Radical Innovations in the Food Industry: Investigating Perceptions and Acceptance of Cultured Meat

Dissertation

zur Erlangung des akademischen Grades eines Doktors der
Wirtschaftswissenschaften (Dr. rer. pol.)
der Fakultät I der Universität Vechta

Erstgutachter: Prof. Dr. Nick Lin-Hi
Zweitgutachter: Prof. Dr. Gerald Eisenkopf

Vorgelegt von
Katharina Burdorf (geb. Schäfer), M.Sc. Food Science

Reinfeld
2024

Acknowledgements

Reflecting on my PhD, I would like to thank so many people for their support and belief in me. Starting with Prof. Dr. Nick Lin-Hi, to whom I would like to express my deep gratitude. It was his perseverance that convinced me to embark on this exciting, albeit exhausting, journey of doing my PhD alongside my job. His passion for research is unmistakable and I am grateful that I was able to learn so much from him and broaden my horizons. I would like to thank him for his support, for his advice and for the encouragement that made it possible to surpass myself in the first place.

Furthermore, I would like to thank my co-authors Dr. Igor Blumberg, Marlene Dettmer, Johanna Böttcher, Dr. Lisa Hollands and Dr. Luca Haensse as well as the rest of the team, Kerstin Gerke and Celine Bökemeyer, who have travelled this path with me. Thank you for your support, advice and the always open exchange. Whether at one of our retreats or at the data collections, it was a great time with you that I will always remember fondly.

I would also like to thank my employer, company Hydrosol GmbH & Co. KG, for giving me the opportunity to work on a PhD alongside my job. Thanks to Dr. Dorotea Pein and Dr. Matthias Moser for believing in my ability to accomplish this. I would also like to thank my other colleagues for their understanding and mental support. As you certainly know, the topic of my PhD has become a subject close to my heart and I am glad that in the meantime I had the chance to inspire some of you.

Moreover, I would like to express my deepest gratitude to my parents, who gave so much to enable me to take this path. Thank you for believing in me and supporting me. I would also like to thank my friends and my husband's family, who supported me in word and deed during this time.

Finally, I would like to thank my husband Vincent Burdorf. Thank you for being by my side for the last 15 years and going through life with me. You are the only one who can imagine what the last few years have been like for me, and without you having my back unconditionally and your mental support, I wouldn't be where I am today. Thank you for everything.

List of Appended Documents

This dissertation is based on the work described in the following papers and contributions to edited volumes:

Burdorf, K., & Lin-Hi, N. (in process of publication). Zelluläre Landwirtschaft und die Zukunft der Ernährung: Kultiviertes Fleisch und tierfreie „Milch“ als Sprunginnovation für eine nachhaltige Entwicklung. To be published in: Wittkowske, S., Reimer, M., & Polster, M. (Eds.), *Nachhaltige Ernährungsbildung im Fokus von Schule und Gesellschaft*. Klinkhardt Verlag: Bad Heilbrunn.

Lin-Hi, N., Schäfer, K., Blumberg, I., & Hollands, L. (2022). The omnivore's paradox and consumer acceptance of cultured meat: An experimental investigation into the role of perceived organizational competence and excitement. *Journal of Cleaner Production, 338*, 130593. https://doi.org/10.1016/j.jclepro.2022.130593

Lin-Hi, N., Reimer, M., Schäfer, K., & Böttcher, J. (2023). Consumer acceptance of cultured meat: An empirical analysis of the role of organizational factors. *Journal of Business Economics, 93*, 707 – 746. https://doi.org/10.1007/s11573-022-01127-3

Lin-Hi, N.*, Blumberg, I.*, Burdorf, K., & Haensse, L. (in process of publication). The performativity of radical innovations for sustainable consumption: An experimental investigation on the example of cultured meat.

Lin-Hi, N.*, Böttcher, J.*, Burdorf, K., Dettmer, M., & Blumberg, I. (in process of publication). Trivializing the Future: Cognitive Dissonance and Incumbents' Underinvestment in Radical Innovations on the Example of Cellular Agriculture.

*The authors contributed equally and should be considered both as first authors.

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Abstract

The modern food system, particularly the production of animal-based foods like meat, imposes a significant ecological burden that contradicts the goals of sustainable development. Despite widespread scientific consensus on the necessity of reducing animal-based food consumption to mitigate the environmental impact of the food system, the negative consequences are expected to be exacerbated by factors such as population growth and rising affluence. A potential paradigm shift toward a more sustainable food system could be realized through cultured meat, a radical innovation produced in vitro using tissue-engineering techniques. This method decouples meat production from traditional livestock farming and holds the potential to transform the meat industry. However, the successful adoption of cultured meat is contingent on consumer acceptance, a critical yet complex challenge given the inherent uncertainty and novelty associated with radical innovations. Research has identified numerous drivers and barriers to the consumer acceptance of cultured meat, emphasizing its multidimensional nature. This dissertation, comprising four articles and an edited volume contribution, investigates the factors influencing consumer acceptance of cultured meat, incorporating organizational factors and stakeholder perspectives. The research aims to provide new insights into consumer perceptions and acceptance, offering strategic implications for the successful market introduction of cultured meat within the food industry.

Framework Paper

1.1 Introduction

In November 2022, the global population surpassed eight billion people, marking a threefold increase since the mid-twentieth century (Roser & Ritchie, 2023). However, this growth is also expected to continue in the future. The latest United Nations forecasts assume that the world population will grow to around 9.7 billion people by 2050, with a large proportion of this growth originating from countries in sub-Saharan Africa and Asia (United Nations, 2022). This is not without consequences for the food and agricultural system, as population growth and food demand are closely linked (Food and Agriculture Organization of the United Nations [FAO], 2022). For instance, according to the FAO (2022), global food consumption increased by more than 37% between 2000 and 2020, measured in billions of kcal per day, significantly outstripping population growth. Moreover, a meta-analysis demonstrates that the total global demand for food is expected to increase between 35% and 56% from 2010 to 2050 (van Dijk et al., 2021).

Modern agriculture and the associated food and farming system are today already leaving an enormous ecological footprint, which is an obstacle to achieving the Paris Agreement's goal of limiting the global temperature rise to 1.5° or 2°C above pre-industrial levels (Clark et al., 2020). According to a study published in *Nature Food*, the food system is responsible for 35% of global anthropogenic greenhouse gas emissions, with 57% of production-related emissions attributable to animal products such as meat and milk (Xu et al., 2021). By contrast, animal products only contribute to 37% of the protein supply and cover only 18% of caloric requirements (Poore & Nemecek, 2018). The results are in line with the prevailing scientific view that the current food system is in conflict with the goal of sustainable development (e.g. Eyhorn et al., 2019; Herrero et al., 2021; Rockström et al., 2020; Stefanovic et al., 2020) and that animal products are at the core of the problem (e.g. Bowles et al., 2019; Carvalho et al., 2023; Godfray et al., 2018; Parlasca & Qaim, 2022; Poore & Nemecek, 2018; Van Mierlo et al., 2017).

As an approach to reducing the ecological footprint of the global food system, a dietary shift with a reduction in the consumption of animal products is constantly emphasized (see Humpenöder et al., 2024; Röös et al., 2017; Springmann et al., 2018; Willett et al., 2019). Indeed, on the one hand, there has been a trend towards reducing the consumption of animal products in some Western countries which, in part, is driven by consumers' growing awareness of health, animal welfare, and climate change issues (Braunsberger & Flamm, 2019; Godfray et al., 2018; Hopwood et al., 2020). On the other hand, such a trend is not evident on a global level. Emerging and developing countries in particular have a pent-up demand for animal products, which is a primary driver for the growing consumption of animal-based foods in the future (FAO, 2018; Gouel & Guimbard, 2019). Due to continuous population growth and

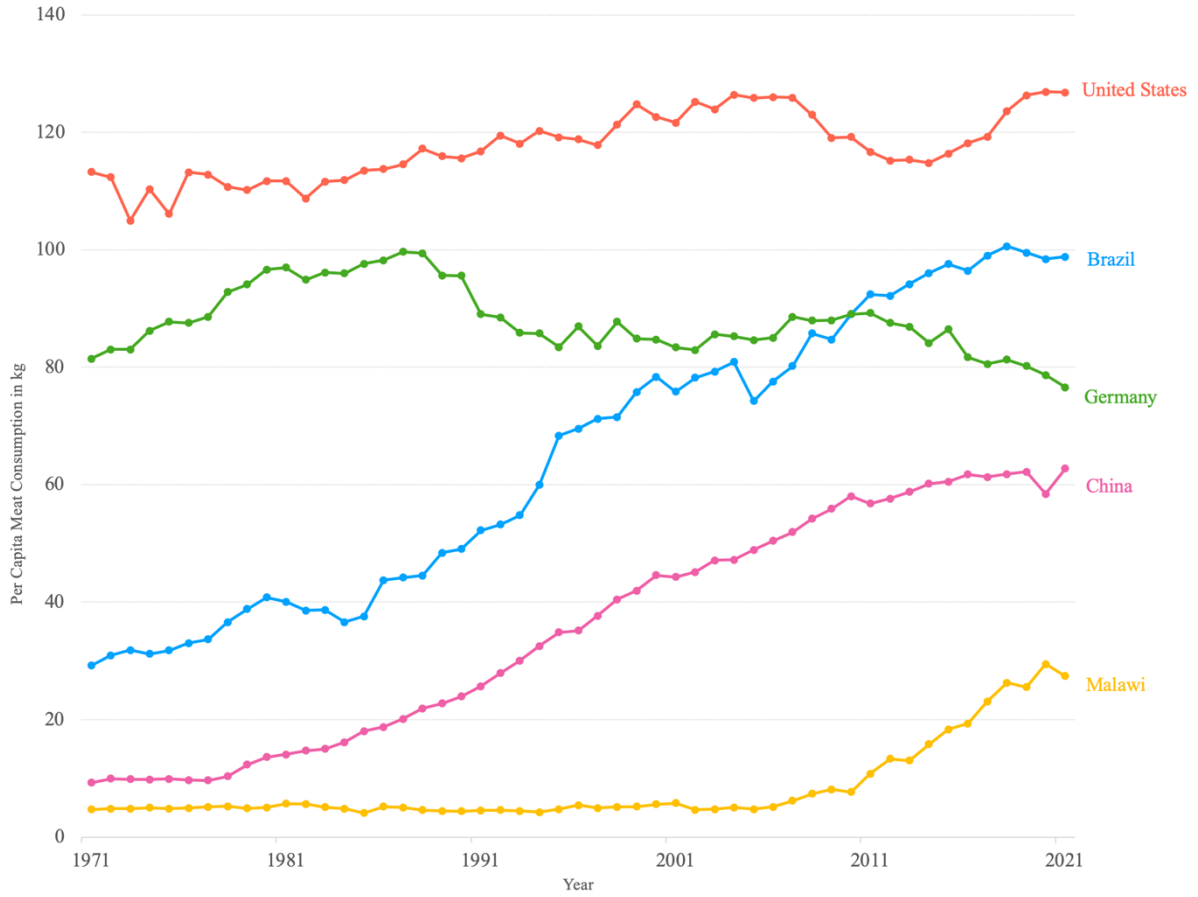
increasing affluence globally, the overall demand for animal products will continue to grow in the future (OECD & FAO, 2023) and thus, further magnify the negative externalities of the global food system.

Among animal-based foods, meat products have a particularly large share of the negative sustainability effects. For instance, meat production results in notably high emissions per unit of energy due to an energy loss at each trophic level (Godfray et al., 2018), i.e. when an organism is eaten by a higher-order consumer. According to estimates, shifting away from livestock farming, with the associated loss of energy, and growing only food for human consumption could increase the number of food calories available by up to 70%, which could feed an additional 4 billion people (Cassidy et al., 2013). Beyond this, the environmental impact of meat consumption, especially red meat, is significant and includes aspects such as great water usage, pesticide and fertilizer use, ocean acidification, soil eutrophication and pollutant emissions (Carvalho et al., 2023; Gaillac & Marbach, 2021; Grosso et al., 2020). Due to the global pressure on resources and the contribution to greenhouse gas emissions, rising meat consumption is a cause for concern about long-term sustainability (OECD & FAO, 2023).

Over the past 50 years, global meat production has experienced a rapid increase, with total output more than quadrupling between 1961 and 2021 (FAO, 2023a; Ritchie et al., 2023). As Figure 1.1 demonstrates, while meat consumption per capita in Western countries such as Germany fell from 81.4 kg to 76.6 kg in the period from 1971 to 2021, other Western countries such as the USA, which already had a very high meat consumption per capita of 113.3 kg in 1971, showed a further increase of 12% to 126.8 kg per capita in 2021. However, emerging countries such as Brazil or China or developing countries such as Malawi in particular recorded a relatively strong increase in per capita meat consumption of 239%, 579% and 484% respectively over the same time period (FAO, 2023b; Ritchie et al., 2023). Factors such as rising population figures, an emerging middle class, growing incomes and ongoing urbanization indicate that global demand for meat is likely to increase by 73% respectively by 2050 compared to 2010 (Gerber et al., 2013). As a widespread voluntary renunciation of meat is not realistic in the near future (Lin-Hi et al., 2022; OECD & FAO, 2023), a paradigm shift in meat production and consumption is needed to enable a sustainable food system.

Figure 1.1

Per Capita Meat Consumption from 1971 to 2021 in Selected Countries



Note. Data excludes fish and other seafood sources; own illustration based on FAO (2023b), Ritchie et al. (2023).

Such a paradigm shift could be heralded by the technology for the production of *cultured meat*, i.e. meat produced in vitro outside of living organisms (Post, 2014). Thus, cultured meat is based on a completely new technology and radically breaks with the traditional, millennia-old approach of producing meat from raising and slaughtering animals (Morais-da-Silva et al., 2022). Instead, the production of meat can be largely decoupled from the number of livestock (Flaibam et al., 2024; Mugabe et al., 2024; Zhu et al., 2024). Therefore, cultured meat has the potential to provide significant advantages over conventional meat products and to substantially transform the existing meat market. Cultured meat thus fulfills the common criteria for a *radical innovation*, which relates to new products, services, processes, etc. that are based on a breakthrough technology and significantly change existing markets or create new markets (Chandy & Tellis, 1998; Govindarajan et al., 2011; O'Connor & Rice, 2013).

One possible advantage of this radically new way of meat production and the associated decoupling from the number of animals is an increased sustainability potential due to various aspects

such as possibly lower emissions (Sinke et al., 2023) and the opportunity to reuse agricultural land that was used for animal feed (Tuomisto, 2019). Furthermore, since the in vitro meat production takes place in a closed system, the production can be independent of climatic conditions (Tuomisto, 2019), which is why cultured meat can also be produced in regions in the future where climate change renders conventional meat production difficult or even impossible. The production of cultured meat can thus help to meet the (growing) demand for meat and strengthen global food security (Lewisch & Riefler, 2023a; Soice & Johnston, 2021; Tuomisto, 2019). However, the potential success of cultured meat in ensuring food security depends primarily on consumer acceptance (Gherman & Bălan, 2022).

The topic of consumer acceptance is the starting point for this framework paper, which investigates perceptions of cultured meat by industry representatives and its consumer acceptance. The next section illuminates the fundamentals of cultured meat and thereby outlines its production process and existing technical hurdles. In the following section, it is argued why cultured meat has the potential to make a significant contribution to the realization of sustainable development. Subsequently, a major hurdle of cultured meat, namely consumer acceptance, is presented on the basis of the current state of research. This will lay the foundation to outline the aims and the main outcomes of this dissertation thesis. Finally, the scientific contribution of this dissertation is presented succinctly.

1.2 The Fundamentals of Cultured Meat

Cultured meat, also known as in vitro meat, cultivated meat, cell-based meat, clean meat and lab-grown meat (Hallman et al., 2023; To et al., 2024), refers to meat which is produced in vitro, i.e. outside a living organism. Cultured meat can be manufactured using various techniques such as cell culture practices, biomanufacturing methods, tissue-engineering techniques and, in some cases, genetic engineering (Post et al., 2020). This approach starts with animal cells, which can be obtained through harmless biopsies from an animal's muscle or using non-invasive methods, e.g. by extraction from a feather (Hogle, 2022). While this approach can be used for a wide variety of animal products such as leather and fur, this technique is primarily used in meat production (Stanton et al., 2019).

Biochemically, conventional meat consists of 72 – 75% water, 21% nitrogenous compounds such as protein, 2.5 – 5% lipids, 1% vitamins and carbohydrates and 1% ash, whereby these values are highly dependent on factors such as the animal species (Cobos & Díaz, 2015). In terms of muscle structure, muscle fibers make up the largest proportion at 90%, followed by connective and fat tissue at 10% (Listrat et al., 2016). Due to this complex composition, several steps are required to replicate conventional meat with cultured meat. The production process essentially consists of four key phases: 1) cell extraction, 2) cell proliferation, 3) cell differentiation and maturation and 4) food processing (Bomkamp et al., 2022; Flaimbam et al., 2024; Guan et al., 2021). Taking the example of the production of cultured muscle cells demonstrates the need for various processes that extend over several phases and require optimal environmental conditions: (1) Harvesting of cells, for example by biopsy or extraction,

(2) Proliferation of the stem cells using a culture medium on a scaffold, a growth surface, within a bioreactor or in single cell suspension, (3) Differentiation of the cells into muscle cells, (4) Fusion of the differentiated cells and formation into myotubes, (5) Growth into myofibers, (6) Harvesting of the myofibers (Bhat et al., 2019; Martins et al., 2024; Post, 2012; Zidarič et al., 2020).

The harvested myofibers form the starting point for further downstream processing into processed meat products such as sausages, burger patties or other unstructured meat products (Bomkamp et al., 2022; Flaibam et al., 2024). For this purpose, the cultivated muscle cells are combined with, for example, a cultivated fat biomass and other ingredients such as plant-based texturates or hydrocolloids to improve the functional and sensory properties of the product (Olenic & Thorrez, 2023). It is expected that these so-called hybrid products will initially dominate the market, mainly for cost reasons, before fully cultivated products reach the mass market (Bomkamp et al., 2023; To et al., 2024). The production of thick tissue constructs such as steaks poses challenges, including supplying the cells with oxygen and nutrients (Albrecht et al., 2024). Research has recently succeeded in producing steaks based on cultured cells with a thickness in the centimeter range using porous scaffolds made of hydrocolloids (H. Lee, et al., 2024). However, other approaches are also being pursued for this type of product, such as 3D printing technology and the development of bio-ink (Albrecht et al., 2024; Bomkamp et al., 2022).

As the in vitro cultivation of animal stem cells mimics the process by which cells grow in an organism (Bomkamp et al., 2022; Pajčin et al., 2022), cultured meat is able to replicate the organoleptic properties of conventional meat to a large extent, particularly its flavor and texture (Post et al., 2020; Yao et al., 2024), as recently demonstrated in a study published in *Nature Communications* (M. Lee, et al., 2024). Accordingly, cultured meat can be understood as "real meat" (Orellana et al., 2020; Szenderák et al., 2022), which sets it apart from other meat alternatives based on plant-based ingredients, mycoprotein, and edible insects. Since consumers particularly buy novel products that resemble existing products without significantly changing their experience of use (Mateti et al., 2022; Verbeke et al., 2015), meat eaters are the primary target group for cultured meat according to the literature (Bryant & Barnett, 2020; Cornelissen & Piqueras-Fiszman, 2023; Gómez-Luciano et al., 2019; Klöckner et al., 2022). Since the majority of humanity can be assigned to this form of nutrition, the (partial) replacement of conventional meat with cultured meat has the potential to be a key lever for sustainable development.

Before cultured meat can make a contribution to sustainable development, there is still the substantial challenge of reaching market maturity, which is mainly due to technical feasibility. In particular, this requires the transfer of production technologies from laboratory scale to industrial production (Cai et al., 2024). To this end, various technical hurdles such as efficient cell culture processes, low-cost serum-free media and the need for larger bioreactors still need to be overcome before cultured meat can be commercialized in large quantities (Cai et al., 2024; Negulescu, 2023). Currently, the largest known bioreactors installed in the cultured meat industry have a capacity of 10,000 liters (Ataman, 2023) and the today's (July 2024) largest known bioreactors in operation within the cultured

meat industry only have a capacity of 2,000 liters (Swartz, 2024). This is an increase compared to 2019, as the proof of concept was performed on a laboratory scale until this year (Byrne & Murray, 2021). For a future commercial production, however, bioreactors larger than 50,000 liters are required that can produce many tons of cultured meat per production cycle (Battle et al., 2024). This scaling step is also a prerequisite for being able to offer cultured meat at competitive prices in the future (Kirsch et al., 2023).

Overcoming various technical requirements and establishing a constant and safe process is also an important aspect that plays a role in the regulatory approval of cultured meat (Lanzoni et al., 2024). Due to its high degree of novelty, cultured meat requires special regulatory approvals. Currently (in July 2024), already Singapore, Israel and the USA have regulatory approvals[1] for cultured meat (CultivatedX, 2024). In Europe, the first applications for the authorization of cultured meat were submitted in Switzerland (Aleph Farms, 2023) and the United Kingdom in 2023 (de Sousa, 2023), no such application for authorization has yet been submitted in the European Union (Lanzoni et al., 2024). However, in order for cultured meat to realize its potential and make a significant contribution to sustainable development, widespread regulatory approval is required to give access to as many consumers as possible.

1.3 The Potential of Cultured Meat as a Lever for Sustainable Development

As previously mentioned, the conventional meat production has an enormous ecological footprint, with particularly pronounced effects for red meat (Carvalho et al., 2023; Clark et al., 2022; Parlasca & Qaim, 2022; Poore & Nemecek, 2018). For instance, greenhouse gas emissions from meat production, which stem mainly from feed production, enteric fermentation in ruminants and the management of manure (Parlasca & Qaim, 2022), accounted for around 54% of the overall emissions from agriculture during the years 2018–2020, measured in CO_2 equivalents (OECD & FAO, 2021). Another aspect that contributes to this is global deforestation, for which meat production is considered the main cause, with beef alone being responsible for 41% of tropical deforestation (Pendrill et al., 2019; Ritchie, 2021). This is accompanied by extensive biodiversity loss due to factors such as farmland expansion (Henry et al., 2019; Parlasca & Qaim, 2022), with beef and pork meat being the main drivers of species loss at 27% and 20% respectively (Crenna et al., 2019). Rising per capita meat production in various biodiverse tropical countries is expected to take up an additional 30 – 50% of their current agricultural land by 2050, exacerbating habitat destruction and species loss (Machovina et al., 2015). Overall, meat

[1] However, there are also initial regulatory restrictions, for instance, the sale of cultured meat and seafood has been banned in the US states of Florida and Alabama (Durbin, 2024). There are similar endeavors in Europe, with Italy attempting to ban the production of cultured meat and the marketing of products made from it in 2023 (Bambridge-Sutton, 2024).

production and consumption is the main driver of various sustainability related impacts, rendering meat a substantial driver of climate change (Godfray et al., 2018; Parlasca & Qaim, 2022).

One lever for drastically reducing the ecological footprint of meat is to decouple livestock farming from meat production as far as possible (Gertenbach et al., 2021). This is exactly what the production of cultured meat enables, as production volumes are largely decoupled from the number of animals, which means that only a fraction of today's animals are needed for meat production (Mugabe et al., 2024), making intensive livestock farming obsolete. To give an example, Tomiyama et al. (2020) estimate that one billion burger patties can be produced from the cell donation of one cow in one and a half months.

The drastic reduction in the number of livestock used to produce cultured meat products makes it plausible to assume that cultured meat offers a variety of sustainability benefits. Fewer animals automatically mean fewer greenhouse gas emissions, which not only counteracts climate change but also improves air and groundwater quality (Parton et al., 2011). In addition, the need for animal feed is substantially reduced, which means that less arable and pastureland is required, which in turn reduces deforestation and contributes to the preservation of biodiversity (Tilman et al., 2017). Furthermore, the land no longer required for feed production can be reforested or used for other carbon sequestration purposes (Munteanu et al., 2021; Tuomisto, 2019). The production of cultured meat can have further sustainability effects by feeding cells rather than animals. Compared to the detour via animals, feeding cells enables a more efficient conversion of crops into animal products (Sinke et al., 2023). This goes hand in hand with a reduced need for crops, which in turn means that less soil and air-polluting fertilizer is required (Sinke et al., 2023). In addition, the cells themselves can for example be supplied with nutrients by hydrolyzed microalgae (Hubalek et al., 2022), which require less space due to their growth in three-dimensional space.

As the technology for producing cultured meat is still at an early stage and production is not yet on a large scale, the sustainability performance can only be estimated so far. Modeling, assumptions and data from laboratory-scale experiments usually form the basis for current estimates of the environmental impact. The system boundaries of the life cycle assessments usually include aspects such as feedstock for the medium, fermentation processes and scaffold production, that vary from study to study and which in turn means that existing forecasts for industrial production can show significant deviations (Vural Gursel et al., 2022).

Based on the relationships just outlined and other considerations, there are some optimistic voices that agree that cultured meat has the potential to be an environmentally friendly product compared to conventional meat (El Wali et al., 2024; Kim et al., 2022; Noble et al., 2024; Rodríguez Escobar et al., 2021; Sinke et al., 2023; Tuomisto et al., 2022; Tuomisto & Teixeira de Mattos, 2011; Vural Gursel et al., 2022). For instance, according to a recent life cycle assessment, the production of cultured beef has the potential to emit up to 92% fewer greenhouse gases and use up to 90% less land and up to 66% less

water than conventionally produced beef from beef cattle (Sinke et al., 2023). In the case of cultured chicken, the carbon footprint is comparable to conventional chicken and can be reduced by 44% in the case of cultured pork compared to conventional pork, while land use could be reduced by an estimated 64% and 67% respectively (Sinke et al., 2023). In both cases, however, water use is higher than for conventional chicken and pork, at 28% and 77% respectively (Sinke et al., 2023). Another life cycle assessment carried out on behalf of the startup SuperMeat by the independent research company CE Delft shows that cultivated chicken meat using renewable energy causes 47% fewer greenhouse gas emissions and uses 90% less land compared to sustainably produced conventional chicken meat (SuperMeat, 2024). In principle, the potential savings depend on various framework conditions and assumptions as well as the species under consideration. The assumptions include, for example, the question of the source of the energy required. The study by Sinke and colleagues (2023) shows that the use of renewable energy is important in order to fully realize the sustainability potential of cultured meat. Provided that renewable energy is used, cultured meat is a sustainable alternative to all conventional meats according to this study.

In addition to the studies outlined above, which see a high sustainability potential, there are also studies that question the superiority of this novel production approach in terms of sustainability[2] (e.g., Lynch & Pierrehumbert, 2019; Mazac et al., 2023; Smetana et al., 2015). For instance, due to the early stage of development of cultured meat technology, it is considered unlikely that cultured meat products will be widely available in the near future, which in turn prevents cultured meat from being considered a solution to the current urgent need for action required to achieve the Sustainable Development Goals (SDGs) by 2030 (Smetana et al., 2023).

As the pressure on the food system to become more sustainable increases due to population growth and the rising demand for (animal-based) food, various approaches are needed in the short to medium term to respond accordingly and improve its sustainability. Although the potential of cultured meat for sustainable development has not yet been conclusively clarified, whether and to what extent this potential can be exploited will ultimately only become clear in a few years' time, once it has been scaled up to industrial production and penetrates the mass market. In view of the large number of unresolved sustainability challenges and the ever-increasing pressure to act, global society would be well advised to give radical innovations such as cultured meat the chance to prove their potential in practice. The latter requires significant challenges to be overcome.

[2] The reason for this lies in the different system boundaries of the life cycle assessments mentioned above, which vary from study to study, meaning that existing forecasts for industrial production can show considerable deviations (Vural Gursel et al., 2022).

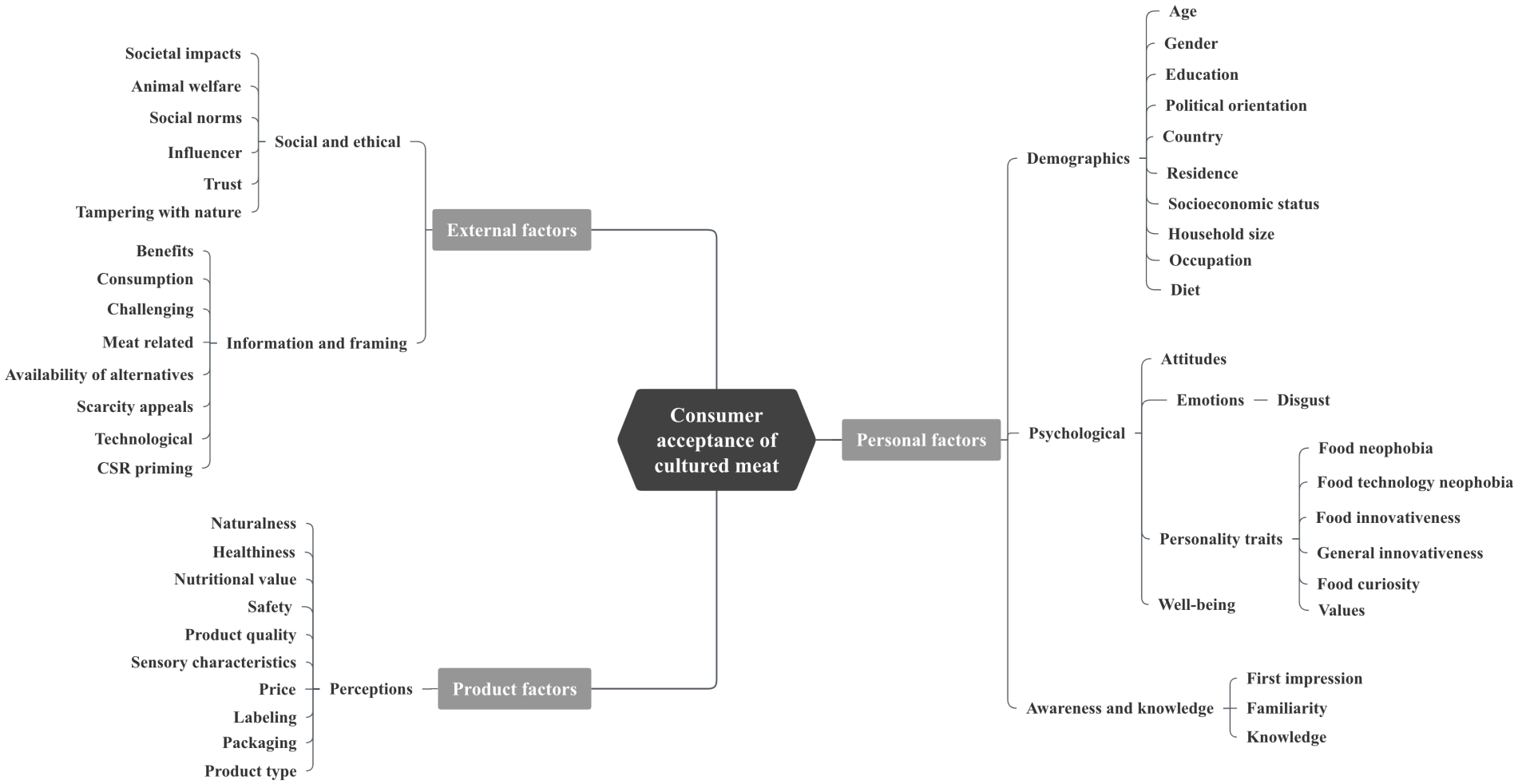
1.4 Acceptance as a Major Challenge for Cultured Meat

Radical innovations such as cultured meat regularly pose social challenges (Jairath et al., 2021; Lin-Hi et al., 2022). These social challenges lie primarily at the level of attitudes towards the radical innovation and the resulting implications. Therefore, radical innovations are viewed with skepticism by consumers as they are associated with great uncertainty (Lin-Hi et al., 2023), which in turn leads to reservations about these innovations. However, radical innovations require social legitimization in order to be successful on the market. This is most evident in consumer acceptance, which is a decisive factor for the success of a novel food product such as cultured meat (To et al., 2024). Broad consumer acceptance of cultured meat is not guaranteed, as consumers often resist innovations that deviate significantly from familiar habits and logics (Heidenreich & Kraemer, 2015; Heiskanen et al., 2007). This resistance is particularly pronounced in the case of radical innovations in the food sector, where the consumption of new and unfamiliar foods is perceived as a potential risk to human health, leading to increased consumer skepticism (Pliner et al., 1993; Pliner & Salvy, 2006). However, consumer acceptance is ultimately a fundamental precondition for cultured meat to establish a strong market presence (Lin-Hi et al., 2023), rendering consumer acceptance of cultured meat one of the most important hurdles to overcome for the success of this radical innovation (Pakseresht et al., 2022; Post et al., 2020).

In recent years, research into the consumer acceptance of cultured meat has increased significantly, as demonstrated by various reviews on the subject (e.g., Bryant & Barnett, 2018, 2020; Deliza et al., 2023, Kouarfaté & Durif, 2023; Laureati et al., 2024; Lewisch & Riefler, 2023a; Pakseresht et al., 2022; Pivoraite et al., 2024; Siddiqui et al., 2022; Tsvakirai, 2024). The research focus was particularly on consumers and on the product level, i.e. consumer perceptions of product factors such as taste (Rolland et al., 2020), nutritional value (Gómez-Luciano et al., 2019) and price (Wilks & Phillips, 2017), but also personal factors of consumers that influence the acceptance of cultured meat such as demographic characteristics (Mancini & Antonioli, 2019), frequency of meat consumption (Franceković et al., 2021) and attitudes towards cultured meat (Dupont et al., 2022). However, as a recently published meta-review of studies on consumer behavior in relation to meat reduction and the acceptance of alternative proteins indicates, personal factors such as demographics might be important, albeit mainly in combination with other drivers for the consumer acceptance of so-called alternative protein sources such as cultured meat (Onwezen & Dagevos, 2024). Research shows that there are various factors that have a positive or negative influence on the acceptance of cultured meat, i.e. that are drivers or barriers to it (Deliza et al., 2023; Tsvakirai, 2024). An overview of important antecedents that influence the consumer acceptance of cultured meat is given in Figure 1.2 and Table A.1 in Appendix A. Further details on how these antecedents influence the consumer acceptance of cultured meat are provided in the remainder of the chapter.

Figure 1.2

Typical Antecedents for the Consumer Acceptance of Cultured Meat



Note. Own illustration based on the references listed in Table A.1 in Appendix A.
A Boolean search in Google Scholar, using the following search terms: (consumer* OR customer*) AND ("cultured meat" OR "clean meat" OR "vitro meat" OR "cell-based meat" OR "cultivated meat") AND (acceptance) returned > 7,500 results. This overview shows common antecedents for the acceptance of cultured meat and aims to provide a brief overview of the literature on the topic.

1.4.1 Personal Factors

As recent reviews demonstrate, demographic factors influencing the consumer acceptance of cultured meat have been extensively studied (Kantono et al., 2022; Pakseresht et al., 2022). Even if the effects of demographic factors vary (Pakseresht et al., 2022), due to the large number of research, characteristics of a potential consumer of cultured meat can be derived. According to this research, a potential consumer of cultured meat tends to be of younger age (e.g., Baum et al., 2022; Lazou et al., 2024), male (e.g., Chia et al., 2024; Cornelissen & Piqueras-Fiszman, 2023), with a higher level of education (e.g., Espinosa & Treich, 2023; Liu et al., 2023), rather liberal political views (e.g., Baum et al., 2023; Bryant, Szejda, et al., 2019), lives in an urban environment (e.g., Fernandes et al., 2022; Shaw & Mac Con Iomaire, 2019), and enjoys eating meat (e.g., Rombach et al., 2022; Sikora & Rzymski, 2023). Whether a consumer of cultured meat works inside or outside the meat industry is unclear, as both cases have been little investigated, but both have been found to be drivers of cultured meat acceptance (see Bryant et al., 2020; Liu et al., 2023). However, there were also exceptions to commonly identified demographic factors affecting acceptance, such as gender. While men in the vast majority of cases showed a higher acceptance of cultured meat, Bryant, Szejda, et al. (2019) found a higher willingness to buy cultured meat among women in China compared to men and Piochi et al. (2022) showed that women were more likely than men to consume cultured meat instead of conventional meat if they had received health-related information about cultured meat. The latter leaves room for interpretation that the marketing of cultured meat to appeal to women should focus in particular on the health benefits of the product.

In addition to demographic factors, there are numerous psychological factors that influence the acceptance of cultured meat as recent reviews on the acceptance of cultured meat demonstrate (To et al., 2024; Tsvakirai et al., 2024). For instance, general attitudes toward cultured meat as food (Dupont & Fiebelkorn, 2020) and attitudes toward a specific food, a burger with cultured meat (Dupont & Fiebelkorn, 2020; Dupont et al., 2022), were identified as drivers of acceptance. Furthermore, emotions have been found to influence the acceptance of cultured meat such as disgust, which has been identified as a major barrier to consumer acceptance of cultured meat (Pakseresht et al., 2022). For instance, a study by Rosenfeld and Tomiyama (2022) showed that many people consider cultured meat too disgusting to eat, while Arango, Septianto and Pontes (2023) found that a reduced sense of disgust increased the willingness to try cultured meat. A similar result can be seen with personality traits such as food neophobia and food technology neophobia. For example, Boereboom and colleagues (2022) found that people with a greater tendency towards food (technology) neophobia were less willing to engage with cultured meat. Whereas food curiosity has been identified as a driver of cultured meat acceptance (e.g., Rombach et al., 2022; Sikora & Rzymski, 2023).

According to a recent meta-review factors such as personal awareness and knowledge are key antecedents for the acceptance of alternative proteins such as cultured meat (Onwezen & Dagevos,

2024). For instance, Engel and colleagues (2024) found that the better the first impression of cultured meat, the higher the overall intention to consume it, the intention to substitute vegan food alternatives for cultured meat, and the intention to substitute non-vegan foods for cultured meat. Furthermore, prior familiarity with cultured meat was identified as one of the best predictors of its acceptance (e.g., Chia et al., 2024; Rolland et al., 2020), although not every study has identified this effect (e.g., Baum et al., 2022; Dupont et al., 2022). Dupont and colleagues (2022) have speculated a possible reason for this could be a lack of differentiation within the questionnaire, as it was only queried whether participants had heard of cultured meat, but this does not imply that they are actually familiar with or have knowledge of the concept.

1.4.2 Product Factors

Various product factors of cultured meat or perceptions of these have been identified that influence the acceptance of this radical innovation as recent reviews indicate (To et al., 2024; Tsvakirai, 2024). Perceptions of product factors play a central role in the acceptance of cultured meat and are predominantly barriers to its acceptance. For example, the perceived lack of naturalness of cultured meat has been identified as a major barrier to the acceptance of cultured meat in both qualitative studies (e.g., Laestadius & Caldwell, 2015; Shaw & Mac Con Iomaire, 2019) and quantitative studies (e.g., Chia et al., 2024; Hibino et al., 2023; Siegrist et al., 2018; Weinrich et al., 2020; Wilks et al., 2019, 2021). For instance, a quantitative study by Bryant, Anderson et al. (2019) has found that messages arguing that cultured meat is natural did not convince consumers. However, a recently published study showed that challenging the link between naturalness and goodness can increase the willingness to try cultured meat and thus increase its acceptance (Arango, Septianto, & Pontes, 2023). The perceived naturalness of cultured meat is linked to its perceived healthiness, which has caused concern among focus group and interview participants about the uncertainty of the long-term health effects of cultured meat (Shaw & Mac Con Iomaire, 2019) and has also been identified in quantitative studies as an important barrier to the acceptance of cultured meat (e.g., Pilařová et al., 2023; Weinrich et al., 2020). Nonetheless, there are also quantitative studies showing that the perceived healthiness of cultured meat can drive cultured meat acceptance (Bryant, Szejda, et al., 2019; de Oliveira et al., 2021; de Oliveira Padilha et al., 2022). For instance, Fu et al. (2023) demonstrated that health benefits related to reduced food safety risks, such as avoiding possible contamination during the slaughter process and thus reducing the risk of foodborne diseases, positively influence the acceptance of cultured meat. Furthermore, the perceived healthiness of cultured meat is linked to its perceived nutritional value and has therefore been shown to be a driver for its acceptance, as the nutritional value of cultured meat can be optimized by enriching it with omega-3 fatty acids, for example (Bryant, Szejda, et al., 2019). In addition to the nutritional value, another important aspect of food is its (perceived) sensory characteristics such as taste. While Wilks and Phillips (2017) showed that US consumers' main concerns were the limited taste of cultured meat and the expected high price, the study by Espinosa and Treich (2023) indicated that the expected tastiness of a

cultured foie gras was a decisive factor in the willingness to purchase the product for French consumers. In a study conducted in the Netherlands, Rolland et al. (2020) demonstrated that the acceptance of cultured meat can further be increased by tasting it, even if in the specific case only conventional meat was tasted, some of which was labeled as cultured meat. Perceptions of the labelling of cultured meat and, more specifically, the name used for the product also has an influence on the acceptance of cultured meat (e.g., Asioli et al., 2021; Hallman et al., 2023). For instance, Chong and colleagues found that the term "cultivated meat" was most popular among Singaporean consumers, some of whom had tried cultured meat before, and was associated with a positive attitude towards cultured meat. Furthermore, perceptions of the product packaging affect the acceptance of cultured meat. Califano and colleagues (2023) showed with an Italian group of consumers that a green color of the packaging of cultured meat can have a positive influence on its acceptance, which is why the authors assume that consumers are more attracted to green packaging as it reflects the "green" product characteristics. In addition to the aforementioned factors, Vural and colleagues (2023) have shown that perceptions of the product type influence the acceptance of cultured meat among UK consumers, as nuggets with cultured chicken meat performed better than conventional chicken nuggets in comparison with cultured burgers that performed worse than conventional burgers, mainly due to disgust, perceived taste and perceived healthiness.

1.4.3 External Factors

The complexity and multidimensional nature of the factors influencing the acceptance of cultured meat, including external factors, was emphasized in a recently published review (Pivoraite et al., 2024). External factors include aspects such as the impact of cultured meat on society and its potential for animal welfare. For instance, Sikora and Rzymski (2023) demonstrated that the most important motivation for Polish consumers to buy cultured meat was to minimize the impact of food production on animals and the environment. A similar observation was reported by de Oliveira et al. (2021) with Brazilian consumers, for whom the expected environmental impact and expected animal welfare conditions played an important role in the decision to potentially replace conventional beef with cultured meat. Nonetheless, a study conducted in China identified societal concerns with cultured meat as a barrier to its acceptance (Wang & Scrimgeour, 2023). Overall, a review concludes that the evidence suggests most people see more societal benefits than personal benefits in consuming cultured meat (Bryant & Barnett, 2020).

Other external factors that influence consumer acceptance of cultured meat include social influences (Pivoraite et al., 2024). For instance, Engel and colleagues (2024) found that consumers in Scandinavia who were surrounded by positive attitudes and intentions towards cultured proteins in their social networks were more likely to consume these products. While Turkish consumers claimed that the consumption of red meat was a social norm and a natural necessity for humans, which in turn had a negative impact on the acceptance of cultured meat (Baybars et al., 2023). In addition, there are other external influences through social media that can affect the acceptance of cultured meat. For instance,

Leite and colleagues (2024) demonstrated in two experimental studies that US consumers are more willing to buy cultured meat when it is recommended via social media by micro-influencers rather than mega-influencers, which can be exploited in the marketing of cultured meat in the future. The authors speculate that the reason is that if micro-influencers have certain expertise, their recommendations in this area are more likely to be perceived as credible and trustworthy. Trust has also been identified as an external factor influencing the acceptance of cultured meat in other areas, for instance negatively in the form of distrust in biotechnology (Hwang et al., 2020) and distrust in scientists (Lewisch & Riefler, 2023b) or positively when it comes to high levels of trust in the food industry (Siegrist & Hartmann, 2020).

External factors can encompass a wide variety of aspects, including the information that consumers receive about cultured meat and the framing, i.e. how the product is presented, which play a role in its consumer acceptance (Pivoraite et al., 2024). For instance, the use of a counter-messaging approach, proved to be effective among British consumers in turning the weaknesses of conventional meat production into a potential strength of cultured meat (Baum et al., 2022). The authors found that presenting information about the negative consequences of conventional meat for animal welfare or environmental impact positively influenced the acceptance of cultured meat. Furthermore, in an experimental study with US consumers, Bryant and Dillard (2019) tested three different types of framing for cultured meat: "societal benefit", "high-tech", and "same meat". The "same meat" framing resulted in the most positive attitudes towards cultured meat, while the "high-tech" framing led to a more negative attitude and significantly lower likelihood of consumption. The authors discuss this critically, noting that cultured meat was predominantly presented in early media coverage in a technical manner, such as with images of petri dishes or test tubes. This could lead consumers to develop a more negative attitude towards cultured meat than they otherwise might have. However, this could, in turn, also lead to greater familiarity with this radical innovation, which has already been discussed as a significant driver of consumer acceptance of cultured meat. Overall, this underscores the importance of how information is provided to potential future consumers of cultured meat.

1.4.4 Summary on the Current State of Knowledge

Research to date indicates that there are numerous antecedents for the acceptance of cultured meat, as illustrated in Figure 1.2, Table A.1 and outlined above. However, acceptance was operationalized in different ways in the various studies. For instance, the willingness to try (e.g., Arango, Chaudhury, & Septianto, 2023; Mancini & Antonioli, 2020; Wilks & Phillips, 2017), the willingness to eat (e.g., Fujiwara & Tachikawa, 2024; Geipel et al., 2018; Lanz et al., 2024), the willingness to buy (e.g., Franceković et al., 2021; Gómez-Luciano et al., 2019; van Dijk et al., 2023), the willingness to pay (e.g., Escribano et al., 2021; Espinosa & Treich, 2023; Vural et al., 2023) and the willingness to consume cultured meat (e.g., Dupont & Fiebelkorn, 2020; Dupont et al., 2022; Leung et al., 2023) were surveyed. Nevertheless, these different operationalizations of consumer acceptance should be

considered in a more differentiated way, as the willingness to try something, for instance, represents a relatively low level of commitment compared to other intentions such as the willingness to buy something (Rombach et al., 2022). As recent reviews indicate, the general consumer acceptance of cultured meat is still relatively low, since even if many consumers are willing to try cultured meat, they would not necessarily substitute it for conventional meat on a regular basis (e.g., Deliza et al., 2023; Siddiqui et al., 2022). Furthermore, recent reviews indicate that there are regional differences in consumer acceptance of cultured meat (Lewisch & Riefler, 2023a; Siddiqui et al., 2022). For instance, studies conducted in the USA and UK (80% at least somewhat likely to try, around 70% at least somewhat likely to buy, Szejda et al., 2021), China (70% willing to taste or buy, Zhang et al., 2020), Brazil (64% of urban respondents willing to try, Fernandes et al., 2022), Italy (64% willing to try, Califano et al., 2023), and Germany (58.4% willing to consume, Dupont et al., 2022) indicate a greater consumer acceptance of cultured meat compared to studies conducted in countries like France (50.6% willing to try, but only 20.3% willing to eat regularly, Hocquette et al., 2022). This may be due to a variety of reasons, from cultural factors (Liu et al., 2023), to the different study design (Bryant & Barnett, 2018). However, the consumer acceptance of cultured meat is likely to increase over time, for instance by providing consumers with greater information on the subject and thus raising awareness (Chriki et al., 2020; Zhang et al., 2020).

As another review demonstrates, even though numerous studies on consumer acceptance of cultured meat have been carried out in various countries, the focus was primarily on Western countries such as the USA (Tsvakirai et al., 2024). However, more research has been carried out in African countries (e.g., Kombolo Ngah et al., 2023; Tsvakirai et al., 2023) and South American countries (e.g., Fernandes et al., 2022; Rombach et al., 2022) in recent years. In view of the growing demand for meat, especially in developing and emerging countries (FAO, 2018; Gouel & Guimbard, 2019), further studies to analyze the factors influencing the acceptance of cultured meat among the population in those countries are important in order to increase the acceptance and develop suitable regional marketing strategies for cultured meat.

Even though different study designs such as qualitative studies with focus group discussions (e.g., Ho et al., 2023; van der Weele & Driessen, 2019), quantitative studies with surveys (e.g., Lazou et al., 2024; Pilařová et al., 2023) and experiments (e.g., Arango, Chaudhury, & Septianto, 2023; Leite et al., 2024) or mixed-method studies (e.g., Rehman et al., 2024; Ruzgys & Pickering, 2020) have been conducted, all study results are based on consumer intentions and not on actual consumer behavior in relation to cultured meat. Although these variables are related, intentions do not always correspond to actual behaviors (Ajzen, 1985). As cultured meat is not yet widely available, is not regulatory approved in most of the world and therefore, with a few exceptions, cannot be tasted anywhere, it has not yet been possible to conduct studies investigating consumer behavior in relation to cultured meat. Even if there have previously been promising attempts, such as the study by Rolland et al. (2020), which comprised

a tasting of conventional meat, some of which was labeled as cultured meat, consumer studies conducted with real cultured meat are lacking (Tsvakirai et al., 2024). For instance, this could be field experiments in markets with regulatory approval that test cultured meat in different settings in order to investigate real purchasing behavior and thus find out, for example, where consumers are most likely to reach for the products, which type of labeling particularly appeals to them, which product type they favor, or which price point is actually accepted. Therefore, it is expected that the availability of cultured meat will enable to conduct studies on the actual choice of the product and gain more reliable insights into its consumer acceptance (Pakseresht et al., 2022).

A recent review concludes that all consumer acceptance studies conducted on the topic of cultured meat came from a field other than management (Kouarfaté & Durif, 2023). Thus, there is a need for further management research on the acceptance of cultured meat in order to provide a holistic view of consumer acceptance of cultured meat that goes beyond product-related and person-related factors and enriches the findings around external factors. Social acceptance research on cultured meat is furthermore underrepresented in relation to stakeholders other than consumers (Kouarfaté & Durif, 2023). Nevertheless, it is assumed that stakeholders like industry representatives are important for the acceptance and marketing of new products such as radical innovations (Aarikka-Stenroos et al., 2014; Evers et al., 2012), as they can shape understandings of products with those consumers are not familiar with (Chiles, 2013a) and are "inherent 'gatekeepers' to this marketplace" (Chiles, 2013b, p. 515). There have already been initial attempts to include the perspective of other stakeholders than consumers, such as by interviewing actors in the agricultural and food system to find out categories of their positions (Chiles, 2013b), to interview experts and stakeholders to find out how they position themselves in relation to an optimistic vision of cultured meat (Böhm et al., 2018), or to evaluate the acceptance and perception of cultured meat by meat scientists (Choudhary et al., 2023). However, the focus was mainly on differences between these stakeholders and consumers in terms of their attitudes towards or acceptance of cultured meat and on their general positionings. For instance, no research has yet been conducted into the propensity of stakeholders to actively engage with cultured meat, i.e. their willingness to invest in it. Furthermore, as a recent review of stakeholder beliefs about alternative proteins demonstrates, studies involving cultured meat have almost exclusively interviewed stakeholders, but no experimental study has been conducted (Amato et al., 2023), highlighting a research gap.

1.5 Aim and Structure of the Dissertation Thesis

Applying a socio-psychological approach and incorporating multiple perspectives, the dissertation aims to illuminate new insights into the research field of cultured meat. More specifically, this dissertation aims to contribute to the research on the perceptions and acceptance of cultured meat, which is particularly important at a stage when the product is not yet available, as understanding the factors that influence acceptance is crucial for future success or failure in the market. Since the

acceptance of cultured meat is multidimensional and requires not only social legitimization from consumers but also stakeholders such as industry representatives, these different perspectives are addressed in this dissertation. To this end, the articles examine the perceptions and acceptance of cultured meat at the micro-level, i.e. on the level of consumers and of organizational members from the food industry. The articles employ an interdisciplinary framework in which management perspectives are fused with psychological methods to provide valuable and diverse insights. To this end, the dissertation uses a variety of behavioral science tools to gain a deeper understanding of individual perceptions and the factors influencing the acceptance of cultured meat. Six quantitative studies were conducted in the form of survey-based experiments and field experiments in which either the intentions or the behavior of individuals were examined. The next section presents an overview of the four papers and the contribution to an edited volume which comprise the dissertation and demonstrates the different approaches used to advance literature on the perceptions and acceptance of cultured meat.

1.5.1 Cellular Agriculture and the Future of Food: Cultivated Meat and Animal-Free 'Milk' as a Leap Innovation for Sustainable Development

The German-language contribution to an edited volume „Cellular Agriculture and the Future of Food: Cultivated Meat and Animal-Free 'Milk' as a Leap Innovation for Sustainable Development" ("Zelluläre Landwirtschaft und die Zukunft der Ernährung: Kultiviertes Fleisch und tierfreie „Milch" als Sprunginnovation für eine nachhaltige Entwicklung") deals with cellular agriculture. Cellular agriculture refers to agricultural products – especially animal products like meat, milk, and leather – that are produced through processes on the cellular level (Rischer et al., 2020). This is in contrast to traditional agricultural processes, which take place at the level of the entire organism (Stephens & Ellis, 2020).

The aim of this contribution to an edited volume is to provide information about these innovative technologies to interested individuals and thus make a contribution to the education on sustainable nutrition. To this end, this work is designed to provide an overview of sustainability challenges within the current food system, highlighting the role of cellular agriculture and the contribution it can make to sustainable development. Therefore, this contribution to an edited volume provides an overview of the technical background to cellular agriculture and its potential for sustainability as well as possible approaches to nutrition education.

It highlights that within cellular agriculture, there are two fundamentally different approaches: the cellular approach and the acellular approach. Cultured meat, which begins with the extraction of animal cells (Post, 2014), belongs to the cellular approach. The acellular approach, on the other hand, does not use animal cells and therefore no animals. Instead, microorganisms such as yeast or bacteria are used and modified in such a way that they produce certain molecules that are otherwise found in animals or animal-based products (Broad, 2019). Therefore, cellular agriculture promises a caesura in

the 10,000-year development of agriculture (Helliwell & Burton, 2021). Previous agriculture was based on the paradigm of the domestication of animals and plants, whereas cellular agriculture heralds the transformation to a "post-animal bioeconomy" (Helliwell & Burton 2021, p. 181). In other words, cellular agriculture aims to produce agricultural products in a fundamentally new way, including decoupling the production of animal products from the number of livestock, which in turn provides a sustainability potential.

There are, however, challenges that could hinder the large-scale spread of cellular agriculture. Radical innovations in particular are viewed with skepticism by consumers, as they are associated with great uncertainty (Lin-Hi et al., 2024). These uncertainties are in turn a typical source of reservations about innovations and can also lead to a focus on their risks, while their opportunities tend to be overlooked. For this reason, it is necessary to provide laypeople with background information in the form of scientifically reliable facts on this kind of subjects and to involve the public at an early stage, i.e. before market launch. In order to promote this, it is advisable to prepare information in a way that ensures it is comprehensible and is explained by referring to something familiar, for instance. In this way, existing uncertainties and associated reservations can be reduced.

1.5.2 The Omnivore's Paradox and Consumer Acceptance of Cultured Meat: An Experimental Investigation into the Role of Perceived Organizational Competence and Excitement

The first article focuses on organizational factors as antecedents for the acceptance of cultured meat as a decisive factor for social legitimacy. Generally, radical innovations like cultured meat are characterized by a high degree of uncertainty and risk (Mugge et al., 2018; O'Connor & Rice, 2013). Due to the fact that food is ingested into the body, consumers are also specifically cautious about innovations in this area, as the fear of negative health consequences is particularly salient here (Pliner et al., 1993). Therefore, consumers need to use organizational associations to make inferences about unobservable product characteristics.

As a theoretical foundation the first article builds on the omnivore's paradox (Fischler, 1980; Rozin, 1976), which refers to people's simultaneous aversion and attraction to new foods. This paper examines the importance of perceived organizational competence and excitement for consumer acceptance of cultured meat in terms of willingness to buy cultured meat. Furthermore, this study examines different types of companies (startups, multinational companies) and different types of collaboration (cooperation, acquisition with integration) with regard to their influence on the willingness to buy cultured meat.

Conducted through a survey-based experiment in Germany, employing a mixed design of dynamic vignettes in two stages, the empirical results from 714 participants suggest that both perceived competence and excitement significantly influence the willingness to buy cultured meat with

consumers' feeling of excitement having an especially strong effect on their level of acceptance. This enhances the understanding of consumer acceptance of cultured meat by complementing the prevailing emphasis on product- and person-related factors and adding further external factors (see Bryant & Barnett, 2018, 2020; Pivoraite et al., 2024) by providing insights into organizational aspects. Moreover, the results indicate that multinational companies are perceived as more competent, contributing to the literature on organizational stereotypes, while startups are more often associated with excitement, contributing to the debate on the liability of newness and smallness. Lastly, an effect that is rather small in size suggests that for a startup, cooperating with a multinational company has a more positive effect on the acceptance on cultured meat than an acquisition. This finding contributes to the relatively limited literature on consumer reactions to mergers and acquisitions and adds a new perspective to this debate by investigating consumer reactions in terms of purchase intentions toward the product.

Overall, the study provides insight into consumer acceptance of cultured meat and helps to identify strategies for companies and managers to maximize the sustainability potential of this radical innovation. It demonstrates, for instance, that the omnivore's paradox becomes a management paradox, which is why cultured meat producers have to manage the omnivore's paradox by simultaneously addressing consumers' fears and curiosity, i.e. on the one hand reducing safety concerns while not reducing excitement and on the other hand increase the excitement factor, without increasing safety concerns.

1.5.3 Consumer Acceptance of Cultured Meat: An Empirical Analysis of the Role of Organizational Factors

The second article deals on the one hand with product-related factors that have already been identified in previous studies as antecedents for the acceptance of cultured meat. On the other hand, the article also looks at emotional factors that have been shown to be drivers of sustainable consumption in the general sustainability literature (Apaolaza et al., 2018; Iweala et al., 2019). In particular, the article focuses on sustainability-related organizational factors as antecedents for the acceptance of cultured meat, as cultured meat can be considered a radical sustainability-oriented innovation.

As a theoretical basis, the second article utilizes established framework concepts for sustainability management. A large number of framework concepts such as the SDGs or Planetary Boundaries are used in sustainability management research. However, they have different strengths and weaknesses and therefore different ways of contributing to the sustainable development of society and companies. To investigate the influence of sustainability-related organizational factors on the acceptance of cultured meat, this study investigated whether organizational factors, i.e. perceptions, evaluations, and cognitions about organizational attributes and actions play a role in the consumer acceptance of cultured meat. To this end, this paper examines the role of external factors, more specifically organizational factors (trustworthiness, corporate social responsibility (CSR) and extrinsic

motives) as well as personal factors, i.e. the perceived emotional benefits of cultured meat consumption in addition to already frequently studied product factors (appearance, taste, texture, nutritional value, health and safety) as antecedents of consumer acceptance of cultured meat.

A pre-post intervention design in the form of a two-part online questionnaire was used, with the final sample consisting of 966 participants from Germany. The study results indicate that not only product-related factors function as antecedents of the acceptance of cultured meat but also second-order associations on the organizational level. Specifically, the results demonstrate that, in addition to product factors, higher levels of trustworthiness and perceptions of CSR can promote the acceptance of cultured meat. This suggests that future marketing strategies for cultured meat should not only focus on product-related factors, but also on management and the emphasis on positive organizational factors. However, it could not be confirmed that the attribution of extrinsic motives has an influence on the trustworthiness of the organization and on the acceptance of cultured meat. This deviates from previous research (Terwel et al., 2009; Vlachos et al., 2009, 2010). Lastly, the results indicate that the emotional benefits that consumers derive from the consumption of cultured meat have a positive influence on the acceptance of this product. This reflects the finding that emotional benefits play a role in sustainable consumption (Hartmann & Apaolaza-Ibáñez, 2012; Hartmann et al., 2017).

Overall, the study not only enhances the understanding of consumer acceptance of cultured meat, but also enriches the broader literature on innovation acceptance by testing a framework that includes various predictors and provides valuable insights into the dynamics of innovation presentation to consumers. Furthermore, it enriches the debate on frameworks for sustainability management by highlighting the importance of sustainability-related organizational factors generally and trustworthiness and CSR perceptions particularly in terms of the acceptance of radical sustainability-oriented innovations.

1.5.4 The Performativity of Radical Innovations for Sustainable Consumption: An Experimental Investigation on the Example of Cultured Meat

The third article frames cultured meat as a radical innovation for sustainable consumption. Given that a radical innovation like cultured meat would allow a sustainable consumption without sacrifice, i.e. without the need to limit meat consumption, it creates a new and better possibility for meat consumers to satisfy their needs than conventional meat. In doing so, cultured meat can reduce consumers' attachment to existing, less sustainable consumption practices. It can be argued that this effect does not only occur when cultured meat becomes available on the market, but also already prior to its market introduction. In other words, it should have a performative effect.

As a theoretical foundation the third article builds on the theory of cognitive dissonance (Aronson, 1969; Festinger, 1957). The theory of cognitive dissonance states that psychological discomfort arises when people have two or more contradictory cognitions, such as attitudes, beliefs,

values, etc., regarding their environment, themselves, or their behaviors. Individuals are motivated to reduce this cognitive dissonance and can achieve this by changing their cognitions or behavior (Festinger, 1957), with research suggesting that changing cognitions is often easier than changing behavior (Heimlich & Ardoin, 2008; McGrath, 2017). For this purpose, so-called defensive strategies are used, such as doubting the credibility of information (Séré de Lanauze & Siadou-Martin, 2019), in order to avoid further questioning the usual (unsustainable) consumption habits and to maintain unsustainable behavior. This article investigates whether the awareness of a future radical innovation for sustainable consumption, i.e. cultured meat, reduces the use of defensive strategies to cope with cognitive dissonance and has a positive effect on more sustainable consumption behavior.

Two experimental studies were conducted in Germany. The first study comprised a final sample of 198 participants and was designed as a factorial survey. The second study was a field experiment and consisted of a final sample of 119 participants. The findings show that the awareness of cultured meat as a future radical innovation for sustainable consumption a) reduces the usage of defensive dissonance reduction strategies by leading to a higher attribution of credibility to inconvenient information and b) promotes sustainable consumption practices by reducing meat consumption in the "here and now". A basic assumption in the literature is that (radical) innovations for sustainable consumption need to be adopted by consumers to unfold their sustainability potential (e.g., Guerin, 2001; Jansson et al., 2017). The present study adds a new dimension to this debate by showing that such innovations like cultured meat are able to influence consumer behavior even prior to their market introduction. Therefore, the results indicate the relevance to communicate about radical innovations for sustainability in the early stages of their development.

Overall, this article advances the existing research on cultured meat by demonstrating its effect on current consumer behavior. Furthermore, it enriches the general debate about future radical innovations for sustainable consumption by showing how a future product can shape the present and in doing so, identifies a new mechanism for accelerating sustainability transitions.

1.5.5 Trivializing the Future: Cognitive Dissonance and Incumbents' Underinvestment in Radical Innovations on the Example of Cellular Agriculture[3]

The fourth article examines what effects it has on organizational members of the meat and fish industry when they are confronted with cell-cultured meat or cell-cultured fish and whether they perceive that their business model could potentially be disrupted by these radical innovations. Considering that radical innovations are an important source of potential organizational change and that they can lead to a variety of aversive consequences for organizational members (Hansson et al., 2008),

[3] This article was originally written in British English and amended into American English to ensure the linguistic consistency of the dissertation. The original title is "Trivialising the Future: Cognitive Dissonance and Incumbents' Underinvestment in Radical Innovations on the Example of Cellular Agriculture"

it can be argued that the confrontation with a radical innovation leads to cognitive dissonance and a trivialization of this radical innovation.

Drawing on the theory of cognitive dissonance (Aronson, 1969; Festinger, 1957), the fourth article explores the psychological discomfort that arises when organizational members possess conflicting cognitions, i.e. when they are confronted with a radical innovation that could potentially disrupt their own business model. As the theory states that the intensity of the psychological discomfort varies depending on the personal importance an individual ascribes to the cognitions that are inconsistent with each other (Festinger, 1957), the article explores whether greater cognitive dissonance arises if a radical innovation is presented that could potentially disrupt one's own business model, e.g., organizational member in the meat industry and cell-cultured meat, vs. a familiar business model, e.g., organizational member in the meat industry and cell-cultured fish. Since individuals are motivated to reduce cognitive dissonance in an easy manner (Festinger, 1957) and trivialization is a common method (Simon et al., 1995), the article examines whether trivialization in the form of downplaying the radicalness of a radical innovation occurs and whether this ultimately leads to a lower willingness to invest in the radical innovation.

Two experimental studies were conducted in Germany. Both studies were designed as factorial surveys, with the first study comprising a final sample of 380 participants and the second study comprising 121 participants, i.e. organizational members. While the first study served to investigate the hypotheses put forward, the second study was carried out to further validate the previous results and to rule out the possibility that they originated from the mere difference in products presented to participants. The findings show that a confrontation with a radical innovation, i.e. cell-cultured meat or cell-cultured fish triggered cognitive dissonance and that organizational members experienced a greater cognitive dissonance, if they were directly personally affected, i.e. if the presented radical innovation could impact their own business model. The results further demonstrate that organizational members reduce the cognitive dissonance through trivialization, more precisely by downplaying the radical nature of the radical innovation, which ultimately reduces their willingness to invest in it. This implies that it is necessary to identify possibilities for organizational members to overcome the trivialization of a radical innovation in order to make an objective evaluation of it. In general, organizational members of the meat and fish industry are not only consumers themselves, but they are also stakeholders who can contribute to social legitimization of cell-cultured meat and cell-cultured fish as it is assumed that stakeholders are important for the acceptance and marketing of new products such as radical innovations (Aarikka-Stenroos et al., 2014; Evers et al., 2012). For this reason, it is also important to specifically engage stakeholders from the established agribusiness on the topic of cell-cultured products through measures such as the involvement of various external experts in the evaluation of the products.

Overall, this article advances existing research on cell-cultured meat and expands the currently limited research on cell-cultured fish. In addition, it enriches research in this field with the perspective

of relevant stakeholders whose perceptions of and willingness to engage with these radical innovations have so far been largely neglected.

1.6 Scientific Contribution

This dissertation uses a socio-psychological approach and incorporates different micro-level perspectives to provide new insights into the research field of cultured meat, making a scientific contribution in a number of different areas. For instance, this dissertation provides a scientific contribution to management research on the acceptance of cultured meat, which has been identified as a research gap (Kouarfaté & Durif, 2023). Furthermore, this work improves the understanding of consumer acceptance of cultured meat by uncovering further antecedents. More specifically, it broadens the understanding of consumer acceptance of cultured meat by introducing new external factors to the prevailing emphasis on product and personal factors. In doing so, the work addresses a previously neglected aspect, namely the organizations that are going to produce cultured meat in the future and the question of what influence certain characteristics of these organizations could have on consumer acceptance of cultured meat. These organizational factors are associations that consumers use to make inferences about unobservable product characteristics, and therefore contribute to a holistic view of the multidimensional nature of consumer acceptance of cultured meat. Given that this multidimensionality of acceptance also involves the legitimization of such radical innovation by other stakeholders, such as industry representatives (Aarikka-Stenroos et al., 2014; Chiles, 2013a), this dissertation expands the previously limited understanding of industry representatives' perceptions of cultured meat

In order to improve the understanding of consumer acceptance of cultured meat and the perceptions of this radical innovation by industry representatives, experiments were conducted in this dissertation. A particular strength of experiments lies in the description of the consequences that result from the deliberate variation of a treatment, i.e. the possibility of investigating cause-and-effect relationships (Shadish et al., 2002). Thus, this work expands the existing literature on the acceptance of cultured meat to include knowledge about previously unknown causal relationships. Even though experimental studies on consumer acceptance of cultured meat have already been carried out, this cannot be considered a standard method for quantitative studies in this area (Kouarfaté & Durif, 2023). In conducting an experimental study of the perceptions of cultured meat by other stakeholders, this work fills a research gap (Amato et al., 2023). Furthermore, the field experiment conducted in article three extends the research by providing one of the first behavioral measurements in the context of cultured meat. The behavioral measurement conducted thus complements the literature that has examined consumer intentions rather than consumer behavior in the context of cultured meat. Since intentions do not always correspond to actual behaviors (Ajzen, 1985), this work enhances the understanding of consumer behavior when consumers are confronted with information about cultured meat as a radical innovation, thus providing insights into the impact of cultured meat on the "here and now".

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Appendix A

Table A.1

Typical Antecedents for the Consumer Acceptance of Cultured Meat

Antecedents of Cultured Meat Acceptance			Driver/Barrier	References
Personal factors	Age	Younger age (18 – 30 years)	Driver	Asioli et al., 2021; Baum et al., 2022; Bryant & Dillard, 2019; Bryant & Sanctorum, 2021; de Oliveira Padilha et al., 2022; Lanz et al., 2024; Lazou et al., 2024; Liu et al., 2023; Mancini &Antonioli, 2019; Pilařová et al., 2023; Piochi et al., 2022; Shaw & Mac Con Iomaire, 2019; Sikora & Rzymski, 2023; Szejda et al., 2021; van Dijk et al., 2023; Wang & Scrimgeour, 2023; Zhang et al., 2020
	Gender	Male	Driver	Baum et al., 2022; Bryant & Dillard, 2019; Bryant & Sanctorum., 2021; Chia et al., 2024; Cornelissen & Piqueras-Fiszman, 2023; Gómez-Luciano et al., 2019; Lanz et al., 2024; Lazou et al., 2024; Shaw & Mac Con Iomaire, 2019; Wilks & Phillips, 2017; Zhang et al., 2020
Demographics	Education	Higher educational qualification	Driver	Espinosa & Treich, 2023; Lazou et al., 2024; Liu et al., 2023; Mancini & Antonioli, 2019; Wang & Scrimgeour, 2023; Zhang et al., 2020
	Political orientation	Liberal	Driver	Baum et al., 2023; Bryant, Szejda et al., 2019; Slade, 2018; Wilks et al., 2019; Wilks & Phillips, 2017
	Country	Cultural influences of the country	Driver	Boereboom et al., 2022; Bryant, Szejda et al., 2019, Bryant et al., 2020; Bryant & Sanctorum, 2021; Chia et al., 2024; Fujiwara & Tachikawa, 2024; Gómez-Luciano et al., 2019; Siegrist & Hartmann, 2020; van Dijk et al., 2023
	Residence	Urban	Driver	Fernandes et al., 2022; Shaw & Mac Con Iomaire, 2019; Tucker, 2014
	Socioeconomic status	High income	Driver	Wang & Scrimgeour, 2023

Antecedents of Cultured Meat Acceptance			Driver/Barrier	References
	Household size	Large household size	Driver	Wang & Scrimgeour, 2023
	Occupation	Outside the meat sector	Driver	Liu et al., 2023
		Inside the meat sector	Driver	Bryant et al., 2020
	Diet	Meat attachment/medium to high frequency meat eater	Driver	Baum et al., 2022, 2023; Bryant, Szejda et al., 2019; Bryant & Dillard, 2019; Circus & Robison, 2019; Cornelissen & Piqueras-Fiszman, 2023; Franceković et al., 2021; Mancini & Antonioli, 2019; Piochi et al., 2022; Rombach et al., 2022; Sikora & Rzymski, 2023; Valente et al., 2019; Wilks & Phillips, 2017
Personal factors *Psychological*	Attitudes	General attitudes towards cultured meat	Driver	Dupont & Fiebelkorn, 2020
		Specific attitudes towards a cultured meat burger	Driver	Dupont et al., 2022; Dupont & Fiebelkorn, 2020
	Emotions	Disgust	Barrier	Arango, Septianto, & Pontes, 2023; Bogueva & Marinova, 2020; Bryant, Szejda et al., 2019; Egolf et al., 2019; Espinosa & Treich, 2023; Rosenfeld & Tomiyama, 2022; Ruzgys & Pickering, 2020; Siegrist & Hartmann, 2020
	Personality traits	Food neophobia	Barrier	Boereboom et al., 2022; Bryant, Szejda et al., 2019; Dupont & Fiebelkorn, 2020; Espinosa & Treich, 2023; Rombach et al., 2022; Siegrist & Hartmann, 2020; van Dijk et al., 2023; Wilks et al., 2019
		Food technology neophobia	Barrier	Asioli et al., 2021; Baum et al., 2023; Boereboom et al., 2022; Fu et al., 2023
		Food innovativeness	Driver	Engel et al., 2024
		General innovativeness	Driver	Engel et al., 2024

Antecedents of Cultured Meat Acceptance			Driver/Barrier	References
		Food curiosity	Driver	Arango et al., 2024; Hwang et al., 2020; Rombach et al., 2022; Sikora & Rzymski, 2023
		Values	Driver	Lewisch & Riefler, 2023b
	Well-being	Higher well-being	Driver	Leung et al., 2023
Personal factors *Awareness and knowledge*	First impression	Positive impression	Driver	Engel et al., 2024
	Familiarity	Familiar with cultured meat	Driver/Barrier	Bryant, Szejda et al., 2019; Chia et al., 2024; de Oliveira Padilha et al., 2022; Escribano et al., 2021; Fidder & Graça, 2023; Heijnk et al., 2023; Piochi et al., 2022; Rolland et al., 2020; Sikora & Rzymski, 2023; van Dijk et al., 2023
	Knowledge	Information provision	Driver	Min et al., 2024
Product factors *Perceptions*	Naturalness	Unnatural	Barrier	Bogueva & Marinova, 2020; Chia et al., 2024; Fidder & Graça, 2023; Hibino et al., 2023; Hwang et al., 2020; Laestadius & Caldwell, 2015; Shaw & Mac Con Iomaire, 2019; Siegrist et al., 2018; Weinrich et al., 2020; Wilks et al., 2021
	Healthiness	Healthiness/unhealthiness	Driver/Barrier	Bogueva & Marinova, 2020; Bryant, Szejda et al., 2019; de Oliveira et al., 2021; de Oliveira Padilha et al., 2022; Fu et al., 2023; Gómez-Luciano et al., 2019; Lanz et al., 2024; Pilařová et al., 2023; Shaw & Mac Con Iomaire, 2019
	Nutritional value	Enrichment	Driver	Bryant, Szejda et al., 2019; Gómez-Luciano et al., 2019
	Safety	Safe/unsafe	Driver/Barrier	Bogueva & Marinova, 2020; Gómez-Luciano et al., 2019; Zhang et al., 2020

Antecedents of Cultured Meat Acceptance			Driver/Barrier	References
	Product quality	Overall quality	Driver/Barrier	Fu et al., 2023; Tsvakirai et al., 2023
	Sensory characteristics	Expected taste	Driver/Barrier	Cornelissen & Piqueras-Fiszman, 2023; Espinosa & Treich, 2023; Gómez-Luciano et al., 2019; Rolland, et al., 2020; Wilks & Phillips, 2017
	Price	High price	Barrier	Asioli et al., 2021; Gómez-Luciano et al., 2019; Kombolo Ngah et al., 2023; Liu et al., 2023; Verbeke et al., 2015; Wang & Scrimgeour, 2023; Wilks & Phillips, 2017
	Labeling	Naming	Driver/Barrier	Asioli et al., 2018, 2021; Bryant & Barnett, 2019; Califano et al., 2023; Chong et al., 2023; Geipel et al., 2018; Hallman et al., 2023
	Packaging	Green color	Driver	Califano et al., 2023
	Product type	Nuggets/burger	Driver/Barrier	Vural et al., 2023
		No negative impact	Driver	de Oliveira et al., 2021
	Societal impacts	Positive impact	Driver	Verbeke et al., 2015; Chong et al., 2023; de Oliveira et al., 2021; Gómez-Luciano et al., 2019; Lanz et al., 2024; Sikora & Rzymski, 2023
		Societal concern	Barrier	Wang & Scrimgeour, 2023
	Animal welfare	Positive impact	Driver	Chong et al., 2023; de Oliveira et al., 2021; Fu et al., 2023, Sikora & Rzymski, 2023
External factors *Social and ethical*	Social norms	Expected social norm to consume cultured meat	Driver	Engel et al., 2024
		Red meat consumption as social norm	Barrier	Baybars et al., 2023

Antecedents of Cultured Meat Acceptance			Driver/Barrier	References
	Influencer	Cultured meat endorsed by micro-influencers	Driver	Leite et al., 2024
	Trust	Distrust in biotechnology	Barrier	Hwang et al., 2020
		Distrust in scientists	Barrier	Lewisch & Riefler, 2023b
		Trust in the food industry	Driver	Siegrist & Hartmann, 2020
	Tampering with nature	Aversion to tampering with nature	Driver	Chong et al., 2023
External factors *Information and framing*	Benefits	Societal	Driver	Bekker et al., 2017
		Personal	Driver	Bryant et al., 2020; Rolland et al., 2020
	Consumption	Conventional consumption practices	Driver	Fidder & Graça, 2023
	Challenging	Challenging the importance of naturalness	Driver	Arango, Septianto, & Pontes, 2023
		Counter-messaging conventional meat	Driver	Baum et al., 2022; Bryant, Andersen et al., 2019
	Meat related	Similarity to meat	Driver	Bryant & Dillard, 2019
	Availability of alternatives	Conventional meat, soy products	Barrier	Hamlin et al., 2022
	Scarcity appeals	Demand-based	Driver	Arango, Chaudhury, & Septianto, 2023
	Technological	High tech descriptions	Barrier	Bryant & Dillard, 2019
	CSR priming	Negative corporate behavior	Barrier	Rabl & Basso, 2021

Note. Own illustration.