeared to be limited, these studies offered valuable insights into consumer attitudes and behaviours. Cultural factors, peer opinions on social media, and social settings all played roles in shaping perceptions and acceptance. Further exploration of these factors within the context of CM may be beneficial to develop a more comprehensive understanding of their impact.

Perceived Exclusivity. Perceived exclusivity, encompassing elements like luxury and scarcity, gained prominence in recent studies examining consumer attitudes toward CM. Arango, Chaudhury, and Septianto's (2023) study on demand-based scarcity appeals provided valuable insights into a marketing strategy that promoted cultured meat by leveraging scarcity to create a sense of limited availability. This approach not only mitigated perceptions of risk but also instilled a feeling of exclusivity among consumers, aligning with the broader literature on scarcity appeals. Septianto et al. (2023) delved into the role of perceived luxuriousness as a mediating factor in consumers' willingness to try clean meat products. Their study revealed that visual representations conveying an artistic and luxurious aura positively influenced consumer attitudes, underscoring the impact of aesthetics in shaping perceptions. However, it is important to acknowledge that while these studies shed light on the role of perceived exclusivity, the broader context of luxury and scarcity in consumer behaviour and its connection to cultured meat requires further exploration.

Regulatory Considerations. Regulatory considerations emerged as another aspect of consumer attitudes toward CM. Zhang, Li and Bai's (2020) study conducted in urban areas of China highlighted the influence of government regulation of food safety on consumer acceptance. Respondents who expressed higher satisfaction with government food safety regulations were more likely to accept cultured meat, underscoring the role of regulatory trust in consumer acceptance. Ryyanen and Toivanen's (2023) analysis of online comments in Finnish media discussions revealed diverse views on the role of the state and decision-making processes in shaping the future of cultured meat. While some individuals emphasised individual choice, others favoured democratic decision-making and policy interventions, suggesting a need for balanced regulatory approaches.

Specht, Rumble, and Buck (2020) explored social media discourse surrounding cultured meat discussions, with regulatory discussions featuring prominently. Conversations highlighted the need for transparent regulations to ensure safety, quality, and consumer confidence in cultured meat products. However, these studies primarily acknowledged the role of regulations without providing extensive details on specific regulatory policies, indicating a need for further research in this area.

3.3 Links between internal and external factors

In examining the interplay of various internal and external factors, the study revealed relationships crucial for understanding the complexity of consumer attitudes towards CM such as the one between consumer knowledge and the perception of CM. Baum, Verbeke and De Steur (2022) found that prior knowledge had a limited impact on altering consumer acceptance, suggesting that mere awareness might not have been the primary driver of attitude change. Conversely, Hwang et al. (2020) reported a positive relationship between prior knowledge and consumer willingness to purchase cultured meat, highlighting the nuanced nature of the knowledge-perception relationship.

The nexus of consumer perception, attitudes, and knowledge emerged as pivotal in the context of CM too. Factors within perception, such as neophobia, fear, disgust, and curiosity, played key roles in shaping attitudes towards these novel food technologies. Strategic messaging and framing moderated negative emotions, influencing the perception-attitude relationship. Conversely, curiosity fostered open-mindedness, contributing to more favourable attitudes (Gómez-Luciano, 2019).

External factors, including ethical concerns, product attributes, information influence, social influence, perceived exclusivity, and regulatory considerations, collectively shaped consumer attitudes. Ethical issues, such as environmental sustainability and animal welfare, consistently influenced attitudes (Dean et al., 2023; Weinrich, Strack & Neugebauer, 2020). Product attributes, including healthiness and naturalness, impacted consumer attitudes, with these perceptions contributing to overall acceptance (Gómez-Luciano, 2019; Giacalone & Jaeger, 2023). Information influence played a pivotal role as well, with message framing affecting consumers' willingness to pay for CM products (Zhang, Shi & Sheng, 2022). Social influence, both through peer opinions and social image motivations, shaped consumer attitudes too (Chong, Leung & Lua, 2022; Leong, 2022). Additionally, perceived exclusivity and regulatory considerations influenced consumer attitudes, highlighting the need for a holistic approach.

The relationship between attitudes and intentions played an important role in consumer acceptance. Positive attitudes towards the environmental benefits of cultured meat were associated with a higher intention to accept it (Dean et al., 2023). Positively framed messages influenced attitudes, leading to greater intentions to purchase artificial meat products (Zhang, Shi & Sheng, 2022). Creating a sense of exclusivity through scarcity appeals positively affected consumer intentions to try cultured meat (Arango, Chaudhury & Septianto, 2023).

The dynamic interplay between internal and external factors in shaping attitudes underscored the complexity of consumer perceptions towards cultured and artificial meat. The overview highlighted the role of attitudes in shaping consumer intentions,

emphasising the importance of cultivating positive attitudes to drive the adoption of these innovative food products.

4 The Conceptual Framework – CAPA model

This section builds upon the exploration of factors affecting consumer behavior and decision-making, obtained from the SLR. It takes a step towards constructing a tailored conceptual framework aimed at assessing consumer responses to innovative food products, with a focus on CM. In acknowledging the limitations of existing work within this context, the development of a more holistic and adaptable conceptual framework becomes imperative, particularly to address the nuanced interplay of decision factors influencing consumer behavior during the pre-purchase stage of CM. This section presents the conceptual framework developed from this research, called CAPA (Cultured Meat Attitude and Perception Assessment).

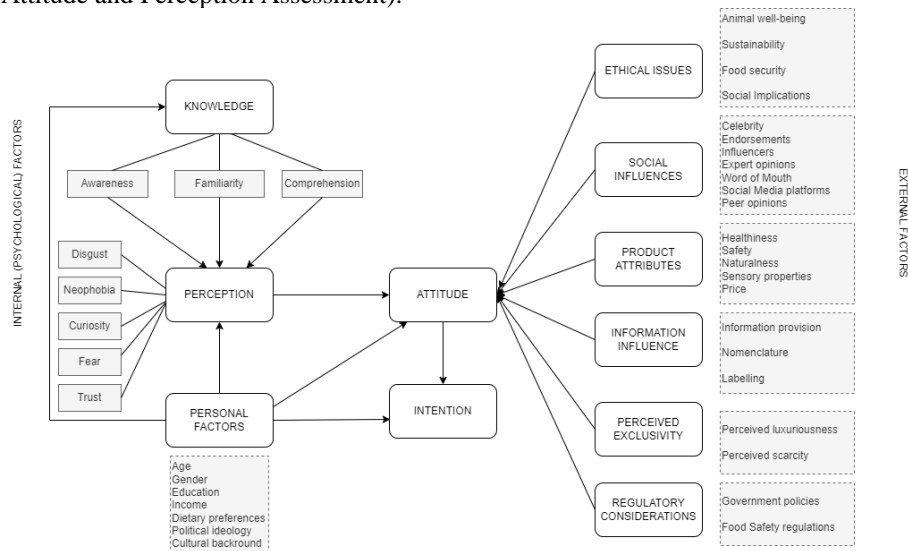


Fig. 2. Cultured Meat Attitude and Perception Assessment (CAPA) framework

Firstly, the CAPA model (Figure 2) introduces a multidimensional approach to knowledge, encompassing awareness, comprehension, and familiarity, as a foundational element. This dimension recognises that consumers' knowledge about cultured meat goes beyond mere awareness and includes a deeper understanding of the product. It shows the dynamic nature of the knowledge construct, acknowledging that consumers may transition between different levels of knowledge, influencing their perceptions towards CM. Consequently, the model aims to illustrate the connections between these knowledge dimensions and their impact on consumer perceptions and attitudes towards CM. By examining how awareness, comprehension, and familiarity interact with the perception construct, the framework offers insights into the cognitive processes underlying consumer decision-making about the product. This approach to knowledge about

CM acknowledges that informed decisions about cultured meat require more than surface-level awareness (Pakseresht et al., 2022).

Secondly, the proposed model incorporates the construct of perception, including emotional responses such as fear, neophobia, disgust, trust, and curiosity. This addition illustrates the emotional dimension of consumer decision-making, which can strongly influence attitudes and intentions (Bettman and Park, 1980; Verbeke et al., 2015; Hornsey & Fielding, 2017). Within the CAPA framework, perception is shown as an interplay between cognitive (knowledge construct) and affective processes (emotions, feelings, attitude), shaping consumer intentions towards CM. By recognising the varied nature of perception, the CAPA model provides a comprehensive understanding of the factors driving consumer behavior in the context of CM adoption.

Thirdly, the CAPA model places significant emphasis on external factors that can impact consumer attitudes and intentions. These external factors include Ethical Issues (sustainability, animal well-being, food security, social implications), Social Influences (celebrity endorsements, influencers, expert opinions, word-of-mouth, social media platforms, peer opinions), Product Attributes (healthiness, safety, naturalness, sensory properties, price), Information Influence (information provision, nomenclature, labelling), Perceived Exclusivity (perceived luxuriousness, perceived scarcity), Regulatory considerations (government policies, food safety regulations). While existing frameworks, such as Theory of Planned Behaviour (TPB) acknowledges the influence of external factors to some extent (Ajzen, 1991), they may not comprehensively address the dynamics of these influences in the context of CM. By integrating the external influences into the framework, CAPA provides a more complete understanding of the contextual factors shaping consumer attitudes and intentions towards CM, enabling researchers and industry practitioners to develop targeted interventions and strategies to promote the acceptance and adoption of CM products.

While CAPA model shares some commonalities with the existing models in recognising the importance of attitudes and intentions, the proposed framework extends further by incorporating additional dimensions such as knowledge, interest, perception, and a more comprehensive consideration of external influences. These additions allow to provide a more holistic understanding of consumer behavior in the context of emerging food products like cultured meat.

5 Contribution to new knowledge

Having established the CAPA model as a response to the nuanced dynamics of consumer behaviour, it is important to explore the broader landscape and evaluate existing models that have traditionally shaped the understanding of consumer decision-making. One foundational model for understanding consumer behavior is the Attention, Interest, Desire, Action (AIDA) model (Lavidge & Steiner, 1961), which consists of four stages: Attention, Interest, Desire, and Action. Commencing with Attention, where consumers

become aware, the process unfolds through cultivating Interest, transforming into Desire, and culminating in Action. Another, the Consumer Decision Journey (CDJ) model, provides a comprehensive perspective by dividing the consumer journey into three phases: pre-purchase, purchase, and post-purchase (Lemon & Verhoef, 2016). Understanding the pre-purchase stage is important as it represents the initial phase of the consumer decision journey, where consumers first encounter a product or brand, prompting their Attention. During this stage, consumers accumulate knowledge and develop Interest in the product, simultaneously forming Desire based on the gathered information. The journey then progresses to Action, marking the point where consumers make their ultimate decision. In the context of CM, it is during this phase that consumers become aware of cultured meat, acquire knowledge about it, and initiate the formation of their attitudes (Pakseresht et al., 2022). Several factors, including knowledge, external influences, and emotional responses, come into play during this stage, influencing consumers' eventual decisions (Fishbein, 1963; Lemon & Verhoef, 2016).

Since cultured meat has not yet reached the market, the purchase phase, involving interactions with the product, brand, and overall purchase experience, cannot be assessed and therefore, is not applicable. Similarly, the post-purchase phase, encompassing consumer experiences following product consumption, engagement, and potential word-of-mouth interactions, cannot be observed as there is no tangible product for consumers to evaluate (Lemon & Verhoef, 2016). Nonetheless, the pre-purchase stage serves as an opportunity for investigating consumer attitudes and intentions towards CM. In this context, the research aims to delve into the factors that influence this critical stage of decision-making, specifically focusing on knowledge, perceptions, and external influences.

While the AIDA and CDJ models have proven valuable in traditional contexts, their limitations surface when applied to the exploration of consumer behavior in the context of food innovations like CM. These models predominantly focus on the stages of Attention, Interest, Desire, and Action, potentially overlooking the intricate dynamics of consumer responses to innovative food products (Lavidge & Steiner, 1961). They may not fully accommodate the multifaceted nature of attitudes shaped by factors like knowledge, emotions (fear, disgust, curiosity, neophobia, and skepticism), and external influences, which are particularly pertinent in terms of CM (Hornsey & Fielding, 2017; Verbeke et al., 2015). Moreover, they may only partially emphasise external influences, such as marketing and advertising, potentially falling short in comprehensively addressing the diverse set of external drivers and barriers that significantly affect consumer attitudes and intentions regarding CM. These include perceived exclusivity, ethical considerations, societal influences, product information, product attributes, and regulatory considerations. Finally, these conventional models may provide limited attention to the multidimensional aspect of knowledge (encompassing awareness, comprehension, and familiarity), which plays an important role in influencing consumer behavior and decision-making in the context of cultured meat (Pakseresht et al., 2022). Given these complexities, there is a need for a more holistic and adaptable framework that can better capture the nuanced dynamics in consumer responses to novel food innovations such as CM.

Considering other relevant frameworks for understanding consumer behavior in the pre-purchase stage, where attitudes and intentions play a primary role, the Technology Acceptance Model (TAM) (Davis, 1986) emerges as a well-recognised theory tailored for technology adoption. TAM primarily focuses on the interplay between perceived ease of use and usefulness, significantly influencing users' attitudes and subsequent behavioral intentions towards technology (Davis, 1986). However, its applicability to understanding consumer behavior regarding novel food products like CM may be limited due to its focus on technology acceptance. While TAM offers insights into technology adoption, it may not fully capture the complexities associated with consumer attitudes and behaviors towards CM (Venkatesh et al., 2003). The model's emphasis on technology-related factors, such as perceived ease of use and usefulness, may overlook elements integral to food acceptance, such as sensory perceptions, ethical considerations, cultural norms (Venkatesh et al., 2003). Furthermore, TAM's focus on perceived ease of use and usefulness may not fully account for the emotional and ethical dimensions influencing consumer acceptance of CM, where factors like disgust, curiosity, and ethical concerns play a role (Hornsey & Fielding, 2017; Verbeke et al., 2015). Therefore, while TAM provides valuable insights into technology adoption, its suitability for understanding consumer behavior towards novel food innovations like CM may be limited.

To address these limitations and offer a more comprehensive framework for understanding consumer behaviour in the context of cultured meat, the Theory of Planned Behavior (TPB) appears as a relevant option. Developed as an extension of the Theory of Reasoned Action (TRA), TPB emphasises attitudes, subjective norms, and perceived behavioural control, providing insights into consumer behaviour (Ajzen, 1991). While TPB focuses on these key elements, the proposed CAPA framework extends the scope, encompassing a wider array of factors to offer a deeper understanding in the context of CM. In contrast to TPB's emphasis, CAPA introduces additional dimensions, including emotional responses, external influences, and the multidimensional aspect of knowledge. TPB suggests that attitudes, subjective norms, and perceived behavioral control collectively shape an individual's intentions, guiding their behaviour (Fishbein, 1963; Ajzen, 1985). This aligns with the significance of attitudes driven by knowledge and external influences in shaping consumer perceptions of CM. External factors such as, marketing strategies, societal trends, and regulatory considerations influence consumer attitudes, along with subjective norms reflecting societal expectations (Ajzen & Fishbein, 1980). While TPB acknowledges the importance of these factors, the CAPA framework further enhances understanding by considering additional dimensions. Although TPB centers on attitudes, subjective norms, and perceived behavioural control, CAPA extends beyond these components, offering a more holistic perspective on consumer behavior in the pre-purchase stage.

The evaluation of models, from AIDA and CDJ to TAM and TPB, highlights the importance of a nuanced understanding of the consumer decision-making, particularly in the context of CM. In addressing these complex dynamics, the CAPA model provides to be a useful tool, offering a comprehensive insight into consumer behaviour during the pre-purchase phase.

6 Conclusions

This research discussed the complexities of consumer behaviour concerning cultured meat (CM) acceptance, employing a systematic literature review (SLR) as the primary methodology. The SLR identified and critically evaluated decision factors influencing consumer perceptions and attitudes, serving a foundation for developing the Cultured Meat Attitude and Perception Assessment (CAPA) model. This novel framework extends traditional models like AIDA, CDJ, and TPB, which proved to be limited in capturing the complex dynamics of innovative food products. The developed CAPA model stands as a valuable contribution to understanding consumer behavior in the context of food innovations, providing insights for industry stakeholders, decision-makers, policymakers, and researchers navigating this evolving field.

While this study advances the understanding of consumer behaviour regarding CM acceptance through the design of the CAPA model, it is important to acknowledge limitations in both the overall paper and the proposed framework. Firstly, the generalisability of findings may be restricted by the SLR's scope, which primarily encompasses existing literature rather than incorporating real-world data or diverse demographic perspectives. Secondly, while comprehensive, the CAPA framework itself is subject to certain constraints. For instance, its dependence on self-reported data for understanding consumer attitudes and perceptions may introduce response biases and limitations in accurately capturing the complexities of consumer behaviour. Future research could address these limitations by incorporating diverse methodological approaches, such as empirical studies and qualitative research, to provide a better understanding of consumer behaviour and enhance the generalisability of findings.

Considering the implications of the CAPA framework, it reveals its potential applications beyond CM, including other innovative foods such as 3D printed food products, cultured seafood, cultured eggs, as well as other consumer behaviour contexts, such as the acceptability of healthcare treatments. Additionally, examining the practical implications of applying the CAPA framework for stakeholders such as food manufacturers, marketers, policymakers, and researchers could be beneficial, as insights gained could inform strategic decision-making, product development, and policy initiatives to promote consumer acceptance of novel food technologies.

The next step of this study will be firstly, to conduct a sentiment analysis using data from Twitter to refine the conceptual framework, exploring possible additional factors that may influence consumer perceptions and attitudes towards CM. This will be followed by collecting primary data via a questionnaire survey and analysing the responses through Structural Equation Modelling to quantify the relationships between different constructs and factors within the CAPA model.

Acknowledgments. This research was conducted as part of a Doctoral Training Account (DTA) funded by the University of Plymouth.

References (Note: not all 67 papers included in the SLR but only selected key references are listed here because of page limit)

- Ajzen, I. (1985) From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), *Action control: From cognition to behavior* (pp. 11-39). Springer.
- Ajzen, I. (1991) The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.
- Ajzen, I., & Fishbein, M. (1980) *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall
- Arango, L., Chaudhury, S. H. & Septianto, F. (2023) 'The role of demand-based scarcity appeals in promoting cultured meat'. *Psychology & Marketing*, 40 (8), pp. 1501-1520.
- Arora, R. S., Brent, D. A. & Jaenicke, E. C. (2020) 'Is India Ready for Alt-Meat? Preferences and Willingness to Pay for Meat Alternatives'. *Sustainability*, 12 (11),
- Asioli, D., Bazzani, C. & Nayga Jr, R. M. (2022) 'Are consumers willing to pay for in-vitro meat? An investigation of naming effects'. *Journal of Agricultural Economics*, 73 (2), pp. 356-375.
- Asioli, D., Fuentes-Pila, J., Alarcón, S., Han, J., Liu, J., Hocquette, J.-F. & Nayga, R. M. (2022) 'Consumers' valuation of cultured beef Burger: A Multi-Country investigation using choice experiments'. *Food Policy*, 112
- Baum, C. M., Bröring, S. & Lagerkvist, C.-J. (2021) 'Information, attitudes, and consumer evaluations of cultivated meat'. *Food Quality and Preference*, 92
- Baum, C. M., De Steur, H. & Lagerkvist, C.-J. (2023) 'First impressions and food technology neophobia: Examining the role of visual information for consumer evaluations of cultivated meat'. *Food Quality and Preference*, 110 pp. 104957.
- Baum, C. M., Verbeke, W. & De Steur, H. (2022) 'Turning your weakness into my strength: How counter-messaging on conventional meat influences acceptance of cultured meat'. *Food Quality and Preference*, 97 pp. 104485.
- Bekker, G. A., Fischer, A. R. H., Tobi, H. & van Trijp, H. C. M. (2017) 'Explicit and implicit attitude toward an emerging food technology: The case of cultured meat'. *Appetite*, 108 pp. 245-254.
- Bekker, G. A., Tobi, H. & Fischer, A. R. H. (2017) 'Meet meat: An explorative study on meat and cultured meat as seen by Chinese, Ethiopians and Dutch'. *Appetite*, 114 pp. 82-92.
- Bettman, J. R., & Park, C. W. (1980). Effects of prior knowledge and experience and phase of the choice process on consumer decision processes: A protocol analysis. *Journal of Consumer Research*, 7(3), 234-248.
- Booth, A., Papaioannou, D., & Sutton, A. (2012). *Systematic approaches to a successful literature review*. Sage Publications.
- Bryant, C., van Nek, L. & Rolland, N. C. M. (2020) 'European Markets for Cultured Meat: A Comparison of Germany and France'. *Foods*, 9 (9),
- Bryant, C. J., Anderson, J. E., Asher, K. E., Green, C. & Gasteratos, K. (2019) 'Strategies for overcoming aversion to unnaturalness: The case of clean meat'. *Meat Science*, 154 pp. 37-45.
- Bryant, C. J. & Barnett, J. C. (2019) 'What's in a name? Consumer perceptions of in vitro meat under different names'. *Appetite*, 137 pp. 104-113.
- Califano, G., Furno, M. & Caracciolo, F. (2023) 'Beyond one-size-fits-all: Consumers react differently to packaging colors and names of cultured meat in Italy'. *Appetite*, 182 pp. 106434.

Chong, M., Leung, A. K. & Lua, V. (2022) 'A cross-country investigation of social image motivation and acceptance of lab-grown meat in Singapore and the United States'. *Appetite*, 173 pp. 105990.

Choudhury, D., Tseng, T. W., & Swartz, E. (2020). The Business of Cultured Meat. *Trends in Biotechnology*, 38(6), 573-577.

Davis, F.D. (1986) A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results. Sloan School of Management, Massachusetts Institute of Technology.

Da Silva, C. P. & Semprebon, E. (2021) 'How about Cultivated Meat? the Effect of Sustainability Appeal, Environmental Awareness and Consumption Context on Consumers' Intention to Purchase'. *Journal of Food Products Marketing*, 27 (3), pp. 142-156.

da Silva, M. B. D. O., & da Cunha, C. F. (2022). Understanding the perception of potential consumers of cultured meat using free word association. *REMark*, 21(5), pp. 1527-1573.

Denyer, D., & Tranfield, D. (2009). Producing a systematic review. In D. Buchanan, D. A. Denyer, D. A. (Eds.), *Handbook of Organizational Research Methods* (pp. 671-689). Sage Publications.

de Oliveira, G. A., Domingues, C. H. d. F. & Borges, J. A. R. (2021) 'Analyzing the importance of attributes for Brazilian consumers to replace conventional beef with cultured meat'. *PLoS ONE*, 16 (5), pp. e0251432.

de Oliveira Padilha, L. G., Malek, L. & Umberger, W. J. (2022) 'Consumers' attitudes towards lab-grown meat, conventionally raised meat and plant-based protein alternatives'. *Food Quality and Preference*, 99 pp. 104573.

Dean, D., Rombach, M., Vriesekoop, F., de Koning, W., Aguiar, L. K., Anderson, M., Mongondry, P., Urbano, B., Gómez Luciano, C. A., Jiang, B., Boereboom, A., Satyajaya, W., Yulindari, P., Rashid, F., Khan, I. & Alvarez, B. (2023) 'Should I Really Pay a Premium for This? Consumer Perspectives on Cultured Muscle, Plant-Based and Fungal-Based Protein as Meat Alternatives'. *Journal of International Food & Agribusiness Marketing*, pp. 1-25.

Dupont, J. & Fiebelkorn, F. (2020) 'Attitudes and acceptance of young people toward the consumption of insects and cultured meat in Germany'. *Food Quality and Preference*, 85 pp. 103983.

Dupont, J., Harms, T. & Fiebelkorn, F. (2022) 'Acceptance of Cultured Meat in Germany-Application of an Extended Theory of Planned Behaviour'. *Foods*, 11 (3),

Fernandes, A. M., Teixeira, O. d. S., Revillion, J. P. & Souza, Â. R. L. d. (2022) 'Beef as a socio-cultural identity: Rural and urban consumers' attitudes from Rio Grande do sul, Brazil, facing cultured beef'. *Journal of Rural Studies*, 95 pp. 438-448.

Fernandes, A. M., Teixeira, O. d. S., Fantinel, A. L., Revillion, J. P. P., & Souza, Â. R. L. d. (2022). Technological prospecting: The case of cultured meat. *Future Foods*, 6, 100156.

Fishbein, M. (1963). An investigation of the relationships between beliefs about an object and the attitude toward that object. *Human relations*, 16(3), 233-239.

Giacalone, D. & Jaeger, S. R. (2023) 'Consumer acceptance of novel sustainable food technologies: A multi-country survey'. *Journal of Cleaner Production*, 408 pp. N.PAG-N.PAG.

Gómez-Luciano, C. A., de Aguiar, L. K., Vriesekoop, F. & Urbano, B. (2019) 'Consumers' willingness to purchase three alternatives to meat proteins in the United Kingdom, Spain, Brazil and the Dominican Republic'. *Food Quality and Preference*, 78

- Gousset, C., Gregorio, E., Marais, B., Rusalen, A., Chriki, S., Hocquette, J.-F. & Ellies-Oury, M.-P. (2022) 'Perception of cultured "meat" by French consumers according to their diet'. *Livestock Science*, 260 pp. 104909.
- Hamlin, R. P., McNeill, L. S. & Sim, J. (2022) 'Food neophobia, food choice and the details of cultured meat acceptance'. *Meat Science*, 194 pp. 108964.
- Hocquette, É., Liu, J., Ellies-Oury, M.-P., Chriki, S. & Hocquette, J.-F. (2022) 'Does the future of meat in France depend on cultured muscle cells? Answers from different consumer segments'. *Meat Science*, 188 pp. 108776.
- Hornsey, M. J., & Fielding, K. S. (2017). Attitude roots and jiu jitsu persuasion: Understanding and overcoming the motivated rejection of science. *American Psychologist*, 72(5), 459-473
- Hubalek, S., Post, M. J., & Moutsatsou, P. (2022). Towards resource-efficient and cost-efficient cultured meat. *Current Opinion in Food Science*, 47, 100885.
- Hwang, J., You, J., Moon, J. & Jeong, J. (2020) 'Factors Affecting Consumers' Alternative Meats Buying Intentions: Plant-Based Meat Alternative and Cultured Meat'. *Sustainability*, 12 (14)
- Krings, V. C., Dhont, K. & Hodson, G. (2022) 'Food technology neophobia as a psychological barrier to clean meat acceptance'. *Food Quality and Preference*, 96 pp. 104409.
- Lavidge, R. J., & Steiner, G. A. (1961). A Model for Predictive Measurements of Advertising Effectiveness. *Journal of marketing*, 25(6), 59
- Lemon, K. N., & Verhoef, P. C. (2016). Understanding Customer Experience Throughout the Customer Journey. *Journal of marketing*, 80(6), 69-96
- Leong, A. D. (2022) 'Framing in the social media era: Socio-psychological mechanisms underlying online public opinion of cultured meat'. *New Media and Society*, 1- 19
- Leung, A. K. y., Chong, M., Fernandez, T. M. & Ng, S. T. (2023) 'Higher well-being individuals are more receptive to cultivated meat: An investigation of their reasoning for consuming cultivated meat'. *Appetite*, 184 pp. 106496.
- Li, H., Van Loo, E. J., Trijp, H. C. M. v., Chen, J. & Bai, J. (2023) 'Will cultured meat be served on Chinese tables? A study of consumer attitudes and intentions about cultured meat in China'. *Meat Science*, 197 pp. 109081.
- Lin-Hi, N., Reimer, M., Schäfer, K. & Böttcher, J. (2023) 'Consumer acceptance of cultured meat: an empirical analysis of the role of organizational factors'. *Journal of Business Economics*, 93 (4), pp. 707-746.
- Liu, J., Hocquette, E., Ellies-Oury, M. P., Chriki, S. & Hocquette, J. F. (2021) 'Chinese Consumers' Attitudes and Potential Acceptance toward Artificial Meat'. *Foods*, 10 (2),
- Mancini, M. C. & Antonioli, F. (2019) 'Exploring consumers' attitude towards cultured meat in Italy'. *Meat Science*, 150 pp. 101-110.
- María Ignacia Rodríguez, E., Cadena, E., Nhu, T. T., Cooreman-Algoed, M., De Smet, S., & Dewulf, J. (2021). Analysis of the Cultured Meat Production System in Function of Its Environmental Footprint: Current Status, Gaps and Recommendations. *Foods*, 10(12), 2941.
- Motoki, K., Park, J., Spence, C. & Velasco, C. (2022) 'Contextual acceptance of novel and unfamiliar foods: Insects, cultured meat, plant-based meat alternatives, and 3D printed foods'. *Food Quality and Preference*, 96
- Onwezen, M. C., Bouwman, E. P., Reinders, M. J., & Dagevos, H. (2021). A systematic review on consumer acceptance of alternative proteins: Pulses, algae, insects, plant-based meat alternatives, and cultured meat. *Appetite*, 159, 105058.

Palmieri, N., Perito, M. A. & Lupi, C. (2020) 'Consumer acceptance of cultured meat: some hints from Italy'. *British Food Journal*, 123 (1), pp. 109-123.

Pakseresht, A., Ahmadi Kaliji, S., & Canavari, M. (2022). Review of factors affecting consumer acceptance of cultured meat. *Appetite*, 170, 105829.

Piochi, M., Micheloni, M. & Torri, L. (2022) 'Effect of informative claims on the attitude of Italian consumers towards cultured meat and relationship among variables used in an explicit approach'. *Food Research International*, 151 pp. 110881.

Rosenfeld, D. L. & Tomiyama, A. J. (2022) 'Would you eat a burger made in a petri dish? Why people feel disgusted by cultured meat'. *Journal of Environmental Psychology*, 80

Ruzgys, S. & Pickering, G. J. (2020) 'Perceptions of Cultured Meat Among Youth and Messaging Strategies'. *Frontiers in Sustainable Food Systems*, 4

Ryynanen, T. & Toivanen, A. (2023) 'Hocus-pocus tricks and moral progressions: the emerging meanings of cultured meat in online news comments'. *Food Culture & Society*, 26 (3), pp. 591-620.

Septianto, F., Quach, S., Thaichon, P. & Japutra, A. (2023) 'Novel products and advertising visuals: the mediating role of perceived luxuriousness on willingness to try clean meat products'. *International Journal of Advertising*, 42 (5), pp. 916-944.

Septianto, F., Sung, B. L. Y., Duong, C. & Conroy, D. (2023) 'Are two reasons better than one? How natural and ethical appeals influence consumer preferences for clean meat'. *Journal of Retailing and Consumer Services*, 71

Shan, L. J., Jiao, X. L., Wu, L. H., Shao, Y. C. & Xu, L. L. (2022) 'Influence of Framing Effect on Consumers' Purchase Intention of Artificial Meat-Based on Empirical Analysis of Consumers in Seven Cities'. *Frontiers in Psychology*, 13

Siegrist, M., Bearth, A. & Hartmann, C. (2020) 'Food disgust sensitivity influences the perception of food hazards: Results from longitudinal and cross-cultural studies'. *Appetite*, 153 pp. 104742.

Siegrist, M. & Hartmann, C. (2020) 'Perceived naturalness, disgust, trust and food neophobia as predictors of cultured meat acceptance in ten countries'. *Appetite*, 155 pp. 104814

Siddiqui, S. A., Khan, S., Ullah Farooqi, M. Q., Singh, P., Fernando, I., & Nagdalian, A. (2022). Consumer behavior towards cultured meat: A review since 2014. *Appetite*, 179, 106314.

Specht, A. R., Rumble, J. N. & Buck, E. B. (2020) "'You Call that Meat?'" Investigating Social Media Conversations and Influencers Surrounding Cultured Meat'. *Journal of Applied Communications*, 104 (1),

Stephens, N., Di Silvo, L., Dunsford, I., Ellis, M., Glencross, A., & Sexton, A. (2018). Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in cellular agriculture. *Trends in Food Science & Technology*, 78, 155-166.

Tomiyama, A. J., Kawecki, N. S., Rosenfeld, D. L., Jay, J. A., Rajagopal, D., & Rowat, A. C. (2020). Bridging the gap between the science of cultured meat and public perceptions. *Trends in Food Science & Technology*, 104, 144-152.

Tsvakirai, C. Z., Nalley, L. L. & Makgopa, T. (2023) 'Development and validation of a cultured meat neophobia scale: Industry implications for South Africa'. *Scientific African*, 20

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.

Verbeke, W., Hung, Y., Baum, C. M. & De Steur, H. (2021) 'The power of initial perceived barriers versus motives shaping consumers' willingness to eat cultured meat as a substitute for conventional meat'. *Livestock Science*, 253 pp. 104705.

Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D. & Barnett, J. (2015) 'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom'. *Meat Science*, 102 pp. 49-58.

Verbeke, W., Sans, P. & Van Loo, E. J. (2015) 'Challenges and prospects for consumer acceptance of cultured meat'. *Journal of Integrative Agriculture*, 14 (2), pp. 285-294.

Weinrich, R., Strack, M. & Neugebauer, F. (2020) 'Consumer acceptance of cultured meat in Germany'. *Meat Science*, 162 pp. 107924.

Wilks, M. & Phillips, C. J. (2017) 'Attitudes to in vitro meat: A survey of potential consumers in the United States'. *PLoS ONE*, 12 (2), pp. e0171904.

Wilks, M., Phillips, C. J. C., Fielding, K. & Hornsey, M. J. (2019) 'Testing potential psychological predictors of attitudes towards cultured meat'. *Appetite*, 136 pp. 137-145.

Zhang, J., Shi, H. & Sheng, J. (2022) 'The effects of message framing on novel food introduction: Evidence from the artificial meat products in China'. *Food Policy*, 112 pp. 102361.

Zhang, M., Li, L. & Bai, J. (2020) 'Consumer acceptance of cultured meat in urban areas of three cities in China'. *Food Control*, 118 pp. 107390.