



# Food innovation towards a sustainable world: A study on intention to purchase lab-grown meat

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## ARTICLE INFO

**Keywords:**  
Sustainability  
Lab-grown meat  
Cell-based meat  
Cultured meat  
Knowledge  
Food innovation

## ABSTRACT

Lab-grown meat has been proposed as a food innovation to meet Sustainable Development Goal 12 of moving towards more sustainable consumption and production patterns. However, although technological innovations in lab-grown meat are advancing, a better understanding is needed regarding the perspectives of potential consumers of this product. Specifically, whether the perceived higher environmental sustainability of this meat compared with conventional meat influences purchase intentions remains unclear. The effects of perceived risks must also be assessed. To address these knowledge gaps, we propose a model that draws on the theory of reasoned action and integrate it with potential consumers' perceptions of environmental sustainability and risks of lab-grown meat. We apply variance-based structural equation modelling using data from a sample of Italian consumers to evaluate the model's explanatory and predictive accuracy. The findings highlight the effects of environmental sustainability and perceived risks on purchase intentions and provide insights for policymakers and businesses.

## 1. Introduction

The global population is expected to grow to 9.7 billion by 2050, which is anticipated to lead to food production increases of at least 70 %; however, the resources needed for food production, such as land and water, are limited (Choudhury et al., 2020; FAO, 2023b). Moreover, the Sustainable Development Goals (SDG) of the 2030 Agenda for Sustainable Development adopted by all members of the United Nations strive to 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture' (SDG 2) and to 'Ensure sustainable consumption and production patterns' (SDG 12), whereby higher efficiency levels are pursued by applying circular economy principles and eliminating food waste (United Nations, 2015). Thus, these challenges are driving the global food system towards more sustainable food production and food innovation (Abbate et al., 2023; Aschemann-Witzel et al., 2023; Cassia and Magno, 2024; Dal Mas et al., 2023; Piancharoenwong and Badir, 2024).

Specifically, meat production poses severe sustainability challenges (Ráty et al., 2023). Livestock farming and crop cultivation for animal consumption occupy approximately 30 % of the world's ice-free land surface and are responsible for 6.2 billion tons of CO<sub>2</sub> equivalent

emissions, which is projected to reach 9.1 by 2050 (FAO, 2023a). Livestock farming systems use fossil fuels and chemical fertilisers extensively and cause land degradation through intensive cattle grazing (European Union, 2018). Moreover, current global dietary consumption patterns are projected to increase the mean surface air temperature by up to 0.9 °C by the end of this century, to which ruminant meat contributes approximately one-third, which is the highest impact of any food type by far (Ivanovich et al., 2023). Consequently, urgent measures must be taken to address the current unsustainability of meat production and consumption (FAO, 2023a). Many organisations and studies have recommended reducing meat consumption or shifting to plant-based meat alternatives (Bauer et al., 2022). In this context, lab-grown meat (also known as cell-based or cultured meat) has emerged as a viable alternative to conventional meat. Lab-grown meat is biologically identical to conventional meat but with far fewer negative environmental effects (Tuomisto and Teixeira de Mattos, 2011), given that to produce it 'a few cells are taken from a live animal and placed in a growth medium in a bioreactor where they proliferate independently' (European Union, 2018).

Although technological innovation has progressed and the production of lab-grown meat has become more efficient, uncertainties remain

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<https://doi.org/10.1016/j.techfore.2024.123912>

Received 28 March 2024; Received in revised form 21 October 2024; Accepted 18 November 2024

Available online 29 November 2024

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regarding the future commercialisation of this product (Reis et al., 2021; Sinke et al., 2023). The transition from conventional to lab-grown meat would result in remarkable changes across whole ecosystems related to livestock farming. Some studies on farmers' perspectives have concluded that lab-grown meat may pose severe challenges but also offers opportunities, such as farmers becoming input suppliers for the lab-grown meat industry or repositioning themselves as small-scale producers of high-quality conventional meat (Räty et al., 2023). Other studies have explored consumer attitudes and purchase intentions towards cultured meat (Kouarfáté and Durif, 2023; Shaw and Mac Con Iomaire, 2019). However, whether the perceived higher sustainability of this meat compared with conventional varieties influences purchase intention remains unclear. This knowledge gap is relevant for the purpose of forecasting consumers' future adoption of lab-grown meat. When presenting this meat, authorities and organisations (e.g., European Union, 2018) emphasise its superior environmental sustainability compared with conventional meat. However, the extent to which, and the mechanisms through which, consumer perceptions of higher environmental benefits relate to purchase intention require further investigation. Furthermore, whether the perceived risks of lab-grown meat could mitigate its expected environmental benefits and hinder its adoption also need to be explored (Pakseresht et al., 2022).

To address these research gaps, in this study, we propose and test a model that links the perceived risks and environmental benefits of lab-grown meat to purchase intentions. Theoretically, the model builds on the theory of reasoned action (TRA) (Fishbein and Ajzen, 1975) and integrates it with the perceived sustainability and risks of such meat. We assess the proposed model using variance-based structural equation modelling (SEM) for determining both its explanatory and predictive validity. Accordingly, the findings provide several theoretical implications and insights for policymakers and businesses.

The remainder of the paper is organised as follows. In Section 2, we present the research background and model. In Section 3, we describe the empirical analysis, including the methods we used, and in Section 4, we present our findings. In Section 5, we discuss the results, and last, in Section 6, we draw conclusions.

## 2. Theoretical background and research model

### 2.1. Lab-grown meat and consumer reactions

Lab-grown meat potentially addresses and mitigates some of the current challenges associated with livestock production by offering several advantages over traditional meat production, such as reduced environmental impact and the reduced use of animals (Choudhury et al., 2020). Thus, its use responds to ethical concerns associated with industrial livestock operations (Reis et al., 2021) and enhances human health via managing harmful elements, such as pathogens, without the use of antibiotics (Baum et al., 2021). Moreover, fewer resources, including land, water and energy, are required to produce cultured meat compared with traditional meat, which could help address global hunger issues (Reis et al., 2020).

The effects of transitioning from traditional to lab-grown meat could vary across the many stakeholders in livestock farming ecosystems, including farmers, consumers, rural residents, and tourism and hospitality businesses (Bui et al., 2024; Rasmussen et al., 2024). The positive or negative effects for each stakeholder may relate to economic, social and environmental aspects (Morais-da-Silva et al., 2022). Among these potential stakeholders, we specifically focus on the perspectives of consumers. Scholars have identified several issues that could affect consumer acceptance of agrifood technologies and their resulting end products (Palmieri et al., 2020). Moreover, they have suggested that consumer acceptance is the greatest challenge in the diffusion of lab-grown meat (Hocquette, 2016). However, whether consumers will accept this meat remains unclear, and the knowledge available on this topic is limited and fragmented (Kouarfáté and Durif, 2023).

In this regard, an individual's acceptance of innovation is based on their joint evaluations of the potential benefits and risks (Rogers, 1995). Moreover, the degree of uncertainty related to innovation tends to bias consumer evaluations, leading to underemphasis on the benefits and overemphasis on the risks resulting from innovation adoption (Kahneman, 2011). Consistent with this premise, studies have indicated that the perceived benefits and risks both need to be assessed to understand the likelihood of consumer acceptance of lab-grown meat (Pakseresht et al., 2022).

Significantly, consumers can easily perceive the environmental benefits of lab-grown meat (Verbeke et al., 2015). Moreover, the opportunity to contribute to environmental sustainability could be a strong driver of consumer willingness to transition from traditional to cultured meat (Slade, 2018). However, consumers have also expressed concerns regarding the health and safety of lab-grown meat, and these perceived risks may be related to the emphasis on technological aspects, including the association between meat and words such as 'laboratory' (Verbeke et al., 2021). Mattick et al. (2015, p. 249) summarised this well by noting that the 'uncertainty associated with new engineered products cannot be completely eliminated prior to introduction, but ongoing environmental assessments of the technologies as they advance can serve to reduce unforeseen risks'.

### 2.2. Theory and research model

The research model we propose in this study draws on Fishbein and Ajzen's (1975) research—they developed the TRA, a widely accepted framework for analysing consumer attitudes, intentions and choices when examining different aspects of consumer behaviour. Several scholars have tested and validated their model both in general (Fitzmaurice, 2005) and in the context of green and sustainable behaviours (Paulraj et al., 2017). According to the TRA, behavioural intention is influenced by attitudes and subjective norms, either of which may be the most critical determinant of any specific behaviour (Trafimow, 2009).

Attitudes towards a behaviour are defined by behavioural beliefs about the likelihood of several consequences and evaluations of how favourable or unfavourable it would be if those consequences occurred. Attitude refers to the psychological emotion routed through consumer evaluations and, if it is positive, behavioural intentions tend to be more positive (Chen and Tung, 2014). Mostafa (2007) found a positive relationship between attitude and behavioural intention across many cultures in the context of green products. Subjective norms are the 'beliefs about what specific important others [such as friends and relatives] think one should do and how much one is motivated to comply with those important others' (Trafimow, 2009, p. 506). Multiple studies have reported the positive effects of subjective norms on the intention to engage in sustainable behaviours (Shanmugavel and Balakrishnan, 2023; Yang et al., 2022).

Consistent with this study's purpose, we integrate environmental benefits and perceived risks into the basic TRA model. In this context, environmental benefits are the perceived advantages lab-grown meat can offer to the environment in terms of lower emissions and higher sustainability (Paul et al., 2016). Perceived risks reflect the concerns that this meat may pose threats to human health, including allergies and intolerances. For example, this factor has emerged as particularly influential on consumer attitudes towards genetically modified foods (Rodríguez-Entrena et al., 2013). Thus, in line with these arguments, we propose the following hypotheses (Fig. 1):

- H1.** Favourable attitudes have a positive effect on the intention to purchase lab-grown meat.
- H2.** Favourable subjective norms have a positive effect on the intention to purchase lab-grown meat.
- H3.** Environmental benefits have a positive effect on attitudes.

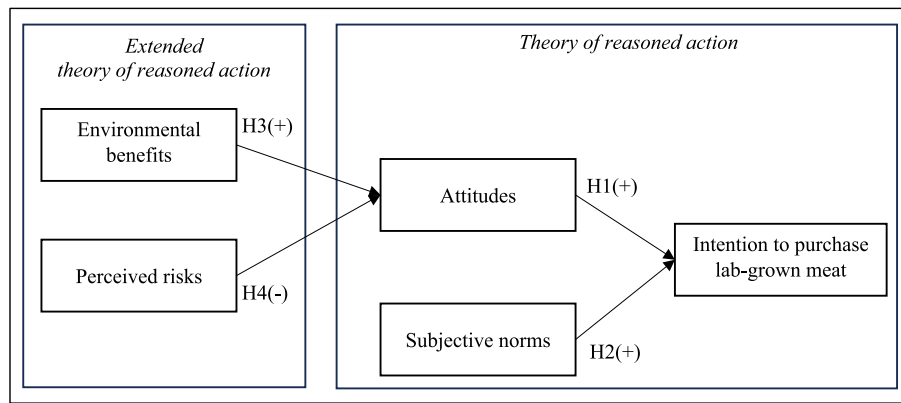


Fig. 1. Model and hypotheses.

H4. Perceived risks have a negative effect on attitudes.

### 3. Methods

In this empirical analysis, we used data collected in January 2024 from a sample of 167 people in Italy. We used convenience sampling and distributed invitations to complete an online questionnaire (uploaded to SurveyMonkey®) through our personal network of contacts. The returned questionnaires contained no missing values because the answers to all questions were compulsory. The choice of sample size was guided by the technical requirements of the data analysis method, which was partial least squares structural equation modelling (PLS-SEM). Recent PLS-SEM guidelines (Sarstedt et al., 2023) advocate for the use of Kock and Hadaya's (2018) inverse square root method to calculate the minimum sample size required for data analysis. This method is more conservative than the traditional 10-times rule (Hair et al., 2022). According to Kock and Hadaya (2018), a minimum sample size of 155 is required to identify paths of a magnitude between 0.11 and 0.20 when the statistical significance is 0.95 and the power is 80 %. Therefore, we aimed to meet this criterion and obtained an appropriate sample size ( $n = 167$ ). The participants' profiles are depicted in Table 1, which shows the prevalence of female respondents and a wide range of age groups.

Table 1  
Overview of the sample.

Variable	Frequency ( $n = 167$ )	Frequency (%)
Gender		
Male	47	28.1
Female	116	69.5
Prefer not to disclose	4	2.4
Age (years)		
<20	9	5.4
25–29	28	16.8
30–39	16	9.6
40–49	20	12.0
50–59	37	22.2
60–69	42	25.0
>69	15	9.0
Education		
Middle school diploma	5	3.0
High school diploma	46	27.5
University degree	89	53.3
Postgraduate degree	27	16.2
Occupation		
Employee	33	19.8
Teacher/Professor	27	16.2
Student	21	12.6
Self-employed	20	12.0
Entrepreneur	6	3.6
Unemployed	1	0.6
Manager	1	0.6
Other	58	34.6

The questionnaire started with an introduction to the study topic, presenting the following official definition of lab-grown meat:

Laboratory-grown meat, often referred to as ‘cultured meat’, is an alternative to conventional meat, biologically identical but with a greatly reduced environmental impact. Lab-grown meat uses stem cell technology: a few cells are taken from a live animal and placed in a growth medium in a bioreactor where they proliferate independently. If meat cultured in this way became widely available, it could significantly alleviate the environmental problems currently caused by livestock production, but without requiring humans to alter their consumption patterns.

(European Union, 2018)

Since lab-grown meat has not yet been commercialised in Italy, we asked participants to consider a situation in which it was and answer the questions accordingly. We also specified that we would maintain the anonymity of the responses and analyse these only at the aggregate level, as such a guarantee can reduce common method bias (Podsakoff et al., 2024).

The questionnaire contained multi-item scales for the five latent constructs of the hypothesised model. All the scales have been used in previous studies on food innovation and green behaviours. We retained the original wording of the items and made only slight adaptations to reflect our research context (i.e. focusing on lab-grown meat). Specifically, we adopted the measures for environmental benefits, attitudes, subjective norms and behavioural intentions from Paul et al. (2016), and the scale for perceived risks from Rodríguez-Entrena et al. (2013). All items were assessed using a 5-point Likert scale (1 = ‘completely disagree’ to 5 = ‘completely agree’). Table 2 shows the items for each construct and their descriptive statistics. A question on participants' familiarity with lab-grown meat was also added. Although not included in the model, this single-item variable was useful for obtaining a descriptive overview of participants' current knowledge of the study topic. Overall, the sample had an intermediate level of knowledge of the subject (3.71 on a 7-point scale, ranging from ‘no knowledge at all’ to ‘extensive knowledge’). The final section of the questionnaire included several questions to assess the demographic profile of the participants.

The data were analysed using PLS-SEM. PLS-SEM and covariance-based structural equation modelling (CB-SEM) are the two main approaches to SEM. Although CB-SEM is usually the preferred option when researchers want to focus on explanations (Hair et al., 2022), PLS-SEM is a variance-based approach that facilitates the evaluation of both the explanatory power and (out-of-sample) predictive accuracy of a suggested model (Sarstedt et al., 2022). In this study, we adopted a causal-predictive research paradigm (Sharma et al., 2024) because we were interested in assessing the accuracy of our model in predicting consumer purchase intentions for lab-grown meat. Therefore, we selected PLS-SEM for the data analysis.

**Table 2**  
Constructs and items.

Construct	Item	Mean	Kurtosis	Skewness	Outer loading	Cronbach's alpha	Average variance extracted
Attitudes	ATT1. I like the idea of consuming lab-grown meat.	3.072	-1.593	-0.109	0.918	0.976	0.934
	ATT2. Consuming lab-grown meat is a good idea.	3.383	-1.495	-0.372	0.981		
	ATT3. I have a favourable attitude towards consuming lab-grown meat.	3.359	-1.563	-0.365	0.986		
	ATT4. Overall, I have a positive opinion of consuming lab-grown meat.	3.317	-1.604	-0.319	0.980		
Environmental benefits	EB1. Consuming lab-grown meat is less polluting than consuming conventional meat.	3.754	-0.751	-0.842	0.951	0.974	0.928
	EB2. People should consider switching to lab-grown meat for ecological reasons.	3.593	-1.094	-0.683	0.961		
	EB3. Consuming lab-grown meat rather than conventional meat makes a positive environmental contribution.	3.677	-0.900	-0.740	0.976		
	EB4. Consuming lab-grown meat rather than conventional meat would reduce negative effects on the environment.	3.647	-0.990	-0.687	0.964		
Subjective norms	SN1. Most people who are important to me think I should consume lab-grown meat.	2.078	-0.105	0.970	0.946	0.914	0.803
	SN2. Most people who are important to me would want me to consume lab-grown meat.	2.036	0.053	1.046	0.951		
	SN3. People whose opinions I value would prefer that I consume lab-grown meat.	2.287	-0.782	0.654	0.935		
	SN4. My friend's positive opinion would influence me to consume lab-grown meat.	2.359	-1.190	0.543	0.734		
Perceived risks	PR1. Consuming lab-grown meat will prove harmful to the environment.	2.210	-0.275	0.748	0.802	0.880	0.733
	PR2. Consuming lab-grown meat will cause allergies and/or intolerance in human beings.	2.689	-1.010	0.275	0.822		
	PR3. Consuming lab-grown meat only serves the interest of large companies.	2.826	-1.370	0.124	0.886		
	PR4. Consuming lab-grown meat could cause issues for human health.	2.611	-0.909	0.413	0.910		
Purchase intention	PI1. In the future, I plan to purchase more lab-grown meat (if it is available) than conventional meat.	3.006	-1.604	-0.060	0.975	0.983	0.967
	PI2. In the future, I expect to purchase lab-grown meat (if it is available).	3.144	-1.635	-0.199	0.990		
	PI3. In the future, I will likely purchase lab-grown meat (if it is available).	3.180	-1.610	-0.218	0.985		

Standard settings were applied to run the PLS-SEM algorithm, including a maximum number of iterations of 300, a  $10^{-7}$  stop criterion and the path weighting scheme. The percentile confidence intervals and the significance of the estimated parameters were calculated using bootstrapping (10,000 bootstrap samples). The PLSpredict algorithm (10-fold, 10 repetitions) was applied (Hair et al., 2022) to evaluate the model's predictive accuracy. All analyses were performed using SmartPLS 4.1.0.0 (Cheah et al., 2024).

#### 4. Findings

The analysis of the PLS-SEM findings is structured into two subsections. First, we present the assessment of the measurement models, which involves analysing the relationships between the constructs and their indicators (Subsection 4.1). After establishing that the measures are both reliable and valid, we address the structural relationships among the constructs (Subsection 4.2).

##### 4.1. Constructs' measurement models

Consistent with their sources, all the constructs were specified as reflective (Paul et al., 2016; Rodríguez-Entrena et al., 2013). To evaluate their measurement models, we first assessed whether each indicator's outer loading was  $>0.708$ , which would indicate that the underlying construct explained  $>50\%$  (i.e.  $0.708^2$ ) of the indicator's variance (Hair et al., 2019). As Table 2 shows, the results indicate that all items met this threshold, thus verifying the reliability of the indicators. The Cronbach's alpha values exceeded 0.70 for all the constructs (Hair et al., 2019), thus also verifying their internal consistency. Furthermore, all average variance extracted values were  $>0.50$  (Table 2), supporting convergent

validity (Hair et al., 2022). Last, we analysed discriminant validity using heterotrait–monotrait (HTMT) ratios (Ringle et al., 2023). After confirming that all HTMT ratios were smaller than 0.90 (Sarstedt et al., 2023), we inspected the 95 % confidence intervals (one-sided) of the estimated HTMT values calculated using bootstrapping (Table 3). For all HTMT ratios, the upper bound of the confidence interval was  $<0.90$ , except for two conceptually close constructs (Ringle et al., 2023). Thus, discriminant validity was also verified. As the measures were both reliable and valid, we could move forward with analysing the structural model.

**Table 3**  
HTMT ratios<sup>a</sup>.

Construct	1	2	3	4	5
1. Attitudes	–				
2. Environmental benefits	0.855 [0.800; 0.898]	–			
3. Subjective norms	0.649 [0.574; 0.719]	0.526 [0.431; 0.615]	–		
4. Perceived risks	0.678 [0.568; 0.776]	0.642 [0.525; 0.744]	0.466 [0.323; 0.598]	–	
5. Purchase intention	0.883 [0.822; 0.935]	0.810 [0.752; 0.863]	0.566 [0.446; 0.680]	0.653 [0.541; 0.753]	–

<sup>a</sup> 95 % confidence intervals (one-sided) between parentheses.

4.2. Structural model

First, we assessed whether collinearity could be a source of bias when analysing the structural relationships. The highest variance inflation factor was 1.603, which was remarkably lower than the threshold of 3. Therefore, collinearity was not an issue in this study and did not bias the regression results (Sarstedt et al., 2023). Fig. 2 and Table 4 show the results of the structural relationship estimations.

The analysis showed that attitudes significantly influenced purchase intentions ( $\beta = 0.856, p < 0.01$ ), whereas subjective norms ( $\beta = 0.015, p > 0.10$ ) did not. Therefore, H1 was supported but H2 was rejected. Moreover, environmental benefits positively and robustly influenced attitudes ( $\beta = 0.707, p < 0.01$ ), thus supporting H3. Last, as expected, perceived risk had a negative effect on attitude ( $\beta = -0.213, p < 0.01$ ). Hence, H4 was also supported. An inspection of the indirect effects provided additional evidence, indicating that for purchase intentions, environmental benefits had a positive indirect effect ( $\beta = 0.605, p < 0.01$ ), whereas perceived risks had a negative indirect effect ( $\beta = -0.182, p < 0.01$ ). Then, we evaluated the relevance of the significant relationships by analysing their sizes (Hair et al., 2022). We concluded that the effects of environmental benefits were stronger than those of perceived risks on both attitudes ( $|0.707|$  versus  $|0.213|$ ) and purchase intentions ( $|0.605|$  versus  $|0.182|$ ).

The next step involved assessing the model's explanatory power by evaluating the coefficient of determination ( $R^2$ ) for the target construct (i.e. purchase intentions). This coefficient indicates the amount of variance in the target construct explained by the exogenous constructs. As shown in Fig. 2,  $R^2$  was 0.749, indicating that the model had high explanatory power for purchase intentions (Hair et al., 2022). Last, we performed a cross-validated predictive ability test based on the PLS<sub>predict</sub> algorithm to assess the model's out-of-sample predictive power. The results indicated that the model had predictive validity for the target construct of purchase intentions because it performed better than the naïve indicator-averages prediction benchmark (average loss difference:  $-1.730, p < 0.01$ ) (Sharma et al., 2023).

**Table 4**  
Structural relationships.

Hypothesis	Effect	Path coefficient	p-value	Confidence interval [95 %, two-tailed]
1	Attitudes → Purchase intentions	0.856	0.000	[0.733; 0.958]
2	Subjective norms → Purchase intentions	0.015	0.846	[-0.141; 0.172]
3	Environmental benefits → Attitudes	0.707	0.000	[0.592; 0.798]
4	Perceived risks → Attitudes	-0.213	0.000	[-0.335; -0.105]
Indirect effect				
-	Environmental benefits → Attitudes → Purchase intentions	0.605	0.000	[0.471; 0.724]
-	Perceived risks → Attitudes → Purchase intentions	-0.182	0.001	[-0.296; -0.085]

5. Discussion and implications

5.1. Discussion of the findings

The results of this study contribute to advancing knowledge of the consumer acceptance and purchase intention regarding lab-grown meat. Specifically, our findings complement prior findings on consumer attitudes towards this product (Kouarfate and Durif, 2023) and highlight the effects of environmental benefits and perceived risks to explain and predict future purchase intentions. First, our study indicates that the perceived environmental benefits of this meat are strongly and positively related to attitudes and, in turn, to purchase intentions. Hence, environmental sustainability plays a crucial role in shaping potential consumers' reactions towards this meat. Prior studies focused on the effects of specific features of lab-grown meat, such as perceived naturalness and taste (Arango et al., 2024; Demartini et al., 2024), but few included environmental sustainability as an influencing factor. In their recent theoretical analysis, Pang and Chen (2024) indicated that

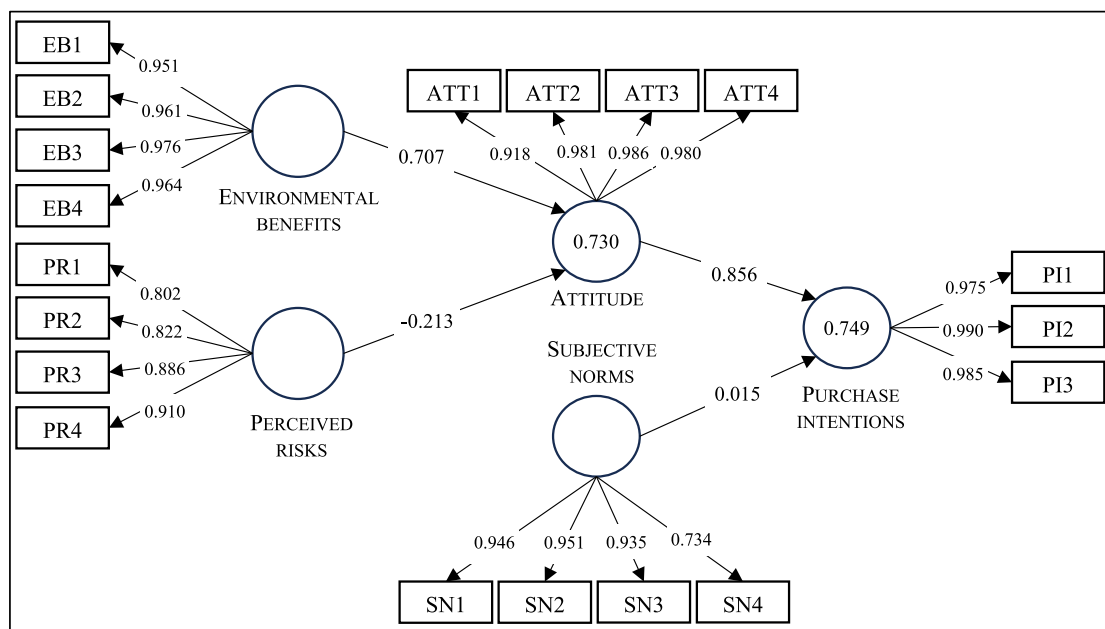


Fig. 2. Overview of the model estimates.

consumers' expenditure on alternatives to traditional meat is positively related to their environmental consciousness. In addition, research on the opinion of other stakeholders in livestock farming ecosystems (e.g. veterinary professionals and meat scientists) has revealed the central role of environmental sustainability (Choudhary et al., 2024). We conducted a similar assessment among consumers by including the factor of environmental sustainability in a comprehensive model of lab-grown meat acceptance.

In addition, our study expands existing knowledge on the role of perceived risks when respondents' form attitudes towards lab-grown meat. Prior studies argued that perceptions of risk could be attributable to a lack of knowledge of the long-term health effects of the consumption of such meat (Pakseresht et al., 2022). For example, Chia et al. (2024) emphasised that the distrust of food technology could negatively influence consumption intention. Similarly, Muiruri and Rickertsen (2024) reported that the perceived risks of illness because of cultured meat consumption reduce consumer willingness to try this novel food. However, consumer evaluations of perceived risks, which include knowledge of the health impact of lab-grown meat, were not integrated into a comprehensive model. We surmised that consumers' evaluation of perceived risks and other factors, such as their value of environmental sustainability, could extend knowledge on the formation of attitudes and behavioural intentions towards this product. Accordingly, our study enhances prior knowledge by including additional factors that affect acceptance into our analysis.

Our study also contributes to the ongoing debate on the role of communication in increasing consumer knowledge and, thus, the acceptance of lab-grown meat (Min et al., 2024). Current research has focused on the effects of different types of advertising and communication strategies, such as employing social media influencers (Leite et al., 2024). However, the role of friends and relatives has been overlooked. Our study fills this gap by also assessing the role of subjective norms. In contrast with one of the central tenets of the TRA (Fishbein and Ajzen, 1975), we found that these did not significantly affect consumer purchase intentions. Several potential explanations can be proposed for these findings. They may indicate that respondents are trying to form their own opinions on such an important topic for their nutrition and health and are not influenced by their friends and relatives. Moreover, these findings may reflect that people do not frequently discuss the consumption of lab-grown meat with friends. In addition, subjective norms are affected by a society's food culture. Thus, in a country with such a strongly rooted gastronomic culture as Italy (Cardoso et al., 2020), one could reasonably assume that a shift towards the consumption of lab-grown rather than conventional meat will be slower and more difficult to accept. Therefore, our findings also enrich prior research suggesting that culinary traditions in specific countries may influence consumer acceptance of lab-grown meat (Chia et al., 2024), providing a theoretical explanation based on subjective norms.

In general, lab-grown meat is subjected to a life cycle similar to that of any new product or technology. Specifically, in the context of this study, this meat is in its developmental stage, which precedes commercialisation. In this case, as emphasised in the diffusion of innovation model by Rogers (1995), potential consumers do not have much information about the new product. Therefore, the current life-cycle stage of this meat may explain why subjective norms did not show a significant influence on purchase intentions and consumers perceived more potential benefits than potential risks (Garlet et al., 2024). This study's findings are consistent with the prevailing idea in extant research suggesting that at the pre-commercialisation stage of the cultured meat life cycle, consumers will perceive higher benefits than risks (Pakseresht et al., 2022). As the lab-grown meat industry matures in the specific context of this study (i.e. Italy), we can expect a more influential role of subjective norms and more accurate perceptions of benefits and risks.

## 5.2. Theoretical implications

The results of this study have several implications for theory related to food innovation and consumer acceptance of novel food, specifically of lab-grown meat. First, this study offers a comprehensive model that extends the well-established TRA to increase knowledge on the formation of consumer attitudes towards this meat and their effect on purchase intention. Most importantly, the extended model considers the effects of perceived environmental benefits and risks and shows overall good accuracy in explaining and predicting the consumer acceptance and purchase intention of lab-grown meat. The successful assessment of the predictive validity of the proposed model offers new insights. Compared with existing studies that only focused on explanations, the proposed theoretical model is also able to accurately predict future consumer intentions.

Moreover, the theoretical model proposed in this study also examined the effects of subjective norms, which have been overlooked in prior research on lab-grown meat (Pakseresht et al., 2022). The effects of communication are fundamental to understanding and predicting consumer acceptance of new products. As highlighted by Rogers (1995) in the diffusion of innovation model, interpersonal communication channels are essential at the persuasion stage in the innovation-decision process and are effective in removing consumer resistance towards innovations. Therefore, incorporating the effects of interpersonal communication (i.e. subjective norms) is necessary to predict the degree of adoption of cultured meat at each stage of its life cycle.

More broadly, this study contributes to enriching the theoretical foundations of the nascent research stream that aims to assess the effects of the transition from conventional meat towards lab-grown meat for various stakeholders in livestock farming ecosystems. Recent research on farmers' perceptions has reported both advantages and disadvantages (Räty et al., 2023). Moreover, prior studies on the perceptions of veterinary professionals, meat scientists and food science scholars found that they considered the lack of information about the consumer acceptance of cultured meat a major threat to cultured meat production (Choudhary et al., 2024). The present study complements this knowledge from the perspective of potential consumers of lab-grown meat. Similarly to the farmers' perspectives, the consumers' perspectives highlighted both pros (environmental benefits) and cons (health risks, such as allergies and intolerances). Overall, from an ecosystem perspective, this study adopted a micro-level analysis that addressed the issue of lab-grown meat using the lens of a specific stakeholder (i.e. the consumer). Hence, similarly to other researchers (e.g., Moritz et al., 2022), we examined the issue of lab-grown meat from the perspective of one specific actor. However, interactions between consumers and other actors in the ecosystem (e.g. agritourism operators or farmers) also play a role in shaping consumer attitudes and behaviours over time. Thus, new theoretical advancements could be reached by connecting all actors through a meso-level analysis of the farming ecosystem (Vargo and Lusch, 2017).

## 5.3. Practical implications

This study's results also offer valuable insights for several stakeholders, particularly policymakers. Across many countries, there are rich debates on whether to authorise and how to regulate the introduction of lab-grown meat in the market and smooth the effects of the transition towards this meat for all the stakeholders involved (European Union, 2018). The public generally shows a high level of awareness that this meat is an innovation with potentially disruptive effects from economic, environmental and social perspectives. The findings of this study suggest that potential consumers perceive the environmental benefits of lab-grown meat and that such benefits strongly contribute to shaping their attitudes. However, the analysis also emphasised the effects of the perceived health risks of the consumption of this meat.

Hence, policymakers must first provide consumers with clear,

accurate information regarding lab-grown meat. The official definitions of this meat, such as that provided by the [European Union \(2018\)](#), albeit accurate, are framed to emphasise this new product's technological aspects. However, potential consumers need simpler messages that can address their demand for food safety and more knowledge of the effects (e.g. for themselves and the environment) of adopting cultured meat consumption in the future. We urge policymakers to reassure the public by enacting appropriate and transparent regulations. Businesses that develop lab-grown meat are also required to respond to safety needs by guaranteeing information and transparency. While it may be relatively easy to convince innovators in small niches to try cultured meat in the long term, the success of this innovation will depend on the ability to shape proper communication strategies to persuade larger segments of consumers. Therefore, more generally, businesses need to engage in research aimed at improving the properties and benefits of cultured meat and making this meat accessible to larger segments of consumers by lowering its price through more efficient production processes.

#### 5.4. Limitations and future studies

Several limitations should be considered when interpreting the findings of this study. First, this study was based on a cross-sectional analysis of a relatively small sample of respondents from a single country. More studies are needed to generalise the findings and reveal the effects of variables we did not include in our model. For example, respondents' connections with the countryside and livestock could moderate their perceptions, as the perceptions of people living in rural areas may differ from those of people living in urban areas. Country-specific and contextual factors should be also considered. For example, recently, the idea of product authenticity linked to the idiosyncratic culture of a certain territory has been extensively emphasised, both in theory and practice ([Andéhn and L'Espoir Decosta, 2021](#)). Therefore, it would be interesting to assess the extent to which lab-grown meat contradicts the desire to have authentic experiences related to the unique character of the gastronomy of a certain territory in which meat is an essential part. In addition, it would be interesting to understand how this challenge can be addressed. Last, personal variables, such as dietary styles, could also be included in future studies.

Moreover, future studies should aim to gain a more comprehensive understanding of the effects of adopting lab-grown meat consumption. Such a broad view should incorporate the perspectives of all stakeholders involved, ranging from consumers to farmers, industry operators, gastronomic business owners, residents of rural areas, and many others. This multi-stakeholder view would enhance the consumer evaluations presented in this study. For example, for some stakeholders, the effects of cultured meat on environmental sustainability could encompass not only positive effects (e.g. reduced emissions) but also negative outcomes. For some, imagining the countryside without livestock farmers and animals is difficult. Animals also have positive effects on the environment that are often neglected, such as cleaning the soil and contributing to the prevention of wildfires.

## 6. Conclusion

Food innovation has become an urgent global priority to achieve food security for a growing population, increase responsible food consumption and reduce global warming caused by unsustainable food production methods. In this context, lab-grown meat has emerged as an important opportunity to address the aforementioned social and environmental challenges. Technological innovation is progressing, and many businesses, including startups, are working to ensure the safe, efficient production and commercialisation of such meat. Meanwhile, scholars are working to develop a comprehensive understanding of the strengths, weaknesses, opportunities and threats associated with the production and consumption of such meat ([Choudhary et al., 2024](#)). Thus, more knowledge is needed regarding the transition from

conventional meat to lab-grown meat from the perspective of all stakeholders in livestock farming ecosystems, including potential future consumers.

The findings of this study advance the literature on consumer attitudes and purchase intentions regarding lab-grown meat and offer insights for its future commercialisation. The analyses indicate that the perceived higher environmental sustainability of this meat compared with conventional meat plays a crucial and positive role in shaping attitudes and purchase intentions towards lab-grown meat. Simultaneously, they highlight the negative effects of perceived potential risks to human health (e.g. allergies and intolerance). Hence, this study has implications for policymakers when reflecting on whether to authorise and how to regulate the sale of lab-grown meat to favour this transition and mitigate the effects on stakeholders. Moreover, future studies should integrate the perceptions of consumers with those of other relevant stakeholders (e.g. current and future meat producers) to gain a comprehensive understanding of the effects of the transition towards lab-grown meat.

Last, while we addressed the pre-commercialisation stage in this study, we found an intermediate degree of familiarity with the topic of lab-grown meat among respondents. Because the debate on this meat is growing rapidly, it would be interesting to replicate this study soon to understand the changes in attitudes and behaviours, specifically regarding the effects of perceived sustainability and risks. If commercialisation is authorised, it would be interesting to explore the extent to which purchase intentions can be transformed into actual purchases. Such analyses could also assess whether the speed of adoption is influenced by country-specific factors, such as the effects of a strong traditional gastronomic culture.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## CRediT authorship contribution statement

**Paola Castellani:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Data curation, Conceptualization. **Fabio Cassia:** Writing – original draft, Software, Formal analysis. **Alfonso Vargas-Sánchez:** Writing – original draft, Validation. **Elena Giaretta:** Validation, Supervision.

## Declaration of competing interest

The authors have no competing financial and nonfinancial interests.

## Data availability

The data that has been used is confidential.

## References

- Abbate, S., Centobelli, P., Cerchione, R., 2023. The digital and sustainable transition of the agri-food sector. *Technological Forecasting and Social Change* 187, 122222. <https://doi.org/10.1016/j.techfore.2022.122222>.
- Andéhn, M., L'Espoir Decosta, J.P., 2021. Authenticity and product geography in the making of the agritourism destination. *J. Travel Res.* 60 (6), 1282–1300. <https://doi.org/10.1177/0047287520940796>.
- Arango, L., Septianto, F., Pontes, N., 2024. The role of conventional meat unnaturalness in cultured meat acceptance: a test of holistic mindset. *Appetite*, 107656. <https://doi.org/10.1016/j.appet.2024.107656>.
- Aschemann-Witzel, J., Mulders, M.D., Mouritzen, S.L.T., 2023. Outside-in and bottom-up: using sustainability transitions to understand the development phases of mainstreaming plant-based in the food sector in a meat and dairy focused economy. *Technological Forecasting and Social Change* 197, 122906. <https://doi.org/10.1016/j.techfore.2023.122906>.
- Bauer, J.M., Aarestrup, S.C., Hansen, P.G., Reisch, L.A., 2022. Nudging more sustainable grocery purchases: behavioural innovations in a supermarket setting. *Technological*

- Forecasting and Social Change 179, 121605. <https://doi.org/10.1016/j.techfore.2022.121605>.
- Baum, C.M., Bröring, S., Lagerkvist, C.-J., 2021. Information, attitudes, and consumer evaluations of cultivated meat. *Food Qual. Prefer.* 92, 104226. <https://doi.org/10.1016/j.foodqual.2021.104226>.
- Bui, H.T., Filimonau, V., Ermolaev, V.A., 2024. Cultivated meat in tourism and hospitality: setting the scene and outlining future research agenda. *J. Foodserv. Bus. Res.* 1–12. <https://doi.org/10.1080/15378020.2024.2355373>.
- Cardoso, L., Araújo Vila, N., de Araújo, A.F., Dias, F., 2020. Food tourism destinations' imagery processing model. *British Food Journal* 122 (6), 1833–1847. <https://doi.org/10.1108/BFJ-08-2018-0557>.
- Cassia, F., Magno, F., 2024. The value of self-determination theory in marketing studies: insights from the application of PLS-SEM and NCA to anti-food waste apps. *J. Bus. Res.* 172, 114454. <https://doi.org/10.1016/j.jbusres.2023.114454>.
- Cheah, J.-H., Magno, F., Cassia, F., 2024. Reviewing the SmartPLS 4 software: the latest features and enhancements. *J. Mark. Anal.* 12 (1), 97–107. <https://doi.org/10.1057/s41270-023-00266-y>.
- Chen, M.-F., Tung, P.-J., 2014. Developing an extended theory of planned behavior model to predict consumers' intention to visit green hotels. *Int. J. Hosp. Manag.* 36, 221–230. <https://doi.org/10.1016/j.ijhm.2013.09.006>.
- Chia, A., Shou, Y., Wong, N.M.Y., Cameron-Smith, D., Sim, X., Van Dam, R.M., Chong, M. F.-F., 2024. Complexity of consumer acceptance to alternative protein foods in a multiethnic Asian population: a comparison of plant-based meat alternatives, cultured meat, and insect-based products. *Food Quality and Preference* 114, 105102. <https://doi.org/10.1016/j.foodqual.2024.105102>.
- Choudhary, F., Khandi, S., Aadil, R.M., Hassoun, A., Bekhit, A.E.-D.A., Abdi, G., Bhat, Z. F., 2024. Understanding crucial factors in cultured meat production: a comprehensive SWOT analysis. *Applied Food Research*, 100474. <https://doi.org/10.1016/j.afres.2024.100474>.
- Choudhury, D., Tseng, T.W., Swartz, E., 2020. The business of cultured meat. *Trends Biotechnol.* 38 (6), 573–577. <https://doi.org/10.1016/j.tibtech.2020.02.012>.
- Dal Mas, F., Massaro, M., Ndou, V., Raguseo, E., 2023. Blockchain technologies for sustainability in the agrifood sector: a literature review of academic research and business perspectives. *Technological Forecasting and Social Change* 187, 122155. <https://doi.org/10.1016/j.techfore.2022.122155>.
- Demartini, E., Marescotti, M.E., Amato, M., Corradini, A., Verneau, F., Gaviglio, A., 2024. Acceptance of alternative meats among different dietarian styles: an explorative analysis in Italy. *Food Quality and Preference* 113, 105060. <https://doi.org/10.1016/j.foodqual.2023.105060>.
- European Union, 2018. What if all our meat were grown in a lab? [https://www.europarl.europa.eu/RegData/etudes/ATAG/2018/614538/EPRS\\_ATA\(2018\)614538\\_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/ATAG/2018/614538/EPRS_ATA(2018)614538_EN.pdf).
- FAO, 2023a. Pathways towards lower emissions. A global assessment of the greenhouse gas emissions and mitigation options from livestock agrifood systems. <https://www.fao.org/documents/card/en/c/cc9029en>.
- FAO, 2023b. The State of Food Security and Nutrition in the World 2023. <https://www.fao.org/documents/card/en/c/cc3017en>.
- Fishbein, M., Ajzen, I., 1975. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Addison-Wesley, Reading, MA.
- Fitzmaurice, J., 2005. Incorporating consumers' motivations into the theory of reasoned action. *Psychol. Mark.* 22 (11), 911–929. <https://doi.org/10.1002/mar.20090>.
- Garlet, T.B., de Medeiros, J.F., Ribeiro, J.L.D., Perin, M.G., 2024. Understanding ethical products: definitions and attributes to consider throughout the product lifecycle. *Sustainable Production and Consumption*. <https://doi.org/10.1016/j.spc.2024.01.010>.
- Hair, J.F., Risher, J.J., Sarstedt, M., Ringle, C.M., 2019. When to use and how to report the results of PLS-SEM. *Eur. Bus. Rev.* 31 (2), 2–24. <https://doi.org/10.1108/EBR-11-2018-0203>.
- Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., 2022. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Sage, Thousand Oaks, CA.
- Hocquette, J.-F., 2016. Is in vitro meat the solution for the future? *Meat Sci.* 120, 167–176. <https://doi.org/10.1016/j.meatsci.2016.04.036>.
- Ivanovich, C.C., Sun, T., Gordon, D.R., Ocko, I.B., 2023. Future warming from global food consumption. *Nat. Clim. Chang.* 13 (3), 297–302. <https://doi.org/10.1038/s41558-023-01605-8>.
- Kahneman, D., 2011. *Thinking, Fast and Slow*. Farrar, Straus and Giroux, New York, NY.
- Kock, N., Hadaya, P., 2018. Minimum sample size estimation in PLS-SEM: the inverse square root and gamma-exponential methods. *Inf. Syst. J.* 28 (1), 227–261. <https://doi.org/10.1111/isj.12131>.
- Kouarfate, B.B., Durif, F.N., 2023. A systematic review of determinants of cultured meat adoption: impacts and guiding insights. *Br. Food J.* 125 (8), 2737–2763. <https://doi.org/10.1108/BFJ-06-2022-0513>.
- Leite, F.P., Septianto, F., Pontes, N., 2024. 'Meat' the influencers: crafting authentic endorsements that drive willingness to buy cultured meat. *Appetite* 199, 107401. <https://doi.org/10.1016/j.appet.2024.107401>.
- Mattick, C.S., Landis, A.E., Allenby, B.R., 2015. A case for systemic environmental analysis of cultured meat. *J. Integr. Agric.* 14 (2), 249–254. [https://doi.org/10.1016/S2095-3119\(14\)60885-6](https://doi.org/10.1016/S2095-3119(14)60885-6).
- Min, S., Yang, M., Qing, P., 2024. Consumer cognition and attitude towards artificial meat in China. *Future Foods* 9, 100294. <https://doi.org/10.1016/j.fufo.2023.100294>.
- Morais-da-Silva, R.L., Reis, G.G., Sanctorem, H., Molento, C.F.M., 2022. The social impacts of a transition from conventional to cultivated and plant-based meats: evidence from Brazil. *Food Policy* 111, 102337. <https://doi.org/10.1016/j.foodpol.2022.102337>.
- Moritz, J., Tuomisto, H.L., Ryyänen, T., 2022. The transformative innovation potential of cellular agriculture: political and policy stakeholders' perceptions of cultured meat in Germany. *J. Rural. Stud.* 89, 54–65. <https://doi.org/10.1016/j.jrurstud.2021.11.018>.
- Mostafa, M.M., 2007. A hierarchical analysis of the green consciousness of the Egyptian consumer. *Psychol. Mark.* 24 (5), 445–473. <https://doi.org/10.1002/mar.20168>.
- Muiruri, S.W., Rickertsen, K., 2024. Norwegian consumers' willingness to try cultured meat. *Future Foods* 10, 100409. <https://doi.org/10.1016/j.fufo.2024.100409>.
- Pakseresht, A., Kaliji, S.A., Canavari, M., 2022. Review of factors affecting consumer acceptance of cultured meat. *Appetite* 170, 105829. <https://doi.org/10.1016/j.appet.2021.105829>.
- Palmieri, N., Perito, M.A., Lupi, C., 2020. Consumer acceptance of cultured meat: some hints from Italy. *British Food Journal* 123 (1), 109–123. <https://doi.org/10.1108/BFJ-02-2020-0092>.
- Pang, S., Chen, M.-C., 2024. Investigating the impact of consumer environmental consciousness on food supply chain: the case of plant-based meat alternatives. *Technological Forecasting and Social Change* 201, 123190. <https://doi.org/10.1016/j.techfore.2023.123190>.
- Paul, J., Modi, A., Patel, J., 2016. Predicting green product consumption using theory of planned behavior and reasoned action. *J. Retail. Consum. Serv.* 29, 123–134. <https://doi.org/10.1016/j.jretconser.2015.11.006>.
- Paulraj, A., Chen, L.J., Blome, C., 2017. Motives and performance outcomes of sustainable supply chain management practices: a multi-theoretical perspective. *J. Bus. Ethics* 145 (2), 239–258. <https://doi.org/10.1007/s10551-015-2857-0>.
- Piancharoenwong, A., Badir, Y.F., 2024. IoT smart farming adoption intention under climate change: the gain and loss perspective. *Technological Forecasting and Social Change* 200, 123192. <https://doi.org/10.1016/j.techfore.2023.123192>.
- Podsakoff, P.M., Podsakoff, N.P., Williams, L.J., Huang, C., Yang, J., 2024. Common method bias: it's bad, it's complex, it's widespread, and it's not easy to fix. *Annu. Rev. Organ. Psychol. Behav.* 11. <https://doi.org/10.1146/annurev-orgpsych-110721-040030>.
- Rasmussen, M.K., Gold, J., Kaiser, M.W., Moritz, J., Rätty, N., Rønning, S.B., Ryyänen, T., Skrivergaard, S., Ström, A., Therkildsen, M., 2024. Critical review of cultivated meat from a Nordic perspective. *Trends Food Sci. Technol.*, 104336. <https://doi.org/10.1016/j.tifs.2024.104336>.
- Rätty, N., Tuomisto, H.L., Ryyänen, T., 2023. On what basis is it agriculture?: a qualitative study of farmers' perceptions of cellular agriculture. *Technological Forecasting and Social Change* 196, 122797. <https://doi.org/10.1016/j.techfore.2023.122797>.
- Reis, G.G., Heidemann, M.S., Borini, F.M., Molento, C.F.M., 2020. Livestock value chain in transition: cultivated (cell-based) meat and the need for breakthrough capabilities. *Technol. Soc.* 62, 101286. <https://doi.org/10.1016/j.techsoc.2020.101286>.
- Reis, G., Heidemann, M., Goes, H., Molento, C., 2021. Can radical innovation mitigate environmental and animal welfare misconduct in global value chains? The case of cell-based tuna. *Technological Forecasting and Social Change* 169, 120845. <https://doi.org/10.1016/j.techfore.2021.120845>.
- Ringle, C.M., Sarstedt, M., Sinkovics, N., Sinkovics, R.R., 2023. A perspective on using partial least squares structural equation modelling in data articles. *Data Brief* 48, 109074. <https://doi.org/10.1016/j.dib.2023.109074>.
- Rodríguez-Entrena, M., Salazar-Ordóñez, M., Sayadi, S., 2013. Applying partial least squares to model genetically modified food purchase intentions in southern Spain consumers. *Food Policy* 40, 44–53. <https://doi.org/10.1016/j.foodpol.2013.02.001>.
- Rogers, E.M., 1995. *Diffusion of Innovations*, 41. Free Press, New York, pp. 1002–1037.
- Sarstedt, M., Hair, J.F., Pick, M., Liengard, B.D., Radomir, L., Ringle, C.M., 2022. Progress in partial least squares structural equation modeling use in marketing research in the last decade. *Psychol. Mark.* 39 (5), 1035–1064. <https://doi.org/10.1002/mar.21640>.
- Sarstedt, M., Hair, J.F., Ringle, C.M., 2023. "PLS-SEM: indeed a silver bullet"—retrospective observations and recent advances. *J. Mark. Theory Pract.* 31 (3), 261–275. <https://doi.org/10.1080/10696679.2022.2056488>.
- Shanmugavel, N., Balakrishnan, J., 2023. Influence of pro-environmental behaviour towards behavioural intention of electric vehicles. *Technol. Forecast. Soc. Chang.* 187, 122206. <https://doi.org/10.1016/j.techfore.2022.122206>.
- Sharma, P.N., Liengard, B.D., Hair, J.F., Sarstedt, M., Ringle, C.M., 2023. Predictive model assessment and selection in composite-based modeling using PLS-SEM: extensions and guidelines for using CVPAT. *Eur. J. Mark.* 57 (6), 1662–1677. <https://doi.org/10.1108/EJM-08-2020-0636>.
- Sharma, P.N., Sarstedt, M., Ringle, C.M., Cheah, J.-H., Herfurth, A., Hair, J.F., 2024. A framework for enhancing the replicability of behavioral MIS research using prediction oriented techniques. *Int. J. Inf. Manag.* 78, 102805. <https://doi.org/10.1016/j.ijinfomgt.2024.102805>.
- Shaw, E., Mac Con Iomaire, M., 2019. A comparative analysis of the attitudes of rural and urban consumers towards cultured meat. *British Food Journal* 121 (8), 1782–1800. <https://doi.org/10.1108/BFJ-07-2018-0433>.
- Sinke, P., Swartz, E., Sanctorem, H., van der Giesen, C., Odegard, I., 2023. Ex-ante life cycle assessment of commercial-scale cultivated meat production in 2030. *Int. J. Life Cycle Assess.* 28 (3), 234–254. <https://doi.org/10.1007/s11367-022-02128-8>.
- Slade, P., 2018. If you build it, will they eat it? Consumer preferences for plant-based and cultured meat burgers. *Appetite* 125, 428–437. <https://doi.org/10.1016/j.appet.2018.02.030>.
- Trafimow, D., 2009. The theory of reasoned action: a case study of falsification in psychology. *Theory Psychol.* 19 (4), 501–518. <https://doi.org/10.1177/0959354309336319>.
- Tuomisto, H.L., Teixeira de Mattos, M.J., 2011. Environmental impacts of cultured meat production. *Environ. Sci. Technol.* 45 (14), 6117–6123. <https://doi.org/10.1021/es200130u>.

- United Nations, 2015. Transforming Our World: The 2030 Agenda for Sustainable Development (A/RES/70/1). UN. <https://sustainabledevelopment.un.org/post2015/transformingourworld/publication>.
- Vargo, S.L., Lusch, R.F., 2017. Service-dominant logic 2025. *Int. J. Res. Mark.* 34 (1), 46–67. <https://doi.org/10.1016/j.ijresmar.2016.11.001>.
- Verbeke, W., Sans, P., Van Loo, E.J., 2015. Challenges and prospects for consumer acceptance of cultured meat. *J. Integr. Agric.* 14 (2), 285–294. [https://doi.org/10.1016/S2095-3119\(14\)60884-4](https://doi.org/10.1016/S2095-3119(14)60884-4).
- 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. *Livest. Sci.* 253, 104705. <https://doi.org/10.1016/j.livsci.2021.104705>.
- Yang, X., Zhou, X., Deng, X., 2022. Modeling farmers' adoption of low-carbon agricultural technology in Jiangnan plain, China: an examination of the theory of planned behavior. *Technological Forecasting and Social Change* 180, 121726. <https://doi.org/10.1016/j.techfore.2022.121726>.