Mapping the potential for UK universities to become research and teaching hubs for cellular agriculture

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Summary

Cellular agriculture is a nascent but rapidly growing field that could contribute greatly to a sustainable future of food. Universities can play a major role in the field's development, housing open access research and training the talent pool for the industry, as recognised by recent launches of dedicated university-based centres of cellular agriculture in the US, Israel, and Canada. Here, we systematically analysed the potential of UK universities to become anchor institutions, or hubs, for this emerging field. We aimed to create a written and visual resource to help various stakeholders understand the academic landscape of cellular agriculture in the UK, its current state and future potential. The analysis was built on multiple indicators that were identified and integrated into a weighted factor model, which was then used to assess all UK universities. Data was gathered on research quality in relevant departments, known academic and student-led activities related to cellular agriculture, and the university's spinout ecosystem (general and field-specific). We present here the longlist of 17 universities with highest potential and their assessment according to our indicators, as well as an interactive map containing details of the universities' potential and current relevant activities. Several case studies of specific UK universities, as well as of existing university-based cellular agriculture hubs in other countries, are explored. It is notable that within the UK, there is currently no single university that clearly leads in cellular agriculture, but rather multiple high-potential universities with strengths in different areas. We believe that building on these will allow them to become cellular agriculture anchor institutions regionally and/or nationally, while complementing each other, in a collaborative effort to create a successful and internationally-competitive environment for this field in the UK. The report includes some suggestions for areas of further work to support the development of cellular agriculture hubs in the UK, such as establishment of a dedicated national academic network, incentivising academic-industry partnerships, development of teaching courses featuring cellular agriculture topics, support for student societies focussed on the field, as well as establishment of clear funding paths for cellular agriculture research.

Introduction

The exponential growth of the global population, which reached 8 billion in November 2022, is placing an unprecedented strain on the traditional animal agriculture industry. As global demand for animal products continues to rise, concerns about their environmental impact, associated public health risks, and animal welfare have increased. The future of food thus calls for more sustainable and equitable production and distribution systems. The UK government recognises this global issue and committed to invest £120 million into research across the food system, including alternative proteins, i.e. plant-based, fermentation and cultivated meat products, in the UK Government Food Strategy released in the summer of 2022. While plant-based products are relatively well-known, foods made via cellular agriculture, i.e. by growing animal cells *in vitro* or producing animal proteins via precision fermentation, have only started to emerge. The cellular agriculture field therefore offers a promising solution to the increasing demand for animal protein, without the negative impacts of traditional farming practices.

The Role of Universities in Advancing Cellular Agriculture

Universities are critical players in the development of cellular agriculture, as places for both education and open-access research. The interdisciplinary nature of this emerging field means it is essential to have experts from various areas, e.g. biology, engineering and food science, working together to develop and advance the technology. As the industry grows rapidly, there will be an increased demand for specialised individuals readily trained to join the sector in a variety of roles spanning from basic research to food safety to commercialization.

Universities can play a fundamental role in advancing research in cellular agriculture by conducting research and promoting open science (1, 2). Unlike industry-driven research that is often focused on proprietary knowledge and intellectual property, universities prioritise collaboration, open access to data, and the dissemination of knowledge for the public good. Academic research often takes place in less constricting time-frames compared to industry, giving researchers the opportunity to answer fundamental questions that might not have an immediate commercial value, but can provide a lot of benefits to the whole field. Moreover, research and data generated in the academic environment get to be peer-reviewed and potentially challenged by other researchers, increasing its robustness while contributing to the

pool of knowledge that other academics and industry players can build on, instead of duplicating the efforts.

UK universities have an excellent international reputation for providing high-quality education and research, attracting talent from all over the world. Many universities are located in and around London, a well-known innovation hub, while others embed themselves in strategic regional innovation ecosystems, making them well positioned to become anchor institutions for a developing field like cellular agriculture. As a recent study commissioned by the Government Office for Science finds, the UK in general has high potential within modern industrial biotechnology, particularly in the agribiotech and food sectors, having world-class research in these areas as well as a diverse range of companies working on commercialisation.

Defining a Cellular Agriculture Hub

Throughout this report, a cellular agriculture hub or anchor institution will be defined as a university-centred ecosystem that accelerates innovation and development within cellular agriculture. Such an ecosystem would involve high-quality teaching, research, and infrastructure that are specifically relevant to cellular agriculture. The goal of such a hub is to bring together researchers, students, and industry partners to facilitate collaboration and advance the field. This type of institution provides a supportive environment for both basic and applied research, as well as for technology transfer and commercialization. Evidence from the literature and from other countries' experience (see below) suggests that the presence of a strong cellular agriculture ecosystem can successfully foster innovation while also helping to attract funding from both industry and government, which can in turn further promote the field overall (1, 2).

Aims and Outcomes

We conducted a systematic analysis of UK universities to assess their potential as anchor institutions for cellular agriculture. By providing a comprehensive evaluation of the cellular agriculture academic landscape and potential in the UK, our work can help accelerate the growth of the sector, enabling stakeholders (e.g. students, academics, policy-makers and funders, companies in the space) to make better-informed decisions. Thus, our aims were as follows:

- Identify key components required for the successful establishment of a cellular agriculture anchor institution.
- Develop a comprehensive resource that provides an overview and understanding of the existing cellular agriculture academic landscape in the UK and its potential for future growth.
- Build the evidence base to support a debate around how the cellular agriculture field could develop in the UK – however the industry develops, universities will likely be key players.

Methodology and Results

We first gained understanding of the factors that contribute to the development of a cellular agriculture hub, based on the recently established centres in other countries (discussed later) and interviews with experts and stakeholders in the field, alongside other reports (1, 2) addressing similar topics. The following indicators for a university's potential were identified, which were then used as a basis for our systematic analysis (Fig.1).

- Academic and research strengths in relevant subjects: biological sciences, chemical engineering and food science
- Existing research in cellular agriculture
- Explicit interest from current students and staff
- Favourable spinout ecosystem (where technology transfer and commercialisation are encouraged)
- Geographic proximity and/or existing links with cellular agriculture companies

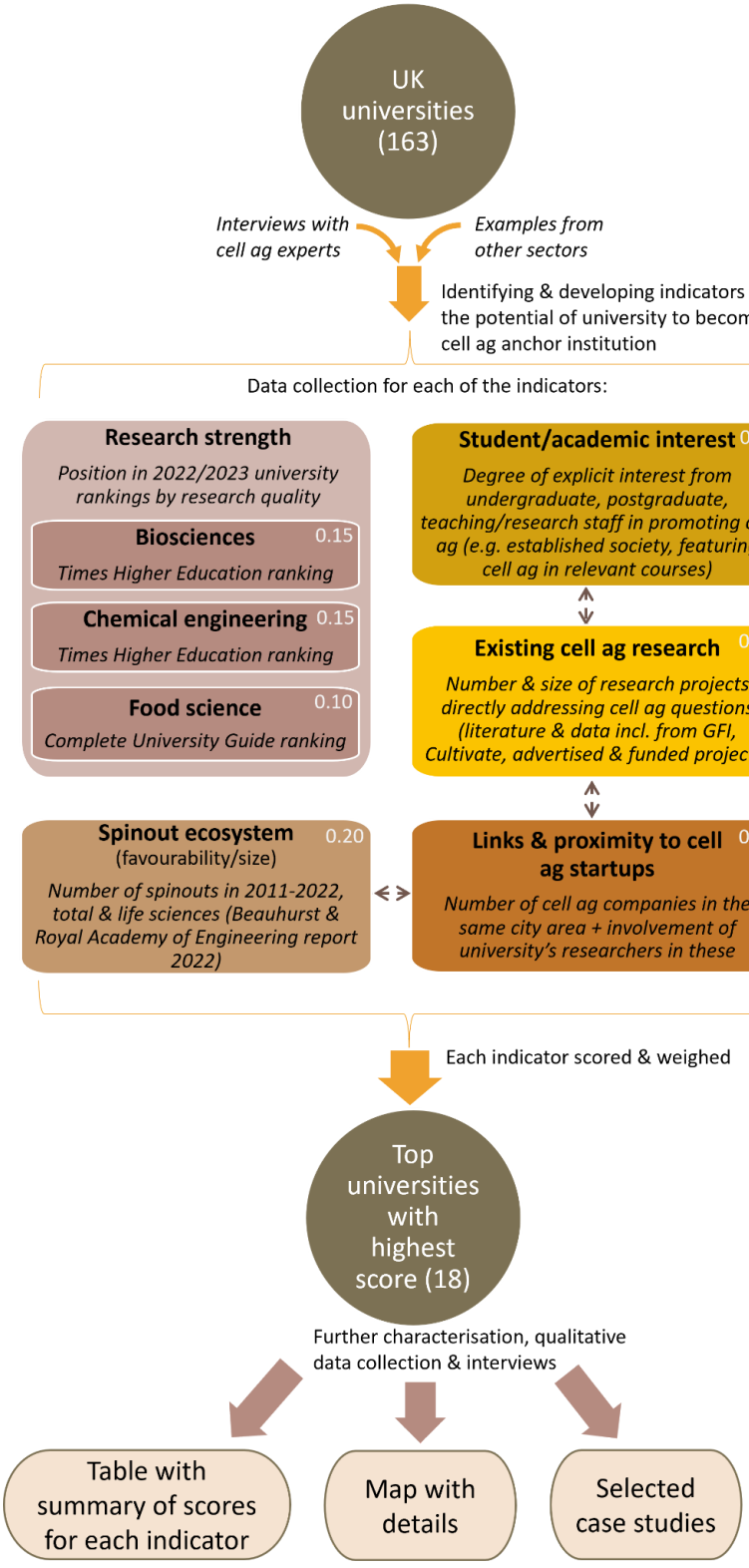
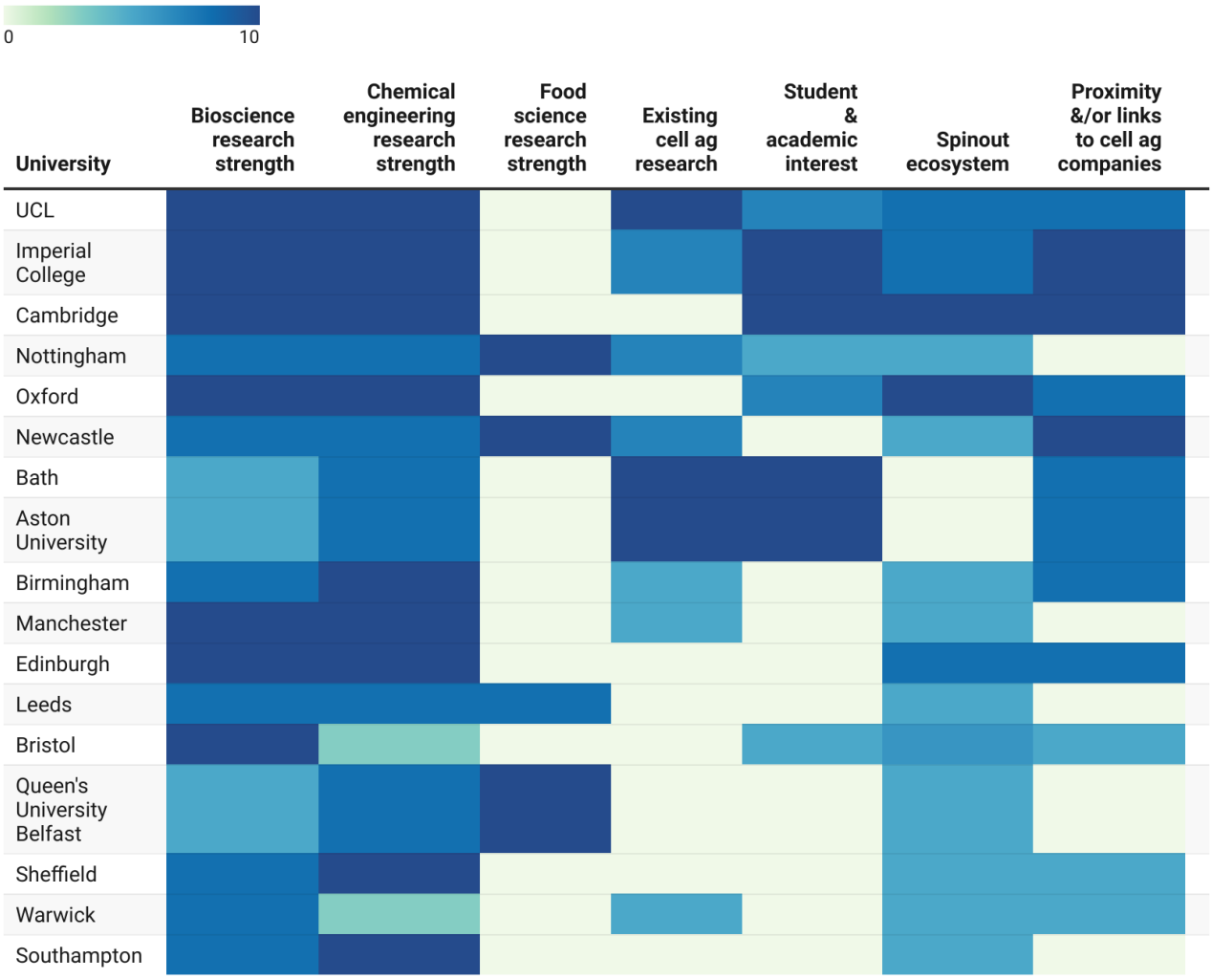


Figure 1. The process employed to systematically assess and characterise the potential of UK universities to become cellular agriculture anchor institutions.

Universities were then assessed according to these indicators. All accredited UK universities that feature teaching and research in biology and chemical engineering were taken into consideration. A scoring system was developed for each indicator based on thresholding (e.g. position in a certain percentile in the rankings). Scores for the more general indicators, i.e. “research strength” and “spin-out ecosystem”, were fully based on the referenced quantitative data. Scores for the other three indicators, that stem directly from pre-existing activity within cellular agriculture, were based on prior knowledge and qualitative data collection. To assess the overall potential, scores were combined using weighting factors (displayed in the top right corner for each indicator in Fig. 1). Details of the scoring system can be found in Appendix 1.

WIth this method, we identified 17 high-potential UK universities, presented in the table below (available also as interactive tool online).

UK universities potential in cellular agriculture - top universities



Created with Datawrapper

In order to make the information more accessible, we also produced an interactive map containing the above universities, including details on the qualitative indicators (notes on relevant researchers, student societies and companies). You can view the map following the link - [UK map of high potential universities for cellular agriculture]

Case studies

We selected five of our top 17 universities as case studies, in order to explore the current environment in more detail, and understand how close each of them are to becoming anchor institutions for cellular agriculture, if resources are allocated in the appropriate direction. We specifically selected universities located in different parts of the UK that also varied in their areas of strengths and potential.,

University of Cambridge

Cambridge is a world-leading research and teaching institution, ranking at the very top among universities not only in the UK, but also internationally. Research in biosciences and chemical engineering is particularly strong, conducted at multiple departments and associated research

institutes, although is predominantly focused on biomedical applications. There is no dedicated food science department, and to our knowledge no researchers currently working on cellular agriculture topics.

Among UK universities, Cambridge has the oldest and the most active student group, currently known as Cambridge Alternative Protein Project. Aside from webinars and other events, the group has organised an online facilitator-led course focusing on various aspects of transition to sustainable proteins, in collaboration with a local Effective Altruism group and the Good Food Institute. Moreover, they are actively trying to catalyse relevant research at the university, undertaking academic mapping and reaching out to researchers that could potentially work on problems in cellular agriculture. Together with Cornell University, the society is also currently undertaking a literature review project, where students in small groups under expert supervision are writing scientific reviews on topics within the field.

Cambridge is home to many R&D companies, from big pharmaceutical companies like AstraZeneca to small start-ups, often spinning off from the university's research. In the UK, the university is second only to Oxford in terms of number of spinouts established in years 2011-2022, with 137 spinouts (among which 54 in life sciences) in that period. There are multiple science and research parks with appropriate facilities in and around the Cambridge area, although demand for these currently far outstrip the supply. Two start-ups focusing on cultivated meat are already based in Cambridge, Higher Steaks and Animal Alternative Technologies. Higher Steaks is one of the early UK cultivated meat companies founded in 2018 and recently having moved to Cambridge, focusing on cultivated pork; Animal Alternative Technologies is a B2B bioprocessing hardware & software spinout from Cambridge University itself. In addition, Qkine, a local company developing growth factors for stem cells, has cellular agriculture as one of their focus application areas.

Cambridge has an extensive innovation ecosystem, and university-affiliated organisations such as Cambridge Judge Business School and the Institute for Sustainability Leadership could bring together various stakeholders interested in cellular agriculture. Overall, Cambridge University has resources, talent pool, and infrastructure making it one of the more obvious contenders for cellular agriculture anchor institution; however, efforts are still absolutely required to realise this potential, especially for developing and attracting academic interest in cellular agriculture, and for its introduction in research and teaching at the university.

Imperial College London

Imperial College London is a world-class university, with particular strengths in Engineering, Natural Sciences, Medicine and Business. Within Biosciences, it is well known for its Centre for Synthetic Biology. Although Imperial College does not offer degrees in food science specifically, it is home to research dedicated to food systems, via its Centre for Translational Nutrition and Food Research, focusing on topics in Nutrition, Foods and Health; Intelligent Food Design, Engineering and Monitoring; Economics and Policies of Foods; and Food Security.

In the space of alternative foods and precision fermentation, the laboratory of Dr Rodrigo Ledesma-Amaro works on the production of microbial foods and ingredients. His research is developing novel processes to produce food products such as proteins, fats, fibres, vitamins, aromas, textures, colourants, antioxidants, and sweeteners in a sustainable manner. He is also working on the production of microbial biomass as a whole food source, enhanced in nutritional properties using synthetic biology and genetic engineering, as well as carrying out research in microbial communities and fermentation processes driven by industrial microbiomes. Other groups working on projects related to microbial foods and ingredients are those of Prof Gary Frost, Prof Karen Polizzi, Prof Patrik Jones, Prof Peter Nixon, James Murray, Prof Tom Ellis, Prof Guy-Bart Stan, Jose Jimenez and Claire Stanley. There is also an active student society, founded in 2022, dedicated to alternative proteins, organising talks with local industry professionals and other events.

Imperial has a well-developed entrepreneurial environment and infrastructure necessary for spinouts, with facilities such as White City Incubator and Scale Space run by or in collaboration with the university. Multus, a company focusing on culture media for cultivated meat, was founded by Imperial students and has taken advantage of facilities above, alongside other cultivated meat and precision fermentation companies in London such as Good Dog Food, Eden Bio, and Perfect Dairy. SynbiCITE, the national centre for commercialisation of synthetic biology technologies, is based at Imperial College. SynbiCITE is promoting academic-industry partnerships, actively participating in supporting the translation of research in the food space and working closely with multiple startups in the alternative protein and food space.

Imperial College London thus appears to be a prime example of how an institution can leverage its expertise in a specific area, e.g. synthetic biology, combining it with a favourable

commercialisation ecosystem. This results in great potential for Imperial to become an academic anchor within the precision fermentation sector of cellular agriculture.

University of Nottingham

The University of Nottingham is part of the prestigious Russell Group of research-intensive universities. Among other subjects, it is ranked highly for its research and courses in agriculture, veterinary medicine, and chemical engineering. It is also one of the few high-ranking UK universities that has an explicit focus on Food Science, conducting relevant research across Divisions of Food, Nutrition & Dietetics and Microbiology, Brewing & Biotechnology, as well as offering both graduate and undergraduate Food Science degrees. The university identifies Future of Food as one of its "Beacons of Excellence", and is launching a new Food Systems Institute in late 2023. Within its Future Protein Platform, there are currently two PhD students working on single cell protein sources, while research at the Biodiscovery Institute focusing on tissue engineering could also play into the cellular agriculture area, e.g. exploring 3D meat structuring.

One of the faculty members of Future of Food university's team is Prof Ramiro Albeiro, who has recently applied his Developmental Biology expertise to research into cell lines for cultivated meat productions. Specifically, his team in collaboration with Prof Austin Smith (formerly Director of Stem Cell Institute in Cambridge, currently Director of the Living Systems Institute at the University of Exeter) has developed methodology for the derivation of embryonic stem cells in multiple domestic animal species. This technology, named "Pluricells", is now commercially available on licence from the University of Nottingham, and is being further developed by the university research staff

Students on Biotechnology masters programme are introduced to the field of cellular agriculture as a prospective career choice highly relevant to their skills, although at the moment there is no active student society related to this space.

Building on its strength in collaborative animal stem cell research and latest food sustainability initiatives, the University of Nottingham has a high potential to become a cellular agriculture anchor institution, especially if it is able to further promote students' and researchers' interest in the field, as well as support spinouts in the space.

Aston University

Aston University was voted 'University of the year 2020' by The Guardian, and named an 'Outstanding Entrepreneurial University' by the Times Higher Education Awards. While cellular agriculture is not yet officially on the curriculum, it is being offered as a research subject for final year projects in the Schools of Infrastructure and Sustainable Engineering, Engineering and Technology and Psychology, thus making students from different academic disciplines aware of this emerging field. At the start of the next academic year (2023-24) there is a plan from Dr Jason Thomas to add 3 hours of lectures and workshop on 'Perceptions of Cultivated Meat' as part of a 3rd year module on Eating Behaviour. Similarly, Dr Eirini Theodosiou is aiming to deliver a 2 hour lecture as an introduction to cultivated meat from the manufacturing perspective, during her 4th year MEng Chemical Engineering module 'Downstream Processing for Biotechnological Products'. Currently, there is no dedicated student society, but the academic body has also started to introduce the cellular agriculture field in various outreach activities, such as Aston Original video and Society Matters Live public lecture, which could further promote university members' interests.

At the postgraduate and research level, there is currently a PhD student working in the development of edible microcarriers for cultivated beef (in Engineering for Health Research group), whilst there are three additional PhD positions at the recruitment stage (two on biomaterials within the Engineering for Health Research group, and one on consumer acceptance within the Applied Health Research group). The multidisciplinary team of materials engineers, bioprocess engineers and psychologists, explore how biomaterials and consumer perceptions can influence the pathway to market of the cultivated meat products. The Aston academics are also collaborating on cultivated meat projects with Dr Petra Hanga's lab at UCL and Reading Scientific Services Ltd, whereas the presence of a Birmingham-based cultivated meat company (Quest Meat, where Dr Hanga is a co-founder and CSO) offers the opportunity to establish additional working partnerships in the near future.

Due to its active and diverse academic engagement in both research and teaching, links with emerging industry, as well as its central location, Aston University is an environment that could become an anchor institution for cellular agriculture. Several components can be targeted to

facilitate this further, such as more active research in biosciences, support for the university's spinouts, as well as mobilisation of the student community.

University of Edinburgh

With a long-standing reputation as one of the UK's most esteemed universities, the University of Edinburgh has a robust research foundation in life sciences, biotechnology, and agriculture. The university has a number of research centres and institutes that could play a role in advancing cellular agriculture, including the Roslin Institute, which is a world leader in animal genetics and genomics, and the Centre for Regenerative Medicine, which focuses on developing new therapies based on stem cells and tissue engineering.

University of Edinburgh's Roslin Institute has a long history of research in animal genetics and breeding, most notably being the birthplace of Dolly the sheep, the first mammal to be cloned from an adult cell. The institute has since gone on to make further breakthroughs in the field of genomics, including the sequencing of the chicken and pig genomes. Currently, Roslin Technologies, a company established in 2017 by the Roslin Institute, commercialises high quality animal cell lines for use in the cultivated meat sector. The company still maintains a partnership with the parent institute and is located on the university campus. This can provide great opportunities for R&D academic-industry collaborations, as well as for university's students to gain exposure to the field of cellular agriculture through potential research projects and internships with Roslin Technologies.

In general, University of Edinburgh has a favourable spin-out ecosystem, especially in life sciences. The university has a dedicated commercialisation service, Edinburgh Innovations, and has spun out 18 life science companies until 2021. It is also embedded within Scottish Government development initiatives and funds, being a key part of Edinburgh Science Triangle, a partnership that includes among others research institutes, science parks and technology transfer organisations in the local area.

In addition to its research expertise, the University of Edinburgh has a strong teaching program in life sciences and biotechnology. However, student knowledge and interest in cellular

agriculture is currently limited. At the moment there are no academics working on cellular agriculture topics within the university.

In conclusion, the University of Edinburgh has significant potential to become a leading research and teaching hub for cellular agriculture, with its expertise in animal genetics, genomics, and tissue engineering, as well as strong academic-industry partnerships in relevant areas. However, to realise this potential the university would have to attract interest in cellular agriculture from its current and future research and teaching staff. This in turn could raise awareness of the field within the student body, whose initiatives would also be very beneficial to promote it further within the university.

University-based cellular agriculture centres worldwide

Outside the UK, there are already a few examples of universities establishing research centres, hubs and consortia focused on cellular agriculture. These hubs first emerged in the US, with Tufts University in Boston acting as an anchor institution on the east coast, and University of California Davis (UC Davis) on the west coast.

At Tufts, Prof David Kaplan's lab has conducted one of the earlier and most extensive cellular agriculture research programmes, hosting many New Harvest PhD Fellows as well as developing courses at undergraduate level. Building on this, in 2021 Tufts University Centre for Cellular Agriculture (TUCCA) was established. TUCCA combines the university's expertise in tissue engineering, nutrition science and veterinary medicine, with more than a dozen senior faculty members currently affiliated. The centre also offers in-person and online teaching, including first graduate certification in cellular agriculture, hosts conferences and events, and is actively involved in outreach to schools and development of shared educational resources. TUCCA engages closely with industry, for specific projects via sponsored research agreements, as well as recently establishing a consortium involving various stakeholders, including cultivated meat start-ups, big biotech and reagent provider companies, and nonprofits. TUCCA has been funded with a US Department of Agriculture 5-year grant of 10 million USD, specifically aimed at both research and teaching programmes in the cultivated meat space. The grant involves a collaborative effort with another 5 US universities (MIT and University of Massachusetts also in Boston, Virginia Tech and Virginia State, and UC Davis).

UC Davis is home to its own Cultivated Meat Consortium (CMC), officially established in 2019. It builds on the university's Biotechnology Program, and was originally catalysed by the interactions between students of the program with the state's extensive ecosystem of start-ups in the alternative protein space, including invited seminars from industry experts and graduate student internships at the relevant companies. Research programmes on cultivated meat have then developed, starting from Prof David Block's lab at Chemical Engineering department, as well as later leveraging university's expertise in animal and food science. Cellular agriculture features extensively in the Biotechnology graduate program, in addition to dedicated short courses and seminars organised by the consortium. The consortium has its own administrative support, and has received National Science Foundation (NSF) grants to support its research, as well as dedicated funds for graduate students' research in cellular agriculture, co-funded by New Harvest. It is also involved in public-private partnerships.

In the last year, the establishment of two more cellular agriculture centres with universities as anchor institutions has been announced. In Canada, University of Alberta will host the new Institute of Cellular Agriculture at its Agri-Food Discovery Place (part of the Agricultural Food & Nutritional Science Department), developed in collaboration with New Harvest Canada and CULT Food Science, a platform for commercial cellular agriculture product development. The partnership aims to support venture opportunities and IP development in the space, while also providing industry-integrated opportunities for students and researchers. Meanwhile, at Technion, Israel Institute of Technology, a Sustainable Protein Research Centre (SPRC) is being established, in collaboration with the Good Food Institute. Israel is already home to a high number of researchers and startups in the alternative protein space, and SPRC hopes to act as a hub and further promote both fundamental and applied multidisciplinary research in the field. With a 5-year budget of 20 million USD, the centre is aiming to attract new faculty as well as construct a FoodTech Innovation Centre.

Successful examples from other countries are important to understand the potential of UK universities, and to further develop some of them into cellular agriculture research and teaching hubs. As described above, universities can build on their various strengths, from existing research excellence to student involvement and links with local industry. The established anchor institutions can then focus on different aspects, such as interdisciplinary research (incl. collaborations within and between universities), teaching at various levels, outreach, and/or commercialisation. The level of funding these centres receive and its sources (universities, governmental agencies, philanthropic bodies) also warrants consideration.

Conclusions & ways forward

From the systemic mapping conducted here, we observed and highlighted the potential of multiple UK universities to lead the way in research and teaching in cellular agriculture. While known research and technology hubs such as Oxbridge and London universities have a lot of necessary components to also become hubs in this field, there are also clear positive prospects for cellular agriculture anchor institutions in the Midlands and the North.

Domain-specific strengths

Our analysis shows that UK universities with high overall potential in cellular agriculture nevertheless vary considerably in their strengths in different domains. For instance, within our very top universities, UCL, Imperial, and Cambridge have the strongest bioscience and chemical engineering research, while Nottingham has dedicated focus to food science and the sustainable future of food specifically; similarly, Nottingham, UCL, and Imperial already have ongoing research within cellular agriculture, although focused on different areas, while Cambridge has most extensive targeted initiatives from students and considerable support for spin-outs, but no directly employed scientists working in the field. Such domain-specific mapping could point to opportunities for specialisation (e.g. in research, training talent, commercialisation etc) and/or for targeted resource allocation to fulfil the full potential of a particular university as a cellular agriculture anchor. We also hope it could serve well to different stakeholders, such as academics looking to start cellular agriculture research programmes, students looking to apply for courses or research projects, companies looking to collaborate with universities, as well as funders and policy-makers.

Building collaborations, networks and partnerships

Overall, in light of different strength areas of UK universities as it relates to their potential in cellular agriculture, it is clear that collaboration between the institutions would be extremely beneficial. This could be promoted by launching a national academic network, scientific society, or consortium focused on this area. Currently, there are a few small non-profit organisations that at least in part target students and researchers in cellular agriculture in the UK, including Cultivate UK and Cellular Agriculture UK. These aim to act as forums, organise events,

outreach, and/or provide landscape overviews for the field (e.g. 1, 2). The European branch of the Good Food Institute, the biggest international non-profit in the space, also engages actively with students, academics and policy-makers in the UK. However, establishing a more formal and expansive UK-specific network, with official affiliations from universities and other cellular agriculture ecosystem members, could be necessary to promote collaborations on specific research and teaching programmes, as well as to attract funding. On the industry side, a similar network - Alternative Protein Association (APA) - was launched in March 2022. APA is an organisation of commercial companies in the space, aiming at promoting alternative proteins, including cellular agriculture-based products, in the UK; they have recently published a policy report including recommendations for government regulation and innovation support of cultivated meat and recombinant proteins. APA's work would complement any potential collaborative university efforts.

In our view, academic cellular agriculture anchor institutions would primarily aim to drive open fundamental research. Compared to the US, there is not as much focus on entrepreneurship and commercialisation of research at UK universities, so to translate the scientific advancements into applied innovation, industry partnerships and consortia are needed. A successful example of this in a related area could be the Bioprocessing Research Industry Club (BRIC), a partnership between UKRI and industry to fund projects supporting bioprocess research and innovation. BRIC's projects were industry-led, but involved many academic partners, as well as included a dedicated doctoral training program. Interestingly, BBSRC and Innovate UK have just this year opened two calls - for feasibility studies and for industrial research on novel low-emission food production systems - with specific focus on alternative proteins, and similar requirements for academics applying to the calls to collaborate with local businesses.

The role of teaching and students

Further to the role of universities for training professionals in the field, we note that there are currently no dedicated cellular agriculture courses offered by UK universities. However, as a topic it is featured in some Biotechnology and Biomedical/Chemical Engineering courses at those universities where scientists are actively engaged in relevant research, e.g. at Aston, Bath, UCL and Nottingham. In the future, courses not only in STEM areas but in social sciences and humanities as well could incorporate various aspects of cellular agriculture [Appendix Table]. Student societies focused on alternative proteins are another part of a cellular agriculture

anchor institution's environment; these can play a role in increasing awareness of the area among university members at all levels, e.g. through invited speaker seminars and even short extracurricular courses.

Funding Opportunities

Given the growing demand for sustainable food production practices, the potential of cellular agriculture cannot be overlooked, and so commitment from government policy-makers, regulators, and funders is also key. Whether it is for a specific anchor institution or a collaborative network, clear funding paths must be established. Based on related areas in UK and experience of other countries, this could be a combination of (1) industry funding, (2) government funding - likely from UKRI and its councils (e.g. BBSRC, Innovate UK), who have already last year identified their priorities within the alternative protein sector, as well as (3) philanthropic agencies focused on cellular agriculture and alternative proteins, such as the Good Food Institute, New Harvest, and/or focused on sustainability and animal welfare in general (e.g. Bezos Earth Fund, Jeremy Coller Foundation, Footprint Coalition).

Update: First announcement of a Cellular Agriculture Hub in the UK – University of Bath as an anchor institution

Data collection and work on this report were conducted from November 2022 to March 2023. Just as the report was being released in April 2023, UKRI and the University of Bath announced the establishment of Cellular Agriculture Manufacturing Hub (1, 2). This initiative is set to run for 7 years, initially focusing on cultivated meat and alternative production of palm oil. It has attracted an investment of £12 million - the largest single grant for alternative protein research by the UK government to date. Professor Marianne Ellis and her colleagues from the University of Bath are leading the interdisciplinary project, which also involves collaboration with UCL, University of Birmingham, University of Aberystwyth and the Royal Agricultural University; besides, multiple companies are mentioned as project partners, including Hoxton Farms, Ivy Farms, 3D Bio-Tissues, Quest Meat, Roslin Technologies, and others. This example highlights the ongoing development of cellular agriculture in the UK, and underscores the significant potential of universities to drive the field forward.

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