MERCK

NEW FOOD REVOLUTION

How Cultured Meat becomes a Game Changer

A comprehensive trend study on cultured meat and its impact on society, the food industry and the future of meat consumption.

- **EXPERT INTERVIEWS**
- **INSIGHTS FROM LATEST STUDIES**
- **KEY TAKEAWAYS**

*image of cultured meat burger provided by Mosa Meat

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FOREWORD

innovation always starts with the right questions. And someone to ask them.

As researchers, we have the task of introducing new solutions to the world. Our expertise and curiosity lead us to exciting new innovation fields, which we explore with passion, courage and curiosity.

One such field is cultured meat. Here we, as a leading science and technology company, can leverage and apply knowledge, talent and expertise from across our organization and apply them to new technologies that will make a true impact and offer solutions to global challenges.

We recognize that cultured meat and the idea of making it a regular part of our diets raise questions that extend beyond technical challenges:

Is the world ready for a new source of food? How natural does our food need to be? How ethical is meat consumption, now and in the future? What are the implications for agriculture and farmers?

Some of these questions seem bold. Some will ask us to leave our comfort zone. However, in innovation you have to embrace uncertainty and the unknown to succeed. While the perspective of consumers is quite well covered by current research, the attitude of other stakeholder groups and opinion leaders is still a blind spot. We focused on a group that is naturally close to us: We surveyed scientists from a variety of disciplines about their views on cultured meat.

We wanted to understand if scientists are more open towards new food options like cultured meat or if they are as skeptical as many end-consumers. Additionally, we talked with experts and peers in our cultured meat network who shared a wide range of perspectives on current state and predictions for the future.

We firmly believe that the purpose of innovation is to make life better – not only for individual consumers, but for society and the planet. This is why we have set ourselves clear objectives along the UN Sustainable Development Goals (SDGs). Sustainable innovations and technologies are key in this strategy. It requires that scientific progress and responsible entrepreneurship go hand in hand.

It takes awareness of ecological issues and a critical look at cultural and social requirements. And it takes the openness to not only pose uncomfortable questions, but also to follow through on the implications of possibly unexpected answers.

This study is intended to stimulate discussion and reflection, with the goal of making progress on fundamental issues of sustainability – for human beings, animals and the planet. This is a topic that can change the world and make it better.
It concerns all of us.

Lavanya Anandan
Head of Group Innovation Portfolio Management and Operations, Science & Technology Office of Merck KGaA, Darmstadt, Germany

What does a science and tech company have to do with cultured meat?

At Merck KGaA, Darmstadt, Germany, we won't actually produce and sell cultured meat. Instead, our focus as technology enabler is to enable the scalable and safe production of cultured meat. We are looking at the full production chain – from support in optimizing meat producer cell lines, the development of suitable and efficient animal origin-free cell culture media to technologies for the production of edible scaffolds and scalable bioprocess design.

Currently, we have more than a dozen dedicated scientists and engineers working in the innovation field and related projects. But we don't stop there.

We have established cross-divisional working groups to deal with topics such as regulations and to drive discussions with regulatory authorities and policy makers. We are also working closely with external partners, including universities, startups and non-profit organizations. And we are raising awareness for the field and to drive consumer acceptance by communicating and educating stakeholders and the public.

This study is one of our contributions to the discussion.

To learn more about how we are supporting cultured meat companies to scale-up visit **www.SigmaAldrich.com/CulturedMeat**

Photo Credit: Aleph farms

CHAPTER ONE

Is the world ready for cultured Meat?

is the world ready for cultured meat?

Rationally, the answer is absolutely yes. We are seeing a rapid increase in global meat consumption, just as the scarcity of resources and climate change are becoming more apparent and more urgent challenges. This is the essential promise of cultured meat: a future in which the desire of more and more people to eat meat can be reconciled with the need to protect the environment, the climate and animal welfare.

Eating meat is an emotional and visceral experience for most people, whether passionate carnivores or committed vegetarians. Those who do not eat meat tend to associate meat consumption with negative feelings like revulsion[1] and guilt, because raising and slaughtering animals violates their moral code.[2] For others, the taste of meat is an essential part of their quality of life. They enjoy eating meat and consider it necessary for well-being and a healthy body. For many people, consuming meat is simply part of being a human being.

Are the glory days of meat over?

Meat is an important status symbol and marker of upward mobility, especially in emerging markets like India and China. Now, for the first time, large segments of the population in those countries can afford to buy conventional meat, even when they're not celebrating a special occasion.

In Western countries, however, meat is declining in popularity and doubts about meat consumption are on the rise.[3]

Reasons are for example health concerns, worries about the ethics of industrial livestock production, or concerns about the environment and climate change.

Meat consumption is no longer an unambiguous pleasure; all too often, people feel compelled to point out that they "really should eat less meat."

The promise of a better world is certainly something everyone can relish

Meat is a cultural as well as a material product – and now more than ever, it is an ethical issue. How open are consumers to cultured meat, with its promise of a better world?

People all over the world are expressing a willingness not only to try cultured meat, but also to purchase it

Bryant et al. 2020

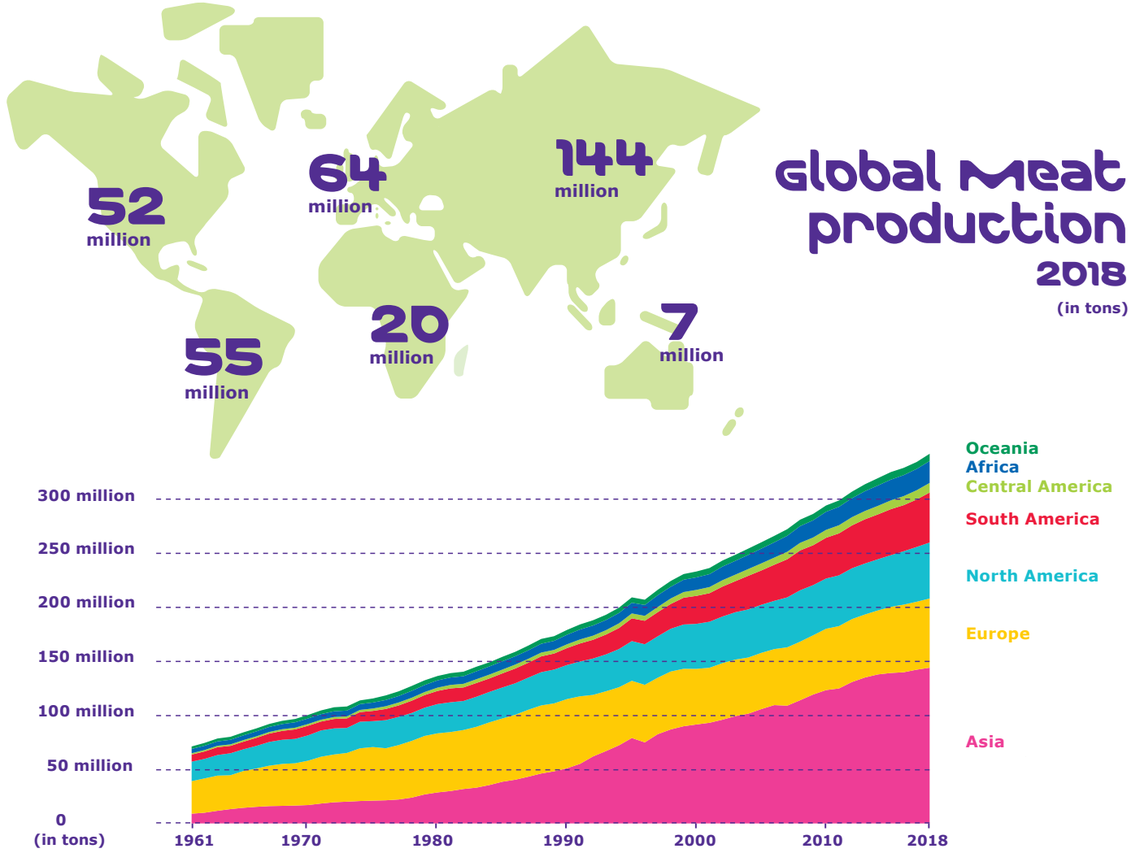


Fig 1.1
Source: UN Food and Agriculture Organization (FAO) Source of graph and data: OurWorldInData.org/meat-production

Consumer research paints an optimistic picture. People all over the world are expressing a willingness not only to try cultured meat, but also to purchase it.[4] At this early stage, however, and given a lack of familiarity with this topic, consumer surveys remain very hypothetical. Sociologist Neil Stephens underscores that point in his interview for this study, noting that most people have never heard of cultured meat.

Studies show that the willingness to accept cultured meat depends on how the topic is framed and the context in which individuals first encounter this product.

In the summer of 2020, Merck KGaA, Darmstadt, Germany conducted a survey of 166 scientists in various countries, none of whom was working for the company or on the topic of cultured meat, concerning their views on this subject, yielding some interesting results. A majority of the respondents were familiar with cultured meat.

Only 17% had never heard of it, whereas this was the case with more than half of the respondents in other consumer surveys. A relatively large percentage of the scientists – 66% – reported that they would be open to try cultured meat. Only 5% rejected the idea out of hand (Figure 1.2).

Other surveys of highly educated individuals revealed less openness to cultured meat; 57% of respondents in Germany[5] and 54% in Italy[6] expressed a willingness to try it, with 25% dismissing the idea entirely.[7]

1) Rozin, Markwith & Stoess 1997, 2) Berndsen & van der Pligt, 2004, 2005
3) van der Weele et al. 2019, 4) Bryant et al. 2020, 5) Weinrich et al. 2020
6) Mancini/Antonioli 2019, 7) Bryant et al. 2019

How interested are you in trying cultured meat?

Imagine that cultured meat has become widely available at grocery stores, restaurants, butchers and markets.

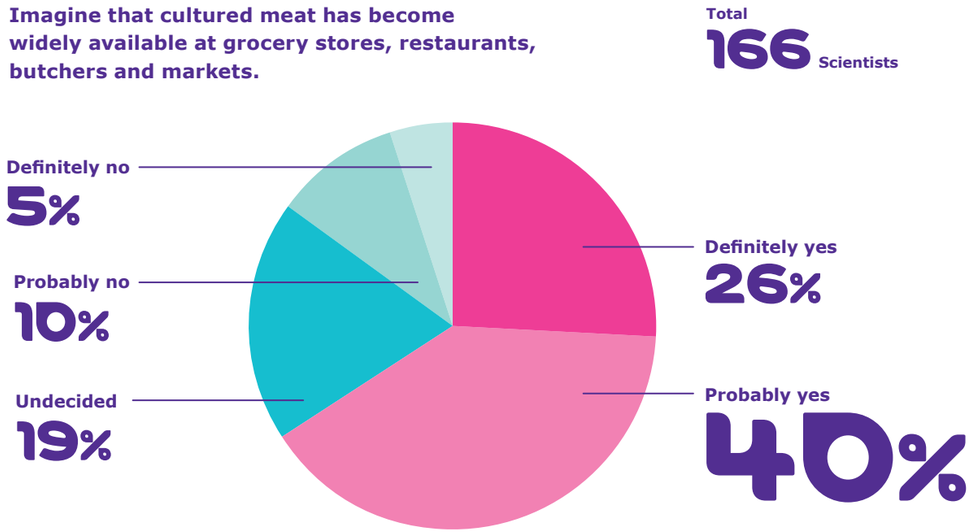


Fig 1.2

Interestingly, the participants in the survey of Merck KGaA, Darmstadt, Germany tended to be less open than the public at large to unfamiliar foods in general. The most important arguments in favor of cultured meat, in their view, were protecting the climate and reducing animal suffering.

Competing to tell the best stories

More and more products are positioning themselves as alternative sources of protein and substitutes for industrially produced meat: vegetables and legumes, vegan products such as seitan and tofu, various insects and new meat-like vegan products, but also meat produced in an ethical and environmentally friendly way.

The management consulting firm Kearney predicts that by 2040 the combined sales of plant-based meat alternatives and cultured meat will exceed sales of conventional meat.[8] All of these products offer competing narratives and promises, targeting consumers who care about sustainability. The Scientists' Study, too, shows that plant-based alternatives and cultured meat are competing for a number of positive attributes (Figure 1.3). Positive environmental effects and animal welfare, for example, are closely associated with plant-based alternatives. These products also have the initial advantage that they are already well established in the market.

In this competitive environment, there will sometimes be critical narratives about cultured meat. Consumer research has not yet considered what impact such narratives may have, Neil Stephens points out. "The discourse and narrative in society are out of the control of the cultured meat community," he says. "The significance of this is sometimes underappreciated when looking at the positive consumer surveys about acceptance."

For the consumer, the situation becomes more complicated with every new producer. The wider the selection, the more important the choice of a specific product. These choices do not happen randomly or thoughtlessly, as the selection of a product demonstrates the values of the consumer. As a result, the stories that are associated with individual

8) Gerhardt et al. 2019

Attributes of alternative meat products – insights from the scientist study

Here are a number of attributes people may ascribe to "alternative protein" food products. For each attribute, select the meat type / source to which you believe it is applicable.

	Conventional meat	Plant-based meat	Cultured meat
Has positive societal implications (e.g., sustains good jobs)	51%	72%	58%
Good for the environment	11%	79%	66%
Positive for animal welfare	8%	80%	75%
Outdated	79%	20%	8%
Improves food security	28%	73%	60%
Healthy and nutritious	67%	75%	40%
Modern	16%	67%	72%
Fits my culinary routines and traditions	86%	38%	20%
Delicious taste	95%	30%	16%
Accessible to everyone regardless of class	65%	45%	18%
Accepted in many social circles	80%	58%	10%
Associated with zoonoses (infectious diseases that have jumped from animals to humans)	80%	13%	20%
Natural	87%	40%	8%

Fig 1.3

products become more significant. Generally, the more ethical a consumer is, the more willing that person is to try industrial meat. But this does not mean that the messages our choices send are only about morality.

Vegans often express a certain worldview through their eating habits, as does the proud owner of a high-end grill. But how do people who eat cultured meat define themselves? What image do they want to project? Quinault Childs, research director at IFTF's Food Futures Lab, says that this is far from clear: "Because it's a new thing. It has never existed before. How are you supposed to identify with it?"

Choice as a factor in success

What about the emotional and sensory qualities of cultured meat? How does a barbecue enthusiast feel when the steak he throws on the grill with such gusto hasn't been cut from an animal? Rose Ha describes her experiences as a chef. Her task was to explore the culinary possibilities of products from the cell-based salmon startup Wildtype. She sees no difference in terms of sensory and tactile quality, and points out other, emotional benefits – such as "having a product that I know everybody can eat and that is not only safe, but possesses

How do you measure love for meat?

Relatively little research has focused on the phenomenon of love for meat. Psychologists have devoted more attention to negative emotions, such as repulsion and guilt.

As awareness of the ethical issues of meat consumption increases, and specifically its effect on resource consumption and climate change, it is more important than ever to ask this question:

Why do so many people love meat?

Psychologist João Graça et al. 2015 and his team have devised a questionnaire to explore how and why people find meat so appealing. It identifies four crucial dimensions:

hedonism (meat consumption as enjoyment), entitlement (meat consumption as something to which humans are entitled), dependence (meat consumption as essential to well-being) and affinity (lack of negative feelings when consuming meat).

A better understanding of why we eat meat may allow us to become more successful at reducing conventional meat consumption – for example by raising awareness.

INTERVIEW

"The first prototype? It melted instantly!"

Photo Credit: Shea Ananda Photography

Rose Ha is probably one of the chefs with the most practice in cooking with cell-based products. Rose has been a chef for more than ten years, with experience in some of the most celebrated kitchens in California. Since 2017, she has involved herself heavily in plant-based cooking. Currently, she is collaborating with Wildtype, a San Francisco based cultured meat startup, to explore and develop how cell-based salmon can be engineered, prepared and served as a taste-bud tickling experience.

Rose Ha

Chef, expert for plant-based cooking, consultant with Wildtype, San Francisco

How did it feel to cook with cell-based salmon for the first time?

As a chef, the first thing I do is, I look at the product and I see what cooking techniques I can apply to it. Can I season it? Can I sear it in a pan? Can I cure it? Can I put it into a marinade? Can we smoke it like traditional smoked salmon?

That day, I wanted to see if I could sear it in a pan, the way I would a typical piece of fish. And that day, it melted instantly (laughs).

That doesn't sound very reassuring. What happened then?

At this time, the salmon lacked the capability to hold its structure at a high temperature, which is why it melted. For a short period of time, we focused on cold preparations such as "poke" a Hawaiian inspired dish consisting of raw fish, soy sauce, scallions and sesame oil.

We then created our own version of smoked salmon or "gravlax" by applying a cure of sugar and salt and cold smoking with applewood.

Where is the product today?

Today, the product has changed so much and it is almost identical to real salmon. I can apply almost every cooking technique to the fish including searing, smoking, curing, marinading and so much more.

The fish is extremely flavorful, has the same oily richness as real salmon but also tastes very clean and fresh. A few years ago, we had a dream of creating the perfect piece of salmon sashimi and I believe we are so close to achieving that goal.

the same nutritional content as salmon. Your child can have it, your grandparents can eat it, your pregnant wife can have it, people who were not able to enjoy sushi before, now they can. As chefs, our job is to feed people, and we love doing that. To do it more freely, I think that's where the emotional connection comes in." For cultured meat products to be successful, in her view, it is critical to offer a diverse range of options that provide pleasure and enjoyment: "If we were to introduce just one cell-based product that consumers are trying – if they decide to hate that product, it doesn't give them the opportunity to see the potential of cell-based meat. We should have multiple options for our consumers." And, she says, "As long as it tastes good, people will eat it."

The evidence suggests that the world is ready for cultured meat – as an environmentally and ethically acceptable alternative to satisfy an ever-increasing appetite for meat.

Plant-based alternatives, too, are working in parallel to achieve the same goal of a better world. There is great confidence that the quality of these products will meet consumers' expectations. Ultimately, however, quality alone will not determine whether consumers are willing to accept cultured meat.

Also needed is a story that inspires and promotes acceptance.

Photo Credit: Wildtype

“Today, the product has changed so much and it is almost identical to real salmon.”

Rose Ha, chef, expert for plant-based cooking, working with Wildtype, San Francisco

What do you like about working as a chef in such a high-tech field as cell-based fish is?

I was attracted to this project at Wildtype, because of the initial knowledge, passion and dedication from the founders, chefs, scientists and engineers. I love that I learn from our scientists every single time I visit the office. For me, it’s a constant circle of learning, giving and creating.

If we continue to do that and focus on our goal, it’s inevitable that we create a great product.

I just hope that every company that pursues cell-based meat, maintains its focus and integrity in creating systems that are efficient all around.

As long as we continue to strive for the same goal which is to create a better way to feed our communities all over the world and to preserve our ecosystems at the end of the day, that’s really all I can hope for.

CHAPTER TWO

How Much naturalness does the Modern diet need?

How much naturalness does the modern diet need?

What is naturalness? And the most important question: How much human impact can nature withstand? The relationship of modern humans to nature is being renegotiated, with the goal of ensuring the long-term survival of our ecosystem. Here cultured meat can play an important role. The fact that cultured meat is capable of reconciling the needs of modern humans with the needs of nature is more important than a definitive answer to the question of its "naturalness".

As a rule, naturalness is said to be "good". Philosophers, however, have recognized that the argument that something is natural is no basis for a moral judgment.

In 1903, George Edward Moore called this the "naturalistic fallacy", pointing out that not everything that is natural is also good.

By the same token, not everything that is unnatural is bad. Yet cultured meat is stigmatized as "unnatural", and this is one of the most important barriers to consumer acceptance.[10]

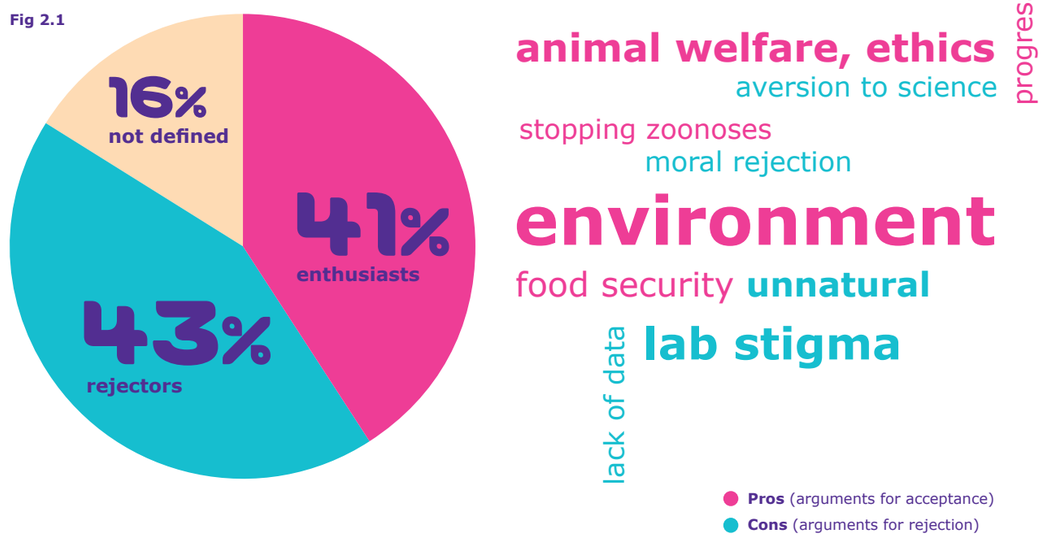
The scientists surveyed by Merck KGaA, Darmstadt, Germany agree with that conclusion: Personally, they are relatively open to cultured meat (see Chapter 1), but they are much more skeptical about the people in their social environment, where approximately the same proportion of people are enthusiastic about cultured meat as reject it (cf. Figure 2.1). The most common reasons people gave for reluctance to consume cultured meat were that it is "unnatural" and its image as "lab food".

The urgency of the climate crisis is introducing new emotions into the conception of an idealized world.

10) Bryant et al. 2020

Assumed openness of scientists' peers re cultured meat, and reasons for rejection and acceptance

Fig 2.1



Longing for the past, concern for the climate

Modern humans find naturalness to be a very attractive quality. The more removed our lives, our work and our food are from nature, and the more uncertain and unpredictable the world seems to be, the more we long for what is natural. We associate naturalness with qualities that are rare and valuable in modern society – tradition, authenticity, transparency, simplicity, safety and a slow-paced life.

Advertisers and industry appeal to these yearnings. Images of happy cows and green pastures lend products an aura of naturalness and related qualities – no matter how industrialized their production may be. But marketing that focuses on nature has lost its innocence. The urgency of the climate crisis is introducing new emotions into the conception of an idealized world.

The degradation of nature is giving rise to psychological phenomena such as "eco-anxiety" (see box), characterized by negative emotions like fear, guilt, sorrow and helplessness. It is a complex, yet worthwhile task to reach people who are in this state of mind; the goal is to assure them that the needs of modern humans can be reconciled with the needs of nature.

Don't judge meat by its label

Labeling products simply as either "natural" or "unnatural" fails to do justice to the multiple dimensions of this topic, with all of the interrelationships and conflicts it entails. Such simplification is actually counterproductive.

Failure to express and acknowledge contradictory emotions and ambivalence leads to paralysis and gridlock.[11] Simplistic labels can put a premature end to discussions and efforts at understanding, or prevent them entirely. Ambivalence and ambiguity are a necessary part of radical moral change,[12] and they need

11) Lertzmann 2015, 12) van der Weele et al. 2019

to be acknowledged and used productively in order to move forward. For example, there is the question of whether cultured meat is, in fact, meat.

Sociologist Neil Stephens believes that people are too quick to respond with an unequivocal "yes". For the farmers who feed and care for animals, high-quality meat is the product of a successful relationship between a human being and an animal. Food technologists are satisfied if the components of cultured meat – protein, fat, carbohydrates, sugar and trace elements – as well as its texture, consistency and appearance are identical to the animal product. These are two different ways of looking at the question. Both are legitimate. We need to encourage broad discussion about what "naturalness" means today.

How well do we know salmon?

For many years, chef Rose Ha has been active at the intersection of both worlds. She pays close attention to the quality and provenance of the foods she works with. Working with Wildtype and cell-based salmon has changed her perceptions of what constitutes natural taste.

"Really good fresh fish is not fishy at all – it's actually very clean and has a very subtle saline kind of taste, sometimes it's sweet and melts in your mouth," she says. "I started to dive into the question of 'What is salmon as we know it?' I never had to break down salmon in that way."

"we're just really combining things that we can find in our everyday environment anyway."

Rose Ha, chef, expert for plant-based cooking, working with Wildtype, San Francisco

Her conclusion: Natural taste is derived from many different sources and does not necessarily have to be produced in the body of an animal. "The color of fish comes from beta carotene. Beta carotene can also be found in carrots. The saline taste comes from algae and seaweed. So, we're just really combining things that we can find in our everyday environment anyway."

Better than nature, better for nature

Cultured meat promises to offer numerous benefits for our ecosystem – such as reducing environmental pollution, water consumption, land use and animal suffering. Consumers, too, are increasingly recognizing the enormous potential of this product. Technologies that are capable of bringing modern humans into harmony with nature are balm for the souls of those who are concerned about the environment and the climate. Consumers who prefer organic foods are not necessarily technophobes or Luddites. Instead, they view technological innovations as opportunities to put their values into practice.[13]

Are mammoth steaks in our future?

If we stop searching for simple answers to the question of the "naturalness" of cultured meat, new perspectives will open up at a number of different levels. For the research community and industry, the goal is to produce meat that is as identical as possible to meat from the body of an animal.

The parameters here include the meat's composition, texture, consistency, taste, appearance and cooking behavior. These qualities must be analyzed and replicated. Over the medium term, though, cultured meat will have to do more than merely simulate natural meat. It can take advantage of its strengths to produce entirely new kinds of meat: "What if we could grow chicken, turkey and duck

Eco-anxiety, environmental melancholia, reef grief.

The dramatic changes caused by climate change are triggering strong emotions: In addition to the anger, sorrow and fear people are experiencing as they witness the ongoing destruction of nature, they also feel a sense of helplessness and powerlessness owing to their inability to affect these catastrophic developments.

So far, the issues of climate change and how best to address it have been discussed primarily in terms of rational arguments. Psychologists like Renée Lertzmann , who coined the term "environmental melancholia", point to the importance of naming and acknowledging the feelings caused by climate change, and taking them seriously.

"Eco-anxiety" is a term used by the American Psychiatric Association to describe "a chronic fear of environmental doom" . In Australia, people experience "reef grief" as the Great Barrier Reef is dying; in Finland, people use the word "talvisuru" to describe their sense of loss as the hard winters of the past are disappearing.

A new vocabulary provides a common basis for discussing these issues. Knowing that many others share our feelings, we are able to mobilize – to come together with the desire, and the ability, to make a difference.

"What if we could grow chicken, turkey and duck cells all together and create a type of meat that no one has ever consumed in all of human history?

Paul Shapiro, CEO of The Better Meat Co., author, podcast host and speaker

13) Slade 2018

“Personally, I’d be way more excited to eat woolly mammoth cultured meat than cultured ground beef.”

Quinault Childs, research director
at the IFTF Food Futures Lab

cells all together and create a type of meat that no one has ever consumed in all of human history? That’s why I think it might not just be a mimicry of animal meat. It might actually be better,” says Paul Shapiro, the author of “Clean Meat”.

He points out that, over the short and medium term, hybrid products that combine cultured meat with other ingredients, such as plant-based proteins, may be a crucial strategy for a successful market launch, with the potential for better products over the long term. “By hybridizing animal protein and plant proteins together,” he says, “you may actually create products that are not only cost-effective, but better than a product that is solely meat. I really believe that in the future people will think of a product that is solely meat as inferior.”

Quinault Childs, research director at the IFTF Food Futures Lab, agrees that the evolution of our current conception of meat is the true competetive advantage of cultured meat, and this is what he finds so fascinating: “I know what meat is like. If it actually does taste the same, then why not go out and try it? [...] Personally, I’d be way more excited to eat woolly mammoth cultured meat than cultured ground beef.”

People today are yearning for what is natural.

Behind that yearning is also a desire for tradition, transparency and safety. As the destruction of our environment continues, people are also experiencing emotions such as fear, sorrow and guilt.

The question of whether something is “like nature” is becoming less important. More relevant is whether something is good or bad “for nature”.

Cultured meat has the potential not only to be better than traditional meat products, but also to be better for the planet.

INTERVIEW

"people eat Meat in spite of its production."

Paul Shapiro is the author of the international bestseller “Clean Meat: How Growing Meat Without Animals Will Revolutionize Dinner and the World”, the CEO of The Better Meat Co., a four-time TEDx speaker, and the host of the Business for Good podcast.

Paul Shapiro
CEO of The Better Meat Co., author, podcast host and speaker

Naturalness seems to be one of the key factors in consumer acceptance. What’s your perspective on the naturalness of cell-based meat?

The food most people eat today would not really be considered natural if you were aware how it was produced. People want to believe that their food is natural. But, for example, most chickens are selectively bred through intensive genetic selection programs to grow so big and fast that many of them have difficulty even taking more than a few steps before they collapse underneath their own bulk. The point is not to depress anybody but it is to say that people eat meat today not because of how it is produced. They eat meat in spite of it. When there is a green safe nutritious alternative, that is cost-competitive and tastes the same, if not better, people will view it as a naturally preferable way to produce meat.

So, meat that is produced without animal suffering will be recognized as a feature?

Yes, I would say that it’s actually preferable. It’s going to taste good, if not better. If it can be cost-competitive, you see how much better it is for the planet. How it means way less land, less water, fewer greenhouse gas emissions and much less animal cruelty.

How do you see consumers’ acceptance? What will be a tipping point towards a significant share of openness?

I don’t think everybody will want it, but I think many people will want it. My guess is what you need is to have prominent people who are highly respected or influential, who are publicly eating it.
To me, that will be like a breakthrough moment. For example, Benjamin Netanyahu became the first world leader to consume meat grown from animal cells. If you could have other people like LeBron James who will publicly eat it, I think that will actually go a long way towards normalizing it.

“We’re not going to be farming the moon or Mars anytime soon. We only have one planet to farm for ourselves.”

Paul Shapiro, CEO of The Better Meat Co.,
author, host and speaker

What other critical stepstones do you see on the way there?

The real key is to remind people that the current path that we’re on is completely unsustainable. We simply cannot continue feeding ourselves the way that we are. We’re not going to be farming the moon or Mars anytime soon.

We only have one planet to farm for ourselves. And we have to share this planet with millions of other species. Right now we’re driving untold numbers of them into extinction.

So, we have to get a lot more efficient about how we produce our food. Going big with animal agriculture is not getting us there.

Going small with cellular agriculture and microbioprotein production is a far more likely way to succeed into the future.

CHAPTER THREE

can we have all of the sizzle but less of the harm?

Can we have all of the sizzle but less of the harm?

Solving big problems and making the world better: This is the long-term promise of cultured meat. In concrete terms, this means potentially safer food, fewer animals living and dying for industrial meat production, less water and energy consumption, less land use and a drop in harmful emissions. Optimists are thrilled, as they see this as a historic step forward for health, the environment and society. Skeptics point to a lack of evidence and plausible scenarios.

According to the Merck KGaA, Darmstadt, Germany Scientists' Study, animal welfare and positive effects on the environment are the most convincing arguments in favor of cultured meat (cf. Figure 1.3). For consumers, cultured meat also promises to be a potentially safe, rich and healthy source of protein.

Transitioning to this new alternative would eliminate many disadvantages of meat, such as a high fat content, heavy metals, antibiotics, germs and other pathogens (zoonoses). It is easy to ensure the quality of cultured meat; moreover, it may be possible to optimize it with respect to certain nutrients.

Healthy alternatives, healthy skepticism

Although cultured meat holds great promise, there is also skepticism. Consumers have concerns: Was this piece of cultured meat created from healthy cells? How healthy or unhealthy are other ingredients? Are cultured meat cells cloned?[17] In addition, there are concerns about the well-being of animals during the process of cell removal.[18]

The many optimistic scenarios for improving the world have yet to undergo a reality check. So far, production has been limited to prototypes and small quantities. Empirical data on scaled-up production is not yet available. Calculations are based on the assumption that cultured meat will have enormous positive effects on the environment.[19]

Although these calculations have become increasingly concrete lately, if and how they will turn into facts depends on many other variables. Moreover, we do not yet know whether the anticipated positive effects on health will in fact occur.[20]

Food safety also depends on future regulations. In addition, some have more fundamental reservations about cultured meat: They argue that cell-based meat production merely addresses a symptom but not the causes of problems in our consumer society. It would allow us to avoid thinking about our own behavior as consumers, which causes other societal problems as well, but no real progress would be made toward sustainability.

Barring fundamental changes, any potential environmental benefits will be offset by rebound effects. Land that is not – or no longer – used for livestock must be managed in a way that promotes biodiversity and sustainability, or even restored to its natural state.

Any reductions in CO_2 emissions should not be used as an excuse to delay the energy revolution or other measures aimed at protecting the climate. This is the only way to achieve a long-term environmental impact.

For consumers, cultured meat also promises to be a safe, rich and healthy source of protein.

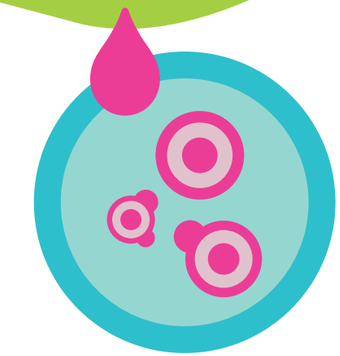
Think big. Change the system

Simply replacing one protein source with another will not bring about fundamental changes in the climate, the environment and society. According to Quinault Childs, we must focus not only on the sustainability of cultured meat, but also on the food system as a whole: "Our existing food systems are not very ideal in many ways. [...] You can't just insert cultured meat into that food system and say 'this is sustainable' even though everything around it isn't sustainable, right?" Cultured meat can lead to critical changes at the systemic level, he says, if its effects at every level are taken into account from the outset: "Everything that this system touches has inputs and outputs, and upstream and downstream effects. And you need to account for that from the beginning." When it comes to cultured meat startups, claiming to have only the best intentions is not enough. Progress toward a better world needs to be demonstrated by data and facts. Evidence is also needed if we are to shape that progress and counteract any unintended effects. "If you don't design your system explicitly for those things, you could fail. You could think that you're doing the right thing, but learn ten years later, there's a huge backlash against it," Childs points out.

Demanding action from the government and society

Cor van der Weele, a biologist and professor of Philosophy at Wageningen University, Netherlands, believes that the government and its institutions must take a stronger stand in the debate over cell-based meat production.

It is important to consider the opportunities and risks of this technology, develop positive scenarios and take active steps to create the necessary conditions: "The governments are probably the most important additional actor that needs to step in more heavily. Cultured meat is almost completely being developed by private parties. There need to be subsidies for research and development, new business models for farmers and generally for trying out new things."



17) Szejda/Dillard, 2020
18) Bryant et al, 2020
19) Sinke/Odegaard, 2021
20) Tiberius et al, 2019

“The future is something that needs to be worked on very actively, if we want to bend it in new directions.”

Cor van der Weele, Professor of Humanistic Philosophy
at Wageningen University, netherlands

In addition, there must be a broad-based, public discussion of fundamental issues concerning cultured meat: How do we want to meet our need for food? What impact does that have on our planet? What role do we want modern technologies to have in our lives? There are some areas of ambivalence and inconsistency.

All concerned parties, both within and outside the cultured meat scene, need to address them openly and constructively (cf. also Chapter 5).

Can we teach old dogs new tricks?

In the future, the ethical credibility of cultured meat will also depend on the business model and evolving corporate structures. Large-scale production requires structures of an appropriate size. Realistically, this involves corporations. They have the necessary market strength, and if they cooperate with or acquire agile startups, significant synergies can result.

But one guidepost should remain: Awareness of the ideals of cultured meat, and an open discourse among all stakeholders on how to maintain them, to avoid following the logic that has brought us climate change, factory farming and scarcity of healthy soil. Achieving such an outcome will require persistent efforts. As Cor van der Weele puts it, “The future is something that needs to be worked on very actively, if we want to bend it in new directions.”

One of the main goals of cultured meat is to ensure the future of our planet. It’s not enough to offer a new source of protein.

Cultured meat must be seen in the context of the overall food system and the ecosystem.

Moreover, economic priorities and policy decisions will determine whether, and to what extent, cultured meat will succeed in fulfilling its promise of a better world.

INTERVIEW

"It's not enough to say, people will buy it."

Cultured meat has ambitious goals for a better future of our planet and our society. Dr. Neil Stephens, Brunel University London, is a Wellcome Trust Research Fellow focused upon the sociology of biomedicine and Science and Technology Studies.

He researches the social, societal and political implication of innovations like cultured meat.

Neil Stephens
Brunel University London

From a sociological perspective, what are the most relevant challenges that you see for cultured meat?

With growing success, critical voices of cultured meat will become stronger. There will be people trying to challenge whether it is meat or not, whether it is healthy or not, whether it is good for the environment. Also, ownership is likely to change. At the moment it is run by mission-driven startups and universities who are motivated by the idea to deliver positive change in the world. In 10 or 20 years, decision-makers may be people who are not mission-driven in the same way. They could be profit-maximizers in large international corporations. Looking at this change in ownership, it will be interesting to see if the clear-cut story in the community today is still the dominant framework.

How can we make sure that cultured meat actually has the positive impact on society it aims for?

There is an important discussion the community should have about accountability. I am starting to develop this idea about cultured meat having a democratic mandate. So asking how we can have confidence that this is a technology that is wanted, beyond any kind of market power. In my idea of a good society, it is not enough to say cultured meat has a democratic mandate because people buy it. It is not good enough to try to limit political choice to a purchasing decision. That would be too late in the process.

What alternatives to acceptance in the market do you propose?

If there was some other group of – let’s say – 10,000 people out there, who are working on a bit of technology that they think

21) Stephens et al. 2019

“I want cultured meat to come into being as part of an open, honest public dialogue on the future of food and the future of people on this planet.”

Neil Stephens, Brunel University London

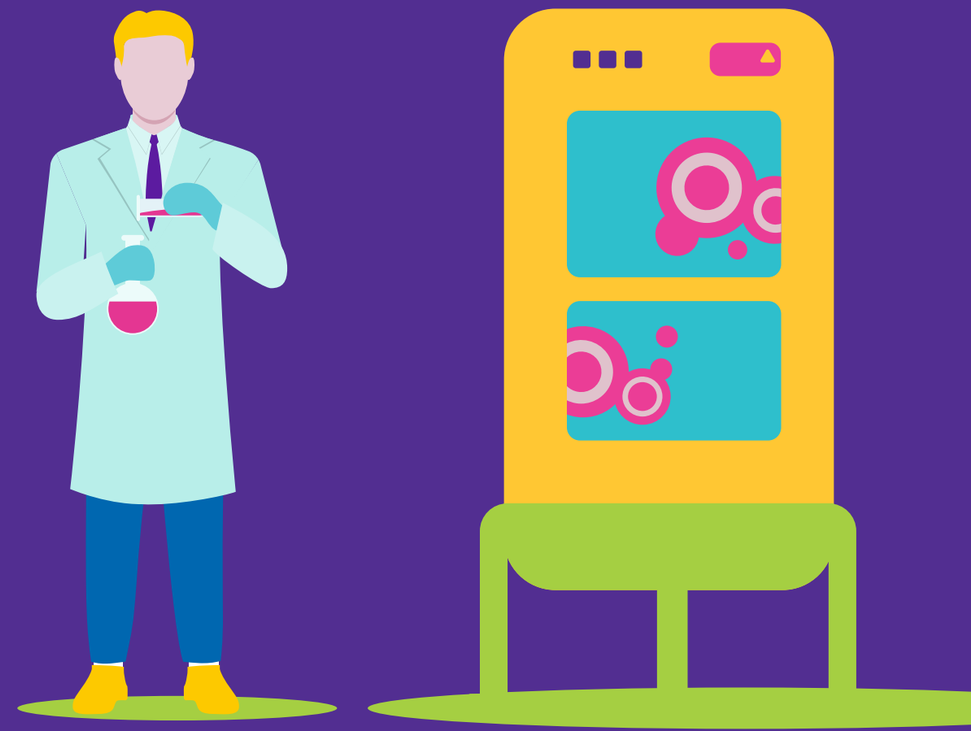
will fundamentally change our economy, our relationship to animals and the environment, within 20 years – we would want to make sure that this group of people is accountable to us in one way or another. In terms of cultured meat, I would like to see this supported through quality discussion and listening. Public engagement does not only involve telling people what they need to know, but also to listen and change what you do.

What are your wishes for cultured meat?

I want cultured meat to come into being as part of an open, honest public dialogue on the future of food and the future of people on this planet, which is evidence-based, but not so tied to quantitative outputs that it ignores the broader cultural and political aspects of what it is to eat as a human being. For people who want cultured meat to be a success, this might be a better way than relying on classic marketing.

CHAPTER FOUR

Who Might be the work force of our future food system?



Who might be the work force of our future food system?

The transformation of food production by cultured meat creates new careers while forcing existing ones to realign themselves. The food work force of the future will be based more in the laboratory manufacturing facility than out on the field. They will use bioreactors instead of tractors. It will take some time before the specific field of activity emerges. But one thing is clear: "Cellular agriculture" will require highly qualified people. Farmers will be tasked with a new and fascinating role as an essential interface between research and production.

Cultured meat promises to deliver a reliable, potentially safer and environmentally friendly supply of meat products for the long term that involves no animal suffering. These achievements will also entail dramatic changes and challenges for everyone involved in meat production.

The meat industry is a key pillar the global food supply and represents around 40% of the world's agriculture.[22] Meat industry value chains are largely centralized.
A relatively small number of large producers dominate the market.

One exception is the breeding of livestock, a field with over 10 million farmers worldwide, not counting small-scale farmers with fewer than 5 hectares of land. How will the coming age of cultured meat transform those farmers' business models?

The answer to that question has many sides, since we still do not know exactly what large-scale production of cultured meat will look like.

Is the traditional farming business model on its way out?

Farmers are a very non-homogeneous group.

Cultured Meat has the potential to play an important role in the transformation of agriculture as we know it.

In developing countries, over half of the population raise crops and livestock at a subsistence level.[23] In industrialized countries, large-scale farming operations predominate. Even within the EU, there can be considerable differences within just a few hundred kilometers. Whereas Germany and France tend to have large farms, far smaller ones are more common in neighboring Switzerland and Austria.

Small and mid-sized farming operations in industrialized countries are often in a perpetual state of crisis. Increasing price pressure on the global agricultural market makes it difficult for farmers to operate profitably while still remaining true to their vision of farming. They also are facing a lack of next-generation farmers and farm workers in general.[24] Despite billions of euros in subsidies from the European Union, thousands of small and

22) The World Bank 2020, 23) FAO 2020, 24) Technikradar 2020, 25) Zinke 2020

mid-sized farmers give up farming each year.[25]

Therefore, a new, more economically and ecologically sustainable business model would appeal to many.

Farmers are also businesspeople

Cor van der Weele, biologist and professor of Philosophy, has explored the implications of cultured meat for farmers in the Netherlands in depth, one of the most technologically advanced regions of the world in terms of food production.

One of the reasons for her study is that she has observed increasingly mixed feelings among farmers about existing production methods: "I had more and more signals that farmers too are very ambivalent about their own productive methods. [...] Ever more farmers are morally concerned about what they are actually doing." However, this sort of self-doubt does not go over well within the farming community: "Everybody knows it, but you cannot say it as a farmer. It is high treason." She sees that cultured meat has the potential to play an important role in the transformation of agriculture as we know it. Cultured meat producers like Mosa Meat are pressing ahead with plans to decentralize production into smaller units – a scenario that also increases farmers' chances of becoming directly involved in innovative meat production. They could use cell material from their own animals to make cultured meat on their own farms.

She has found enough open, tech-savvy and innovative farmers who are willing to try out new technologies at an early stage and help move developments forward: "They want to start tomorrow if it would be possible." Pilot testing and prototypes would not only result in some farmers becoming "early adopters" – they would also yield new knowledge and perspectives. For example, how these technologies can be developed further into a workable business case for everyone involved. Paul Shapiro is also feeling optimistic. He considers farmers as entrepreneurs: "They want to be forward thinking and look at what the future may hold and how they might be able to innovate.

Some of them might have their head in the sand, [...] but most of them are businesspeople and not ideologically headed to the idea that meat must always grow in an animal's body."

Marketing experts, breeding experts, sustainability experts

Cultured meat will disrupt the meat industry. Alternatives and new business models need to be considered early on. That applies to farmers as well as to those developing cultured meat, who stand to benefit from farmers' expertise and resources. It is reasonable to assume that meat grown in the traditional way, from animals, will have a different status once cultured meat becomes established.

It would likely be positioned as a premium product with a history: Quinault Childs is certain that "Grass-fed heritage lamb from New Zealand will still have a niche market, because it'll be the real thing." Demand for cell material will grow. That is why high-quality meat cells will be in especially high demand. Childs sees it as an opportunity to establish specific breeds or lines as a branded product: "Genetics become a brand, which is really interesting to me. Then, the value of some farmers is not actually producing a cow, it's producing the genetics of the cow and selling those genetics as a brand." Childs cites the sought-after Wagyu beef as an example. Cultured meat products can benefit from the breeding and marketing work that has gone into Wagyu beef: "Wagyu is already a trusted brand. When you spend 80 bucks on a Wagyu steak, you know that you're getting a high quality steak. So, if a cultured meat company offers a molecularly, genetically identical product, people will trust it. EAT JUST who is already working with a Wagyu Farm from Japan, seems to be on a right track. Farmers working in the production of cultured meat would, of course, need an entirely different skill set, such as genome selection, bioengineering, gene editing and reproductive biology skills. It represents a challenge, but also an opportunity to make this new type of farming attractive to younger generations.

How attractive is cultured meat as a career for scientists?

So far, how do researchers view the possibilities of working in the cultured meat field? And how attractive do they find them? The Merck KGaA, Darmstadt, Germany Scientists' Study set out to find answers to these questions.

The study revealed that a majority of the researchers surveyed consider themselves (at least to some extent) sufficiently qualified to work on cultured meat (see Figure 4.2). A quarter view their own skills as relevant. Half of those would be extremely or very interested in working for a cultured meat start-up or company.

Competitive pay emerged as a key factor in the free-form responses. Among the appealing factors, respondents cited the scientific challenge as well as opportunities to develop patents and other IP rights at a commercial level. And once again, the opportunity to work on making the world a better place featured centrally.

Fig 4.1

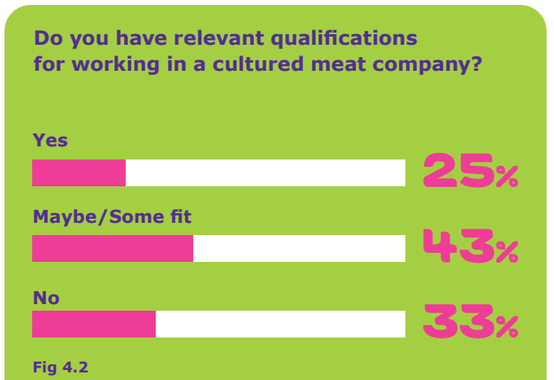


Fig 4.2

Cultured meat is fundamentally changing the requirements for production. And that includes workers' skill sets. ***Highly qualified jobs are emerging in research and in agriculture.***

Farmers' job profiles will be revolutionized in a world of cultured meat, for instance transforming into critical suppliers of cell material or experts for breeding premium-quality bloodlines.

For farmers, cultured meat could open up new, sustainable and ethically valuable business models.

INTERVIEW

"Disrupting the farmer's system means disrupting the farmer's living."

Cor van der Weele is professor of Humanistic Philosophy at Wageningen University in the Netherlands. As a trained biologist and a philosopher, she has been studying changing appreciations of meat and cultured meat for the last twelve years.

Currently, she is working on the questions if and how cultured meat might be an opportunity for farmers.

Cor van der Weele

Professor of Humanistic Philosophy at Wageningen University

Everybody is talking about the openness of consumers towards cultured meat. You have been asking farmers. Why?

Cultured meat not only needs to be consumed, it also needs to be made and this comes with a disruption of traditional farming. But that also means disrupting the farmers living.

So, to make it a really responsible innovation we also have to think about societal aspects of the production side. Although we don't know precisely when it will be ready for the market, it is coming closer. And we have to be in time if we want to discuss how and by whom and on what scale it is being made.

And how open are farmers towards cultured meat?

Farmers are not a homogenous group at all. There are old and young farmers, existing farmers and also new entry farmers. There is also this new tendency that people from cities go to rural areas and start farming practices.

Some farmers want to produce the highest yields at the highest efficiency and scale. Others are really caring for their animals and have very mixed feelings seeing animals mainly as production machines. It was not easy to find interested farmers for the study. And even if they participated, many were sceptical to various degrees. But a few were extremely interested.

What drives these farmers to get involved in cultured meat?

Motives vary. Sustainability, a search for new economic opportunities, closing the gap with consumers and society. Farmers see that consumers want animal-friendly meat, although most are not prepared to pay for it.

“Cultured meat not only needs to be consumed, it also needs to be made and this comes with a disruption of traditional farming.”

Cor van der Weele, professor of Humanistic Philosophy at Wageningen University

Some farmers already give workshops, like cooking workshops with the meat of their cows, to increase connections with consumers. And some farmers have come to develop moral concerns about animal farming themselves, although they do not readily talk about that.

How could working with cultured meat look like for farmers?

If and how farmers might be involved in cultured meat production is far from clear and it was discussed a lot in the focus groups: “It is far too technological. It doesn’t fit the image of a farmer. It doesn’t fit the consumer’s image of a farmer.” Farmers agreed that it can only succeed if there are real reasons for making it on a farm.

Perhaps it might work, for example, to link cultured meat to a specific cow or a specific pig, they thought. Then, you can have cultured meat with a kind of story to it. You need a story for what you do. Not just to convince consumers, but it is also important for the farmers themselves. They need to know what they are doing and that it is a good thing. Stories that can bridge the tension between industrial production and traditional ways of working, should clearly not be about choosing technology or tradition, but about finding new combinations of the two new forms of authenticity.

CHAPTER FIVE

A cultured Meat society – what innovations are needed?

A cultured meat society – What innovations are needed?

Societal changes require a critical mass of people who are willing to accept and implement them. Cultured meat is new to the world's dinner plates, and it has the potential to reshape many aspects of our food culture.

The production, sale, consumption and preparation of meat might soon take on completely new forms. That is, if everything goes as planned.

Cultured meat has the potential to spark major transformation – but it still has some hurdles to overcome. From among seven critical challenges through 2027, raised by an international Delphi study on in-vitro meat[26], the researchers surveyed as part of the Merck KGaA, Darmstadt, Germany Scientists' Study are most optimistic about the technological ones:
They trust the producers to develop healthy products and to master production using bioreactors.

They are more skeptical about market acceptance or that the environmental benefits will be proven (see Figure 5.1).

Technology is just the beginning

Cultured meat can make a breakthrough, but it's still got a long way to go. First, it has to be made ready for mass production. Some milestones have already been reached in this regard: In Israel, SuperMeat is offering tastings of its cell-based chicken in a restaurant-like test kitchen.

In 2020, cultured meat overcame a regulatory hurdle in Singapore when it was approved for sale as food, albeit in small quantities. And other countries have committed to promoting cultured meat as a technology of the future. For instance, the Belgian government has created a consortium dedicated to the development of cell-based goose liver.[27] And finally, cultured meat start-ups have reported higher investments than ever before. Although investments exceeded US$ 75 million in 2019, a single investment round in early 2020 outdid that number: Memphis Meat raised close to US$ 600 million in 2020 to build production sites and create a ready-for-market product.[28]

Critical obstacles remain, though. For example, cell lines that are suitable for large-scale, food grade production have yet to be developed. Scientists also still have to create so-called "edible scaffolds" and animal-free cell culture serum that can be produced cost effectively. The process of building an entire cultured meat ecosystem that covers all aspects of production has only just begun.

As yet, no manufacturers can deliver the needed hardware, such as bioreactors, or consumables like cell serum for mass production.

Cultured meat startups have reported higher investments than ever before.

26) Tiberius et al. 2019
27) Crosser 2019
28) Byrne 2021

Who defines it? Who regulates it?

But, as the results of the Merck KGaA, Darmstadt, Germany Scientists' Study and the illustrations in the previous chapters show, technological innovation alone will not be enough to establish broad acceptance for cultured meat in the industry and among consumers.

A crucial factor for the product's success will be the approval of cultured meat as a food product. Despite some initial movement in that direction, there are no guarantees that the necessary regulations will come to pass.

The interests of the cultured meat producers will have to be balanced with those of policymakers and the general public as well as those of existing meat producers. And this is where the critical question will be answered: Can cultured meat be called "meat"? Social and cultural aspects will be absolutely essential to its success.

Will vegetarians warm to the idea of cultured meat? Will there be vegans who feel it is acceptable to use even a single cell? Childs puts even more questions out for consideration: "Is cultured shrimp kosher? Or would cultured pork be halal?" Or, at a more practical level, can we imagine the grilling aficionado tossing a cell-based T-bone steak on the barbecue with the same gusto as its animal-based equivalent? Childs expects cultured meat to change certain rituals around food – and to create new ones as well. He points to the new rituals that arose around beer with the emergence of microbreweries (see the interview on page 38).

Fertile ground for social and cultural innovation

Relationships and habits vary by region and culture. Cultured meat also has to be adapted to these local realities. Childs firmly believes that this also holds true for local food systems. "Any food system is going to have local problems. You have to adapt to the environment. In the U.S., we are approaching it in the classic Silicon Valley style – and all of a sudden, [the new product] is everywhere. The Indian approach to it is likely to look very different."

One challenge that is unique to developing countries is whether the rising middle classes will be able to leapfrog right over conventionally produced industrial meat to cultured meat. Studies that assume that consumers in these markets in particular will, in fact, be more open to cultured meat are encouraging. For instance, 70% of urban Chinese are willing to try cultured meat, and 58% said outright that they would buy it.[29] In any case, cultural and social innovations cannot be planned and managed the way technological innovations can.

They need to be given sufficient space and "airtime" so that they can evolve on their own or that people can develop them. The same applies to the other major ecological, ethical or practical questions that will arise, as highlighted in the previous chapters. For Cor van der Weele, it is essential to try concrete applications with stakeholders from a variety of fields early in the process.

That's how her "pig in the backyard" scenario developed (see page 37): "I think that experiments and pilots are extremely important for opening up the societal, sociological, philosophical imagination and moral imagination for those new stories that do not fit in with the old stories. Such experiments create new possibilities and opportunities."

New food systems need economic innovation

Prototypes and the courage to run specific experiments are also crucial to economic innovations. In the last decade, capitalism as we know it has been confronted with a deep existential crisis, and alternative economic paradigms have gained increasing popularity and relevance.

These alternatives have ranged from an expanded concept of capitalism that includes social and ecological elements like creating shared value[30] to concepts that are keenly focused on the environment, like the

29) Dempsey/Bryant 2020
30) Porter/Kramer 2011

circular economy[31], and even to approaches as far-reaching as a post-growth economy.[32]

In the context of cultured meat, this raises exciting questions: What might cultured meat business models look like that measure their success on creating shared value?

What implications arise for the development of cultured meat built on the premises of post-growth economics or the circular economy? What role might the notion of open innovation play in the development of cultured meat technologies and their promise of making the world a better place?

Faced with so many questions, it is ultimately good to have a sure response ready. The innovative power of cultured meat can extend far beyond the foodie community.

The potential is there to positively transform our society.

Assessment of selected key challenges

(items replicated from Tiberius et al.)

Fig 5.1

	Not agree at all	Somewhat disagree	Somewhat agree	Completely agree	Average
Cultured meat can be enriched with more vitamins, minerals and poly-unsaturated fatty acids than conventional meat.	2%	4%	46%	33%	4 of 5
Mass production of cultured meat will be possible (due to progress with bioreactors or other production methods)	5%	13%	51%	11%	3.5 of 5
It will be possible to produce highly structured cultured meat (e.g., steak).	3%	17%	40%	12%	3.4 of 5
Consumer acceptance will increase due to high safety standards and relevant certifications in the production process of cultured meat.	7%	18%	42%	7%	3.2 of 5
The demand for cultured meat will be positively influenced by offering more attractive non-price related aspects (e.g., health benefits) in cultured meat to consumers	7%	19%	39%	6%	3.2 of 5
Environmental advantages and disadvantages of cultured meat will have been sufficiently investigated and proven	5%	25%	32%	11%	3.2 of 5
Cultured meat will have a larger market share than other meat substitutes (like products made from soy, lupinesor insects)	18%	30%	18%	2%	2.6 of 5

Average from 1 ‚not agree at all' to 5 ‚completely agree

% of 'neither agree nor disagree' answers not shown for better readability

31) Braungart/McDonough 2003
32) Jackson et al. 2019

Pig in the backyard

Wouldn't it be wonderful to have a cute pig in your backyard from which you extract a few cells every couple of weeks to grow meat in a community bioreactor as needed?

This scenario was developed as part of an earlier research project by Cor van der Weele and Clemens Driessen in a workshop involving participants from various professional backgrounds and life stories. And it created quite a stir – "[a] combination of joy, inspiration and amazement".[33]

It promises to reconcile seemingly incompatible notions, like enjoying meat without causing any pain or suffering to animals and having a relationship to animals and simple technologies close to home.

For the researchers, the "pig in the backyard" scenario addresses existing sources of ambivalence and offers a way to reconcile them. To have a pig in your own backyard that provides cells has appeal for all who wish to eat meat but not from industrial production.

For all who want to know where their meat comes from but do not want to slaughter an animal. And for all who find the idea of cultured meat attractive but distrust large corporations.

The pig in the backyard scenario suggests that cultured meat can open up entirely new possibilities and meet more needs than just the need to eat meat.

33) van der Weele/Driessen 2013

"To have a pig in your own backyard that provides cells has appeal for all who wish to eat meat but not from industrial production."

One of the main goals of cultured meat is to ensure the future of our planet. It's not enough to offer a new source of protein.

Cultured meat must be seen in the context of the overall food system and the ecosystem.

Moreover, economic priorities and policy decisions will determine whether, and to what extent, cultured meat will succeed in fulfilling its promise of a better world.

INTERVIEW

"Why not invent some new rituals how we eat meat?"

Quinault Childs is a research director at the Food Futures Lab at IFTF. His focus of work is to explore future directions in the way we produce, process, distribute and enjoy food. His research focuses on sustainability in the global food system.

He also has a history in food and agriculture entrepreneurship, co-founding a company that uses insects as animal feed.

Quinault Childs
Research director, Food Futures Lab at IFTF

What major drivers do you see in our food and eating culture?

Climate change, of course, will be a huge systemic disruption to every aspect of the food system – from agricultural labor to fine dining, everything is going to be utterly changed over the next decades. Also, we may see some sort of second iteration of the Roaring Twenties after the COVID pandemic. Once people can go out again, there will be this influx of people saying, let's start a new restaurant, let's start new ways to have eating experiences. That will propel a lot of cultural shifts.

There will be more people in the food industry who are willing to take chances on new things, and more space and opportunity for experiments to happen.

Can you name some examples?

For example, things like dark kitchens are transforming the way that food is created. You no longer have to have the restaurant in order to have the restaurant experience. It's the same with grocery stores. If you go to a grocery store now in the middle of a workday [in California], it's full of personal shoppers. They are walking around following the instructions on their smartphone and treat the grocery store like a warehouse. So, for a cultured meat brand to take off, within a decade they'll need to be successful in a totally different mode of shopping for food.

Why not have a distributed network where I can order my cultured meat from the local bioreactor? And it shows up 15 minutes later because the local bioreactor is down the street.

Do you see any changes in how we will eat cultured meat any differently from conventional meat?

That's an interesting question. I would classify it as the rituals around cultured meat. We think of a barbecue and we have these cultural ideas of like men standing at the barbecue grilling the steaks. But that ritual could be totally transformed, right? To me, that is really exciting and something that companies that have a new transformative product often don't think about. They rely on the existing rituals. They say, you can just throw cultured meat on the barbecue like you did with regular meat. But if you have this new product, why not understand the new rituals and why not try to invent some new rituals?

Photo Credit: Cultivated Shrimp Dumplings, Creative Commons by Shiok Meatsææ

Can you think of an example where a new food has actually transformed an eating ritual?

What comes to mind, is the craft brewery movement in the United States. Going to a microbrewery, sitting there amongst the machinery and having this fancy new beer rather than going to the bar – that's a new ritual, because it's an entirely new space and a totally different experience. The ritual actually brings you closer to the production methods.

"There will be more people in the food industry who are willing to take chances on new things"

Quinault Childs, research director at the IFTF Food Futures Lab

WRAP UP

The future of cultured meat affects us all.

"The future is not some place we are going to, but one we are creating. The paths are not to be found, but made, and the activity of making them, changes both the maker and the destination." – This is how the political scientist John Schaar describes the challenges of modern society. Cultured meat is not a goal in the future that we can get closer to by working through technology milestones. Rather, cultured meat is itself one of those paths into the future that are currently in the making.

This study shows, too, that building these paths does not only require creative energies. Above all, what is required is the willingness and openness to change. The most obvious thing is that consumers become open to new products and are willing to change their eating habits. Also, there is also the openness of governments and interest groups when it comes to regulations, subsidies or simply the willingness to cooperate. However, this study reveals the relevance of the openness of the actors in the industry itself. We are used to that when it comes to new technologies.

But innovation and open-endedness are also required when it comes to formulating common goals, questioning one's own convictions and changing common approaches.

Every major technological renewal entails a series of changes in the system: New technologies require new value creation systems, new infrastructure, suppliers, competencies and skills. We currently observe this in the conversion of the automotive industry into an e-mobility industry, for example. The commitment of the most diverse stakeholder groups is required in the various forms of simple communication to cooperation, collaboration and healthy competition.

Above all, what is required is the willingness and openness to change.

Technology may determine whether cultured meat can be successfully produced. But technology alone will not determine whether cultured meat will be a success for our society.

The most successful electric vehicle would not be as successful as it is without infrastructure providers of e-filling stations, battery suppliers, government subsidies and consumers who are willing to upgrade their garage. Cultured Meat still has a long way to go. The challenges ahead concern many. This is also shown in this study. Governments, farmers, consumers – they all need to be aware that the future of Cultured Meat also affects their own future. And they should feel encouraged to take part in building that path into the future.

Technology may determine whether cultured meat can be successfully produced. But technology alone will not determine whether cultured meat will be a success for our society. To do this, it is necessary to ask uncomfortable questions.

We at Merck KGaA, Darmstadt, Germany are challenged just as much as all other players in industry. Some of these questions were taken up in this study: How much naturalness do modern humans need? What role do traditional industries like agriculture play in a cultured meat future? Or: How to scale up without selling out on your ideals? These questions will take you out of your comfort zone. They require an openness that goes beyond the usual understanding in innovation development. They concern the core of corporate values and strategies, and still are best explored in collaboration across companies, disciplines and industries.

How we answer these questions decides in which future cultured meat will lead us. And their relevance goes far beyond cultured meat. They concern fundamental course settings for the future of our society and our planet – and the role that companies want to play in it.

Those who want to be fit for the future will have to wwventure out of the comfort zone and actively work on constructive answers and solutions. Conversation and exchange are the essential first step. We hope this study is able to spark a few of these conversations.

Key Takeaways

1. Design systems, not products.

The study shows: a single product will not save the world. Rather, it is about redesigning entire value creation and consumption networks. This requires the ability to think and act in complex systems and contexts. Cooperation with others is crucial. A culture of cooperation that assures the implementation of certain values (e.g. ecological sustainability) while maintaining individual interests is as well.

2. Add ecological and societal variables to your business model.

Cultured Meat inspires because it’s a promise. Namely for a sustainable way out of one of the many crises on our planet. The result: less animal suffering, a smaller ecological footprint, less environmental pollution. These benefits need to be integrated into the business model as must-have criteria just like key financial figures. Anything else jeopardizes the credibility of everyone involved

3. challenge your own credibility.

Pure promises won’t take you far when it comes to accountability. The impact of your purpose can be put in numbers, just like your profits and market penetration are. Working with experts outside your field (e.g. NGOs) ensures that relevant and credible indicators are used. This may result in unexpected and inconvenient outcomes. However, the learnings will push cultured meat beyond the boundaries of the industry.

4. Learn from those who don't share your opinion.

Cultured meat challenges us on many levels: as a society and as a culture and production community. Is cultured meat really meat? How natural is it?
And how healthy? Your actions must be informed by interacting with people who think very differently and listening to their arguments. Only by engaging with others can the industry develop holistic strategies that are actually socially relevant.

5. Take on the challenge of cultural innovation.

The industry is sufficiently prepared for the technological challenges ahead. However, we have learned that the success of cultured meat for our society relies heavily on the cultural innovation – be it as innovation in innovative business models and corporate strategies or fundamental system innovation on a societal level. Challenge yourself with innovation tasks in these unusual fields. Take these cultural innovation challenges as seriously as your technological innovations. Setting up innovation teams and incubators for cultural innovation could be an interesting first move.

6. Embrace innovation in other fields.

Some of the challenges that became evident in this study seem particularly difficult. Especially when you see them from the perspective of a technology provider.
In fact, exciting new approaches can be found in a wide variety of areas and disciplines from ecology to economics. Actively engaging in this discussion can produce interesting results for the cultured meat industry. Findings and approaches need to be explored, applied and further developed in practice. And working with the most unusual partners produces truly extraordinary results.

EXPERTS

Rose Ha

Chef, expert in plant-based cooking, consultant with Wildtype, San Francisco

Rose Ha is probably one of the chefs with the most practice in cooking with cell-based products. Rose has been a chef for more than ten years, with experience in some of the most celebrated kitchens in California. Since 2017, she has involved herself heavily in plant-based cooking.

Currently, she is collaborating with Wildtype, a San Francisco based cultured meat startup, to explore and develop how cell-based salmon can be engineered, prepared and served as a taste-bud tickling experience.

Photo Credit (Rose Ha):
Shea Ananda Photography

Paul Shapiro

CEO of The Better Meat Co., author, podcast host and speaker

Paul Shapiro is the author of the bestseller ”Clean Meat: How Growing Meat Without Animals Will Revolutionize Dinner and the World“, the CEO of The Better Meat Co., a four-time TEDx speaker, and the host of the Business for Good podcast.

Neil Stephens

Brunel University London

Cultured meat has ambitious goals for a better future of our planet and our society. Dr. Neil Stephens, Brunel University London, is a Wellcome Trust Research Fellow focused upon the sociology of biomedicine and Science and Technology Studies.

He researches the social, societal and political implication that are induced by innovations like cultured meat.

Cor van der Weele

Professor of Humanistic Philosophy at Wageningen University

As a trained biologist and a philosopher, Cor van der Weele has been studying changing appreciations of meat and cultured meat for the last twelve years.

Currently, she is working on the questions of if and how cultured meat might be an opportunity for farmers.

Quinault Childs

Research Director, Food Futures Lab at IFTF

Quinault Childs’s focus of work is to explore future directions in the way we produce, process, distribute and enjoy food. His research focuses on sustainability in the global food system.

He also has a history in food and agriculture entrepreneurship, co-founding a company that uses insects as animal feed.

Lavanya Anandan

Head of Group Innovation Portfolio Management and Operations, Science & Technology Office of Merck KGaA, Darmstadt, Germany

Lavanya Anandan has been instrumental in defining the strategy, building and guiding cross functional teams to develop innovative project concepts and driving relationships & partnerships with the alternative protein ecosystem.

Prior to joining the Science & Technology Office, Lavanya contributed within the Life Science division at MilliporeSigma, where she led the global marketing program focused on biologics and biotech startups. Lavanya holds a PhD in Molecular & Cellular Biology.

AUTHORS

This Trend Study, was initiated by the Science & Technology Office of Merck KGaA, Darmstadt, Germany, namely by Helge Carstens, Market Research Manager New Businesses, Claudia von Reinhardstoettner, Marketing and Communications Manager, Lavanya Anandan, Head of Group Innovation Portfolio Management and Operations, and Thomas Herget, Head of Silicon Valley and China Innovation Hub. The study, including the interviews, was conducted and written by Maria and Christoph Angerer (measury Sozialforschung OG).

METHODOLOGY

For the Merck KGaA, Darmstadt, Germany Scientists' Study, conducted by Helge Carstens, Market Research Manager New Businesses and Eric Reyes, Customer Insights Manager, 166 scientists were asked to complete a survey online. Of respondents, 58% worked in academic research or for a research institution. The rest were in corporate research. A share of 55% of respondents were from North America, 6% from the UK. Most of the remainder were from Europe, and just a few scientists in Latin America and Asia could be reached. Two-thirds of respondents were male, one-third female.

In addition, guidelines-based interviews were conducted for this publication with the experts cited.

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