

# The Main Pillars of Supporting the Acceptance of Cultured Meat as a Possible Alternative Source for Sustainable Food Consumption

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## Abstract

Cultured meat obtained in vitro from animal cells represents one of the recent concern of specialists, who thus try to solve part of the issues related to animal welfare and sustainable meat production. Beyond the technical difficulties that must be overcome, the acceptance of cultured meat by consumers is not an easy goal to achieve, as it depends on factors acting both at global and local level. Since this paper focuses on Romanian consumers, the authors emphasize the importance of developing a general information framework that would allow firstly their understanding and further their acceptance of cultured meat. For this purpose, a systematic literature review, based on 38 articles, was carried out in order to observe good practices at international level, which led, in the past, to the acceptance of other significant innovations in the food field. Thus, five directions of action were identified: communication, knowledge, trust, perception and attitudes. Based on these, a model of cultured meat acceptance by Romanian was developed. This initiative is unique in Romania so far and its results can be of interest for many categories of specialists, from scholars and researchers to practitioners interested in launching new products on the market or policy-makers in the field of nutrition, public health and agriculture. Further research is needed on the relationships between food security and safety, traditional meat production and cultured meat as alternative to real meat, before the marketplace launch of this new product.

## Keywords

Cultured meat, consumer acceptance, sustainable food consumption, new food product, emerging technologies

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## Introduction

Meat overconsumption, especially the red one, specific to nowadays' Western diet has had a negative impact both on environment and consumers' health (De Graaf, 2019). In this context, the transition towards a low-meat diet appears to be the right choice from human health, animal welfare and environmental protection point of view. On the basis of this increased call to reduce meat consumption, a new trend of industrial meat substitutes has emerged, where cultured meat or lab-grown meat, which represent the focus of our research, is a part of (Gómez-Luciano, Vriesekoop and Urbano, 2019).

Cultured meat (also called lab-grown meat, cultivated meat, artificial meat or in vitro meat) is an innovative product of cellular agriculture, obtained from stem cells, which, after being taken from animals through a small biopsy of muscle tissue, are placed in a special nutrient-rich medium in a bio-reactor independent from the animal to promote growth (Post, 2012; Ben-Arye and Levenberg, 2019).

Although it is not yet available to consumers, cultured meat is described in recent literature as having positive effects on environmental sustainability, animal welfare, food safety and world hunger issue (Post,

2012; Sinke et al., 2023). Thus, cultured meat appears to be a more efficient alternative to conventionally produced meat. But cultured meat comes with drawbacks too, the most often reported in the scientific literature refer to: the safety concerns generated by the use of a potentially contaminated animal serum in the culture medium, the higher energy use in production process and the potential perception of in vitro technology as unnatural (Stephens et al., 2018).

Because prior research has proven that consumer acceptance is decisive for the success of new foods and food technologies (Fischer and Reinders, 2022) and given the tendency of people to be reluctant to adopt food innovations, perceiving them as too industrial, unnatural or "fake" (EIT Food Trust Report, 2021), we consider *consumer acceptance of cultured meat as being an issue that require further attention*. Significantly little research has been done with regard to this issue, compared with the high interest for technological aspects of cultured meat. Among the studies that investigated consumers' reactions towards cultured meat in early stage of product development, underlying consumer acceptance as important issues related to commercial success of cultured meat, are to be mentioned those of Siegrist, Sütterlin and Hartmann (2018), Stephens et al. (2018) or Bryant and Barnett (2020).

Therefore, the aim of present paper is to fill this gap by designing a general framework for consumer acceptance which will contribute to a correct understanding of cultured meat before its commercial release. To do this, a systematic literature review was performed to identify examples of different good practices used to achieve consumer acceptance in the case of some previous food innovations (such as genetic modification, food irradiation, entomophagy or the use of nanotechnology), that could be helpful in the development of our model. This allowed us to put forward a model of consumer acceptance of cultured meat based on the following drivers: communication, knowledge, trust, perception and attitudes. This study, which represents a unique initiative in Romania, could be valuable for scholars and practitioners, as well as for policy makers in the field of nutrition, public health or agriculture.

Although paper's rhetoric is focused on cultured meat, our study should not be perceived as a pleading for agriculture transition to cultured meat production as the primary solution for the sustainable diet of the future and for cultured meat as the best alternative for conventional meat. The paper intends to bring to the foreground the need to inform and educate consumers so that when the product will be available on the market, they can make an informed purchase decision.

## 1. Methodology

As the main purpose of our study is to develop a model of consumer acceptance of cultured meat, we conducted a systematic review of the scientific literature to uncover different best practices used to achieve consumer acceptance for several previous food innovations.

The review followed the steps outlined in literature (Khan et al., 2003): formulating the question, identifying relevant publications, assessing study quality, summarizing the evidence, and interpreting the findings.

Although numerous articles, empirical studies or review papers, were identified in international databases, only 38 articles were selected as the most suitable for the purpose of our research, based on the following criteria: focus on consumer acceptance, presentation of empirical data or findings of the literature review, publication in a peer-reviewed journal, publication in English language. Then, the selected articles were grouped in five categories, as follows: *genetic modification* (Frewer, Howard and Shepherd, 1995; Hoban, 1997; Byrne et al., 2002; Lusk and Sullivan, 2002; House et al., 2004; Siegrist, Gutscher and Earle, 2005; Tenbült et al., 2005; Costa-Font, Gil and Traill, 2008; Costa-Font and Gil, 2009; Frewer et al., 2013; Wunderlich and Gatto, 2015), *food irradiation* (Bord and O'Connor, 1990; Bruhn, 1998; Oliveira and Sabato, 2004; Behrens et al., 2009; Sapp and Downing-Matibag, 2009; Bearth and Siegrist, 2019), *entomophagy* (Lensvelt and Steenbekkers, 2014; Ruby, Rozin and Chan, 2015; Woolf et al., 2021; Padulo et al., 2022), *the use of nanotechnology* (Siegrist, 2007; Besley, 2010; Stampfli, Siegrist and Kastenholz, 2010; Gupta, Frewer and Fischer, 2017; Gómez-Llorrente et al., 2022) and *new foods and food technologies in general* (Alhakami and Slovic, 1994; Frewer, Howard and Shepherd, 1995; Siegrist, Gutscher and Earle, 2005; Siegrist, 2007; Costa-Font, Gil and Traill, 2008; Shepherd, 2008; Frewer et al., 2014; Román, Sánchez-Siles and Siegrist, 2017; Bearth and Siegrist, 2019; Macready et al., 2020; Rabbanee, Afroz and Naser, 2020; Rembischevski and Caldas, 2020; EIT Food Trust Report, 2021; Wu et al., 2021). A summary of the evidence was done for each category from which a key-word predictor of consumer acceptance was extracted.

The review of the scientific literature in the field of food innovations led to the identification of the following pillars of consumer acceptance: communication, knowledge, trust, perception of benefits and risks and attitudes.

## 2. Results and Discussions

Based on the results of the undertaken systematic literature review we built up the cultured meat acceptance model based on the following drivers: *communication, knowledge, trust, perception of benefits and risks and attitudes*.

### **Communication**

*Since, in general, the benefits associated with an innovation in the food offer are not tangible for consumers, they must be explicitly communicated to the large public* (Siegrist, 2007). But, alongside the benefits, the drawbacks and hazards have to be communicated to the public as well. Frewer, Howard and Sheperd (1995) pointed out that it is important the dialogue be established between communicators and the large public, so that issues addressed reflect the real concerns of the public. Shepherd (2008) advocated the involvement of the public in the management of food risk issues, citing the Fischhoff 's (1995) schema of risk communication where consumers are seen as partners in this process.

Based on previous communication experience regarding food innovations, we consider that an effective communication about cultured meat should focus primarily on the benefits, emphasizing its potential of mimicking the sensory and nutritional characteristics of natural meat as well as its positive impact on human health, animal welfare, economic efficiency and environmental sustainability. Similarly, the risk messages should address specific concerns related to food safety, lack of naturalness and energy use in order to be more relevant to Romanian consumers.

### **Knowledge**

The investigated pieces of research (Costa-Font, Gil and Traill, 2008; Behrens et al., 2009; Wunderlich and Gatto, 2015; Rolland, Markus and Post, 2020; Woolf et al., 2021; Gómez-Llorente et al., 2022; Padulo et al., 2022) show that consumer knowledge of new products or technologies correlates positively with acceptance and willingness to consume those products.

In the process of increasing consumer confidence in the consumption of cultured meat and, as a consequence, in developing a favorable perception and attitude towards this innovative product, previous experiences related to entomophagy, irradiated food, genetically modified foods or nanotechnology foods highlighted the importance of providing by both entrepreneurs and academia, credible information and arguments emphasizing aspects such as environmental sustainability, production and consumption ethics, food safety and security of disadvantaged population.

Considering the predominant eating behaviour in many areas of the world, including Romania, characterized by a high consumption of meat and meat-based products, we believe that a direction of increasing consumer acceptance of cultured meat could be a strong and well-argued emphasis of the actors in the food system on the fact that nutrients of its composition fulfill the same physiological functions in the human body as those of traditional meat, allowing the normal development of physical and intellectual activity. In other words, the potential of cultured meat to mimic the nutritional value of real meat has to be highly emphasized.

### **Trust**

Consumer trust is an important factor influencing the perception of both risks and benefits of the previous significant food innovations (Siegrist, Gutscher and Earle, 2005; Costa-Font, Gil and Traill, 2008; Macready et al., 2020; EIT Food Trust Report, 2021; Wu et al., 2021). As long as acceptance of new foods and willingness to buy them is directly determined by the perceived risks and the perceived benefits, *trust can be said to have an indirect impact on the acceptance of new foods or new food technologies* (Siegrist, 2007).

In a today's extremely diversified agri-food market, which offers to consumers multiple alternatives in structuring the daily diet, the emergence of a new type of product such as cultured meat inevitably brings to the foreground the issue of consumer acceptance. To solve this issue, the overwhelming importance of trust cannot be ignored. This must be built and maintained between the main actors of any market, producer and consumer alike.

It is widely recognized that, in general, a high level of trust can reduce the consumer's perceived risks and also put in the spotlight the potential benefits of consuming a food product, which we argue is also true for cultured meat, even more so if we consider the controversies that this revolutionary product has already raised.

Consequently, in order to raise the level of trust, we believe that the responsibility of informing Romanian consumers cannot be the exclusive task of entrepreneurs, but it must be shared with high credibility experts, government bodies such as the Ministry of Health, the Ministry of Agriculture, the National Authority for Consumer Protection or the National Sanitary-Veterinary and Food Safety. These bodies may be involved in adapting the existing legislative framework or in the drafting of new regulations related to the production, marketing and fair labeling of cultured meat, respectively in developing new methods that allow quantitative and qualitative measurements of the chemical components of this product.

### **Perceptions**

A great deal of the examined studies revealed that acceptance of new foods is largely determined by both perceived risks and benefits associated with their technology (Siegrist and Cvetkovich, 2000; Siegrist, 2007; Besley, 2010; Stampfli, Siegrist and Kastenholtz, 2010; Ruby, Rozin and Chan, 2015; Bryant and Barnett, 2020). The perceived benefits appear to be the most important predictor for willingness to buy. Therefore, as prior research have shown, consumer acceptance is strongly influenced by perceived benefits and weakly influenced by perceived risks.

However, consumer perception of food-related benefits and risks is a very complex issue, depending not only on the objective and measurable aspects, but also on subjective aspects that define individual's values, such as social, cultural, psychological, ethical or moral ones (Bord and O'Connor, 1990; Rembischevski and Caldas, 2020).

The accelerate innovation pace of today's food market requires concerted efforts of stakeholders to promote the new products. In this process, which cannot be supported only by the traditional marketing methods successfully applied in the past, a favorable perception and, subsequently, a positive attitude of consumers towards new food products represent a difficult or even impossible goals to achieve. This can be explained by the cognitive dissonance that occurs when consumers evaluate the ratio of benefits to risks. Thus, when the technology behind a product is new and poses health risks, as is the case with cultured meat, many consumers tend to believe that the potential benefits can only be low or even neglectable.

In this context, the actions aimed at forming a favorable perception and a positive attitude of Romanian consumers towards cultured meat must not be based on overly persuasive or misleading advertising, but rather on their determination to act based on the principle of cognitive coherence. In this regard, it is necessary for consumers to acquire that consistency in beliefs that lead them to make correct decisions. These must be based primarily on objective, measurable elements, such as official communication, correct declaration of the chemical composition, educational sessions supported by experts who present the risks and the benefits of consumption, tasting sessions, etc. Moreover, taking into account the findings of prior research, for an objective perception of both risks and benefits of cultured meat among Romanian consumers, we consider imperative that communication strategies of scientific knowledge be aligned with approaches that also take into account the defining aspects of consumers' human dimension, such as values, culture, ethics, psychological motivations, etc.

### **Attitudes**

Attitude, briefly defined as a summary evaluation of an object, which can vary from positive to negative and is experienced as an affect (Ajzen, 2001), is a concept that has been used in research to explain public reactions to new foods and technologies (Frewer and Miles, 2003).

Generally, attitude is based on knowledge about the product attributes (Costa-Font, Gil and Traill, 2008). As it has been shown in previous research, *a highly important attribute that influences attitude toward new foods is the perceived naturalness*, which refers to product origin, the technology and ingredients used and the properties of the final product (Frewer et al., 2013; Román, Sánchez-Siles and Siegrist, 2017; Beath and Siegrist, 2019).

In the case of cultured meat, consumer perception of its naturalness has aroused scholars' interest since the early stage of product development. Pieces of research to date (Verbeke, Sans and Van Loo, 2015; Hocquette, 2016; Bryant and Barnett, 2020; Siegrist and Hartmann, 2020) has shown that while perceived naturalness is positively associated with consumer acceptance and willingness to consume, the perceived unnaturalness may act as a psychological barrier, contributing to low acceptance of cultured meat.

In Romania, due to the fact that natural meat is deeply embedded in local food culture, being the main ingredient in most of the traditional food products and dishes (Voinea et al., 2020; Stanciu, Rizea and Ilie, 2015), it is quite likely that most consumers would exhibit a negative attitude towards cultured meat, perceiving its artificial nature in opposition to their demands for naturalness and authenticity that traditional meat can fulfill. Therefore, the acceptance of cultured meat in Romania will depend on how this conflict of cultural values will be resolved, both at individual and collective level.

Therefore, to increase the acceptance of cultured meat among Romanian consumers, as Siegrist and Hartmann (2020) outlined in their study, communication strategies should be focused on emphasizing the similarity of cultured meat to traditional meat, rather than the technical aspects of the production process. In other words, this emerging technology of in vitro meat should be framed in ways that resonate with people's existing views (Besley, 2010)

## Conclusions

Meat is the food of animal origin that raises the most environmental sustainability issues, as its production process requires a lot of soil and nitrogen and also emits the most greenhouse gases (Austgulen et al., 2018). Moreover, meat is responsible for the dramatic increase in the incidence of the so-called diseases of civilization, such as obesity, type 2 diabetes and cancer (Popkin, 2006). Thus, the need to redefine the contemporary food style through a consistent decrease in the consumption of traditional meat has become imperative. In this context, the production of industrial meat substitutes with the help of avant-garde technologies has emerged as a new trend. Among these newly developed meat analogues is cultured meat too, also called artificial meat or in vitro meat, which presents both advantages (environmental preservation, animal welfare, food safety and consumer food security) and risks (potentially toxic animal serum in the culture environment, high energy consumption in the production process or too much interference of its technology with nature).

The main aim of our research is to design and, thus, put into public debate the principles of a general framework for cultured meat acceptance by Romanian consumers, before this product becomes a reality in the food market. However, our approach shouldn't be understood as a plea for the large-scale transition of agriculture to the production of artificial meat, as a unique alternative to the traditional meat consumed today.

To achieve the proposed goal, the methodological approach consisted of a systematic review of the scientific literature to identify the best practices that led to consumer acceptance of several food innovations in the past, such as: food genetic modification, food irradiation, entomophagy and food nanotechnology. As a result of the review of 38 articles, the following pillars were identified, which we consider relevant for the acceptance of cultured meat too: communication, knowledge, trust, perception of benefits and risks, respectively attitudes.

In the **communication** activity we consider that the benefits of cultured meat must be firstly highlighted, these being related to the following aspects: the potential of mimicing the sensory and nutritional characteristics of natural meat, the promotion of an environmentally friendly food product, the food security of some disadvantaged groups, and last but not least, the animal welfare. The public presentation of the disadvantages of artificial meat must also be part of the communication strategy, with focus on the lack of naturalness, the potential risks regarding the safety of consumption and the higher energy consumption in the production activity, compared to natural meat.

To determine a favorable attitude towards this new product, in the process of **knowledge** transfer to consumers, it is mandatory that both entrepreneurs from the food industry and academia give a huge emphasis to the fact that the nutrients provided by cultured meat perform the same physiological functions in the human body as those of real meat, fact that allows the deployment of a normal physical and intellectual activity, as before.

To increase the level of **trust**, the responsibility for informing consumers must be shared between several categories of actors, such as: food entrepreneurs, scientists and experts with recognized credibility and governmental bodies, the latter ones being, in the case of Romania, the Ministry of Health, the Ministry of Agriculture, the National Authority for Consumer Protection and the National Sanitary-Veterinary and Food Safety Authority.

The process of persuading consumers to try cultured meat, with the main aim to determine a positive **perception** and to achieve their acceptance, should not be relied upon on overly persuasive or misleading advertising, but rather on determining them to act based on the principle of cognitive coherence.

Having as premise that knowledge of product itself plays a decisive role in the *attitude* forming process (Costa-Font, Gil and Traill, 2008) and consumers often show aversion to unusual food technologies or those perceived as artificial (Bearth and Siegrist, 2019), we appreciate that, in the effort to improve the acceptance of cultured meat, communication should focus on emphasizing its similarity to natural meat, rather than the technical aspects of the production process, which are more susceptible to generate negative associations and disgust feelings.

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