

Are Malaysians ready for the future of food? Exploring intentions to embrace cultured meat

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Abstract

With growing global concerns about food security, environmental sustainability, and industrial farming ethics, cultured meat (CM) presents a potential solution. However, consumer acceptance remains a critical challenge. This study explored Malaysian consumers' perceptions of CM as a sustainable alternative to conventional animal protein. Using a transcendental phenomenological approach, nine in-depth interviews with diverse Malaysian consumers identified key motivations and barriers to CM consumption. Thematic analysis revealed four major themes: personal motivations, concerns, community-level opportunities, and societal challenges. While participants expressed curiosity and acknowledged CM's potential benefits for hygiene, sustainability, and food security, apprehensions about unfamiliarity, food neophobia, sensory limitations, affordability, and perceived health risks persisted. Additionally, scepticism toward corporations, cultural and religious considerations, and uncertainty surrounding Halal certification further influenced acceptance. These findings underscore the need for transparent communication, regulatory clarity, and targeted education to build consumer trust. This study provides valuable insights for policymakers and industry stakeholders aiming to promote sustainable food innovations in culturally diverse markets. Future research should expand on these findings through ethnographic and longitudinal studies, focus groups, or community-based participatory research, prioritising rich, context-driven narratives to deepen understanding of evolving consumer attitudes toward CM.

1. Introduction

Sustainability research has surged since 2015, driven by the global commitment to the 17 UN Sustainable Development Goals (SDGs) by 2030. Experts emphasise that transforming food systems is crucial for reshaping consumer habits and accelerating progress (United Nations, 2021, 2022). By 2050, feeding a projected global population of 9.73 billion will require increasing overall food production by 50% to 70% (OECD/FAO, 2022), with demand for animal-based proteins expected to rise by 70% (Adesogan *et al.*, 2020). While global food production has kept pace with population growth over the past 50 years (Willett *et al.*, 2019), dietary patterns have shifted toward more resource-intensive and energy-dense foods (Tallard *et al.*, 2022). As the global middle class expands, the demand for animal protein continues to rise (Sadowski *et al.*, 2024).

Although per capita meat consumption is lower, Asia leads in total meat consumption, consuming twice the volume of Europe and North America combined (Wang and Scrimgeour, 2021). This trend is particularly evident in Southeast Asia (SEA), where economic progress has driven a "dietary shift" from plant-based to animal-source proteins (Drewnowski *et al.*, 2020). In Malaysia, an upper-middle-income nation, total protein intake exceeds recommended guidelines (Lee *et al.*, 2019), with chicken being the most consumed meat (Khusun *et al.*, 2022). Over the past six decades, Malaysian meat consumption has increased by 375% (+141.25 g/day), the highest in SEA, surpassing the global average increase of 87% (FAO, 2023).

Despite Malaysia's high demand for animal protein, the country's self-sufficiency ratio (SSR) remains low, with only 18.4% for beef and 10.6% for mutton in 2021 (Department of Statistics Malaysia, 2022), making it

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heavily reliant on imports. The COVID-19 pandemic further worsened food security challenges, as prior national policies had reduced local livestock production, worsening supply shortages (Mohamed Arshad, 2022). In response, the Veterinary Services Department Malaysia announced plans to expand cattle farming to reduce reliance on ruminant imports (Shah, 2020; Ministry of Agriculture and Food Industries, 2021).

However, continued reliance on conventional animal agriculture presents significant environmental, social, and ethical challenges (Byrne and Murray, 2021). Large-scale livestock farming drives deforestation and habitat destruction due to the increased demand for feed crops (Garcia *et al.*, 2017). The sector also contributes to greenhouse gas emissions, exacerbating climate change (Reisinger and Clark, 2018). Additionally, close human-livestock interactions heighten the risk of zoonotic disease outbreaks, such as swine flu and avian flu, posing significant public health threats (Klous *et al.*, 2016). Compounding these issues, the widespread use of antibiotics in livestock for disease prevention and growth promotion accelerates the emergence of antimicrobial-resistant (AMR) bacteria, a growing global health concern (Rahman *et al.*, 2022).

Growing concerns over animal products' negative impact have led to increased demand for alternative protein sources (Sá *et al.*, 2020). Potential alternatives include plant-based proteins (e.g., cereals, legumes, and pseudo-cereals), unconventional sources (e.g., agro-industrial by-products), microorganisms (e.g., fungi and bacteria), algae, cellular agriculture, and insects (Loveday, 2020). Despite the widespread availability of plant-based products, consumer acceptance remains limited, with low-quality and poor-taste experiences cited as primary reasons for rejection (Kerry, 2019; Lang, 2020). Compared to well-established protein sources, significantly less is known about emerging alternatives such as cultured meat (CM) (Otero *et al.*, 2022).

Initially developed for medical applications to regenerate damaged tissue, CM technology involves culturing muscle cells from biopsied skeletal muscle stem cells in a nutrient-rich serum within a controlled bioreactor, eliminating the need for animal slaughter (Stephens *et al.*, 2018; Post *et al.*, 2020). Various terminologies have been used to describe CM, including clean (Bryant and Barnett, 2019), in vitro (Baum *et al.*, 2021), lab-grown (Van Loo *et al.*, 2020), cultivated (United Nations Environment Programme, 2023), cell-based (Ong *et al.*, 2020), and artificial meat (Liu *et al.*, 2021). Proponents argue that CM is a more sustainable alternative to conventional meat, utilising resources more efficiently, reducing the environmental footprint of

industrial animal farming, and optimising feed-to-meat conversion (Boereboom *et al.*, 2022; Chen *et al.*, 2022). However, the validity of this claim remains uncertain, as CM has only recently been approved for sale in three countries worldwide.

Under the principle of "Food Security is a Shared Responsibility," the Malaysian government is actively exploring CM and alternative proteins to strengthen national food security and sustainability. The initiative was approved by the National Food Security Policy Committee in 2024, underscoring Malaysia's commitment to agricultural modernisation (Sabu, 2024). Prime Minister Anwar Ibrahim reaffirmed this dedication, highlighting efforts to advance the industry ecosystem, integrate technology, and explore future foods such as CM and cell-based products (Ibrahim, 2024).

Notwithstanding technological and industrial advancements, consumer acceptance remains a key challenge (Bryant and Dillard, 2019). While CM has attracted widespread attention across industries, politics, and the media (Mancini and Antonioli, 2020), public scepticism persists, with some studies indicating hesitation toward its consumption (Bryant *et al.*, 2020), while others present contradictory findings (Siegrist and Hartmann, 2020), highlighting the complexity of consumer attitudes. Acceptance of CM varies globally and is influenced by factors such as media exposure, cultural dietary norms, trust in food stakeholders, and food or technology neophobia (Bryant and Barnett, 2020; Pakseresht *et al.*, 2022). Given these dynamics, this study aimed to examine Malaysian consumers' perceptions of CM's risks and benefits to inform effective communication strategies that enhance consumer understanding and acceptance.

2. Materials and methods

2.1 Method

This study employed a transcendental or descriptive phenomenological qualitative approach, which, as Lindgreen *et al.* (2021) suggest, effectively captures participants' perceptions and experiences. The primary aim was to explore informants' lived experiences using a phenomenological reduction technique. Rooted in Husserl's phenomenology, this approach follows three key steps: focusing on the object (CM) of study, applying transcendental phenomenological reduction, and identifying the essence or invariant characteristics through free fantasy variation (Giorgi *et al.*, 2017). While CM remains relatively unfamiliar in Malaysia, phenomenology, as Husserl (1964) asserts, examines the phenomenon itself rather than the individual. Moreover,

Moustakas (1994) emphasises that in transcendental investigation, the object's actual existence is secondary, as it can still manifest in consciousness.

2.2 Ethics statement

This research obtained clearance from the Ethics Committee for Research Involving Human Subjects (JKEUPM) at Universiti Putra Malaysia (JKEUPM-2023-294). Before engaging in the study, all participants granted their electronic consent by selecting "Yes, I am willing to participate in this study" in a preliminary online survey via the Google Form platform.

2.3 Participants and recruitment

Between March and April 2024, we conducted nine in-depth online interviews with Malaysian consumers from diverse demographic backgrounds, each lasting approximately 1 h. Participants were recruited using a combination of convenience and maximum variation purposive sampling, allowing for the exploration of common patterns across a heterogeneous sample (Palinkas *et al.*, 2015). Key demographic variations included age, gender, dietary preference and race (Table 1).

Recruiters employed multiple outreach strategies, such as word-of-mouth, posters, and social media, to engage potential participants. Eligibility was restricted to Malaysian citizens or permanent residents in the Klang Valley aged 20 and above. Klang Valley was selected due to its diverse, urbanised population, which is generally more exposed to emerging food technologies and global food trends, making it a suitable region for studying CM acceptance (Shaw and Mac Con Iomaire, 2019; Zhang *et al.*, 2020). Additionally, as Malaysia's central hub for the food industry, research institutions, and regulatory bodies, Klang Valley provides valuable insights into market feasibility and consumer perceptions, particularly as CM is expected to be introduced there first.

Interested individuals submitted their contact details and demographic information via a Google Form. To

acknowledge their contributions and compensate for time and effort, each participant received RM100. Financial incentives have been shown to enhance response rates and reduce participation burdens without evidence of undue coercion (Groth, 2010; Largent *et al.*, 2022).

2.4 Data collection and analysis procedure

This study employed Castillo-Montoya's (2016) Interview Protocol Refinement (IPR) Framework, an approach designed to enhance the rigour of qualitative research, particularly in multicultural settings, as recommended by Shoozan and Mohamad (2024). Following the guidance of Giorgi *et al.* (2017) and Moustakas (1994), the interviews began with two broad, open-ended questions: "What have you observed about the CM phenomenon?" and "How has the CM phenomenon impacted or changed your experiences?" followed by follow-up questions exploring their perceptions.

Data analysis was conducted using Moustakas's (1994) phenomenological method, supplemented by techniques from Giorgi *et al.* (2017), chosen for their clarity and accessibility to novice qualitative researchers (Creswell and Creswell, 2018). To ensure the researcher's objectivity, bracketing was applied throughout the study, as Chriki *et al.* (2022) emphasised the need to exclude researcher bias to capture participants' perspectives accurately.

During the interviews, detailed reflective and descriptive notes were taken, and transcriptions were completed verbatim immediately after each session. Initial coding was conducted as part of an iterative process, and by the seventh interview, data saturation was reached. Two additional interviews were conducted to confirm this, and data collection concluded at the ninth informant, as no new themes emerged. The transcribed data, derived from audio recordings and notes, were analysed using NVivo software, which is widely recommended for phenomenological studies (Vignato *et al.*, 2022).

Table 1. Profile of research participants.

Code	Age	Gender	Dietary preference	Race	Current occupation
IDI1	37	Male	Meat eaters	Chinese	Fitness instructor
IDI2	31	Female	Vegetarian	Chinese	Activist
IDI3	26	Male	Meat eaters	Indian	Medical student
IDI4	50	Male	Lacto-ovo vegetarian	Malay	Marketing Manager
IDI5	35	Male	Vegetarian	Indian	Researcher
IDI6	45	Male	Meat eaters	Malay	Software Developers
IDI7	36	Male	Flexitarian	Chinese	Programmer
IDI8	36	Female	Meat eaters	Malay	Lecturer / Dentist
IDI9	24	Male	Meat eaters	Malay	Student

3. Results

Through data analysis, four overarching themes emerged: (i) personal motivations and benefits, (ii) individual concerns and barriers, (iii) community-driven opportunities and influencing factors, and (iv) societal challenges and constraints. Each theme is further divided into subthemes, which are explored in detail in this section.

3.1 Theme 1: Personal gains and motivations

3.1.1 Curiosity

Despite general scepticism surrounding CM acceptance, curiosity emerged as a strong motivator among participants, driving their willingness to explore this novel food. Despite their initial reservations, many were open to trying CM, viewing it as an intriguing technological advancement. IDI3, who had the rare opportunity to sample CM at a climate conference, expressed excitement and admiration for its innovation, which heightened his curiosity and receptiveness. Similarly, IDI4 emphasised the need for direct experience, stating, "We won't know until we taste it. We need to give it a shot."

Beyond the mere interest in trying CM, some participants were particularly curious about its potential affordability and practicality. IDI6 speculated about its future as a widely available product, questioning, "If it's delicious, budget-friendly, and simple to prepare, why not give it a shot?" Others were drawn to the possibility that CM could be a healthier alternative. IDI8, for example, wondered about its nutritional benefits, stating, "I'm curious if this CM can be healthier than individuals like me who prioritise our health would be intrigued." These insights suggest that curiosity about its taste, affordability, and potential health benefits is key to consumer openness toward CM.

3.1.2 Safer and cleaner alternative

Another key motivation for CM consumption among participants was its perception as a safer and cleaner alternative to conventional meat, particularly in contrast to the unsanitary conditions associated with traditional slaughterhouses. Informants highlighted concerns about hygiene in meat production, viewing CM as a more controlled and sterile option. IDI7 emphasised this: "I feel like CM is a more hygienic process overall ... traditional meat is produced in messy environments, with blood, water everywhere, a bad smell, and bacteria."

3.1.3 Transparency

Participants emphasised that the success of CM hinges on transparency, particularly in fostering trust and consumer acceptance. They stressed the need for clear,

accessible information about CM's safety, benefits, and production process. IDI3 highlighted this necessity, stating that consumers must feel "informed and reassured" about the product. Transparency in communicating the environmental impact of CM was also deemed essential; as IDI7 pointed out, "People need concrete evidence of how their choices affect the environment. Without that, it's hard to see the benefits." This need for reliable information was reinforced by IDI8, who expressed greater trust in independent research over corporate claims, stating, "Findings from the lab are more aligned with reality." Collectively, these perspectives underscore the importance of transparency in shaping public confidence and ensuring the responsible development of CM.

3.1.4 Inevitability of technological advancements

The inevitability of technological advancements in food production was a key personal theme among participants. IDI6, previously unaware of CM, acknowledged its growing presence, stating, "Before this interview, I had never even heard about it ... but now I know some countries are already selling it. I guess we will see the product soon." IDI9 echoed this sentiment, emphasising adaptation to progress: "The further we move forward, the more advanced the technology becomes. So, we must accept the advancements happening now and in the future." These perspectives underscore the acceptance of innovation as a natural progression in food systems.

3.2 Theme 2: Personal concerns and obstacles

3.2.1 Unfamiliarity

Unfamiliarity with CM and its underlying technology emerged as a key personal concern, fueling scepticism and reluctance among participants. Despite being aware of other alternative proteins and supplements, informants such as IDI4, IDI6, and IDI9 admitted they had never encountered the concept of CM before. Furthermore, alternative proteins were rarely a subject of in-depth discussion within their social circles. IDI1 highlighted this lack of engagement, noting that conversations about CM often remained brief or fragmented due to limited awareness and interest. He further illustrated this hesitation when discussing CM with friends: "There's always this hesitation, like 'erm [pondering] ... I just don't believe it's safe,' they said." This reluctance underscores how unfamiliarity fosters scepticism, reinforcing the need for greater public awareness and education on CM.

3.2.2 Food neophobia

Food neophobia, the fear of trying new foods, is a natural self-preservation response and was evident in

participants' hesitation toward CM. While some were open to new experiences, they remained cautious about unfamiliar foods. IDI5 acknowledged his willingness to explore but admitted scepticism about CM: "I don't mind exploring new things, but when it comes to food, I'm not as open. I'm cautious about trying new food." Similarly, despite having a positive encounter with CM at a conference, IDI3 hesitated at the idea of trying it independently: "I don't believe I would have attempted it [CM] outside of a conference environment ... I would have had significant reservations and uncertainty." These responses highlight how food neophobia influences consumer hesitation, reinforcing the importance of familiarity and exposure in shaping acceptance.

3.2.3 Sensory limitations

Sensory attributes play a crucial role in Malaysian cuisine, and many participants expressed scepticism about CM's ability to replicate the taste and texture of conventional meat. Given its novelty, concerns arose about whether CM could deliver a familiar eating experience. IDI4 emphasised the significance of taste, stating, "We are in Malaysia, and ultimately, we cherish our flavour... Despite all the discussions surrounding the environment and technology, the fundamental question remains, does it taste good?" Similarly, past experiences with alternative proteins influenced perceptions of CM, as IDI3 noted, "Whenever I eat plant-based meat, they always feel weird when I chew them; it's not like meat at all." These responses highlight the challenge CM faces in gaining acceptance, without a convincing sensory experience, consumers may struggle to embrace it as a viable alternative.

3.2.4 Health risk

Apprehensions regarding health risks were among the most pressing concerns surrounding CM consumption. Participants voiced scepticism about its long-term effects, given its status as a novel food. The lack of familiarity fueled doubts, with IDI5 questioning, "It's very new, so people will have doubts, especially about the health aspects, like, could it cause any side effects? In the long run, might it lead to conditions such as cancer or other health issues?" Transparency in production was seen as crucial, as IDI4 stressed the need for "solid, concrete studies" to reassure consumers. He elaborated, "What we don't know is how these chemicals might react or interact with what's already in our bodies, right?" These concerns highlight the critical role of scientific validation and clear communication in fostering public trust in CM's safety.

3.2.5 Affordability

Despite their interest in CM, participants viewed cost as a significant barrier to its acceptance, fearing it would remain inaccessible to the public. IDI1 highlighted this concern: "Regardless of how sustainable CM may be if it comes with a high price tag, I won't feel inclined even to consider trying it." The financial aspect was a primary consideration in food choices, often outweighing factors like taste, ethics, or environmental impact. When asked about other influences, IDI7 acknowledged, "Well, not exactly. I still have to consider the price." Drawing from past experiences with alternative proteins, IDI1 further emphasised affordability issues, noting, "They're super expensive, so much so that I could buy four pieces of chicken breast for the same price." These concerns underscore the necessity for CM to be competitively priced to achieve mainstream acceptance.

3.2.6 Ethical concerns

Concerning the ethical implications of CM surfaced among participants, with some questioning its necessity and underlying motivations. IDI8, for instance, challenged whether CM is the right solution for food security and environmental issues, suggesting that "maybe better distribution could solve problems like hunger." This perspective reflects scepticism about whether technological advancements in food production are essential or if existing solutions could be improved instead. Similarly, IDI2 questioned the ethical rationale behind CM, asking, "The purpose of producing this type of food must be very clear. Are they doing it for fun?" These concerns highlight the importance of transparent communication about CM's intended benefits and ethical considerations to build public trust and acceptance.

3.2.7 Religious adherence

Religious adherence plays a crucial role in shaping food choices, particularly among Muslim consumers who prioritise Halal certification. Informants expressed strong concerns about CM's Halal status when considering its acceptance. While IDI8 showed interest in trying CM, she emphasised that official Halal certification would be essential for her acceptance. She further shared, "My sister, the one who works with JAKIM (the Malaysian Islamic authority)... always says, 'If a restaurant has no Halal certification, there must be something wrong because getting Halal certification is actually very easy.'"

When asked whether CM could be Halal, most Muslim participants trusted the authority responsible for certification, believing that CM could be deemed Halal if it met specific criteria. IDI6 explained, "My assumption is that it could be Halal, but I believe the *majlis fatwa*

[fatwa committee] would need to issue a ruling if they are to allow a Halal emblem on it in the future. From a technological perspective ... if the process is clean and only uses Halal ingredients... then I would assume it's Halal."

3.3 Theme 3: community-level opportunities and pull factors

3.3.1 Influence of social groups

Familial and social networks are pivotal in shaping dietary choices and influencing CM acceptance. Informants highlighted that having a knowledgeable family member can significantly impact perceptions of CM, fostering greater receptivity within their household. IDI8 illustrated this dynamic, sharing how her scientific background influences her family's food decisions: "My husband is very old-school. Usually, he'll ask me, 'Eh, can we eat this?' And then I'll explain it to him... he usually listens to my opinion, and he'll make sure his parents listen to me too." This example underscores how trust in an informed individual within a social group can ease scepticism and facilitate broader acceptance of CM.

3.3.2 Environmental contribution

Participants viewed CM as a potential solution to environmental concerns, with those already committed to sustainable lifestyles seeing it as an extension of their efforts. IDI8 stated, "If it's genuinely shown to be more beneficial for the environment [compared to conventional meat], then I would be more inclined to support CM." Similarly, IDI5 (a vegetarian) affirmed, "If CM is proven to be better for the environment, then I will try it." These responses highlight the importance of clear evidence of CM's environmental benefits in shaping consumer acceptance.

3.3.3 Food security

The COVID-19 pandemic heightened Malaysians' awareness of food security vulnerabilities, particularly the risks of heavy reliance on food imports. This concern was reflected in discussions about the potential role of CM in strengthening Malaysia's Food Self-Sufficiency Rate. Some informants considered CM a viable solution to global food distribution challenges, with IDI2 emphasising its long-term impact: "Another angle I'm looking at is whether they're doing this to address global food security issues. Could this technology help solve food distribution problems in the world? It's possible, but is it going to be a good long-term solution if we're looking 20 to 30 years ahead?"

3.4 Theme 4: community-level challenges and barriers

3.4.1 Preservation of cultural and religious traditions

Cultural and religious traditions play a pivotal role in shaping food preferences, making the acceptance of CM a complex issue for many participants. IDI2 reflected on how her aunts and uncles, raised in a village setting, firmly adhered to traditional farming and meat consumption, viewing these practices as integral to their identity. She anticipated that their dietary habits would remain unchanged, stating, "For my aunts and uncles, their views on animals and poultry are shaped by how they grew up. I believe that even 30 or 40 years from now, they will likely maintain the same eating habits."

Beyond personal habits, religious and cultural rituals heavily influence what is deemed acceptable in food choices. IDI1 voiced concerns about how CM might challenge significant religious practices such as Korban (Islamic animal sacrifice), raising doubts about its role in such traditions. The preference for conventional meat during major celebrations, such as Hari Raya and Chinese New Year, further complicates CM's acceptance. IDI1 highlighted this sentiment: "I sense that some of my friends and family may continue to prefer real meat for special occasions ... such as Hari Raya or Chinese New Year, they may express, 'Let's opt for real meat.' I mean for Korban, since CM doesn't involve slaughter, what approach would you take to carry out the ritual?" These concerns illustrate how deeply cultural and religious traditions shape food choices, potentially limiting CM's integration into long-standing practices.

3.4.2 Mistrust of large corporations

Trust in food producers and corporations emerged as a crucial factor influencing participants' acceptance of CM. Many informants expressed scepticism toward large corporations, particularly regarding their transparency and motives. IDI2 articulated this concern: "I always have a hard time believing their [food production companies] overclaims regarding benefits and safety."

This scepticism was further fueled by broader anxieties surrounding the commercialisation of sustainability, where companies often market ethical commitments that consumers perceive as performative rather than genuine. IDI3 echoed this sentiment: "It's difficult for me to have faith in what companies claim due to previous experiences and reports that I read about food recalls and such." The lack of transparency was a recurrent concern, with participants suspecting corporations might conceal potential health risks associated with CM. IDI7 noted, "If large corporations

can hide bad health effects associated with conventional meat, they could employ similar tactics with CM."

Beyond safety concerns, some participants feared that large corporations might monopolise the CM industry, potentially shifting its focus away from food security and accessibility toward profit-driven motives. IDI7 warned, "I do have concerns. While CM seems promising academically, when it hits the market, big companies might monopolise it, which could have negative effects."

4. Discussion

4.1 Personal motivations versus concerns

Since CM entered the market in 2021, numerous studies have examined consumer perceptions and acceptance. However, research on multiracial consumer groups remains limited. While some factors identified in this study align with previous findings, this section will focus on the relatively new and less explored factors, particularly within the Malaysian market.

Informants generally expressed curiosity about CM and a willingness to try it once it is available. Curiosity, driven by a perceived knowledge gap, motivates individuals to seek new information and experiences (Loewenstein, 1994), making it a key driver for first-time encounters with CM (Jach *et al.*, 2024). This suggests a potential market for CM in Malaysia. However, unfamiliarity with CM and its production technology also emerged as a source of scepticism. The relationship between familiarity and acceptance remains inconclusive in the literature. While Boereboom *et al.* (2022) found that greater awareness of CM increased willingness to engage, Munz Fernandes *et al.* (2021) reported no significant correlation.

Ethical considerations further complicate consumer acceptance. While many studies highlight CM as a more ethical alternative to conventional beef due to its potential to reduce animal cruelty and promote humane agriculture (Chriki *et al.*, 2022; Liu *et al.*, 2021), others, such as Circus and Robison (2019), identify ethical concerns as barriers to adoption. Malaysian participants in this study were particularly sceptical about whether CM's necessity and benefits were overstated by its proponents. This underscores the need for careful and transparent ethical messaging to prevent confusion and foster trust.

To leverage curiosity while addressing concerns over familiarity and ethical considerations, industry players must be ready to invest in extensive pre-launch promotions that provide clear and accurate information, particularly regarding taste, affordability, safety, and

potential health benefits. Transparency is crucial, and proper certification and regulatory measures can play a vital role in building consumer confidence. Malaysia's Regulation 3A under the Food Regulations 1985 currently governs foods developed through modern biotechnology, primarily genetically modified organisms (Ministry of Health Malaysia, 2017). However, CM does not fit neatly within this framework, highlighting the need for updated regulations tailored to cellular agriculture (Mridul, 2024). To ensure safe commercialisation and industry competitiveness, Malaysia should consider revising Regulation 3A or introducing a novel food framework aligned with global best practices for emerging food technologies.

The Halal status of CM remains a primary concern among consumers. Malavalli *et al.* (2021) found that New Zealand consumers hesitated to consume CM even with religious approval or Halal certification, while Ho *et al.* (2023) noted similar potential rejection from religious groups in Singapore. For CM to be deemed Halal for Muslim consumption, it must comply with Halalan Toyyiban biomaterials and Shariah principles (Mohd Kashim *et al.*, 2023). Hamdan *et al.* (2018) identified two key conditions: first, the cells must originate from a Halal-slaughtered animal, as Al-Tarmizi (1480) explains that anything severed from a living livestock animal is considered non-Halal (al-Syirbini, 1994); second, serum use must be either avoided or proven not to compromise meat purity. The Malaysian Mufti of the Federal Territory's Office affirmed these criteria, further clarifying that tissue from marine animals remains Halal since they do not require slaughter like terrestrial animals (Noordin, 2021). Most recently, on February 3, 2024, Singapore's Fatwa Committee issued a ruling stating that CM is generally Halal if it meets the necessary conditions, positioning Singapore once again as a leader in regulatory advancements for CM (Majlis Ugama Islam Singapura, 2024).

4.2 Societal push factor versus barrier to consume cultured meat

Informants primarily based their perceptions of CM's societal benefits on the openness of their social and familial networks. In Malaysia, where food choices are deeply tied to cultural identity, the country's vertically collectivist nature shapes the acceptance of novel foods like CM (Triandis and Gelfand, 1998; Thien *et al.*, 2014). Authority figures, peers, and family play a crucial role in shaping consumer attitudes, presenting an opportunity to leverage social influence in fostering acceptance.

However, societal trust in large corporations remains a significant barrier to CM adoption (Van Loo *et al.*,

2020). Malaysia's cultured meat industry is still in its infancy, with Cell Agritech, a local startup, pioneering cultured seafood production (Ayamany, 2023). Smaller, homegrown companies may find it easier to gain consumer trust, whereas larger, more established brands could face scepticism in entering the market.

Beyond trust issues, concerns about food culture also contribute to consumer hesitation. Many worry that CM could disrupt these long-standing customs in Malaysia, where traditional dietary practices hold deep significance. Siegrist and Hartmann (2020) found that consumers in nations with strong culinary heritage tend to be less receptive to novel food technologies, reinforcing these apprehensions. CM's integration into local traditions must be clearly communicated to improve acceptance, ensuring it is seen as complementary rather than disruptive to Malaysia's food culture.

5. Conclusion

For CM to succeed in Malaysia, key concerns must be addressed before market introduction, with trust emerging as a significant barrier to adoption. However, informants expressed confidence in government-led regulation and standardisation, emphasising the need for swift policy development and Halal certification. Overcoming consumer scepticism toward large food corporations will be essential for future companies entering the Malaysian market. Branding and promotion strategies must carefully consider social group influence, the appeal of CM as a safer and cleaner alternative, and its potential impact on Malaysia's rich food culture. Addressing these factors strategically will foster consumer acceptance and long-term market success.

Expanding qualitative research is essential for understanding the complexities of CM perceptions within Malaysia's diverse socio-cultural landscape. Ethnographic and longitudinal studies could track how consumer attitudes shift with increased awareness and exposure. Given the strong influence of social networks, future research should explore family dynamics, peer influence, and religious authority perspectives through focus groups and community-based participatory research. Additionally, comparative studies between rural and urban populations could uncover differences in acceptance based on lifestyle, traditions, and access to novel foods. Furthermore, as food technology evolves, interdisciplinary research combining behavioural science, food technology, and policy analysis could provide valuable insights into future CM adoption trends and consumer education strategies.

Conflict of interest

The manuscript has been reviewed and approved by all authors, with no conflicts of interest to disclose. The authors confirm they have no known financial or personal relationships that could have influenced this work.

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