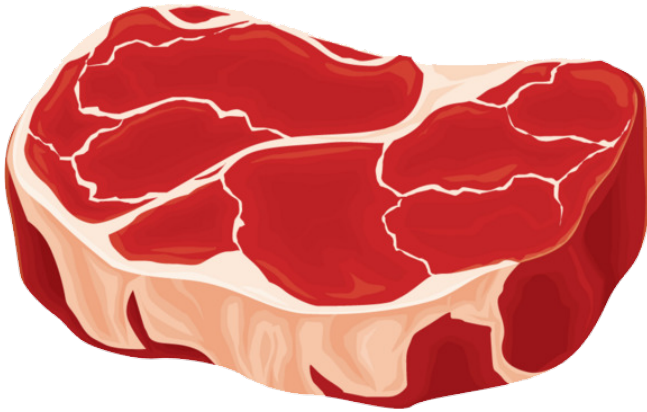


APPLICATION BRIEFING

CULTIVATED MEAT



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Emissions from livestock account for 14.5% of all human-induced greenhouse gases worldwide¹. Cultivated meat promises to curb these while remaining cost-effective and removing animal welfare concerns². Singapore and the US have become the first countries in the world to approve the sale of these products³, while the UK's Food Security Agency (FSA) is currently reviewing evidence⁴. However, numerous complex challenges remain before cultivated meat can be commercially, technically, and environmentally viable at a large scale^{5,6}. This note summarises current evidence and discusses relevant policy issues.

Background

How is cultivated meat made?

Cultivated or lab-grown meat is produced by growing animal cells in a sophisticated container filled with a slurry of nutrients (bioreactor). The cells use the nutrients or 'growth medium' to grow and multiply. These cells are then differentiated into different cell types and processed for human consumption. Over time, these cells will form muscle tissue.

Environmental promises

The environmental impact of traditional livestock farming comes from various sources. Land conversion for pasture or feed production, freshwater consumption, manure and digestive processes are the primary sources of pollution^{7,8,9}. Cultivated meat promises to drastically reduce land and water consumption, with the primary source of emissions being the energy used for growth medium and meat production¹⁰.

Overview

- Cultivated meat could curb greenhouse gas emissions and provide highly skilled jobs.
- The environmental, economic, and technical feasibility of cultivated meat at a large scale requires numerous scientific breakthroughs.
- Investment in research would also benefit the pharmaceutical and broader biotech sector.
- Environmental impact assessments, food labelling and safety standards can ensure consumers make informed choices.
- Renewable energy must be used to power cultivated meat plants in order to ensure their sustainability compared to traditional meat products.

Economic promises

No cultivated meat company has been operating commercially on a large scale. However, some preliminary analyses using data from 15 industrial partners have suggested the economic feasibility of scaled-up cultivated meat production, if certain major challenges are overcome.¹¹

The Challenges

Multiple recent analyses have raised serious concerns about the feasibility of scaling up the industry both from technical and sustainable points of view. Three main challenges affect the future of cultivated meat.

Growth Medium

The growth medium contains nutrients such as vitamins, minerals, sugars and amino acids used by the cells to grow and multiply. The level of refinement of the growth medium correlates to the energy required for cultivated meat production¹². A highly refined growth medium is energy-

intensive and costly⁶. The level of refinement required in a scaled-up industry is still unknown, but scientists, consultancies and non-profit organisations are currently trying to figure this out^{6,7,13}. Some studies suggest that food-grade requirements could make cultivated meat competitive with traditional livestock meat¹¹. However, if pharmaceutical-grade practices are used, numerous technological breakthroughs would be required to make cultivated meat financially and environmentally viable^{6,13}. A highly refined medium is likely necessary due to the culture not having an immune system and being susceptible to viruses and contamination.

Reactor Size

Studies showing the environmental feasibility of a scaled-up cultivated meat industry have assumed small and cheap reactors¹¹. However, this contradicts the requirement for large high-grade reactors to reduce costs and avoid contamination losses. One estimate to make cultivated meat feasible requires around a third of all the reactor capacity in the pharmaceutical industry^{11,13}. Technological breakthroughs are needed to produce the cultivated meat industry's reactor capacity. These innovations would also benefit the pharmaceutical industry¹³.

Cell Density

Our current scientific understanding suggests that there are physical and chemical limits to the density of cells in a reactor⁶. These constraints limit the return on investment and scalability of cultivated meat.

The Opportunities

Growth Medium

Developing a highly refined growth medium cheaply is important for the cultivated meat and pharmaceutical industry^{6,13}. A Newcastle University spin-out has already taken a step forward in this direction by producing medical-grade growth medium from forestry byproducts¹³. Plant-based growth mediums derived from soybeans promise to be cheap and environmentally friendly¹⁴. However, if cultivated meat were to replace a significant portion of the traditional meat market, it could exacerbate deforestation resulting from increased demand for soybean plantations¹⁵.

Specialised Jobs

The UK is next in line to approve the sale of cultivated meat products and has the strongest biomedical pipeline in Europe¹⁶. The cultivated meat sector could boost highly skilled jobs.

Policy Recommendations

Environmental Impact Assessment

The potential environmental benefit of cultivated meat is a key concern, with 40% of UK consumers who are already willing to try lab-grown meat, would do it for sustainability reasons¹⁷. Therefore, it is imperative to ensure that cultivated meat production facilities uphold their promises of reduced environmental impact. However, the sustainability of cultivated meat plants is unclear, and some scholars

suggest it might never be achieved^{6,12}. Regulations requiring a comprehensive environmental impact assessment of any new cultivated meat facility would be important to confirm claims regarding environmental benefits.

Clean Energy Sources

Cultivated meat facilities powered by fossil fuels could have up to 25 times larger environmental footprint than conventional meat^{5,9,18}. Some estimates suggest that if renewable sources are used, the environmental impact of beef could be reduced by 93%^{2,11}. Government and regulatory bodies should incentivise cultivated meat companies to adopt renewable energy sources. The World Energy Outlook suggests that investment in clean energy has risen by 40%, and manufacturing capacity is expanding at pace worldwide¹⁹.

Standards and Labelling

The US and Singapore have deemed some cultivated meat products safe to eat^{4,5}. If the FSA approves cultivated meat products entering the market, it is crucial to establish clear food safety standards and labelling regulations. This will help consumers make informed choices and trust the safety and sustainability of the products.

Education and Public Awareness

Preliminary survey results show that 30% of UK consumers would be willing to try meat¹⁸. Educating the public about cultivated meat's potential benefits and challenges could increase this figure. This could be through information campaigns or public consultations.

Investment in Research and Development

Numerous challenges remain before cultivated meat can be financially and environmentally feasible^{6,7}. Resolutions of these challenges would likely have important effects in the pharmaceutical and broader biotech industry^{6,13}. Investing in research and development could shine more light on the feasibility of this new industry.

Collaboration with Industry

Close collaboration with industry stakeholders could provide important feedback on whether regulations are practical and effective. Regular consultations or establishment of an industry advisory group would also help this.

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