

AWARENESS, PERCEPTION, AND WILLINGNESS TO ACCEPT CULTURED MEAT AMONG MACEDONIAN CONSUMERS

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A b s t r a c t: The aim of this study was to assess the awareness, attitudes, and willingness to accept cultured meat among Macedonian consumers by employing a quantitative cross-sectional design. Data were collected electronically via Google Forms over a three-week period using a structured questionnaire consisting of demographic items and questions related to awareness of cultured meat, perceptions of food innovations, concerns, and willingness to taste or purchase. A total of 400 respondents voluntarily participated, forming a diverse yet non-representative convenience sample, which limits the generalizability of the findings. Descriptive statistics were applied to summarize the results, while chi-square tests were used to examine associations between demographic characteristics and consumer attitudes. The findings showed that most respondents were unfamiliar with cultured meat and expressed predominantly negative attitudes toward this technology. The most frequently reported concerns were related to safety, taste, and quality. Only two demographic factors, gender and place of residence, demonstrated statistically significant but moderate associations with specific survey items. Overall, the results indicate low consumer acceptance and highlight the need for more effective communication and public education regarding the potential of cultured meat as a sustainable alternative.

Key words: innovation; perception; awareness; acceptance; cultured meat

СВЕСНОСТ, ПЕРЦЕПЦИЈА И ПОДГОТВЕНОСТ ЗА ПРИФАЌАЊЕ КУЛТИВИРАНО МЕСО КАЈ МАКЕДОНСКИТЕ ПОТРОШУВАЧИ

А п с т р а к т: Целта на ова истражување беше да се процени запознаеноста, ставовите и подготвеноста за прифаќање на култивираното месо кај македонските потрошувачи, применувајќи квантитативен пресечен дизајн. Податоците беа собрани електронски преку Google Forms во период од три недели, со користење на структуриран прашалник составен од демографски прашања и прашања поврзани со запознаеноста со култивирано месо, перцепциите за иновации во храната, загриженоста и подготвеноста за дегустација или купување. Вкупно 400 испитаници доброволно учествуваа во истражувањето, формирајќи разновиден, но нерепрезентативен погоден примерок, што го ограничува генерализирањето на добиените резултати. За резимирање на податоците беа применети дескриптивни статистики, додека хи-квадратниот тест беше користен за испитување на поврзаноста меѓу демографските карактеристики и ставовите на потрошувачите. Наодите покажаа дека поголемиот дел од испитаниците не биле запознаени со култивираното месо и изразиле претежно негативни ставови кон оваа технологија. Пријавените загрижености најчесто се однесуваа на безбедноста, вкусот и квалитетот. Само два демографски фактора, полот и местото на живеење, покажаа статистички значајни, но умерени поврзаности со одделни прашања од анкетата. Во целина, резултатите укажуваат на ниска прифатливост кај потрошувачите и ја нагласуваат потребата од поефективна комуникација и јавна едукација за потенцијалот на култивираното месо како одржлива алтернатива.

Клучни зборови: иновација; перцепција; свесност; прифаќање; култивирано месо

INTRODUCTION

Global meat consumption has increased substantially in the past decades, driven by population

growth, urbanization, and rising income levels (Smil, 2002). However, conventional livestock production is associated with growing environmental, ethical, and health-related concerns. Livestock

farming contributes up to 16.5% of global greenhouse gas emissions (Aschemann-Witzel et al., 2021), and disease outbreaks such as African swine fever and avian influenza continue to threaten food security (Costa & Akdeniz, 2019; Blome et al., 2020; Brown et al., 2024). These challenges have intensified the search for sustainable alternatives to traditional meat production (Hoek et al., 2011).

One such alternative is cultured meat, produced through cellular agriculture using animal stem cells and tissue engineering techniques (Rischer et al., 2020). Cultured meat – also referred to as clean, cell-based, or lab-grown meat (De Paula Soares Valente et al., 2019), has been recognized as a radical innovation with potential contributions to sustainable development (Lin-Hi et al., 2022). Potential benefits include reduced environmental impact (Lynch & Pierrehumbert, 2019; Mattick et al., 2015), lower risks of zoonotic diseases (Hayek, 2022), and decreased animal suffering (Laestadius & Caldwell, 2015; Wilks & Phillips, 2017).

Despite these advantages, consumer acceptance remains a critical determinant for the successful market introduction of cultured meat. Existing studies emphasize that perceptions, beliefs, and attitudes strongly influence responses to emerging food technologies (Frewer et al., 2014; Mancini & Antonioli, 2019). Understanding how consumers evaluate cultured meat – particularly in relation to health, ethics, environment, and price, is essential for predicting its future adoption.

The aim of this study is to assess consumer knowledge, attitudes, and willingness to accept cultured meat. The research examines key consumer concerns across health, ethical, environmental, and economic dimensions, and evaluates perceptions of cultured meat as a sustainable alternative to conventional meat.

MATERIALS AND METHODS

This research employed a quantitative methodology using a structured questionnaire. The survey included demographic questions, as well as items related to consumers' awareness, attitudes, and acceptance of cultured meat. A cross-sectional design was applied, meaning that data were collected at a single point in time without longitudinal tracking of attitudinal changes.

The survey was administered electronically via the Google Forms platform, and the link was distributed through social media and e-mail channels. Participation was voluntary and anonymous. Data

collection was conducted over a three-week period. A total of 400 respondents took part in the study, representing a diverse sample in terms of age, educational level, and place of residence. However, the sample was formed using a convenience sampling approach, resulting in a diverse but non-representative sample, which limits the generalizability of the findings.

The questionnaire was organized into two main sections: (1) demographic information – including gender, age, education level, and place of residence; and (2) consumer attitudes toward cultured meat – including questions related to participants' awareness, opinions, concerns, and acceptance of cultured meat. Most questions were closed – ended with predefined answer choices. For certain parts of the survey, filter questions were applied: respondents who lacked prior knowledge of cultured meat were not prompted to answer questions about its attributes or acceptability.

The collected data were analyzed using IBM SPSS Statistics (IBM Corp., 2021) and Microsoft Excel (Microsoft Corporation, 2021). Descriptive statistical methods were applied, including frequency analysis and percentage distribution of responses. In addition, to evaluate potential differences in attitudes based on respondents' demographic characteristics, inferential statistical testing was conducted.

Since the variables in the questionnaire were categorical, the associations between demographic characteristics and survey responses were examined using the chi-square (χ^2) test of independence. For all statistically significant results, Cramer's V was calculated to determine the strength of the association. The application of the χ^2 test was based on the fulfillment of standard statistical assumptions, including the categorical nature of the variables, independence of observations, and sufficient expected frequencies within the contingency table cells. Fulfillment of these assumptions ensured the validity and reliability of the statistical conclusions.

RESULTS AND DISCUSSION

The demographic section of the questionnaire provided insight into the profiles of the survey participants (Table 1). Of the 400 respondents, 252 (63.00%) were female, while 148 (37.00%) were male. This gender distribution suggests that women demonstrated a higher level of interest in the topic, as reflected in their higher participation rate. The

largest age group consisted of individuals aged 35–44 years, totaling 123 respondents (30.75%). This was followed by those aged: 25–34 years, 97 respondents (24.25%), 45–54 years, 79 respondents (19.75%), and 18–24 years, 54 respondents (13.50%). The lowest participation was observed in the age group above 55 years, with 47 respondents (11.75%).

In terms of educational background, the majority of participants had completed higher education 183 respondents (45.75%). Secondary education

was reported by 158 respondents (39.50%), while 42 participants (10.50%) held postgraduate degrees and 17 (4.25%) held doctoral degrees. These results indicate that the survey was conducted among a relatively well-educated population. Moreover, a large proportion of respondents, 318 (79.50%), reported residing in urban areas, while 82 respondents (20.50%) resided in rural areas.

Overall, the study included a diverse sample of respondents, and the obtained results are related to the characteristics of this specific group.

Table 1

Demographic characteristics of the respondents

Category	Subcategory	Number of respondents	Percentage (%)
Gender	Male	148	37.00
	Female	252	63.00
Age	18 – 24 years	54	13.50
	25 – 34 years	97	24.25
	35 – 44 years	123	30.75
	45 – 54 years	79	19.75
	Over 55 years	47	11.75
Education	Secondary	158	39.50
	Higher	183	45.75
	Postgraduate	42	10.50
	Doctorate	17	4.25
Place of residence	Urban	318	79.50
	Rural	82	20.50

The second section of the questionnaire comprised nine items related to awareness, attitudes, and acceptance of cultured meat. Respondents were directed to specific follow-up questions based on their previous answers using logical branching.

In response to the question “Are you familiar with the term cultured meat?” (Figure 1), results revealed that out of 400 respondents, 254 (63.50%)

reported being unfamiliar with the term, while 146 (36.50%) stated that they knew what cultured meat refers to. These findings indicate that a significant portion of Macedonian consumers lacks awareness of cultured meat, which is consistent with findings from previous studies (Verbeke et al., 2015; Wilks & Phillips, 2017; De Paula Soares Valente et al., 2019; Grasso et al., 2019;).

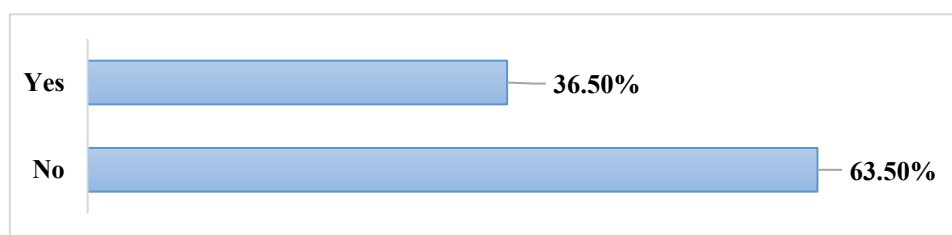


Fig. 1. Awareness of the term “cultured meat”

Among the 254 respondents who reported being unfamiliar with the term cultured meat, the follow-up question “Would you like to learn more about cultured meat?” yielded revealing insights. A majority of these participants – 170 individuals (66.90%), stated that they were not interested in obtaining further information. In contrast, 84 respondents (33.10%) expressed interest in learning more about this novel food technology (Figure 2). These findings suggest a moderate, though not widespread, level of curiosity about cultured meat as an emerging

innovation in meat production. Siegrist and Hartmann (2020) associate such consumer disinterest with a phenomenon referred to as technoskepticism, highlighting that it is natural for consumers to exhibit distrust toward new technologies – especially when those technologies are applied in the context of food production. This is further supported by Rolland et al. (2020), who argue that food innovations often provoke resistance due to perceptions of unnaturalness and uncertainty.

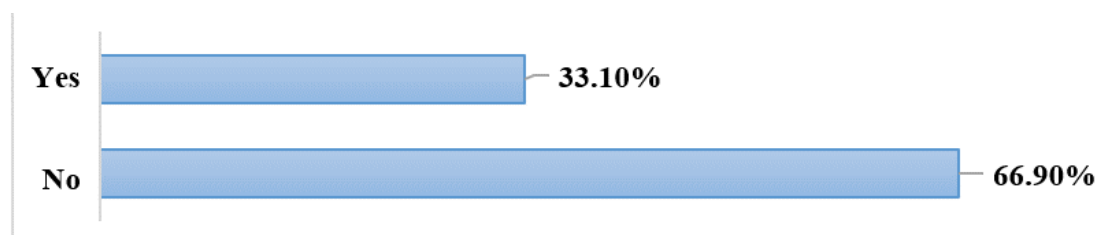


Fig. 2. Interest in additional information on cultured meat among respondents unfamiliar with the term

When asked “What is your opinion on food innovations such as cultured meat?”, the responses of the 254 participants who had previously indicated unfamiliarity with the term revealed a predominantly negative stance. As shown in Figure 3, only 66 respondents (26.00%), expressed a positive opinion regarding such innovations, while 52 participants (20.50%) held a neutral view. The largest proportion – 136 respondents (53.50%), reported a negative

perception of food innovations like cultured meat. These findings align with observations made by Wilks and Phillips (2017), who note that consumers tend to be skeptical of new food technologies. This skepticism is often rooted in concerns about safety, unnatural production processes, and a general reluctance to deviate from traditional food sources.

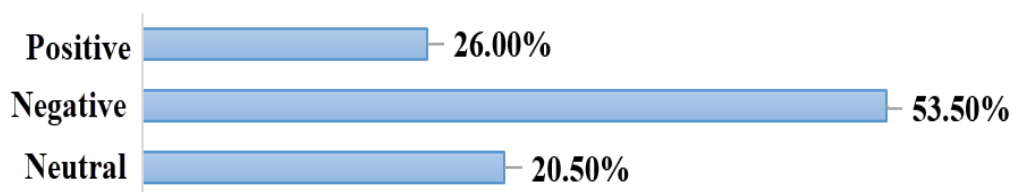


Fig 3. Attitudes toward food innovations, including cultured meat, among respondents unfamiliar with the term “cultured meat”

Among the 146 respondents who reported being familiar with the term cultured meat, responses to the question “Where did you learn about cultured meat?” revealed that the majority – 59 individuals (40.40%) – had obtained information through the internet and social media. Additionally, 42 respondents (28.80%) cited traditional media sources, 32 respondents (21.90%) attributed their knowledge to friends and family, and 13 respondents (8.90%)

learned about cultured meat from other sources (Figure 4). These findings highlight the dominant role of digital media in shaping public awareness of cultured meat, which aligns with previous research (Bryant & Dillard, 2019). However, social media platforms are frequently associated with the dissemination of unverified information, which may contribute to negative consumer perceptions of emerging food technologies (Luo & Cui, 2021).

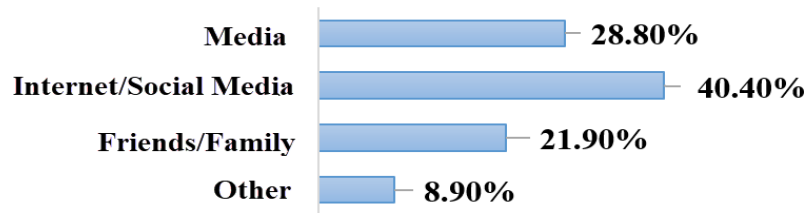


Fig. 4. Sources of information on cultured meat among respondents familiar with the term

In response to the question “What is your opinion on cultured meat?”, the answers provided by the 146 respondents who were familiar with the concept revealed predominantly negative perceptions. Specifically, 78 respondents (53.40%) expressed a negative opinion, while 42 respondents (28.80%) reported a positive view, and 26 respondents (17.80%) indicated that they had not yet formed an opinion (Figure 5). These results are consistent with

previous studies (Verbeke, 2015; Wilks & Phillips, 2017; Bhat et al., 2019; Siegrist & Hartmann, 2020), which have also identified widespread consumer skepticism and resistance toward cultured meat. The findings highlight the need for further dissemination of information and public education regarding the potential benefits and safety of cultured meat in order to improve its acceptance as an innovative and sustainable protein source.

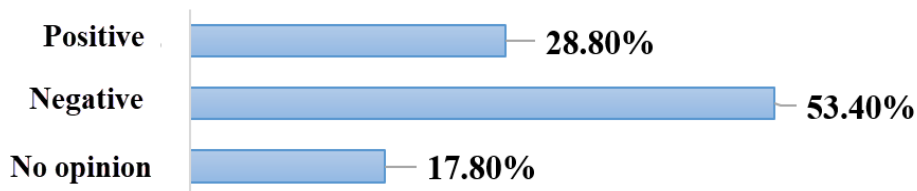


Fig. 5. Opinions on cultured meat among respondents familiar with the term

Among the 146 respondents who reported being familiar with the concept of cultured meat, responses to the question “Would you be willing to try cultured meat?” revealed relatively low openness to consumption. Only 41 respondents (28.10%) indicated that they would be willing to try cultured meat, while 77 respondents (52.70%) stated they would not, and 28 respondents (19.20%) reported being uncertain (Figure 6). These findings suggest that, overall, consumers are not yet ready to embrace

cultured meat as a viable food option. Compared to earlier research, the current study shows a lower level of consumer willingness to try cultured meat. Previous studies have reported greater openness toward sampling such products (Verbeke et al., 2015; Wilks & Phillips, 2017; Slade, 2018; Bryant & Barnett, 2018; Bryant et al., 2019; Bryant & Dillard, 2019; Giménez-Luciano et al., 2019; Mancini & Antonioli, 2019).

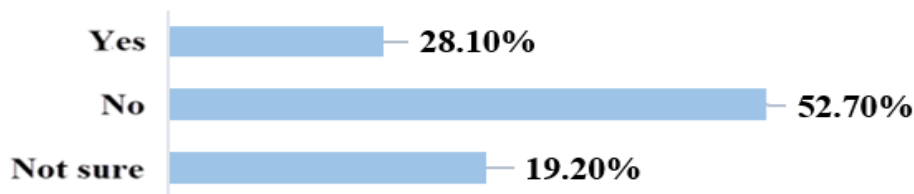


Fig. 6. Willingness to try cultured meat among respondents familiar with the term

In response to the question “What are your main concerns regarding cultured meat?”, the 146 respondents who reported being familiar with the concept of cultured meat identified several key

issues. The most frequently cited concern was health safety, reported by 82 participants (56.20%). Taste and product quality were the second most common concern, noted by 39 respondents (26.70%). Price

was mentioned by 10 participants (6.85%), followed by environmental impact – 9 respondents (6.15%), and ethical considerations 6 respondents (4.10%) (Figure 7). These findings are in line with previous research, which has consistently identified safety as the primary consumer concern regarding cultured meat (Bryant & Barnett, 2018; Wilks et al., 2017; Siegrist & Hartmann, 2020). In addition, a

substantial proportion of respondents expressed concerns about the taste and quality of cultured meat (Bryant & Barnett, 2018; Wilks et al., 2017). Other relevant concerns – economic, ethical, and environmental, were also noted, consistent with earlier studies (Bryant & Barnett, 2018; Van der Weele & Driessen, 2019; Verbeke et al., 2021).

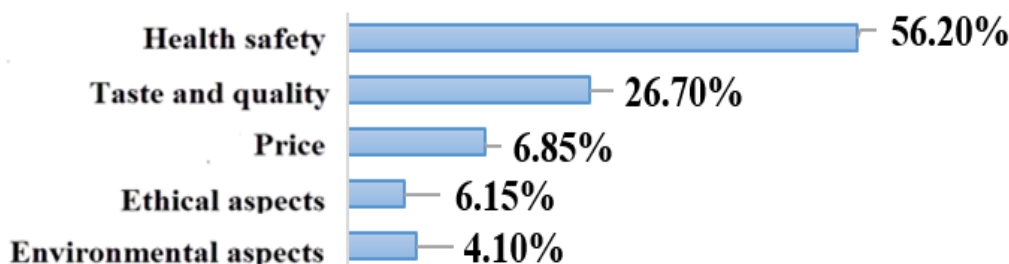


Fig. 7. Main concerns regarding cultured meat among respondents familiar with the term “cultured meat”

In response to the question “Would you purchase cultured meat if it were available on the market?”, the general opinion among the 146 respondents familiar with the term cultured meat was predominantly negative. A total of 77 participants (52.70%) stated they would not purchase cultured meat, 31 respondents (21.20%) indicated they would, while 38 respondents (26.10%) reported being unsure (Figure 8). These results are consistent with previous studies that have identified similar trends in consumer perception. While some consumers are willing to try cultured meat, they tend to

prefer continuing the consumption of conventional meat (Verbeke et al., 2015; Wilks & Phillips, 2017; Slade, 2018;). Conversely, other studies have shown that a portion of consumers is willing to purchase and regularly consume cultured meat (Bryant & Barnett, 2018; Mancini & Antonioli, 2019). These findings suggest that acceptance of cultured meat varies across different consumer groups. This variation may be attributed to factors such as ethical beliefs, environmental concerns, and individual perceptions regarding product safety and sensory quality.

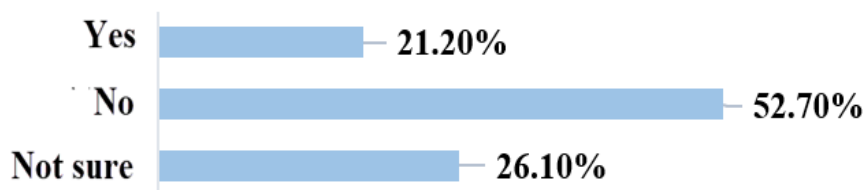


Fig. 8. Willingness of respondents familiar with the term “cultured meat” to purchase it if available on the market

Out of a total of 146 respondents who are familiar with the term cultured meat, in response to the question “Do you believe that cultured meat can be a sustainable alternative to conventional meat?”, only 43 respondents (29.50%) believe that cultured meat could serve as a sustainable alternative to traditional meat. In contrast, 74 respondents (50.70%) do not believe that this innovative technology can replace the conventional method of meat production,

while 29 respondents (19.80%) believe that cultured meat might be a sustainable alternative to conventional meat (Figure 9). Rosenfeld & Tomiyama (2023) state that the acceptance of cultured meat is limited by numerous social, psychological, and structural barriers, and research from cognitive science can provide deeper insights into these obstacles and point to effective strategies for overcoming them.

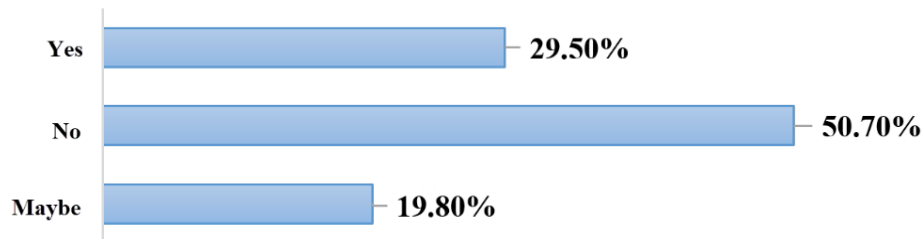


Fig. 9. Attitudes of respondents familiar with the term “cultured meat” regarding the sustainability of cultured meat as an alternative to conventional meat

The chi-square analysis revealed two statistically significant associations between demographic characteristics and survey responses (Table 2). Gender was significantly associated with the willingness to purchase cultured meat ($\chi^2 = 7.43$, $df = 2$, $p = 0.024$), which indicates that men and women differ in their purchasing intentions. Place of

residence was significantly related to the belief that cultured meat could serve as a sustainable alternative to conventional meat ($\chi^2 = 9.12$, $df = 2$, $p = 0.010$), which suggests that urban and rural respondents hold different perceptions regarding its sustainability potential.

Table 2

Statistically significant associations between demographic variables and survey questions (χ^2 test)

Demographic variable	Survey question	χ^2	df	p -value
Gender	Would you purchase cultured meat if it were available on the market?	7.43	2	0.024
Place of residence	Do you believe that cultured meat can be a sustainable alternative to conventional meat?	9.12	2	0.010

These results indicate that certain demographic factors play a role in shaping consumer attitudes toward cultured meat. The gender differences observed in this study are consistent with previous research, which shows that men generally display greater openness toward novel food technologies (Wilks & Phillips, 2017; Moerbeek & Casimir, 2005; Šostar & Ramanathan, 2025). This influence of place of residence may stem from the greater exposure of urban residents to discussions on sustainability and innovation, whereas rural respondents may maintain stronger ties to traditional food production systems.

CONCLUSION

Based on the results obtained from the conducted survey, the following conclusions can be drawn:

- The findings indicate that within the surveyed group, consumers show a generally low level of awareness regarding cultured meat, and the majority express a negative attitude toward this technology.

- The most common concerns reported by respondents relate to safety, taste, and quality, while only a small proportion perceive cultured meat as a sustainable alternative to conventional meat.

- Among all examined demographic factors, only gender and place of residence demonstrated statistically significant, though moderate, associations with attitudes toward cultured meat, whereas the remaining demographic characteristics did not exhibit a meaningful influence on acceptance.

- Although a degree of interest was observed among some respondents, the results highlight the need for increased education and public discussion to enhance understanding and potential acceptance of this technology.

- In light of global trends toward sustainable food production, future initiatives should focus on improving consumer perception through transparent communication and by addressing the most common public concerns.

These results should be interpreted within the context of the surveyed group, taking into account the nature of the sample.

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