
Talking points on the cultural politics of cultured meat

Neil Stephens, University of Birmingham, UK; and Alexandra Sexton, University of Sheffield, UK

- 1 Introduction
- 2 Public life of cultured meat
- 3 Economic life of cultured meat
- 4 Political life of cultured meat
- 5 Cultured meat and social change
- 6 Conclusion
- 7 Acknowledgements
- 8 Where to look for further information
- 9 References

1 Introduction

Cultured meat technologies are seeking to change the world in a significant way, and like anything that seeks to change the world – irrespective of whether it is a change we want to see or not – it requires critical inspection in terms of what that change looks like and who it will impact. In this chapter, we introduce a number of talking points on the topic of cultured meat, including issues for further consideration, and provide open questions to be explored subsequently. We have grouped the themes into four headings: the public life of cultured meat, the economic life of cultured meat, the political life of cultured meat, and cultured meat and social change. These are intended to open up key points of reflection for anyone engaged in cultured meat to think about, in order to consider what types of impact the technology might have, and where some of the uncertainties remain.

Cultured meat technology has always been articulated through a set of promissory narratives about what it will be and how it will change the world (for the better). These narratives are likely already familiar to readers of this book, and some are discussed in more depth elsewhere within this book. One key vision has been the capacity to produce meat in a way that is beneficial for the environment compared to existing production methods, with lower use of land, water, and energy, potentially resulting in lower greenhouse gas emissions.

A second key vision is to produce meat while killing either none, or at least far fewer animals than current systems, bringing with it moral value in terms of reducing global violence and animal exploitation. A third core vision within these promissory narratives has been producing meat that is healthier or safer than traditional production methods, with sub-themes within this pointing to meat production without antibiotic use, novel forms of engineered nutrition, and a meat free from the risks of zoonotic disease. Beyond this core three themes, there have been other narratives that become more or less visible at different moments, such as the capacity to produce meat for space travel, the economic benefits of developing new companies and sectors within national economies, and the capacity to make new eating experiences through innovative forms of meat. The narratives have also been developed over time, with more focused species or region-specific narratives developed by companies which focus on distinct markets, for example the fish-oriented companies in Asia which reference the specific marine ecology or local cultural tastes.

These promissory narratives, we have long argued (Sexton et al., 2019; Stephens, 2010, 2013; Stephens et al., 2019), do more than articulate a vision of the future. They are active parts of shaping cultured meat today, by attracting resources, being the basis of debate about how desirable or tractable the technology and its goals are, and by asserting a framework of meaning around what cultured meat actually is (as well as who will consume it and why). Cultured meat technology, and the way people talk about it, is an attempt to reshape the world of today and tomorrow; it is intended as a clear intervention into our societies, our ethics, and our planetary health.

If cultured meat is successful, it will be inherently cultural. People will eat it, identify with it, use it to further their politics, maybe even normalise it. It will become embedded within cultural and public life. But there is no guarantee that this will happen, and no clear-cut ways of knowing what form these new food cultures might take, or their broader impact, if they come into being. This chapter is written in this spirit. It raises talking points about the cultural politics of cultured meat.

2 Public life of cultured meat

A key frame used within the cultured meat community for the public life of cultured meat has been the 'consumer acceptance' model. Studies have been conducted on public and consumer acceptance issues, employing both survey and focus group methodologies (as discussed elsewhere in this book). The findings vary, with the variance connected to both the territory or demographic asked, as well as the study design and how cultured meat is introduced within it (Bryant and Barnett, 2018, 2020). Studies find publics have a variety of responses to cultured meat, with some very supportive, others very critical,

and many in between. In general, the studies tend to show greater acceptance among younger, educated, male, urban individuals. They tend to show larger numbers say they would try it, as opposed to commit to eating it regularly. However, studies also tend to show that the largest cohort is still people who have not yet heard of the technology and are yet to develop a clear opinion.

Another recurring theme is that the type of information provided to people about cultured meat shapes their responses, with more positive framings leading to more positive responses (Bekker et al., 2017; Bryant and Dillard, 2019; Rolland et al., 2020). Given this, it is worth remembering that real-world public responses to cultured meat will be framed by the societal information context at the time, which will depend upon the dominant or competing narratives in popular circulation at the time. Furthermore, we suggest there has been at times an overemphasis on the role of consumer acceptance studies, as they can offer an overly reductive framing of broader publics, and under-represent the richness and nuance of people's understandings of the political, social, and identity elements of food choices. Studies that focus primarily on whether consumers will or will not purchase cultured meat, and what factors may increase their likelihood of purchasing cultured meat, are important and needed, but by limiting the core point of consideration to a binary purchasing decision, they do not allow us to fully grapple with the diversity and complexity of people's engagement with cultured meat technology, which extends far beyond whether to buy or not.

This is relevant, as meat has a long history of being associated with identity, and this has taken different forms at different times and contexts. As examples, meat has been associated with displays of masculinity, wealth, strength, and health (Adams, 2015; Rosenfeld et al., 2020). As such, the social status of meat in any given context is a variable that supporters of cultured meat need to be attentive to. Equally, it raises questions about if and how cultured meat might alter the social status of meat if it becomes adopted. As one example, the status of cultured meat within specific religious thinking has been an ongoing topic of discussion. Primarily, this focuses upon its permissibility within Islamic halal and Jewish kosher practices (Hamdan et al., 2019; Hamdan et al., 2021; Kenigsberg and Zivotofsky, 2020; Krone, 2022). Discussions of this type typically highlight specific variables that would impact upon a halal or kosher designation, with the cell source, media content, and specific process used being important in both cases. As an example, it has been suggested cultured meat would only be halal if the cells are extracted from a halal slaughtered animal, and no blood is used in the media. In terms of being defined as kosher, similarly, the importance of being from a kosher species and being kosher slaughtered has been raised. However, in the case of both halal and kosher, this discussion remains ongoing as both the technology and thinking in this area develop.

Analysis of English language media coverage of cultured meat has shown that news stories tend to be generally positive about the technology (Goodwin and Shoulders, 2013; Hopkins, 2015; Painter et al., 2020). This is because the reporting generally reflects narratives from cultured meat advocates, either the companies or supportive NGOs and individuals. These stories are often based upon company-issued press releases and feature interviews from cultured meat proponents. In our observations, the news framing has been fairly standardised for many years. Cultured meat is presented as an interesting and unusual science, which might be very beneficial for the environment, animal welfare, and health reasons, before questions are raised about whether people would choose to eat it, or more recently, how it might be regulated. Early stories were premised mostly around future-oriented claims from scientists or entrepreneurs saying the production of cultured meat could soon be possible. Increasingly, such stories now use a company announcement as a hook, for example a new image or tasting opportunity of a cultured meat prototype, or recently raised money.

In the media and elsewhere, cultured meat has been given many names (Bryant and Barnett, 2019; Stephens et al., 2019). Around 2005, *in vitro* meat was used most regularly within the community of people working to produce it. Over time this shifted to cultured meat, which was the dominant name by 2015. Then, clean meat was suggested, and became prominent for a few years, before decreasing in use again, as cell-based meat and then cultivated meat also became popular. Other names have been used outside of the community. The media frequently uses lab-grown meat, with other terms including synthetic meat, fake meat, and Frankenstein meat seen as antagonistic to the technology by those within the community (Painter et al., 2020). The choice of name is important, as it frames how cultured meat is understood by accentuating some interpretations and diminishing others. Importantly, all of these retain the word meat as a descriptor, asserting the technology's meatness.

Another important issue is the number of uncertainties about the future of cultured meat, which include the technical process it may involve, the resources needed to produce it, the price, the political and consumer response, the impact on other markets, and related impacts on the environment, landscapes, and rural communities (Stephens et al., 2018). This leads to questions about how accountable public discussion - in the media, policy, and other contexts - should best proceed to engage with that uncertainty (Ryynänen and Toivanen, 2022; Sexton et al., 2019). This, of course, is not an issue specific to cultured meat, it is also true of numerous other innovative technological projects; however, working through the specifics of this in the cultured meat context remains important.

3 Economic life of cultured meat

To be successful, cultured meat needs to be an economic success. Key discussion points here include the likely market impact, as well as funding and business models being used, and how these issues relate to broader economic factors like government support and power within the food sector.

A key discussion point that shapes many other issues is what impact cultured meat might have in the market. There are many unknowns that compound the complexity of making accurate predictions. Key variables will include the quality, availability, and price of any cultured meat products (Treich, 2021; Van Loo et al., 2020). However, the question is more than just what level of market penetration cultured meat might achieve in any given time frame given these quality and price attributes. We must also consider what might happen to livestock-based meat sales, and different subcategories within these. The typical starting narrative used within the cultured meat community is that cultured meat sales will displace sales of livestock meat, as consumers switch from one product to the other. This can be characterised as a type of substitution effect, in which the total volume of meat sales remains the same, but consumers shift from livestock to cultured sources. The capacity of cultured meat to deliver environmental benefits is premised upon this reduction in livestock-based meat.

However, there are multiple ways the real-world market dynamics of cultured meat introduction may be more complex than this one-for-one substitution effect. One possibility would be an addition effect, in which livestock-based sales do not decrease as cultured meat sales increase, with the net result of more meat produced and consumed (livestock and cultured combined) (Stephens et al., 2018). The ratio of increases in cultured meat to decreases in livestock-based meat will be important, and this again has inherent complexities. Attempts could be made to predict these outcomes based upon experiences of other innovations that sought to replace established products. However, issues including the cultural significance of cultured meat and uncertainties about the technical process make such predictions difficult.

One key dynamic is 'sausages versus steaks', which asks what the different market impacts might be of cultured meat systems that can only produce processed meats (sausages, burgers etc.), as opposed to cultured meat systems that can also effectively produce more complex structures (steaks, chicken breasts, etc.). The issue here is whether the industrial production of cultured meat processed foods would impact the profitability of livestock production sufficiently to lower the number of animals farmed, or whether the market for steaks and other complex meats would be sufficient to sustain farmed animal numbers. In other words, to what extent do processed cultured meat products hit the margins of livestock farmers, and what impact might this have. It is, of

course, likely that such trade-offs would play out differently in different and changing contexts.

Another question is where the market impact would be felt. For instance, we can ask whether reductions in livestock numbers would happen in the country of consumption, or whether it is more likely (or more or less beneficial) for production reductions to happen elsewhere in the world (and where that might be). This is a point we return to later in the section on social change.

Another core point to consider is the underlying funding model. The cultured meat sector has been characterised by two waves of investment models and personnel (Stephens et al., 2019). The first wave broadly covered the period from the early 2000s to 2013 and involved mostly individual university-based projects funded through small government grants – in some cases as side projects within existing research grants – and awards from third sector organisations. Early cultured meat research programmes faced multiple barriers to securing funding. Cultured meat was seen to blur existing disciplinary boundaries between biomedical and food innovation and so often failed to fit neatly into established funding bids. Many early cultured meat researchers also reported a general sense of oddness attributed to their work from their colleagues and usual sources of university support. The nascency of the technology during the first wave was also seen as too early stage, too high risk, and too expensive for many public funds.

The transition between the first and second waves of cultured meat investment in the 2010s was characterised by the entry of high net-worth philanthropic individuals (e.g. Sergey Brin, Bill Gates) and investment streams more associated with high-tech ventures, such as technology accelerator programmes and private venture capital firms. The San Francisco Bay Area in California, popularly referred to as Silicon Valley, attracted increasing cultured meat activity. The numbers of companies steadily rose from a handful in 2015–2016 to around 100 by the early 2020s, and we suspect those numbers may continue to rise in the near future. Typically, these companies begin with a founder duo, who develop the vision and business plan for the company, by looking to find a point by which they can differentiate themselves from existing companies, while still remaining sufficiently similar to the core model for the sector to attract venture capitalist support and subsequently grow their staff. There have also been a number of investments in these companies from multinational livestock companies and incumbents within the middle of the agri-food value chain (processing, food retail, and services), for example Tyson Foods and PHW Group, and globally recognised food retail brands such as KFC, which have made strategic investments and partnerships within the section, often to keep track of this emerging and potentially rival industry.

Recent years have seen increasing calls within the cultured meat industry for more government financial support, be that through public-private joint ventures or standard academic funding. Prominent corporate actors within the

sector have highlighted that greater sums of capital and longer time frames of R&D than seed-level venture capital can provide may be needed to transition lab-scale prototypes to larger scale pilot and commercial facilities. Some have also highlighted frustrations with the lack of collaboration and data sharing within the industry, in part a product of the intellectual property that has been tied to the private high-tech investment streams that have to date shaped this emerging sector (Dutkiewicz, 2019). A shift to greater public funding would potentially build in more open-source models of knowledge production that could benefit the industry and possibly other sectors outside of protein food production (Newton and Blaustein-Rejto, 2021) – for example, bringing the cost of cell culture medium down could make the production of certain biopharmaceutical products cheaper. More democratic sources of funding and R&D models could also mitigate against these technologies repeating the context of genetic engineering and pharmaceuticals whereby a small number of companies reap the majority of economic benefits, and in doing so perpetuate the imbalance of power and ownership that currently drives significant inequalities in the global food system. Asking who is funding the sector, both through private and third sector means, requires continuous critical scrutiny as investment streams play a central role in shaping how technologies like cultured meat are developed and the possibilities they present in both technical and sociopolitical terms.

We also need to consider the business models that companies are using to support their work. Most of the first wave of cultured meat companies positioned themselves as largely vertically integrated companies developing their own meat products, culture media, and bioreactor technology, and a B2C business targeting sales of meat to consumers. Over time, more companies were launched that instead focused upon a specific component of the process, e.g. culture media or bioreactors, operating as B2B companies supplying others in the sector. This has seen more discussion of the early companies operating in a less vertically integrated way by working with other companies as suppliers. Recently, the sector has seen a small number of acquisitions, as larger cultured meat companies have bought smaller ones to take in-house their expertise and technology.

These business models will in part shape the impact of cultured meat on ongoing discussions and concerns about the concentration of power within the food industry (Broad, 2019; Treich, 2021). Whether cultured meat will support or challenge the increasing concentration of power among a small number of corporate actors is currently unclear, though recent developments within the sector suggest that it will likely be ‘incorporated as reforms within the corporate food regime’ (Broad, 2019). Continued partnerships between cultured meat ventures and multinational food corporations (aka ‘Big Food’) reveal that some of the most powerful agri-food incumbents are making strategic investments in

cultured meat and other alternative proteins to ensure they are the disruptors, not the disrupted. It is unclear whether cultured meat will eventually displace or simply add new revenue streams alongside the conventional livestock operations of incumbents, or whether the cultured meat ventures, once acquired, will be closed down to mitigate competition. The buy-in costs of cultured meat for the near future are expected to be prohibitive to small- and medium-scale agribusinesses without some form of subsidised support. A critical question to ask, then, is not only whether cultured meat presents opportunities for conventional agribusiness, but who among incumbent supply chains has the economic power to take early advantage of this emerging sector.

Some accounts of future cultured meat production envision a form of localisation and democratisation of meat production, with many smaller-scale producers operating as a challenge to existing large-scale food production in a similar manner to previous alternative food networks (van der Weele and Driessen, 2013). Cultured meat potentially offers opportunities for making small mixed farming of heritage livestock economically viable for the producer and more affordable for the eater. This cultured meat scenario is linked more closely to current visions of a 'small farm future' (Smaje, 2020) and seeing this novel technology within a more holistic plan of farming as a suite of ecological, economic and sociocultural services.

Another key economic aspect is the role of governments, which have the capacity to support or hinder the development of cultured meat through multiple mechanisms. This includes whether governments decide to provide support for the sector in terms of research grants, or to help develop and promote training opportunities with the sector. Another is tax and subsidy regimes. This includes whether cultured meat producers should receive subsidies, and the extent to which this could relate to food production or environmental stewardship (Treich, 2021). There is also scope for discussions of whether the potential of cultured meat relates to the sometimes-mooted issue of a meat tax, or emissions trading schemes (Funke et al., 2021). Analysis is needed into how might a global agricultural subsidy models change in this context.

4 Political life of cultured meat

As we have made clear, if cultured meat is successful, and even if it is not, it will have political ramifications. This impact will be framed by issues, including power in the food system, the distribution of resources, the types of political discussions that people have, and the role of governments.

A key talking point is access and food justice. A common goal of the cultured meat sector is to create products that are cheap, tasty, and convenient. Care must be taken however not to assume that cheap food is the route to a fair food

system, and that if cultured meat is cheap, it will be affordable and accessible to all. We are currently living in an age where food has never been cheaper and at the same time, food poverty and hunger have been rising in both Minority and Majority nations. As has been widely evidenced, the costs of the cheap food model are inevitably paid somewhere, and often disproportionately by the most vulnerable and marginalised populations. Depending on how cultured meat scales up as an industry, the costs of a race to the bottom could come in terms of livelihood loss, breakdown of rural communities, further consolidation of power and ownership in the agri-food system, predatory delay by incumbents to stall change, more overall production and resource use due to the addition rather than substitution effect, continued public health issues associated with cultures of over-consumption generally and of meat products specifically, and continued dependence on intensive monocrop models of agriculture (i.e. land sparing) to supply this new industry.

Achieving food justice through cultured meat is not automatic, and if unregulated, could be unlikely. More research is needed to consider what optimal modes of responsible innovation and more holistic understandings of food and farming could provide for considering how cultured meat might fit into sustainable and just agricultural models. Some ideas that have been proposed include a 'socialised' funding model (Dutkiewicz, 2019) to encourage open-source knowledge production and a 'food tech justice' approach (Broad, 2019) that works to build in established principles of food justice into the innovation processes and outcomes of cultured meat development. More research is needed to explore these kinds of alternative models for scaling cultured meat development, and it will require active commitment by the cultured meat industry to build in public goods into their processes, as well as support and incentives from the third sector.

Issues of food justice, in many nations, open up discussions about democracy and accountability. Some visions of the future of cultured meat anticipate profound social, economic, and environmental change. Indeed, these changes are for many the core reason to support the technology. However, the potential for such change leads to questions about what an optimal mode of accountability for this change might look like. It is reasonable to ask what kind of democratic mandate is necessary for change of this scale to be deemed legitimate. One possibility is to let the market adjudicate, in that if sufficient numbers of people purchase cultured meat, then that establishes a democratic mandate. However, it could be argued that this approach, first, leaves the democratic decision too late in the process to effectively shape the development pathway, and second, that food-purchasing decisions are shaped by other constraints beyond the free giving of support for or against a political project. This, then, leads to a question of what other forms of accountability may be appropriate, for example, dialogue models or government-led projects.

Clearer visions are required for what an accountable and legitimate cultured meat future could look like.

Critical commentators have also argued that cultured meat represents the familiar model of 'non-disruptive disruptions' (Goldstein, 2018) – that is, technofixes that allow businesses, politicians, and individuals to avoid taking hard decisions, such as pursuing strong policies of behaviour change and regulatory penalties for corporates engaging in ecologically damaging practices, in favour of markets and 'Science' providing solutions in the near future. In this view, cultured meat could be seen as part of a mandate for inactivity that gives licence to societies to avoid hard decisions and strong actions that are required today. Based on publicly available data, it is difficult to imagine that within the next 5 years, cultured meat will both (a) be available as an affordable mass market product in multiple countries and (b) have meaningfully replaced conventional meat production and its various associated harms. We would tentatively suggest that such outcomes are currently ambitious to expect even within the next decade, and thus provide no such mandate for inactivity on all aspects of addressing climate crisis and food justice.

Clearly, the concern is that the future promise of a set of technologies that include cultured meat could be used to absolve politicians from the moral responsibility to act now. It is widely accepted that the next decade is critical for making substantial systemic changes to global food practices to mitigate against the most extreme consequences of climate change, as well as address other looming crises such as antimicrobial resistance. Critics have argued that the quantity of funds, time, and effort being expended on technofixes like cultured meat detract from supporting agri-food solutions that already exist, such as agroecology, which have established proof of efficacy and offer more ecologically holistic and socially democratic outcomes. Where some cultured meat advocates claim there is no time to reinvent capitalism and scale lower tech approaches from the ground up, a counter-argument could see cultured meat as a form of 'predatory delay' that enables the biggest perpetrators of agri-food-related harms to continue with business as usual as they wait for technofixes to be developed. It is important to note too that there is currently no certainty that cultured meat and other cellular agriculture products will ever be technologically or economically viable as larger-scale commercial enterprises, meaning they would be unable to deliver on their promises of global-scale benefits for societies and the planet.

5 Cultured meat and social change

Changes in the market for meat products could have associated changes in related labour markets (Newton and Blaustein-Rejto, 2021). Uncertainties about

the impact of cultured meat on the market thus introduce parallel uncertainties about labour market change (Stephens et al., 2018). A successful cultured meat sector would bring new employment opportunities, and even new job types, though not necessarily an increase in the number of overall food and agricultural jobs. The new jobs created by a cultured meat sector may contribute to the knowledge economy and economic growth within host nations. The impact on existing labour markets in livestock, meat processing, and associated sectors (such as feed production) depends on the substitution or addition effect of cultured meat as discussed earlier, as well as on the design and scale of cultured meat production systems. Declining livestock-based meat production would likely lead to less employment in the sector and those aligned to it. Certain technical requirements and economies of scales of cultured meat production, such as maintaining a sterile culturing environment, also favour automation over human labour. In such a context it may be relevant to discuss what 'just transition' (McCauley and Heffron, 2018) may look like in this context, as a set of social interventions to support workers whose jobs may be coming under threat to ensure workers and communities do not bear the costs of change. This given, an emergent cultured meat sector might offer new opportunities for a minority in terms of cell sourcing, working with heritage breeds, and the feed industry in producing input materials for cultured meat production, and also new possibilities in meat processing. A key discussion point is where these labour market shifts could occur, regionally and internationally.

Cultured meat presents potential opportunities and impacts for rural communities (Newton and Blaustein-Rejto, 2021). Some predict cultured meat will produce equal or greater amounts of meat than conventional livestock production on a significantly smaller land footprint. This could lead to the loss of agricultural businesses connected to conventional livestock production, which in turn could have significant sociocultural and economic impacts on rural communities. At the same time, job opportunities within conventional agriculture in places like the United States and United Kingdom have been on a downwards trend over recent decades. This is in large part due to the shift away from more labour-intensive mixed farming models to industrialised agriculture which has replaced the majority of on-farm jobs with mechanisation and chemical inputs.

Investing in rural and agricultural economies has been highlighted as a key priority in many countries. As discussed earlier, cultured meat may potentially offer new job opportunities that could benefit rural communities. Possible options for existing farmers could be to provide inputs to the cultured meat industry, such as donor cells and plant-based ingredients for the growth serum. Locating cultured meat production facilities in rural areas could provide new job opportunities; it is important that the quality, safety, and security of these jobs, as well as overall number, are assessed in comparison with those offered

by existing agricultural models, ranging from industrial to agroecological. There are a number of competing factors for choosing the location of cultured meat facilities which will determine the possible opportunities for rural communities: these include land price and existing infrastructure, as well as the ecological and economic savings of being close to energy sources (e.g. wind, water), key inputs (e.g. crops for growth serum), and concentrated customer bases (e.g. urban areas).

There are certain technical requirements and economies of scale that may result in cultured meat production being significantly automated and thereby requiring a reduced labour force compared with both industrial and more extensive, low-input agricultural models. If cultured meat catalyses large-scale rewilding efforts, another and possibly greater opportunity for rural communities may come from conservation and ecotourism. The development of a 'craft' industry of cultured meat production has also been envisioned by some in the sector. While the technical and economic feasibility of smaller-scale, on-farm facilities are yet to be evidenced, it is possible that craft-cultured meat enterprises could provide rural communities and food producers with new opportunities to develop artisanal, *terroir*-based food ventures that could also support the re-introduction of small herds of native and heritage livestock breeds.

Achieving optimal social and ecological goods through land-use change is far from automatic and currently a highly contested topic, particularly concerning the role of livestock in landscape stewardship. Ongoing research suggests that small numbers of livestock farmed in agroecological ways can potentially play a key part in climate solutions, particularly in nations like the United Kingdom that have climates suited to grassland. Advocates of rewilding promote a combined ambition of 'core' rewilded areas that exist beyond human intervention and supporting farmers to practice 'wilder' and 'nature-friendly' farming. More research is needed to consider what good practice in landscape stewardship could look like if cultured meat becomes a viable large-scale industry. Strong policies and commitments by the cultured meat industry will be needed to prevent any resultant land-use change leading to worse environmental and socio-economic impacts. Consideration of what a just transition to cultured meat could look like in terms of land-use change raises a number of issues, including the interconnected issues of carbon sequestration, biodiversity and habitat restoration, air and water pollution, inequalities in land ownership, livelihood opportunities and quality of work within food production, and ensuring public access to green spaces. It should also refrain from a one-size-fits-all model and instead acknowledge the specific geographies, ecologies, economies, and cultures of different landscapes.

Connected to the theme of landscape change are questions of global food security, and where cultured meat might be made and where it will be

consumed. Commentators have cautioned against the political economic forces that may see the cultured meat industry perpetuate colonial patterns of past and present food systems – i.e. where richer Minority countries have the economic and technical power to become the primary exporters of these novel foods to poorer Majority countries. This potential spatial organisation would further entrench the problematic model of global food security that has been widely criticised for placing primary emphasis on a nation's and individual's ability to *purchase* food, rather than having access to the means of producing food.

Conversely, some cultured meat proponents envision their technologies offering radically different geographical possibilities than conventional livestock given their unique uncoupling from the land. Small-scale cultured meat facilities offering localised food production and livelihood opportunities to inhabitants of refugee camps and remote rural communities around the world have been proposed (the technological and socio-economic viability of these scenarios have yet to be evidenced).

A further point to highlight is that food insecurity is an inherently geographical and geopolitical issue with a diverse range of drivers and nutritional characteristics. There has been a propensity for the narratives of the cultured meat industry to speak of food insecurity at the global scale and as an issue of insufficient overall quantity of food produced. The sector has also tended to characterise conventional animal agriculture as a homogeneous sector of practices and harms. These narratives risk neglecting the political economic factors that drive continued food insecurity in the world. Not only has food insecurity been shown to be a product of unequal distribution rather than insufficient quantity, but the role of protein in food insecurity issues is hugely context-specific – for example, it is widely established that most Minority countries consume enough, and in some cases too much, protein in their diets while protein remains deficient in a number of Majority nation populations.

6 Conclusion

If cultured meat is to achieve the most ambitious goals that have been set for it, then it will create significant change. However, exactly what that change will look like remains indeterminant. As such, at this stage, it is necessary for the collective discussion around cultured meat to remain open and reflexive about a diverse range of possibilities, and to retain a self-critical perspective. In this review of key talking points, we have outlined a number of visions for cultured meat, and discussed economic, political, and cultural aspects of these potential futures. This piece has aimed to be broad but concise, with each point introduced but not covered in depth. It is also not exhaustive, as uncertain futures open too many possibilities to make a fully comprehensive

account achievable. We have also offered little in the way of solutions or resolutions for these issues. But we hope to have raised some talking points, which will aid both those who are new to thinking about the technology and those who have been involved for an extended period, in keeping their thoughts on the broader social implications of the emergent world of cultured meat.

7 Acknowledgements

Neil Stephens' work was supported by a Wellcome Trust Research Fellowship (grant number WT208198/Z/17/Z). Alexandra Sexton's work was supported by a Leverhulme Trust Early Career Research Fellowship (grant number ECF-2020-105).

8 Where to look for further information

The following articles provide a good overview of the subject:

- Broad, G. M. (2019). Plant-based and cell-based animal product alternatives: An assessment and agenda for food tech justice. *Geoforum* 107, 223-226. <https://doi.org/10.1016/j.geoforum.2019.06.014>.
- Newton, P. and Blaustein-Rejto, D. (2021). Social and Economic Opportunities and Challenges of Plant-Based and Cultured Meat for Rural Producers in the US. *Frontiers in Sustainable Food Systems* 5. <https://www.frontiersin.org/article/10.3389/fsufs.2021.624270>.
- Stephens, N., Di Silvio, L., Dunsford, I., Ellis, M., Glencross, A. and Sexton, A. (2018). Bringing cultured meat to market: Technical, socio-political, and regulatory challenges in cellular agriculture. *Trends in Food Science & Technology* 78, 155-166. <https://doi.org/10.1016/j.tifs.2018.04.010>.
- Stephens, N., Sexton, A. E. and Driessen, C. (2019). Making Sense of Making Meat: Key Moments in the First 20 Years of Tissue Engineering Muscle to Make Food. *Frontiers in Sustainable Food Systems* 3, 45. <https://doi.org/10.3389/fsufs.2019.00045>.

9 References

- Adams, C. J. (2015). *The Sexual Politics of Meat - 25th Anniversary Edition: A Feminist-Vegetarian Critical Theory*. Bloomsbury Publishing.
- Bekker, G. A., Fischer, A. R. H., Tobi, H. and van Trijp, H. C. M. (2017). Explicit and implicit attitude toward an emerging food technology: the case of cultured meat. *Appetite* 108, 245-254. <https://doi.org/10.1016/j.appet.2016.10.002>.
- Broad, G. M. (2019). Plant-based and cell-based animal product alternatives: an assessment and agenda for food tech justice. *Geoforum* 107, 223-226. <https://doi.org/10.1016/j.geoforum.2019.06.014>.

- Bryant, C. and Barnett, J. (2018). Consumer acceptance of cultured meat: A systematic review. *Meat Science* 143, 8-17. <https://doi.org/10.1016/j.meatsci.2018.04.008>.
- Bryant, C. and Barnett, J. (2020). Consumer acceptance of cultured meat: an updated review (2018-2020). *Applied Sciences* 10(15), Article 15. <https://doi.org/10.3390/app10155201>.
- Bryant, C. and Dillard, C. (2019). The impact of framing on acceptance of cultured meat. *Frontiers in Nutrition* 6, 103. <https://doi.org/10.3389/fnut.2019.00103>.
- Bryant, C. J. and Barnett, J. C. (2019). What's in a name? Consumer perceptions of in vitro meat under different names. *Appetite* 137, 104-113. <https://doi.org/10.1016/j.appet.2019.02.021>.
- Dutkiewicz, J. (2019). Socialize lab meat. *Jacobin*. Available at: <https://jacobin.com/2019/08/lab-meat-socialism-green-new-deal>.
- Funke, F., Mattauch, L., van den Bijgaart, I., Godfray, C., Hepburn, C. J., Klenert, D., Springmann, M. and Treich, N. (2021). Is meat too cheap? Towards optimal meat taxation (SSRN Scholarly Paper No. 3801702). *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3801702>.
- Goldstein, J. (2018). *Planetary Improvement: Cleantech Entrepreneurship and the Contradictions of Green Capitalism*. MIT Press.
- Goodwin, J. N. and Shoulders, C. W. (2013). The future of meat: A qualitative analysis of cultured meat media coverage. *Meat Science* 95(3), 445-450. <https://doi.org/10.1016/j.meatsci.2013.05.027>.
- Hamdan, M. N., Post, M., Ramli, M. A., Kamarudin, M. K., Md Ariffin, M. F. and Zaman Huri, N. M. F. (2021). Cultured meat: Islamic and other religious perspectives. *UMRAN – International Journal of Islamic and Civilizational Studies* 8(2), Article 2. <https://doi.org/10.11113/umran2021.8n2.475>.
- Hamdan, M. N., Ramli, M. A. and Rahman, A. A. (2019). Penggunaan Sel Stem dalam Pengkulturan Daging: analisis Menurut Perspektif Hukum Islam: the Use of Stem Cells in Cultured Meat: analysis According to Islamic Law Perspective. *Journal of Fatwa Management and Research*, 18(1), 8-24. <https://doi.org/10.33102/jfatwa.vol18no1.2>.
- Hamdan, M. N., Ramli, M. A., Zaman Huri, N. M. F., Abd Rahman, N. N. H. and Abdullah, A. (2021). Will Muslim consumers replace livestock slaughter with cultured meat in the market? *Trends in Food Science and Technology* 109, 729-732. <https://doi.org/10.1016/j.tifs.2021.01.034>.
- Hopkins, P. D. (2015). Cultured meat in western media: the disproportionate coverage of vegetarian reactions, demographic realities, and implications for cultured meat marketing. *Journal of Integrative Agriculture* 14(2), 264-272. [https://doi.org/10.1016/S2095-3119\(14\)60883-2](https://doi.org/10.1016/S2095-3119(14)60883-2).
- Kenigsberg, J. A. and Zivotofsky, A. Z. (2020). A Jewish religious perspective on cellular agriculture. *Frontiers in Sustainable Food Systems* 3, 128. Available at: <https://www.frontiersin.org/article/10.3389/fsufs.2019.00128>.
- Krone, A. (2022). Religion, animals, and technology. *Religions* 13(5), Article 5. <https://doi.org/10.3390/rel13050456>.
- McCauley, D. and Heffron, R. (2018). Just transition: integrating climate, energy and environmental justice. *Energy Policy* 119, 1-7. <https://doi.org/10.1016/j.enpol.2018.04.014>.
- Newton, P. and Blaustein-Rejto, D. (2021). Social and economic opportunities and challenges of plant-based and cultured meat for rural Producers in the US. *Frontiers*

- in Sustainable Food Systems* 5. Available at: <https://www.frontiersin.org/article/10.3389/fsufs.2021.624270>.
- Painter, J., Brennen, J. S. and Kristiansen, S. (2020). The coverage of cultured meat in the US and UK traditional media, 2013–2019: drivers, sources, and competing narratives. *Climatic Change* 162(4), 2379–2396. <https://doi.org/10.1007/s10584-020-02813-3>.
- Rolland, N. C. M., Markus, C. R. and Post, M. J. (2020). The effect of information content on acceptance of cultured meat in a tasting context. *PLoS ONE* 15(4), e0231176. <https://doi.org/10.1371/journal.pone.0231176>.
- Rosenfeld, D. L., Rothgerber, H. and Tomiyama, A. J. (2020). Mostly vegetarian, but flexible about it: investigating how meat-reducers express social identity around their diets. *Social Psychological and Personality Science* 11(3), 406–415. <https://doi.org/10.1177/1948550619869619>.
- Ryynänen, T. and Toivanen, A. (2022). Hocus-pocus tricks and moral progressions: the emerging meanings of cultured meat in online news comments. *Food, Culture and Society* 0(0), 1–30. <https://doi.org/10.1080/15528014.2022.2027688>.
- Sexton, A. E., Garnett, T. and Lorimer, J. (2019). Framing the future of food: the contested promises of alternative proteins. *Environment and Planning. E, Nature and Space* 2(1), 47–72.
- Smaje, C. (2020). *A Small Farm Future: Making the Case for a Society Built Around Local Economies, Self-Provisioning, Agricultural Diversity and a Shared Earth*. Chelsea Green Publishing.
- Stephens, N. (2010). In vitro meat: zombies on the menu. *SCRIPTed: A Journal of Law, Technology & in Society* 7, 394–401.
- Stephens, N. (2013). Growing meat in laboratories: the promise, ontology, and ethical boundary-work of using muscle cells to make food. *Configurations* 21(2), 159–181. <https://doi.org/10.1353/con.2013.0013>.
- Stephens, N., Di Silvio, L., Dunsford, I., Ellis, M., Glencross, A. and Sexton, A. (2018). Bringing cultured meat to market: technical, socio-political, and regulatory challenges in cellular agriculture. *Trends in Food Science and Technology* 78, 155–166. <https://doi.org/10.1016/j.tifs.2018.04.010>.
- Stephens, N., Sexton, A. E. and Driessen, C. (2019). Making sense of making meat: key moments in the first 20 years of tissue engineering muscle to make food. *Frontiers in Sustainable Food Systems* 3, 45. <https://doi.org/10.3389/fsufs.2019.00045>.
- Treich, N. (2021). Cultured meat: promises and challenges. *Environmental and Resource Economics* 79(1), 33–61. <https://doi.org/10.1007/s10640-021-00551-3>.
- van der Weele, C. and Driessen, C. (2013). Emerging profiles for cultured meat; ethics through and as design. *Animals: an Open Access Journal from MDPI* 3(3), 647–662. <https://doi.org/10.3390/ani3030647>.
- Van Loo, E. J., Caputo, V. and Lusk, J. L. (2020). Consumer preferences for farm-raised meat, lab-grown meat, and plant-based meat alternatives: does information or brand matter? *Food Policy* 95, 101931. <https://doi.org/10.1016/j.foodpol.2020.101931>.