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Cultured Meat Consumer Acceptance: Addressing Issues of Eco-Emotions

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Abstract
Meat substitutes, in particular cultured meat, appear to be an effective way of combating climate change, ensuring human and animal welfare, and meeting the challenges of food security. In the face of the climate emergency, we need to speed up the decarbonization of local and national economies and curb populations' negative emotional responses. Eco-emotions (such as fear) can indeed go so far as to cause disengagement from the environmental transition and hamper action. The aim of this article is to understand and predict, from the perspective of the extended theory of planned behaviour (TPB), (i) consumer intentions and (ii) the determinants of the adoption of cultured meat by introducing two important variables drawn from the literature on eco-emotions, i.e. eco-anger and eco-depression. The results show that, in addition to the traditional TPB variables (attitudes, subjective norms, perceived behavioural control), eco-depression has a significant effect on consumer intentions and the acceptability of cultured meat. This research can help to improve decision-making processes and to effectively predict intentions, acceptability, and purchasing behaviour with regard to cultured meat. Organizations will be able to use this model to propose differentiated marketing techniques, optimize marketing campaigns, and improve citizen engagement.

Key Words: Artificial meat, cultured meat, eco-anger, ecoanxiety, eco-depression, eco-emotion, social acceptability.

JEL Classification: M00, M30, M31

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1. Introduction

In recent years, the meat industry has succeeded in considerably reducing its greenhouse gas (GHG) emissions by adopting various environmental practices such as taking part in the GHG offset trading systems (Bryant et al., 2019; Zhang et al., 2020). Despite this trend, it still accounts for 15–20% of global GHG emissions (Kashim et al., 2023), not to mention the impact on deforestation and water (Zhang et al., 2020). There is an urgent need therefore to find nutritious, healthy and environmentally friendly alternatives to animal farming for meat in order to reduce the impact on the environment (Morais-da-Silva and Semprebon, 2021).

Most scientific studies (e.g. Wood and Tavan, 2022) point out that meat substitutes, including cultured meat (Nobre, 2022), are a valuable solution (i) to the challenges of food security in the face of the growing world population and meat consumption, (ii) to the climate issues associated with

conventional livestock farming (Deliza et al., 2023), and (iii) to issues of human welfare (nutritional intake) and animal welfare (protection of animal rights) (Lewisch and Riefler, 2023).

The production of meat alternatives (e.g. plant and soy milk-based meat, insects and cultured meat) has been underway for a number of years in developed countries, driven in particular by vegan associations and movements (Hoquette, 2016). In June 2023, once the United States Department of Agriculture (USDA) had given the green light, the United States became the second state to authorize the marketing of cultured meat (cultured chicken by Upside Foods) after the Republic of Singapore in December 2020 (EatJust chicken nuggets).

The climate emergency has made it necessary to accelerate the decarbonization of local and national economies (Howard et al., 2023) and to limit the negative emotions that can inhibit individual action towards environmental transition (Rehling, 2022). A growing number of citizens are tired of the amount of alarmist information presented in the media in relation to the environment (e.g. 41.3% of the population of Quebec in Canada; Observatoire de la consommation responsable, 2023). Understanding the role of eco-emotions (e.g. eco-anxiety, climate anxiety, climate sorrow, environmental despair, eco-anger, eco-depression, climate grief or eco-guilt: Pihkala, 2020; Bernard and Colin, 2023; Voski, Wong-Parodi and Ardoin, 2023) in human health and behaviour is a necessary step to conducting more effective interventions in favour of environmental health and behaviour in the context of the intensification of the global environmental crisis (Voski, Wong-Parodi and Ardoin, 2023). While eco-emotions do not necessarily lead to a loss of motivation, fear is seldom a driver of engagement (Gaborit, Le Lann and Solnon, 2023), hence the pertinence of this study. Indeed, in the literature, authors consider that some emotions resulting from the consequences of climate change are not only detrimental to individuals' well-being (e.g., Pihkala, 2020; Pihkala, 2022) but also significantly influence their consumption intentions towards "green" products. However, the literature review has identified research gaps concerning the role of eco-emotions in the specific adoption of cultivated meat.

Despite the growing body of literature on eco-emotions in recent years, particularly on how they affect health (e.g. Stanely et al., 2021), analysis of their impact on the social acceptability of new goods or practices is scarce, and, to our knowledge, altogether lacking in relation to the adoption and social acceptance of cultured meat. Yet, “consumer acceptance is critical for cultured meat success in the market” (Pakseresht, Kaliji and Canavari, 2022).

So far, the literature on the adoption of cultured meat has focused on (i) the determinants of future consumer acceptance or rejection (e.g. Szejda, Bryant and Urbanovitch, 2021; Pakseresht, Kaliji and Canavari, 2022; Kouarfaté and Durif, 2023a, b); (ii) the factors that positively or negatively influence consumption intention (e.g. Verbeke et al., 2015; Hwang et al., 2020; Weinrich et al., 2020), including “sustainability appeal” and “environmental awareness” (e.g. Morais-da-Silva and Semprebon, 2021); (iii) the likelihood of trying, buying, paying for and consuming (e.g. Wilks and Phillips, 2017; Wilks et al., 2019); and (iv) cultural and cross-cultural purchase intent (e.g. Bryant et al., 2019; Weinrich, Strack and Neugebauer, 2020; Chong, Leung and Lua, 2022) or purchase intent based on information received (e.g. Bekker et al., 2017; Baum, Bröring and Lagerkvist, 2021).

The role of eco-emotions in the adoption of cultured meat is thus an important avenue of research that can bridge the gap between the science of cultured meat and public perceptions. For this reason, the aim of this article is to use the extended theory of planned behaviour (Wang et al., 2018, Yarimoglu and Gunay, 2020) to understand and predict (i) consumer intentions and (ii) the determinants of acceptance of cultured meat by introducing two variables considered of significance in the literature (cf. Pihkala, 2020) in relation to eco-emotions, i.e. eco-anger and eco-depression.

2. Literature review

In most countries, public acceptance of cultured meat is coming up against a number of obstacles. In Canada, for example, the acceptance rate for this innovation was barely 22% in 2020 (cf. La Presse,

2020). Several recent studies (e.g. Siddiqui et al., 2023; Lewisch and Riefler, 2023; Rosenfeld and Tomiyama, 2023; Deliza et al., 2023, Kouarfaté and Durif, 2023a, b) have explored the question of the determinants likely to affect consumer attitudes. A number of key determinants have been identified, including food neophobia; health and food safety concerns; social and cultural beliefs; regulations; nutritional and sensory characteristics (Kouarfaté and Durif, 2023 a, b; Deliza et al., 2023); health and environmental benefits (Rosenfeld and Tomiyama, 2023); packaging design (Deliza et al., 2023); cultural, economic and religious factors (Kashim et al., 2023, Kouarfateé and Durif, 2023a, Lewisch and Riefler, 2023); and psychological well-being (Leung et al., 2023). Essentially, the adoption of cultured meat seems to be linked to intrinsic, ethical, informational (Hwang et al., 2020; Kouarfaté and Durif, 2023a, b) and belief determinants (Kouarfaté and Durif, 2023a, b).

In any case, consumers are still sceptical, and little, if anything, is known about the nature and causes of their hesitation (be it in relation to perception, intention or acceptability) (Francekovic et al., 2021). Indeed, the results of the study by Francekovic et al. (2021) showed that even at a price equivalent to that of conventional meat, only 41% of consumers (from Croatia, Greece, and Spain) intend to buy cultured meat. Furthermore, the consumption of conventional meat is associated with a number of sociocultural attributes and behaviours tied to individuals' nutritional needs, cultural dogmas and religious laws (Stora-Lamarre, 1992), but also to pro-environmental behaviours (Parlasca and Qaim, 2022). We chose to use the Theory of Planned Behaviour to highlight consumers' attitudes to this food innovation insofar as it can explain and predict the main categories of food-related behaviour (consumption of healthy, organic, environmentally friendly or highly innovative products such as insect-based products, Ajzen, 1991; McDermott et al., 2015; Yarimoglu and Gunay, 2020).

In the studies Fishbein and Ajzen conducted in 1975, they suggested using the theory of reasoned action to study consumer intentions on the basis of attitudes and subjective norms (or social influence) in order to understand their actual behaviour. To improve this theory, whose predictive value he considered insufficient, Ajzen (1985) developed the Theory of Planned Behaviour (TPB) by adding a third construct (perceived behavioural control) as an antecedent not only of consumers' intentions, but also of their actual behaviour (Madden, Ellen and Ajzen, 1992). In addition to its effectiveness in explaining certain complex human behaviours (Ajzen, 1991:206), the TPB suggests that certain factors (attitudes, subjective norms and perceived behavioural control) can predict consumer intentions.

In recent years, a number of researchers (e.g. Wang et al., 2018, Yarimoglu and Gunay, 2020) have further suggested extending the TPB by introducing new variables, in particular emotional and sociocultural variables, to increase the model's predictive power and adaptability to research contexts (Perugini and Bagozzi, 2001). The extended TPB has been widely used to analyse the intentions and actual behaviours of consumers in general and "green" or "sustainable" consumers in particular (e.g. Yadav and Pathak, 2017; Verma and Chandra, 2018; Wang et al., 2018; Yarimoglu and Gunay, 2020). For example, by introducing new variables (anticipated emotions, sensory appeal, environmental concern and desire) into his work on ecologically sustainable diets, Chen (2022) demonstrated a strong interrelationship between consumer attitudes and purchase intentions towards plant-based alternatives to meat in Taiwan.

The theory of planned behaviour is based on three original factors:

1. Consumer attitudes, which are formed by consumers' beliefs and judgement about the desirability of the behaviour and its consequences. According to (Ajzen, 1991), it is consumers' attitudes that define their intentions with respect to a particular behaviour;
2. Subjective norms, which refer to normative beliefs and the influence and opinion of a person's close circle in regard to a particular behaviour (social norms);
3. Perceived control or self-efficacy, which is the consumer's belief about their ability to successfully adopt a particular behaviour. These are internal control factors (emotions) and external control factors (market opportunities and threats) (Fishbein and Ajzen, 1975; Ajzen, 1985; Ajzen, 1991).

This study poses the following three initial hypotheses emanating from the original TPB constructs:

H1. Attitudes towards cultured meat have a positive influence on the intention to eat cultured meat.

H2. Subjective norms have a positive influence on the intention to eat cultured meat.

H3. Perceived control has a positive influence on the intention to eat cultured meat.

Impacts of Eco-emotions.

Research associated with cultured meat is considered to be a study of pro-environmental behaviour, yet the literature shows that there is a relationship between consumer attitudes and pro-environmental behaviour (Chen, 2022; Bernard and Colin, 2023). The challenge of promoting pro-environmental behaviour is that much greater when the pro-environmental behaviour concerned is novel (Kronrod et al., 2023) because of the combined effect of obstacles to the adoption of pro-environmental behaviour (such as the costs involved, Van Horen, Van Der Wal, & Grinstein, 2018) and obstacles to the adoption of innovation (difficulty of adopting discontinuous innovations, Gallen et al., 2019).

Defined as negative emotions, eco-emotions such as eco-anxiety, eco-depression and eco-anger (Stanley et al., 2021; Bright and Eames, 2022) are the outcomes of vigorous adaptation and mitigation measures to climate change issues based on feelings of urgency (Chen, 2022; Bernard and Colin, 2023). Emotion is a complex and intense psychophysiological outcome of an individual's state of mind (anger, joy, anxiety, depression, etc.) linked to biochemical and environmental influences (Pihkala, 2020; Chen, 2022; Bernard and Colin, 2023).

A number of authors consider certain emotions that emerge as a consequence of climate change to be damaging to the well-being of individuals (e.g. Pihkala, 2020; Pihkala, 2022). Some of those emotions (e.g. eco-anger and eco-depression) are of interest in the context of our study because, on the one hand, their pertinence has been demonstrated in previous research and, on the other hand, they have not yet been used in research focusing specifically on cultured meat. However, it has already been shown that emotions shape people's reactions to the climate crisis in profound and complex ways (Pihkala, 2022), giving rise to a vast and dynamic field of study (Pihkala 2020). This is why some authors consider eco-emotions to be a fundamental lever for behaviour change (Petit and Ballet, 2021; Chen, 2022; Bernard and Colin, 2023). Albeit understudied, eco-anger is believed by several scholars to be the more impact-inducing of those emotions as regards consumer intentions (Bright and Eames, 2022; Bernard and Colin, 2023).

Similarly, eco-depression is a significant emotional response associated with the climate crisis (Stanley et al., 2021, Pihkala, 2022). Depression can be defined in several different ways but for the purpose of this research it is considered to be a state of intense sadness and not a psychiatric disorder (Webb and Pizzagalli, 2016; Bernard and Colin, 2023). "Depression is usually a composite of several emotions, including sadness, anxiety, anger, and guilt" (Lazarus, 1991). Depression is said to be an emotion triggered by an irreversible loss, leading to a slowing down of the cognitive and motor systems and therefore unlikely to motivate action (Bernard and Colin, 2023). Some authors even believe that eco-depression is not associated with action; rather, it can predict disengagement (Lazarus, 1993; Nabi, 2002).

In this study, the two research hypotheses associated with eco-emotions are used to verify the existence of a significant relationship between the two eco-emotions mentioned above and consumer intentions.

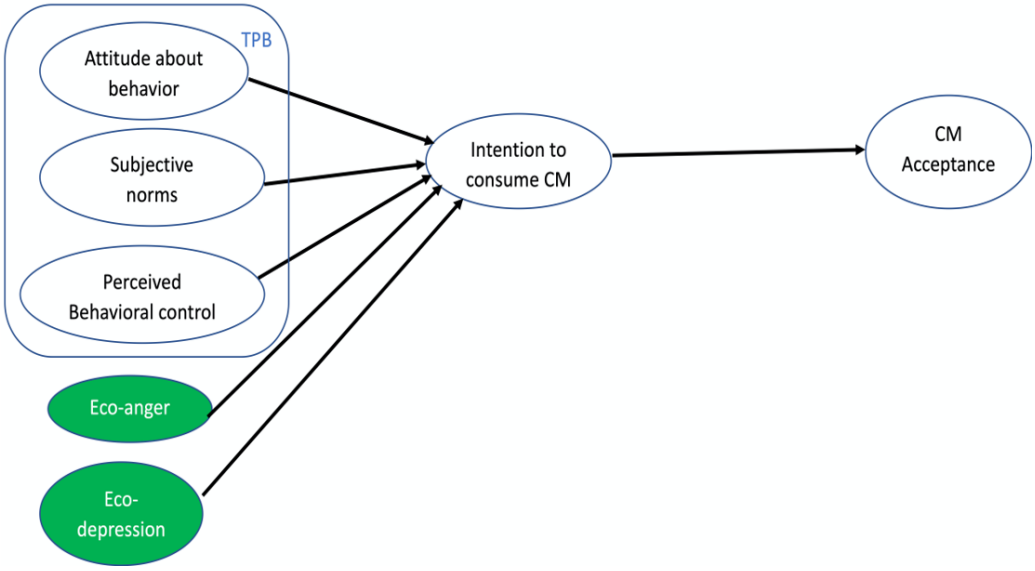
H4. Consumers' eco-anger has a positive influence on their intention to eat cultured meat.

H5. Consumers' eco-depression has a negative influence on their intention to eat cultured meat.

Finally, based on the TPB model, according to which intentions generate actual consumption behaviour, we pose a final hypothesis to ascertain the relationship between consumers' intention to consume and acceptance of cultured meat.

H6. Consumers' intention to consume cultured meat has a positive influence on their acceptance of cultured meat.

Figure 1. **Conceptual frame**



Source: own research

3. Methods

3.1 Survey

Sampling and data collection: the data was collected in July 2023 by a market research firm through a web panel survey of consumers aged 18 and older, representative of the population of a Canadian province (See Table A1, which represents the demographic description of the sample in the appendix).

Measurement instruments: following Cox III (1980) recommendations, all the measurement scales used are 7-point Likert-type scales (1 = "strongly disagree" to 7 = "strongly agree"). These are scales that have been developed and tested by other researchers and that our literature review found to be robust scales (Verbeke et al., 2015; Wilks and Philipps, 2017; Bekker et Al., 2017; 2019; Weinrich et al., 2020; Hwang et al., 2020; Wilks et al., 2019; Chen, 2022; Bernard and Colin, 2023).

The independent variables are the three original TPB variables (attitudes, subjective norms, perceived control) and the eco-emotions (eco-anger and eco-depression). For the eco-emotions experienced when individuals think about climate change, we use the measures developed by Hogg et al. (2021) and Bernard and Colin (2023).

The dependent variables are the intention to consume (Bryant et al., 2019) and acceptance of cultured meat (Rolland et al., 2020).

3.2. Sample characteristics and data analysis

Based on the theoretical framework, the data were analysed using structural equation modelling. The optimal sample size for structural equation analysis was respected. According to Wu (2009) and Iacobucci (2010), the optimal "sample size/questions" ratio (300/21 = 14.28/1) is between 10/1 and 15/1. Therefore, with a 21-item questionnaire and a sample of 300 valid responses, our study met the conditions for the ideal sample size, which should be 210 to 315 based on these authors' recommendations.

The sample comprised 130 men (43.3%) and 170 women (56.7%). While 60% of respondents had Christian religious beliefs, 26.7% had no religion or held secular views. In terms of education, 39.7% of respondents had a university degree and 60.3% had a college or lower level of education. Regarding income, 42% of respondents had an annual income of CA$50 000 or less and 45.6% had an income between CA$50 001 and CA$100 000.

3.3 Data analysis

Data analysis was carried out using quantitative research methods and IBM SPSS Statistics 29.0 and AMOS29 statistical software. A three-stage statistical analysis method was used:

- First, bivariate descriptive analyses (ANOVA, analysis of variance and correlation) were used to summarize all the raw data from the study;
- The second step was to carry out a confirmatory factor analysis (CFA);
- The third stage involved an overall analysis of the model's physical condition.

4. Results

4.1 Results of the descriptive analysis

Descriptive analysis shows that acceptance of cultured meat varies significantly between socio-professional groups (F = 2 593, df = 6 and sig = 0.018). Blue-collar workers and people not engaging in a professional activity were most accepting of cultured meat; the group of craftspeople, merchants and business executives, as well as retired people were the most unaccepting of cultured meat.

From the standpoint of marital status, the "separated" and "never married" individuals were most likely to accept cultured meat. Married people were the least likely to accept it (F = 5 588, df = 4 and sig = 0.001). As for the age variable, it is the extended 18–59 age group that is most likely to accept to consume this product (F = 4 996, df = 11 and sig = 0.001).

Analysis of covariance and correlation showed a significant, positive and weak linear relationship (cov (xy) =3 451, Pxy = 0.236 and sig = 0.001) between acceptance and level of familiarity with cultured meat. The more familiar consumers are with cultured meat, the more likely they are to accept to eat it. However, conventional meat consumption habits have no effect on acceptance of cultured meat. Finally, there are no significant differences in the level of acceptance of cultured meat based on confession, level of education or gender (men and women).

4.2 Evaluation of measurement models

The measurement items used in this research were identified and selected from the existing literature. Under these conditions, confirmatory factor analysis was the right tool to test whether the use of these measurement instruments was appropriate for our research topic and for the participants in this study. Factor loadings for all dimensional and variable items, Cronbach's alpha coefficients (α), composite reliability (CR), and average variance extracted (AVE) values are presented in Table 1. For eco-depression and attitude, as the measures include only two items each, the Spearman-Brown correlation coefficients (rSB) are presented as measures of reliability. In this case, it is a more conservative indicator than Cronbach's alpha. With rSB coefficient values of 0.794 for eco-depression and 0.977 for attitude, these values are considered satisfactory (Laveault and Grégoire, 2002).

4.2.1 Measuring instrument reliability

First, examination of the standardized factor loadings showed that all the items of all the variables included in the model had significant standardized factor loadings greater than 0.70, thus complying with the recommendations made by Nunnally and Bernstein (1994) and Hair et al. (2006), according to which factor loadings should be at least greater than 0.5 (Nunnally and Bernstein, 1994 and Hair et al., 2006). These results (see Table 1) confirm the validity of all the measurement tools used in this study.

Second, the internal consistency of the constructs was assessed.

4.2.1.1 Internal consistency of variables

Two indicators were used to analyse the internal consistency of the constructs: composite reliability (CR) and Cronbach's alpha values or Spearman-Brown correlation coefficients (rSB). The values obtained ranged from 0.798 to 0.977 (i.e. greater than 0.70), showing that all indicators for all variables were satisfactory. To ensure that a measurement scale is reliable, the α or Spearman-Brown (rSB) coefficients should ideally be greater than or equal to 0.7 for confirmatory studies (Hinton et al., 2004; Hair et al., 2006) and the composite reliability (CR) values should be greater than 0.6 (Bagozzi and Yi, 1988). These results therefore confirm that the variables in this study have a highly significant degree of internal consistency (see Table 1).

4.2.2 Validity of the measurement model

Convergent and discriminant validity were calculated separately to measure construct validity.

4.2.2.1 Convergent validity of the measurement model

To assess convergent validity, the metric used was the average variance extracted (AVE) for all the items in each construct. The AVE values for each variable are presented in Table 2. The recommended threshold for convergent validity is 0.5 (Bagozzi and Yi, 1988). All constructs were accepted as valid because their AVE values were greater than 0.5 (see Table 1).

Table 1. **Summary of measurement model reliability and AVE values**

Variable/Item	Mean	standard deviation	Standardized Factor Loading	Cronbach's alpha coefficients (α)	Average Variation Extracted (AVE)	Composite Reliability (CR)
Acceptance (AC)	3,088	1,873		0,937	0,838	0,939
AC_1A- Are you in favor of cultured meat?	3,360	2,044	0,890			
AC_1B- Would you be willing to purchase cultured meat products?	3,113	2,005	0,940			
AC_1C- Would you be willing to replace conventional meat with cultured meat in your daily diet?	2,793	1,912	0,916			
Intention to consume CM	3,065	1,762		0,897	0,704	0,903
IC_2A- I would be willing to try cultured meat	3,807	2,252	0,826			

IC_2B- I would buy regularly cultured meat	2,660	1,832	0,925			
IC_2C- I would eat cultured meat instead of conventional meat	2,630	1,877	0,902			
IC_2D- I would rather eat cultured meat than plant-based meat alternatives	3,167	2,075	0,682			
Attitude (AT)	3,143	1,968		0,977	0,954	0,976
AT_3A- It would be a good idea to eat cultured meat	3,140	1,990	0,982			
AT_3B- It would be a wise choice to consume cultured meat	3,147	1,993	0,972			
Subjective norms	2,232	1,398		0,867	0,708	0,877
SN_4A- Most people who are important to me would think I should buy cultured meat	2,210	1,556	0,906			
SN_4B- Most people I like would rather buy cultured meat	2,193	1,502	0,921			
SN_4C- Those around me would strongly influence my decision to buy cultured meat	2,293	1,658	0,676			
Perceived Behavioral control	3,425	1,699		0,860	0,635	0,871
BC_5A- I would be willing to pay more for cultured meat to protect the environment	2,553	1,849	0,732			
BC_5B- I believe cultured meat can improve the environment	3,730	1,996	0,841			
BC_5D- I think it will be relevant to buy cultured meat	3,077	1,969	0,976			
BC_5E- I will decide for myself the choice of cultured meat	4,343	2,266	0,590			
Eco-anger	4,057	2,054		0,943	0,846	0,943
EAR_6A- When I think about climate change - I feel frustrated	4,057	2,153	0,953			
EAR_6B- When I think about climate change - I feel irritated	4,110	2,188	0,911			
EAR_6C- When I think about climate change - I feel anger	4,007	2,165	0,896			
Eco-depression	2,880	1,801		0,792	0,666	0,798
ED_7A- When I think about climate change - I feel depressed	2,607	1,879	0,753			

ED_7B- When I think about climate change - I feel sad	3,153	2,076	0,875

NB: for constructs that are measured by a number of items less than or equal to 2, it is the Spearman-Brown coefficient (rsb) which is calculated instead of Cronbach's alpha.

Source: own research

4.2.2.2 Discriminant validity of the measurement model

The discriminant validity of the constructs was measured on the basis of the comparison of the square root of the AVE values of each construct with the correlations with other constructs. For the criterion of discriminant validity to be considered satisfactory, Fornell and Larcker (1981) suggest that the square root of the average value of variance extracted (AVE) should be greater than the correlation coefficient between the matched variables (Fornell and Larcker, 1981). As the results of this analysis, presented in Table 2, show, the square root of the AVE value of each construct is greater than the correlation coefficients between the matched variables (inter-construct correlation coefficients). Discriminant validity is therefore demonstrated (Fornell and Larcker, 1981).

Table 2. **Correlation coefficient and square root of the AVE of the measurement model**

	Correlations							
		1	2	3	4	5	6	7
1	Acceptance	**0,915**						
2	Intention	,892**	**0,839**					
3	Attitude	,886**	,879**	**0,977**				
4	Subjective Norms	,677**	,676**	,683**	**0,843**			
5	Perceived Behavioral Control	,813**	,798**	,847**	,645**	**0,797**		
6	Eco Anger	,195**	,158**	,181**	,182**	,166**	**0,920**	
7	Eco Depression	,253**	,248**	,305**	,272**	,289**	,527**	**0,816**
	**The correlation is significant at the 0.01 level (two-tailed).							

Source: own research

4.3 Overall model fit assessment

After a preliminary analysis of the structural model, it was found that some items (AT_3C, IC_2E, BC_5C) from some constructs were cross-loaded into other variables and their fit values were not acceptable. In accordance with the method developed by Yarimoglu and Gunay (2020), these items were eliminated. This item adjustment in the model did not, however, affect the reliability and validity levels of these measurement instruments. The results for reliability and validity presented in Tables 1 and 2 are those obtained after the adjustment of the structural model was performed. In the end, we retained a total of 21 measurement items for analysis, providing good fit based on the criteria outlined by Byrne (1994), Schumacker and Lomax (2004 and 2016).

4.4 Overall analysis of the structural model path and hypothesis testing

In order to examine the explanatory power of the research model, a structural equation analysis was performed. This analysis of the overall adequacy of the model is based on various indices of quality. According to the following fit indices, the conceptual model in this study exhibited good fit: χ 2/df = 2 153, goodness-of-fit index (GFI= 0.90), adjusted goodness-of-fit index (AGFI= 0.855), normed fit index (NFI = 0.946), relative fit index (RFI= 0.934), comparative fit index (CFI= 0.970), incremental fit index (IFI= 0.970) and Tucker-Lewis index (TLI=0.964) (Byrne, 1994, Schumacker and Lomax, 2004, Schumacker and Lomax, 2016). In addition, with a root mean square error of approximation (RMSEA=0.062) and a standardized root mean square residual (SRMR=0.0324) that are less than 0.08 and 0.05 respectively, these indices also meet the judgement criteria (Schumacker and Lomax, 2016). Consequently, the study design has good global relevance and validity.

Table 3. **Results of hypothesis tests**

Hypothesis	Path Relationship	Std. estimate (β)	SE	t value	p value*	Results
H1	IC <--- ATT	,556	,081	6,883	,000	supported
H2	IC <--- SN	,237	,051	4,669	,000	supported
H3	IC <--- PBC	,357	,117	3,045	,002	supported
H4	IC <--- EAR	,052	,029	1,819	,069	Not supported
H5	IC <--- ED	-,117	,048	-2,432	,015	supported
H6	AC <--- IC	,953	,050	19,116	,000	supported

Source: own research

The results of the analysis reached statistically significant levels ($p < 0.05$) for five of the six research hypotheses of the study model. Only the results for H4 were not significant. The results of the validation of the hypotheses are presented in Table 3. The TPB variables, namely attitudes towards cultured meat (H1, $\beta = 0.556$, $p < 0.01$), subjective norms (H2, $\beta = 0.237$, $p < 0.01$) and perceived behavioural control (H3, $\beta = 0.357$, $p < 0.01$) have a positive and significant effect on the intention to consume cultured meat. Hypotheses H1, H2 and H3 were therefore confirmed.

As regards the other constructs added to those of the TPB, only ecological anger (H4, $\beta = 0.052$, $p = 0.069$) has no effect on the intention to consume cultured meat. Eco-depression (H5, $\beta = -0.117$, $p = 0.015$), on the contrary, was found to have a negative and statistically significant effect on the intention to consume cultured meat. Hypothesis H5 is therefore confirmed. The R-squared of all the independent variables on the intention to consume is = 0.906. This means that all of these predictors of intention to consume explain 90.6% of its variance.

Finally, examination of the intention-behaviour relationship in the TPB also showed that intention to consume cultured meat (H6, $\beta = 0.953$, $p < 0.01$) positively affected acceptance of cultured meat in the population (R-squared = 0.953), confirming hypothesis H6.

In terms of influence, consumer attitudes, perceived behavioural control, subjective norms and ecological depression, in that order, have the greatest predictive power over behavioural intention.

5. Discussion

The study indicates the existence of significant positive relationships between the original TPB constructs. Specifically, hypothesis H1 shows that the intention to consume cultured meat is largely driven by consumer attitudes. These results are consistent with the results of research relating to other food technologies. Recent studies (Siegrist and Hartmann, 2023; Siddiqui et al., 2023) have thus shown that attitudes play an important role in the transition to meat alternatives. These studies reported a correlation between attitudes favourable to meat alternatives and healthy eating (Siddiqui et al., 2023). This conclusion is supported by several other earlier studies (e.g. Verma and Chandra, 2018, Yarimoglu and Gunay, 2020). However, there is a discrepancy in the literature regarding this finding. For example, Lam and Hsu (2006) have observed that consumer attitudes have no significant effect on intentions.

We also found that subjective norms had a positive and significant effect on intentions. This means that when individuals perceive that people in their close circle of friends and family or their peers support their intention to buy cultured meat, the likelihood that they buy this product increases, which corroborates a number of earlier studies (e.g. Han et al., 2010; Yarimoglu and Gunay, 2020, Chen, 2022).

Similarly, in relation to the cultured meat industry, perceived behavioural control positively affects consumer intentions. According to our findings, perceived behavioural control is the second TPB construct after attitudes with the most significant predictive power on intentions to consume cultured meat. This is consistent with a number of studies (e.g. Ajzen, 1991; Verma and Chandra, 2018, Chen, 2022). However, our result contradicts other research (Yazdanpanah and Forouzani, 2015; Yarimoglu and Gunay, 2020) showing that intentions are not affected by perceived behavioural control.

As for the effect of eco-anger on intention, the results of the study were inconclusive, suggesting that eco-anger has no significant effect on intention. This is in line with the findings reported by Chu and Yang (2019).

Conversely, we found a negative and significant relationship between eco-depression and intention, which indicates that the more a person is eco-depressed, the weaker their intention is to consume cultured meat. This confirms our initial hypothesis, as well as the results of several other studies. In addition, prior research has shown that eco-depression is not associated with action and that it can predict disengagement instead (Lazarus, 1991; Nabi, 2002). However, based on findings of their own, Webb and Pizzagalli (2016) and Bernard and Colin (2023) argue the contrary.

Regarding the mediating power of intention on the acceptability of cultured meat, the results show that consumers who have the intention to consume cultured meat are also highly likely to socially accept this meat. Similar findings have been reported in earlier studies (Han et al., 2010; Verma and Chandra, 2018, Yarimoglu and Gunay, 2020).

5.1. Theoretical and practical contributions

The descriptive analysis has shown that there is a significant difference in the level of acceptance in relation to certain socio-demographic variables such as socio-occupational groups, marital status, age and level of familiarity with cultured meat. This finding is a major contribution to the extent that it points to the importance of adopting appropriate marketing policies such as the introduction of consumer segmentation based on the different variables. Improving familiarity with discontinuous innovations is an effective way of arousing curiosity and the desire to consume, as has been demonstrated in the case of edible insects among both children and adults (Marie et al., 2022; Nicolas-Hemar et al., 2023). In addition, given that the degree of familiarity impacts the acceptability of cultured meat, we recommend using an educational means that is based on the cognitive approach, i.e. on information processing in which mental processes play a predominant role. For example, advertising techniques and public seminars involving the mental repetition of "the dominant determinants of the components of attitude" (Kouarfaté and Durif, 2023a, b) will stimulate the creation of various associations aimed at enriching the encoding context of the information, and in turn familiarity with cultured meat.

By providing evidence of the actual influence of the three TPB constructs on consumers' purchasing intent regarding cultured meat, this study makes another theoretical contribution. To understand and predict consumers' buying intent, it would be necessary to make their attitudes favourable and to focus on their behaviour control and on subjective norms. On this subject, several studies had already suggested ways to induce favourable attitudes in consumers towards cultured meat (e.g. Kouarfaté and Durif, 2023a).

Moreover, given the importance of attitudes and subjective norms in the study's predictive model, consumers' decision-making behaviour is strongly associated with the opinions of other people. The study thus brings to light the importance of influence marketing when it comes to consumers' purchase intention for cultured meat. For example, companies should work with opinion leaders to get them to support adoption and acceptability messages in the various media.

Insofar as the addition of eco-emotions allowed the extended TPB model to explain 90.3% of the variance in consumer intent, it is important to consider eco-emotions, particularly eco-depression, in future advertising messages. This means avoiding depressing messages emphasizing the harmful effects of climate change for example and preferring optimistic messages such as those advocating happy sobriety. This change in communication style will reduce eco-depression, thereby increasing consumer intent and, as a result, acceptance of cultured meat. This is a significant original contribution, being the first recommendation based on eco-emotions to be formulated in relation to the agri-food industry in general and the cultured meat sector in particular.

By analysing behaviour (i.e. consumer acceptance of cultured meat), this study highlights the predictive power of intention for the acceptability of this meat, which is yet another pertinent contribution. The study shows that it is indeed consumer intention that helps to determine acceptance of cultured meat to the extent that the predictive power (95.3%) of intention confirms the mediating link between these two constructs. Other researchers have identified other mediating variables such as desire (Chen, 2022) and the willingness to pay more (Yarimoglu and Gunay, 2020) to explain actual behaviour.

By proposing a robust predictive model, this study is the first contribution to an understanding of consumer behaviour based on eco-emotions and TPB. On the one hand, it will improve decision-making processes and maximize business outcomes and on the other, it will effectively predict intent, acceptability and purchasing behaviour.

Finally, the results of the study will help food industry managers and organizations to develop optimal marketing strategies for target markets and improve research into the factors influencing behavioural intention for novel foods (Chen, 2022) in general and cultured meat in particular.

5.2. Limitations and future research

An initial limitation of this study is that it adds to the model only two of the three main eco-emotions identified in the literature, i.e. eco-anger and eco-depression, therefore excluding eco-anxiety. The concept of eco-anxiety is measured by a large number of dimensions (3) and items (13) in the literature. For the purpose of this study, the research team chose to remove it from the theoretical model to avoid cross-loading between these items and items from the other constructs in the model during data analysis, thereby reducing the model's predictive power. However, the absence of this construct did not affect the predictive power of the model, thus consolidating the researchers' methodological choice.

This study could have focused on other theoretical models such as the value-belief-norm theory, the stakeholder theory or the moral foundation theory among others. By deliberately choosing the TPB, the researchers put forward hypotheses that proved to have very good fit and predictive power for the model. Another limitation is associated with potential biases related to the research methodology, particularly the data collection based on a single province of Canada. Although this sample is representative of a Canadian province, caution should be exercised when generalizing the results to other regions or countries, as cultural, economic, and societal factors may vary.

Although several studies have mentioned culture and religion as areas for research, few (Hamdan, 2019; Kouarfaté and Durif, 2023) have explored to any degree the impact of these factors on consumption behaviour of cultured meat. In this study, the descriptive analysis did not detect any significant effect of religion on its acceptance. Yet, some researchers have shown that meat consumption is strongly influenced by culture and religion (Nam, Jo and Lee, 2010; Hamdan, 2018). Therefore, in order to understand the influence of culture and religion on the acceptance of cultured meat, future research should analyse the behaviours of consumers from different cultural and religious backgrounds. Additional research using a large sample or highlighting other variables could be carried out. Finally, the results of this study open up the prospect of a new area of research focusing on eco-emotions.

6. Conclusion

This study proposed a robust and valid predictive model, and the results confirmed all the research hypotheses except hypothesis H4. In addition to considering the original TPB constructs in marketing strategies, the study makes a contribution to existing research by suggesting that consumer eco-emotions should be taken into account to develop an understanding of the determinants of the adoption of cultured meat. For example, the types of messages that could induce depression in consumers should be avoided. On the contrary, it should be clearly demonstrated that artificial meat is beneficial for the environment because of its lower carbon footprint. This will enable us to meet our greenhouse gas emission reduction targets.

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Appendix

Table A1 represents the demographic description of the sample.

Table A1. **Demographics of respondents**

Variable	Frequency	(%)
Gender		
- Male	130	43.33
- Female	170	56.67
Age		
- 18 to 24 years old	14	4.67
- 25 to 29 years old	12	4.00
- 30 to 34 years old	17	5.67
- 35 to 39 years old	21	7.00
- 40 to 44 years old	31	10.33
- 45 to 49 years old	22	7.33
- 50 to 54 years old	22	7.33
- 55 to 59 years old	29	9.67
- 60 to 64 years old	38	12.67
- 65 to 69 years old	40	13.33
- 70 to 74 years old	33	11.00
- 75 years old and older	21	7.00
Marital status		
- Married	95	31.67
- Never married (including living together)	139	46.33
- Separated (including living together)	11	3.67
- Divorced (including living together)	39	13.00
- Widowed (including living together)	16	5.33
Education		
- No diploma	8	2.67
- DEP (Diploma of Vocational Studies)	28	9.33
- DES (High School Diploma)	57	19.00
- AEC (Attestation of College Studies)	22	7.33
- DEC (Diploma of College Studies)	66	22.00
- BAC (Bachelor's Degree)	85	28.33
- Master's Degree	33	11.00
- Doctorate and above	1	.33

Religion		
- Orthodox	1	.33
- Muslim	7	2.33
- Christian	180	60.00
- Jewish	1	.33
- Buddhist	1	.33
- Other religious or spiritual traditions	30	10.00
- No religion or secular perspectives	80	26.67
Social and professional activities		
- Craftsmen, tradesmen, and business owners.	4	1.33
- Executives and higher intellectual professions.	33	11.00
- Intermediate professions.	21	7.00
- Employees.	109	36.33
- Workers.	4	1.33
- Retirees.	107	35.67
- Other individuals without professional activity.	22	7.33
Region of residence		
- Greater Montreal Area	131	43.67
- Greater Quebec City Area	69	23.00
- Elsewhere in Quebec	100	33.33