



# In-vitro meat: A solution for problems of meat production and meat consumption?<sup>1</sup>

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## Abstract

In 2013, Mark Post and his colleagues at the University of Maastricht presented the first cultured meat (in-vitro-meat) burger made from bovine stem cells. The technological innovation is intended to offer a possibility of reducing or even eliminating the negative effects of current meat production and meat consumption on humans, animals, and the environment. Large scale production, however, is not yet possible, and the question remains whether cultured meat will be able to keep what the developers promise.

The following article deals with this question, addressing the results of expert and stakeholder interviews as well as participative processes that were carried out in a project at the *Institut für Technikfolgenabschätzung und Systemanalyse* (Institute for Technology Assessment and Systems Analysis = ITAS). Among other aspects, the manufacturing process, possible impact on the environment, animals and humans, consumer acceptance, as well as the subsidy of research and development of cultured meat will be discussed.

Cultured meat presents an interesting alternative to conventional meat production, although many questions are as yet unanswered, particularly with regard to technical feasibility and ethical as well as social aspects. More research is essential; the search for a sustainable alternative to current meat production should, however, also involve other approaches such as ecological agriculture.

**Keywords:** cultured meat, meat consumption, food technology, world nutrition, animal ethics, sustainable nutrition

## Introduction

The question of future nutrition is the focus of public discourse, particularly with regard to the prognosis of a growing world population [1]. The discussion is about how we can make our current diet sustainable. Considerations of the topic of “meat” are inevitable in this context. It is evident that today’s meat production and meat consumption are having a negative impact on the environment, human health, and animal welfare, and are exacerbating the issue of world hunger. For instance, worldwide livestock farming is contributing 18% of anthropogenic emissions of greenhouse gases, mainly through CO<sub>2</sub> from slash-and-burn clearing of (tropical) forests for feed cultivation and grazing land, nitrous oxide from fertilizers used for feed cultivation, and methane from the digestive tracts of ruminants [2]. If global trends in the consumption of animal products continue, the global mean temperature will rise by more than 2 °C, even if emissions from non-agricultural sectors are drastically reduced [3].

A sustainable conversion of the current mass production system is not possible [2, 4–6]. It is therefore essential to consider possible alternatives to common meat production and meat consumption.

One possible technological solution could be cultured meat (in-vitro-meat) [7]. The meat we consume consists largely of animal muscle

Citations from expert interviews are identified as such. The interviews were abbreviated with the letters A–L, the following number refers to the line number in the transcript.

Interview A: Representative of an ecological agriculture association, June 13, 2016

Interview B: Representative of an animal rights organization, June 15, 2016

Interview C: Cultured meat researcher, innovator, June 15, 2016

Interview D: Representative of agricultural policy, June 16, 2016

Interview E: Representative of an environmental protection organization, June 22, 2016

Interview G: Representative of the food industry, July 13, 2016

Interview H: Food technician, June 28, 2016

Interview I: Cultured meat researcher, June 28, 2016

Interview J: Researcher in the field of tissue engineering, June 30, 2016

Interview K: Representative of a conventional grower’s association, July 13, 2016

Interview L: Representatives of system catering, July 19, 2016

### Box 1: Expert interviews

fiber. The basic idea behind cultured meat is to grow this muscle fiber in cell cultures based on muscle stem cells. This would eliminate the necessity of using enormous amounts of resources to raise animals for the purpose of producing meat (♦ Figure 1). In August 2013, the first cell-cultured hamburger made of bovine stem cells was presented at a press conference in London [8]. The burger patty had been produced by Mark POST and his colleagues at the Dutch University of Maastricht. In principle, then, the production of cultured meat for human consumption is possible.

Cultured meat is presented as an environmentally-friendly, animal-friendly, and healthier alternative to conventional meat, and thus as a plausible technological solution to the problems of current meat production and meat consumption [9, 10].

This article deals with this vision and addresses the results of expert and stakeholder interviews that were conducted as part of the project. It examines various aspects of cultured meat: the production process, the innovators’ vision, the question

of impact on the environment, animals, and humans, and the subsidy of research and development of cultured meat.

### Project “*Visionen von In-vitro-Fleisch*” (visions of cultured meat)

The project titled “*Visionen von In-vitro-Fleisch (VIF) – Analyse der technischen und gesamtgesellschaftlichen Aspekte und Visionen von In-vitro-Fleisch*” (visions of cultured meat (VIF) – analysis of technical and social aspects and visions of cultured meat) has been ongoing since October 2015 at the *Institut für Technikfolgenabschätzung und Systemanalyse* (Institute for Technology Assessment and Systems Analysis = ITAS) at the *Karlsruhe*

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# Production of cultured meat: basics

## Production process

The process by which cultured meat is created is called tissue engineering and originated in the field of regenerative medicine [11]. For the process of producing cultured meat, muscle stem cells are taken from a donor organism in a muscle biopsy, and are then proliferated in-vitro at the laboratory. The cells are cultivated in growth media using matrices, where they multiply (proliferation). Finally, the stem cells grow into muscle cells (differentiation), which then turn into muscle fibers (♦ Figure 1) [12].

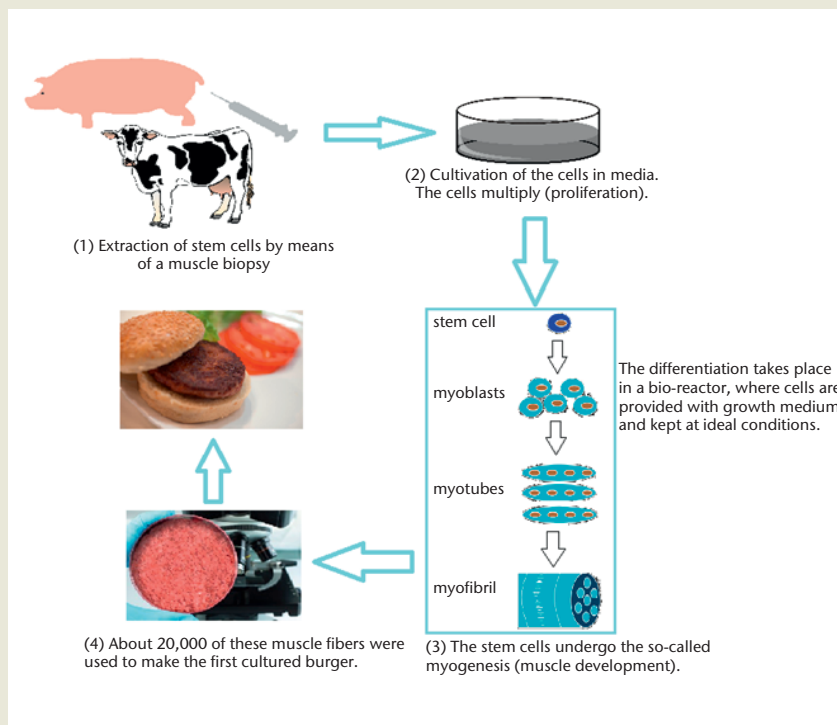


Fig. 1: Cultured meat production process [own illustration]

## Challenges

After the research team around Mark Post at the University of Maastricht presented the first burger of cultured beef in August 2013, the US American start-up Memphis Meats followed suit in February 2016 with the first cultured meat ball made of bovine stem cells, and in March 2017 with cultured poultry [13]. Memphis Meats and Post's team expect to market cultured meat within 4–5 years [13, 14]. The Maastricht team, for instance, was already able to lower production costs for one burger patty to \$11.36, compared to the costs of the first cultured meat burger, which had amounted to roughly \$325,000 [15].

Although the production of cultured meat is possible in principle, there is as yet no process for large-scale production of cultured meat. This is owed largely to the fact that the basic components of a cultured meat process need to be researched in more depth. Among other issues, the production of cultured meat requires suitable cells, an appropriate growth medium (ideally non-animal in origin, see [16], because animal components can contain communicable diseases, see section "Health and safety"), suitable (edible) materials for the matrices (e.g. fibrin-hydrogen gel), along which the cells can grow to produce thicker pieces of meat [16], as well as low-cost and efficient bio-reactors of sufficient size [C, I, J]. One expert from the field of tissue engineering expressed doubts that these challenges can be solved in the near future or at all [J].

Also, there is as yet no process for multiplying not just muscle cells but fat cells as well, which is relevant for nutritious meat and particularly for taste. Furthermore, it is not yet possible to produce continuous pieces of meat such as steaks, for example, because thicker tissue structures cannot yet be consistently supplied with oxygen and nutrients during the growth period. This, however, would be relevant for replacing conventional meat, since ground meat products are generally less in demand than larger pieces of meat [I].



Institut für Technologie (KIT) and subsidized by the German *Bundesministerium für Bildung und Forschung* (Federal Ministry of Education and Research = BMBF).

The project is dedicated to answering the scientific, technological, social, cultural, and political questions regarding the guiding principles and visions of current research into cultured meat. The results are intended to provide guidance for research policy and governance<sup>2</sup>.

Various methods were used to examine the research question: a literature analysis was used to determine the current state of research, as well as opportunities, risks, and challenges. These results along with further information were published on a German-language home page, which is to serve as an information platform for citizens. Also, twelve expert and stakeholder interviews as well as participative processes with citizens were conducted (♦ Box 1), in order to probe their ideas about cultured meat. This is followed by an analysis of the ethical aspects of the guiding principles and visions of cultured meat based on the previous tasks. At the end of the project, some research policy options for national research policy are presented. The results of the empirical research elements are discussed in section ■■■ “Visions of cultured meat”.

## Method

Over the course of the project, expert and stakeholder interviews were conducted, as well as focus groups and a Citizens’ Jury<sup>3</sup>. This article is based on the results of the expert and stakeholder interviews. After some research in publications and on relevant web sites, a selection was made of five experts from the fields of tissue engineering (medical application), cultured meat research and food and environmental sciences, as well as seven stakeholders from the realms of environmental

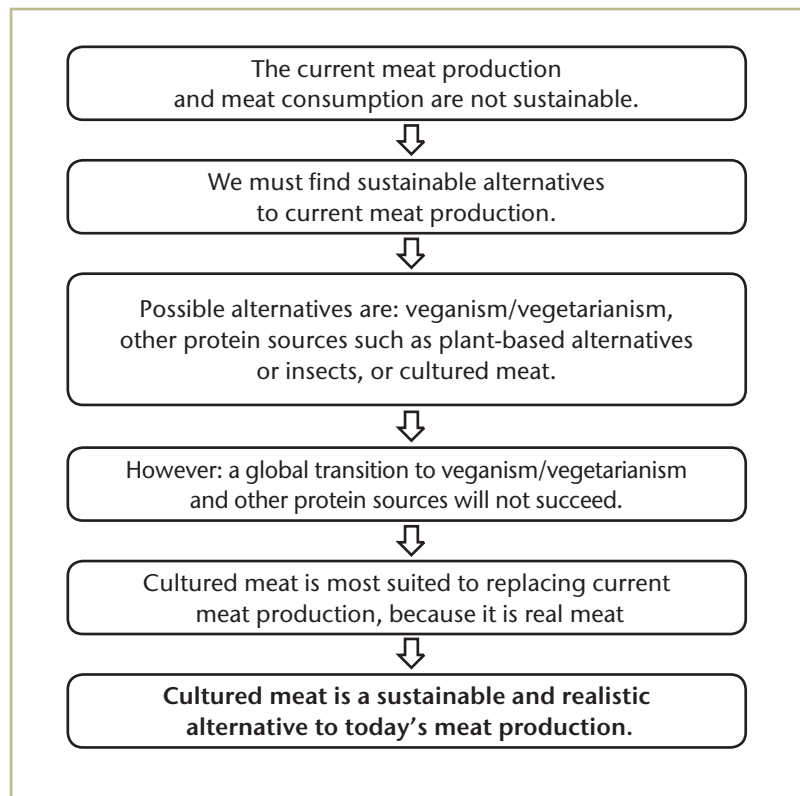


Fig. 2: Reconstruction of innovators’ argumentation [own illustration]

and animal protection, politics, conventional meat production, ecological associations, and system catering (♦ Box 1). Qualitative, semi-standardized individual interviews (45–75 min.) were conducted from June to July 2016. For each interview partner, personalized questions were added to a standardized guideline, the experts were asked five additional questions on technical aspects. The questions referred to the previously prepared innovators’ visions regarding cultured meat, to opportunities, risks, and challenges, to the future of a world with cultured meat for animals, agriculture, and society, to environmental impact, the cultural significance of meat, to changes in the relationship between humans and animals potentially caused by cultured meat, and to the (financial and ideological) support of cultured meat research. The responses were evaluated using a computer software.

## Visions of the innovators

„If you want to solve the meat problem, you need to be able to produce meat.“ [C369f.]

The innovators, meaning those who are researching cultured meat or support such research, focus on the claim that cultured meat is a plau-

<sup>2</sup> Governance describes the control or regulation of processes, in this particular case of cultured meat the way policy makers handle the new technology, particularly with regard to research (subsidy), possible market entry, etc.

<sup>3</sup> The Citizens’ Jury is a participative process. Citizens are invited to discuss the topic at hand with experts. At the end of a Citizens’ Jury, a citizen’s report or position paper is prepared. The Citizens’ Jury in the project was conducted with participants (aged 18–25 years), in order to focus on the attitudes of the generation that will potentially be most affected by the impact of cultured meat.

sible technological solution to the current problems of today's meat production and meat consumption [9, 10]. The innovators' argumentation can be reconstructed as shown in ♦ Figure 2.

This shows clearly that the innovators consider cultured meat to be a feasible and sustainable solution to the current problems of today's meat production. They claim that cultured meat is more environmentally and animal friendly, healthier, and safer (♦ Figure 2). Some of these aspects will be addressed in the following.

### Environmental friendliness

The innovators present cultured meat as an environmentally friendly alternative. Their statements are mainly supported by a life cycle analysis, which arrives at the supposed result that the production of cultured meat would consume less land and water and emit fewer greenhouse gases and pollutants than conventional meat production [17]. However, there are other life cycle analyses that qualify those results [18]. This is mostly because the studies are premised on different basic assumptions, for example regarding the resources used. These different assumptions and results are owed to the fact that there is as yet no large-scale production system for cultured meat which the analyses could reference, so they describe not so much the actual status as possible future scenarios [18].

One of the interview partners expresses criticism and emphasizes that he sees cultured meat as a potential solution for more sustainability and environmental friendliness, but that he cannot make any certain statements in this regard as long as there is not yet a marketable product [1317, 322]. Another interview partner, on the other hand, ensures that the impact on land, water, and climate change will be virtually eli-

minated compared to conventional meat production, and that energy consumption as well would not be higher than it is currently [C460]. Another interview partner says he cannot imagine that cultured meat could result in sustainable nutrition or that it would be more resource-friendly [J251, 293].

Beyond that, the ecological advantages vary greatly depending on the type of meat. The existing studies merely allow for the conclusion that cultured meat from bovine cells *could* present an environmentally-friendly alternative to beef. It cannot be concluded from the studies that cultured meat is more environmentally friendly than perhaps poultry or pork. The statement that cultured meat is more environmentally-friendly than conventional meat can thus not safely be made based on the available studies. The anticipatory studies could, however, serve as indications of what aspects will be essential in the development of cultured meat in order to in fact create a more environmentally-friendly product.

### Animal welfare

The advantages of cultured meat in terms of animal ethics include the reduction of the number of animals needed for meat production. The literature on the subject formulates the vision that a single animal might be enough to satisfy the worldwide need for meat [9]. Though this might be an exaggeration, it is conceivable that the reduced number of animals could make factory farming obsolete, resulting in better living conditions for the few animals still needed.

Another argument is the fact that no animals have to be killed to obtain stem cells. It is not clear, however, how painful a muscle biopsy is and whether animals would stay alive but be subjected permanently to cruelty. The prophesied "liberation of animals" is also not yet fea-

sible because of the use of other animal products, mainly the fetal calf serum used as a growth medium. Other components of the production process also contain animal products, such as growth factors and the materials for the matrices [I, J]. The innovators are striving to replace particularly the fetal calf serum with alternatives (e.g. algae, yeast) [C, H].

Representatives from the field of critical animal studies express concerns that cultured meat will serve to further cement the central role of meat in human nutrition. The meat paradigm, the social matter-of-causes and normality of consuming meat would remain. Veganism as an attitude opposes the meat paradigm and is an expression of unease about eating animal products – an unease that can be the driver for a radical change. Cultured meat would alleviate this feeling of unease: animals would continue to exist only as a means to an end [19, 20]. One of the interviewed stakeholders takes a similar view, stating that *"cultured meat production would further accelerate the already progressing estrangement of consumers from animal production"* [E69].

### Health and safety

Cultured meat is also presented as being healthier, because it is produced in the laboratory under controlled conditions. There is no factory farming and no necessity for antibiotics [21]. Yet, antibiotics were used during the production of the first cultured burger, because cell cultures do not have an immune system [21]. POST assumes that antibiotics will no longer be needed once large-scale production in sterile systems has become possible [14, 21]. It remains unclear, however, if and to what degree antibiotics are necessary for cell cultures. This is corroborated by the assessment of another interviewed

expert: “[...] it is already safe, with the right cells and the right quality standards. And it will probably be healthy as well, as we will generally know what is really in it.” [J269, see also H543]

Since the production of cultured meat requires little or no contact with animals, the risk of zoonosis is reduced. Zoonosis is the spread of diseases that can be passed from animal to human and from human to animal. However, fetal calf serum and other animal components can harbor communicable diseases [22]. A non-animal alternative is therefore the desirable solution.

Many studies confirm the connection between excessive meat consumption and obesity, cardio-vascular disease, hypertension, and type 2 diabetes mellitus [23]. Here as well, it is not clear if and to what degree such health risks would also result from excessive consumption of cultured meat.

Furthermore, cultured meat could become a functional food, meaning a food that is enriched with nutrients like vitamins or n-3 fatty acids in order to achieve a positive effect on human health [21]. However, the health effects ascribed to functional foods are not widely scientifically proven [24].

## Visions of cultured meat

Cultured meat as a technology is still in its infancy, because large-scale production is not yet possible. At the moment, cultured meat lives on promises and future projections, also called visions. Visions play an important role in the examination of the interaction of social and technological change. This is why the project “*Visionen von In-vitro-Fleisch*” (visions of cultured meat) deals with these visions. The following is an introduction of some of the visions found in the literature and derived from the expert and stakeholder interviews. They are not necessarily only visions of cultured

meat per se, but also visions of the future of meat or the future of nutrition in general.

Interviews were conducted with experts and stakeholders primarily from the German-speaking region with different professional backgrounds who are involved in the innovation of cultured meat or will probably have some contact with it in the future. The interview partners (♦ Box 1) from the realms of science, society, and politics were confronted with the innovators’ argumentation.

The innovators’ vision of a better world with cultured meat was shared by some of the interview partners. Some think that cultured meat could be an improvement on the original without the negative effects. Others believe that cultured meat could be a step toward a society without animal exploitation, because it stimulates reflection on meat consumption. Cultured meat should thus be supported for pragmatic reasons: *“I think cultured meat will be an interim solution. Consumers have to ask themselves: do I really have to kill animals to be able to eat meat? The answer is no. The task of cultured meat will be to achieve this and thereby reduce the consumption of conventional meat. People will then realize that plant-based alternatives are better than cultured meat.”* [B196]

This view is also found with VAN DER WEELE and DRIESSEN: Cultured meat could be an instrument of *“techno-moral change”, “a chance to change our thinking”* [25].

There could also be a restructuring of agriculture that would lead to more appreciation for farmers and animals and thereby drive back factory farming. To make that happen, it is crucial to start a dialogue with farmers about cultured meat and make them familiar with this innovation. Cultured meat could, according to the statement of one interview partner, be a support to farmers who do not engage in or-

ganic animal farming for economic reasons. Cultured meat could enable them to compete with factory farming [I254].

Other interview partners questioned the vision of cultured meat. They present a different, preferable solution for the problems of current meat production and meat consumption, an approach that they also consider more realistic: the reduction of meat consumption by half, and organic animal farming (▣▣▣ following section). Cultured meat, by contrast, would further advance the estrangement of consumers from animal products. Meat production would become even more industrialized and thus continue to increase meat consumption. Respect for meat and animals could be lost even more than it has been already. The removal of animal farming from agriculture would also destroy the natural cycle that is essential for sustainable agriculture [A, B, D, E, K].

Some interview partners do not see meat production and consumption as a problem, but still think cultured meat could be a product for people who still eat meat, but have a guilty conscience about it:

*“Ultimately, cultured meat is normal meat without the animal welfare discussion”* [K42].

## Future of agriculture: Organic animal farming

Representatives of environmental organizations and organic farming associations as well as politics present an alternative approach to solving the problems of current meat production and meat consumption: the reduction of meat consumption by half and meat produced through organic animal farming are seen as the most obvious and most realistic solution for the current problems of meat production [A, D, E]. This solution is supported in the climate protection plan 2050 of the German civil society as part of the climate



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**To date, there is no process for proliferating not just muscle cells but also fat cells, which are particularly relevant for taste. It is also not yet possible to produce larger pieces of meat such as steaks.**

conference in Paris in 2015 by numerous non-government organizations [26].

This approach contradicts the innovators' argumentation which assumes that meat consumption will continue to rise and a reduction of it will not be realistically feasible, because people like to eat meat too much. The only thing to replace meat, they say, is "real meat" – so cultured meat is the only realistic solution [C].

### Acceptance and potential consumers

According to one of the innovators and a spokesperson of an animal rights organization, cultured meat must be perceived as being original, not just a copy, in order to succeed [B140, C231]. Cultured meat may under no circumstances be associated with genetically modified foods or foods from the USA, as these are viewed with skepticism by German consumers [B139]. Proponents should focus on the advantages to human health and food safety, e.g.

better nutritional composition, as one animal rights representative and one food scientist suggest [B47, H296, H317]. The innovator assumes that cultured meat could alleviate consumer concern about meat contamination, for instance with zoonosis like BSE [C193, C297]. However, the long-term health effects of cultured meat have not yet been sufficiently studied and present an ethical-moral problem, according to a politician and a spokesperson of a conventional farming association [D20, K237].

Several studies emphasize the relevance of more research, both for acceptance of cultured meat as well as acceptance of aspects that are important to consumers like safety, health, and environmental impact [27, 28]. Acceptance cannot generally be taken for granted, particularly due to consumer insecurity about risks, the assumption of unnaturalness, and long-term effects (concerning a lasting and comprehensive transition from conventional meat production and consumption to cultu-

red meat) [29]. HOCQUETTE et al. [30] go so far as to conclude that cultured meat will not be accepted by the majority of consumers.

### Cultured meat as an everyday product

On the one hand, cultured meat could become a product for indifferent, uninformed consumers, who do not care about enjoyment and culture [A300], the origin of the animals, and "agrarian culture" [E260]. This is closely connected with the question of naturalness and artificiality of cultured meat (III section "Naturalness and artificiality").

On the other hand, cultured meat could become a product for ethically aware, educated wealthy people and those interested in innovative products [B150]. It should therefore first be an exclusive product for an elite group of persons [H102, H487], before it can become an affordable mass product in the long term. The innovator also assumes that cultured meat will initially be a premium product [C514, C546] before gaining a significant market share as an everyday product: a product for "mass consumption" [C242, G95, I172].

If, however, cultured meat remained an exclusive product for the rich or turned out to not taste good, it would not solve the meat problem [C317, I] – particularly since a study has shown that consumers are not willing to accept inferior taste in exchange for a healthier product [31]. It is therefore crucial that cultured meat will be able to compete with conventional meat in terms of price and taste [H110, H92, H546]. This view is also reflected in various studies: cultured meat will have to satisfy consumer expectations, especially taste and price will have to be comparable with those of conventional meat, but aspects of food safety are also emphasized [27–29, 32].

The representative of an environmental protection organization describes two possible economic



scenarios: when cultured meat hits the market, it could either result in reduced animal farming and “real” meat would become a premium product, or it could spark a price war between factory farming and cultured meat [E126]. In both cases, cultured meat will be viewed as a product for everyday consumption. The basic assumption of a representative of the food industry is that conventional meat will become significantly more expensive in the future and therefore become something special [G337]. In this case, cultured meat would be the more affordable alternative [G44, G47]. Conventional meat would then be a premium product – which would be a positive development in the view of a cultured meat researcher, because it would then once again be appreciated [I170].

#### **Naturalness and artificiality**

*“Is cultured meat equal to meat or rather something artificial?”* [G64]

The representatives of an organic and a conventional growers’ association are of the opinion that the production of cultured meat is not a natural, normal process. It is viewed as “small-scale cloning” [A326, K62]. In their view, the enjoyment of eating different meat types (e.g. from different species of cattle) cannot be imitated with artificial meat [D41, A301, K317]. Also, the artificial product cultured meat does not appear to be quite suitable for the archaic charcoal grills, says the representative of the food industry [G95]. Conventional meat is thus implicitly perceived as a natural product, whereas cultured meat is rejected as an artificial product.

The literature also reveals that the perceived unnaturalness of cultured meat deters potential consumers [29, 32]. A food scientist remarks, however, that current meat production is a long way from being natural [H298]. If people eat meat from factory farming, then cultured meat

doesn’t appear all that bad, says a cultured meat researcher [I286].

*“If you put it on the table in front of me and I had no information about it, I would not eat it”* [K297ff].

The representative of a conventional grower’s association and a politician emphasize the importance of safety and transparency. Consumer safety must be proven in long-term studies. Consumers must be informed about what cultured meat is. Before it can be accepted, a lot of educating must be done. The demand for more (long term) studies also appears in the literature (III► section “Animal welfare”).

The representative of the food industry believes that consumers have reservations about artificial foods: *“Eating is one of the most natural things in the world. The trend goes first towards naturalness”* [G261].

To successfully establish cultured meat on the market, then, the innovators must resolve the conflict between artificiality and naturalness [G140]. Communication is essential: the consumer must be convinced of the additional advantages of the new product. As long as conventional meat is still affordable, it will be difficult to justify the necessity for cultured meat [G151]. Cultured meat should therefore be positioned as a product that is artificial, but has an ethical-moral added value because it is more sustainable. This would be a novelty and would stimulate sales [G267], as a study shows that consumers are increasingly willing to spend more money for products made with acceptable processes such as better treatment of farm animals [33]. Another novelty would be to change the composition of the product and to produce for instance crocodile-kangaroo meat [H56, H105] or meat of extinct animals [B46]. Ultimately, however, the representative of the food industry believes, taste will be more important than health or ethical considerations: *“I think the most important*

*thing is that consumers recognize a benefit: why should they buy this and not something else? This benefit must be more than just a lower price. And an absolutely necessary condition is convincing consumers in terms of taste. They will only reach for an alternative if that alternative is better or at least offers a different benefit than the previous product was able to offer”* [G323].

#### **Transparent subsidy and development**

For the formulation of research policy options for the BMBF, it is particularly relevant if and how the research and development of cultured meat should be subsidized by the state. Some of the interview partners agree that cultured meat research and production should be subsidized by the state [B, C, I].

*“Although the subsidy should focus more on plant-based alternatives, society has a duty to support cultured meat, because it is more sustainable, because normal meat is already heavily subsidized even though it is less sustainable, more costly to produce, and more harmful to the animals. I would support this for economic as well as ethical reasons.”* [B35]

Subsidies should be granted, because the basic problem is a social one and the government could influence the consumer [C40]. The neutral position that would go hand in hand with state subsidy is also emphasized:

*“I think that particularly the government and industry should subsidize this. I don’t think it’s the place of NGOs, because that would again give the whole thing an ideological character, which it should not have”* [L36].

Some interview partners do oppose state subsidy: *“The question is whether the state should spend its money on this. I would be very cautious about that. This must develop out of the economy or the participants; I am skeptical about the state getting*



involved” [K29]. This rejection is justified by the fact that other areas need subsidies much more urgently: “It cannot be accepted to spend funds on such a future technology when we need more funds for solving current problems” [E23].

## Conclusion

Cultured meat appears to be an interesting alternative to conventional meat production. There are, however, many open questions, both regarding technical feasibility and ethical and social aspects – whether cultured meat can keep its promises remains doubtful. More basic research is necessary, not only of the production system, but also with regard to potentials and risks. Involvement of societal players and citizens will be absolutely necessary to create acceptance through transparency.

In principle, the search for a sustainable alternative to meat production should focus not only on the technological innovation of cultured meat, but should also pursue other approaches, such as the reduction of meat consumption, abolishment of factory farming and the ecological conversion of agriculture, the support of plant-based alternatives and other protein sources (e.g. insects, algae) etc. The great challenge of a sustainable future food supply can only be met by pursuing various sustainable solutions that become truly effective only when combined. Cultured meat represents one of many possibilities for solving these problems.

### Conflict of Interest

The authors declare no conflict of interest.

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