

La carne coltivata. Cos'è? Come si produce? Le sfide attuali

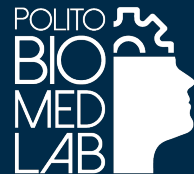
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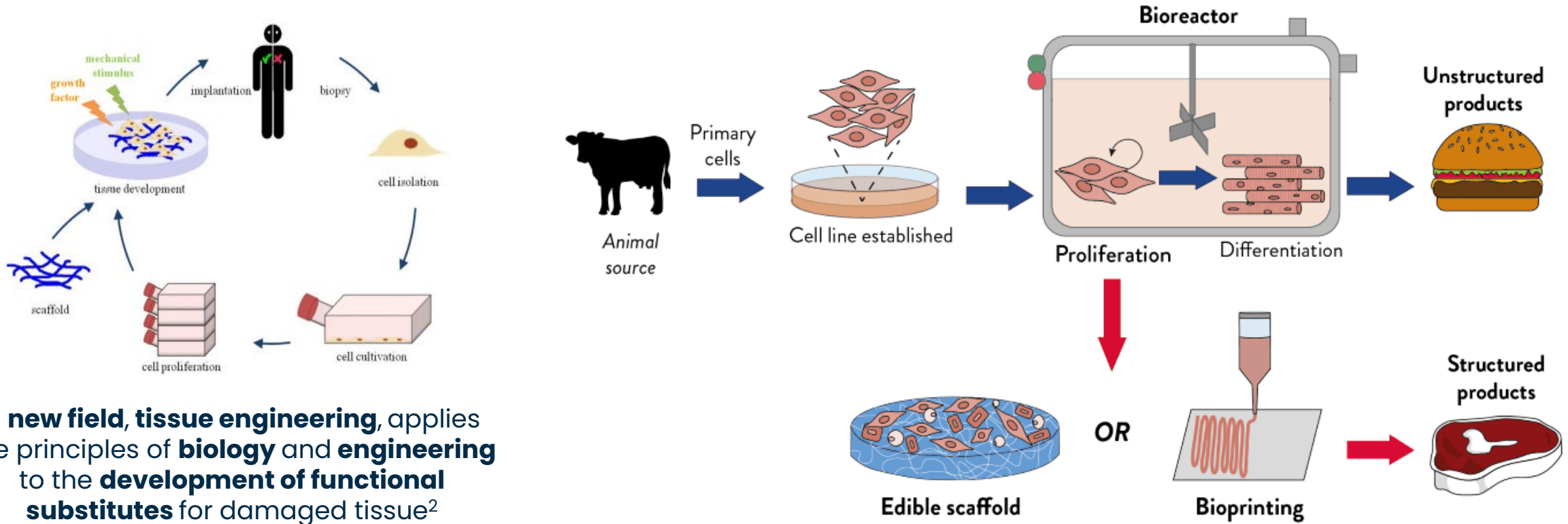


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Cos'è e come si produce la carne coltivata?

Mark Post (2012): “As one of the **alternatives for livestock meat production**, **in vitro culturing of meat** is currently studied. The **generation of bio-artificial muscles from satellite cells** has been ongoing for **about 15 years**, but has **never been used** for generation of meat”



A new field, **tissue engineering**, applies the principles of **biology** and **engineering** to the **development of functional substitutes** for damaged tissue²

Schema del processo di produzione della carne coltivata³

[1] Post, *Meat Sci.*, 2012
 [2] Langer and Vacanti, *Science*, 1993
 [3] <https://www.amsbio.com/cultured-meat/>

Esempi di prodotti a base di carne/pesce coltivata/o

Aleph Farms (Israele)



Memphis Meat (UPSIDE Foods, USA)



Shiok Meats (Singapore)



WILDTYPE (USA)



Meatable (Paesi Bassi)



Vantaggi della carne coltivata

La domanda di carne sta aumentando a livello globale⁴ e tale richiesta non potrà essere soddisfatta dalla produzione convenzionale⁵

(FAO: 360 milioni di tonnellate di carne prodotta nel mondo)



Riduzione di uso di terreno, consumo di acqua e tempo di processo⁶
(terreno, acqua e risorse sono limitate)



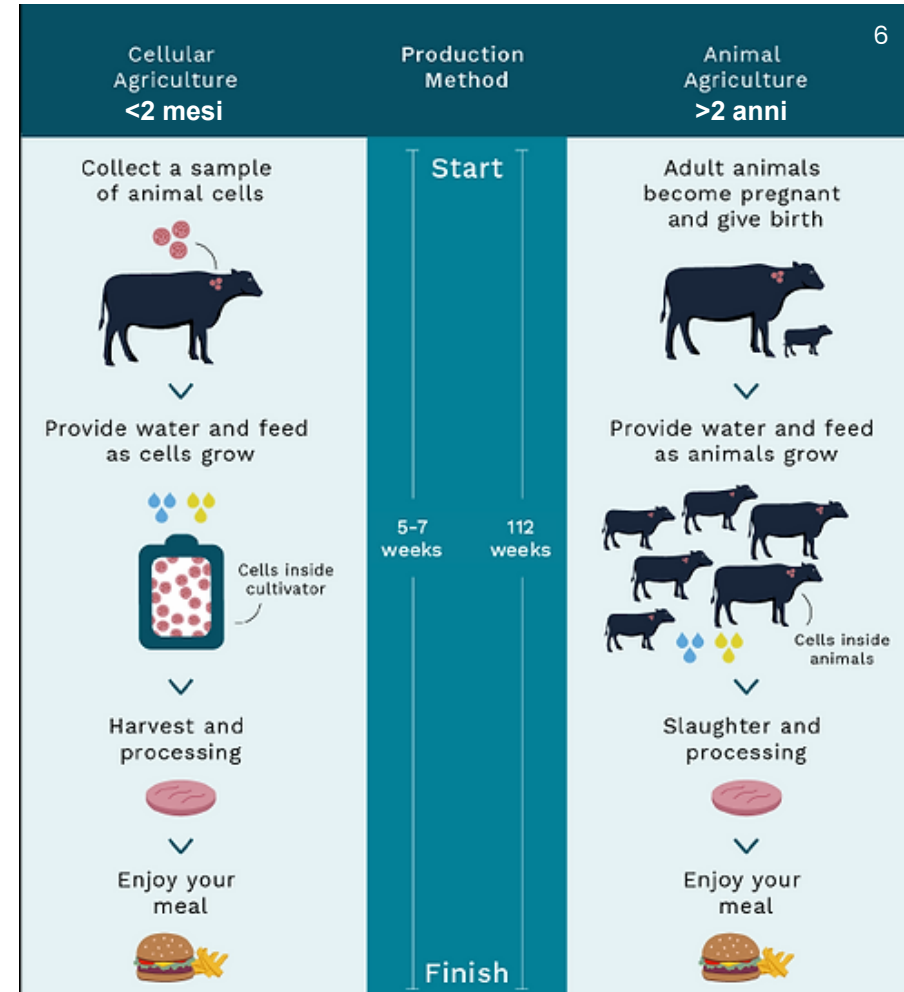
Riduzione dell'emissione di gas serra⁷
(impatto ambientale degli allevamenti intensivi)



Riduzione di rischi sanitari legati a malattie causate da batteri e dovute a spillover/salto di specie⁸
(uso di antibiotici)



Riduzione di problemi etici legati al benessere animale



6

[4] FAO Food Outlook – Biannual Report on Global Food Markets, 2022
 [5] Ben-Arye and Levenberg, *Frontiers in Sustainable Food Systems*, 2019
 [6] <https://www.whatiscultivatedmeat.com/process>
 [7] Sinke and Odegard, *LCA of cultivated meat*, *CE Delft*, 2021
 [8] Bonny et al., *Journal of Integrative Agriculture*, 2015

A che punto è lo sviluppo del mercato della carne coltivata?

2013

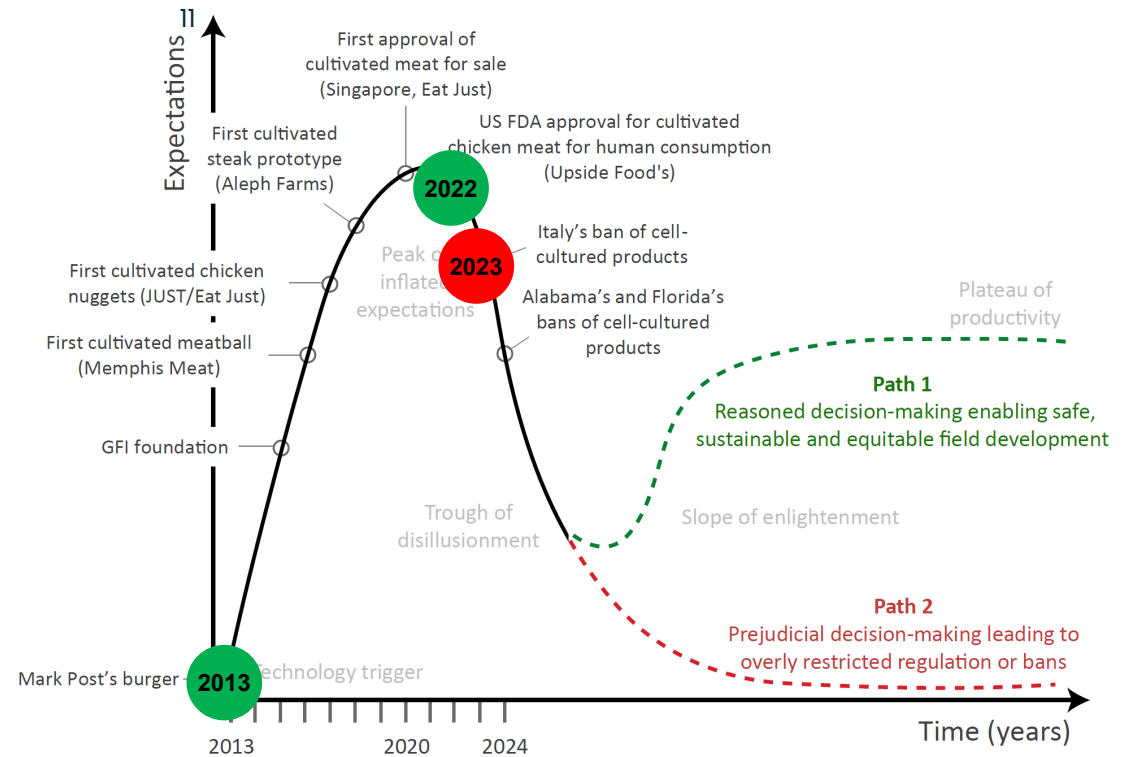


Primo hamburger a base di cellule coltivate di bovino realizzato da **Mark J. Post**, fondatore di Mosa Meat⁹ (Paesi Bassi) (costo ~ €250000)

2022



UPSIDE Food e GOOD Meat¹⁰ (USA) ricevono **approvazione** da parte di **USDA** per prodotti a base di **cellule di pollo coltivate per consumo umano**



2023

Legge italiana (172/2023) che, prima al mondo, **vieta la produzione e vendita di prodotti a base di cellule animali coltivate**

[9] Post et al., *Nature food*, 2020 (<https://www.youtube.com/watch?v=sIsIQLZL2EI>)

[10] <https://gfi.org/resource/cultivated-meat-industry-summary/>

[11] Fino et al., *Nature Food* (submitted)

Mercato della carne coltivata

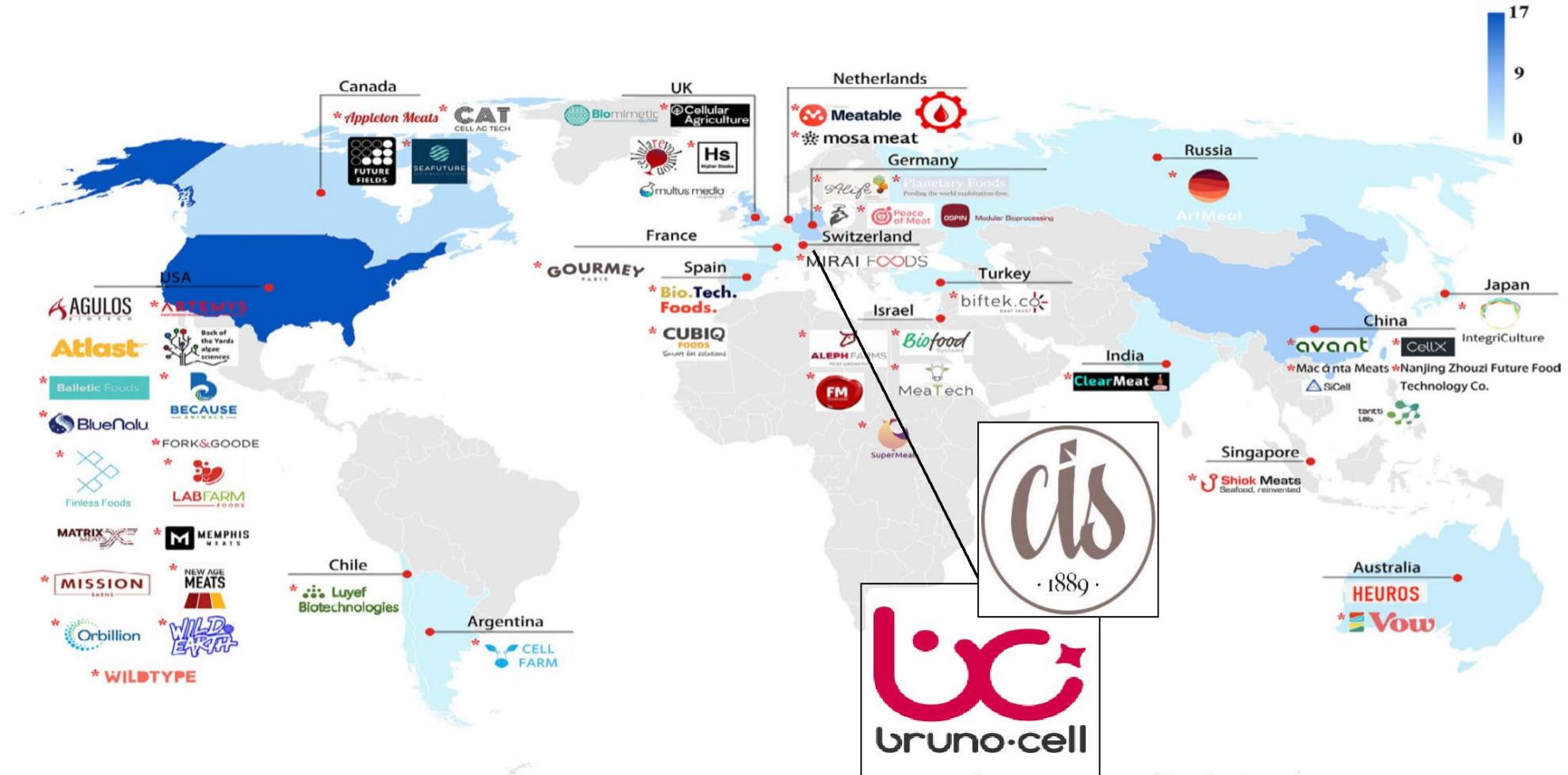
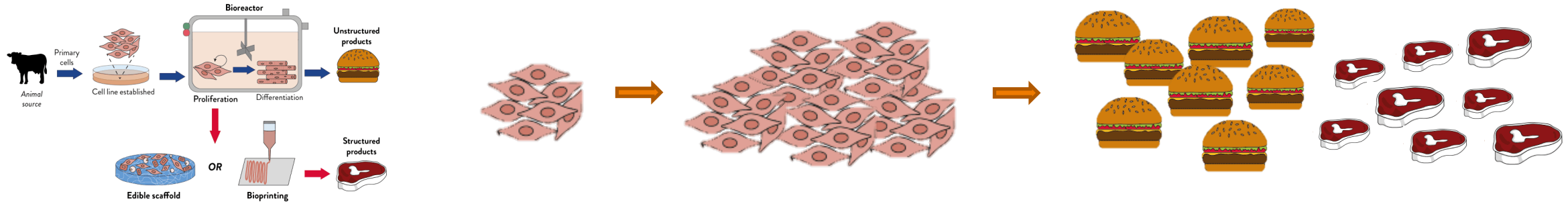


Fig. 1. Geographic distribution of cultured meat companies. Fifty-eight companies in the field of cultured meat/fish are included, focusing on cultured meat end-products, raw materials, or equipment along the value chain. More information on these companies is available in GFI's company database (GFI, 2021).

[12] Guan et al., Future Foods, 2021

Sfide tecnologiche per produzione su larga scala



Bioreattori per produzione su larga scala

R&D

<3L bioreactor

Grams of cultivated meat per production cycle

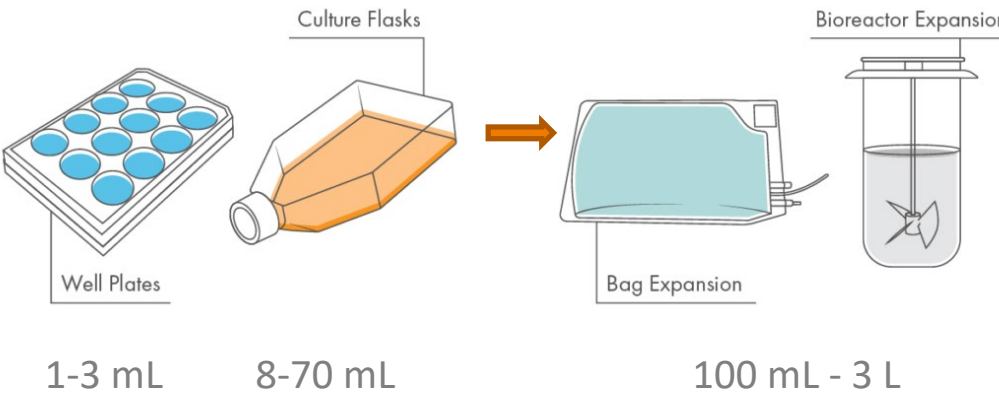
Bench scale

<25L bioreactor

<10kg of cultivated meat per production cycle



<p>Pre-pilot</p> <p><100L bioreactor</p> <p><10s of kg of cultivated meat per production cycle</p>	<p>Pilot</p> <p><1000L bioreactor</p> <p><100s of kg of cultivated meat per production cycle</p>
<p>Industrial</p> <p><50,000L bioreactor</p> <p><10s of tons of cultivated meat per production cycle</p>	<p>Commodity</p> <p>>50,000L bioreactor</p> <p>>10s of tons of cultivated meat per production cycle</p>



[13] Harsini and Swartz, Trends in cultivated meat scale-up and bioprocessing, GFI, 2023

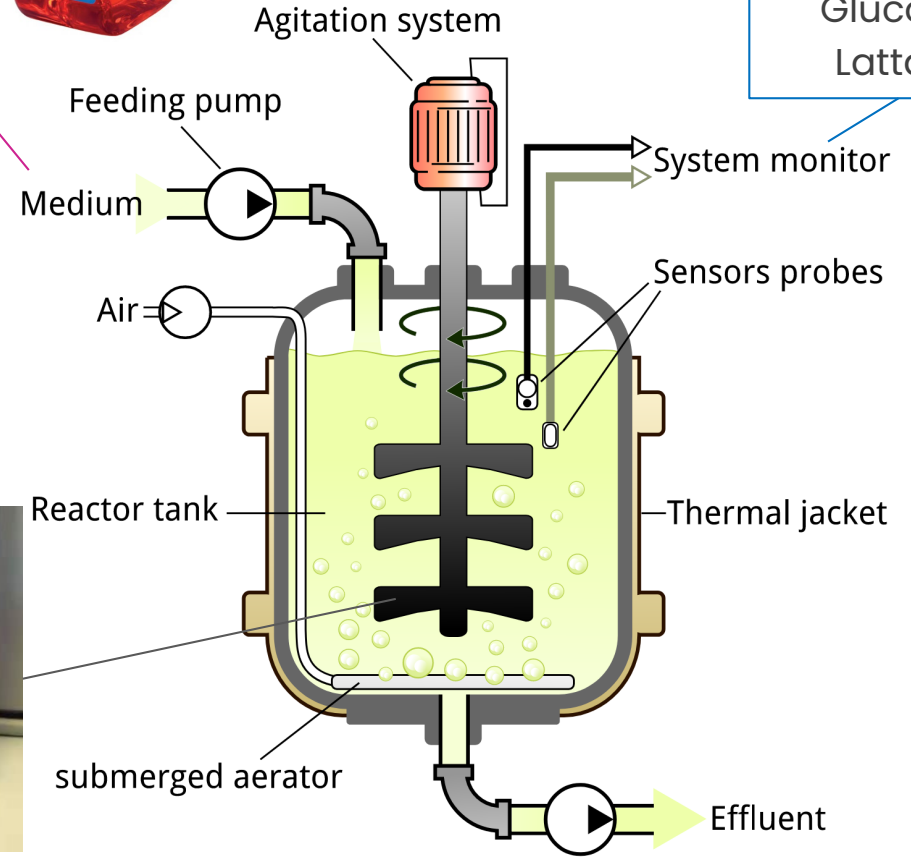
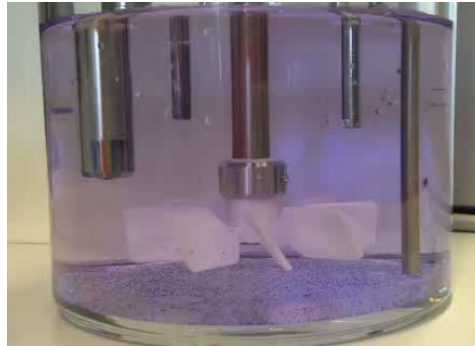
Sfide tecnologiche per produzione su larga scala



- TERRENO DI COLTURA**
- Acqua
 - Amminoacidi (€)**
 - Glucosio
 - Sali
 - Vitamine
 - Elementi
 - Lipidi
 - Proteine (€€)**
 - Fattori di crescita (€€€)**

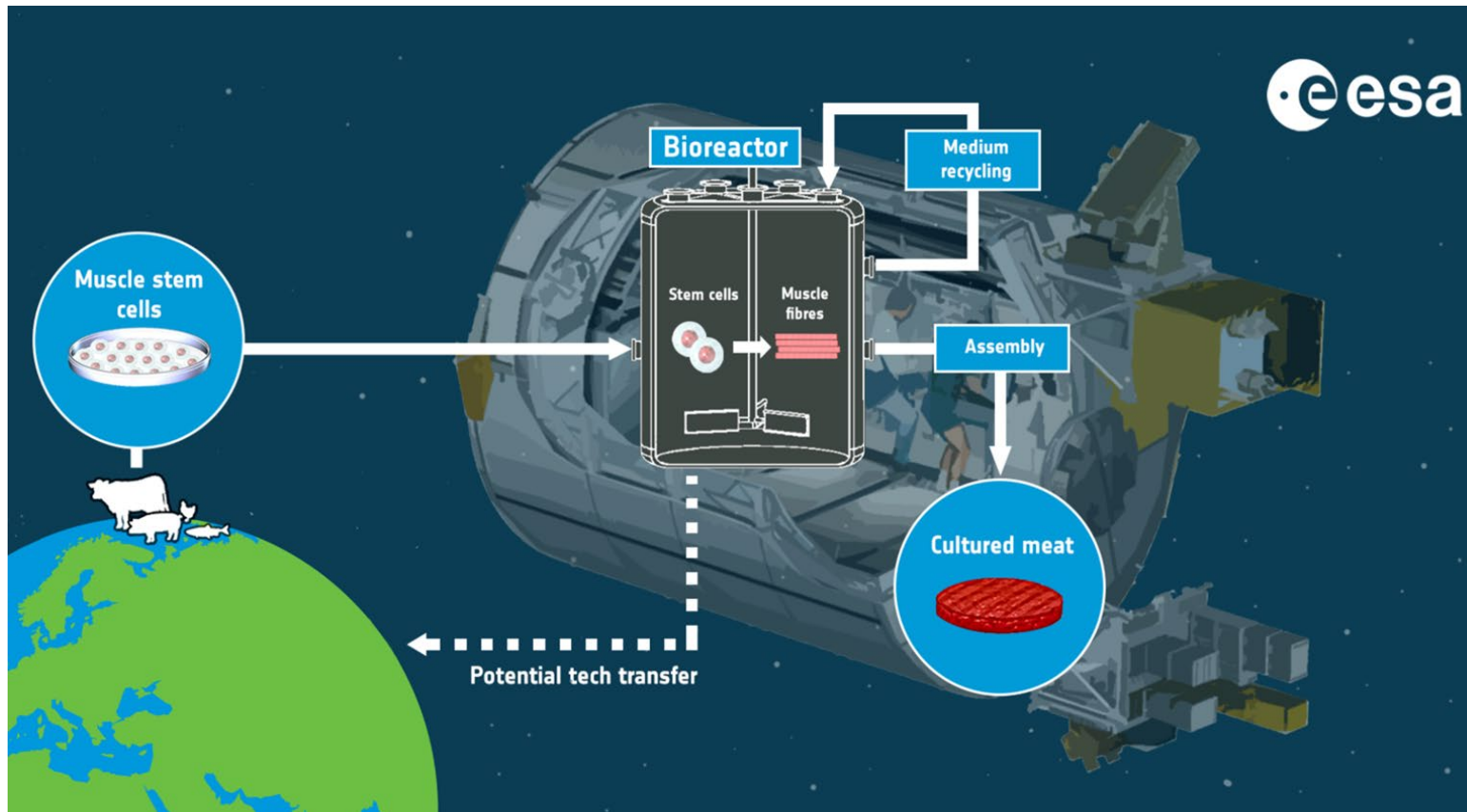


- SENSORI**
- Temperatura
 - pH
 - O₂
 - CO₂
 - Glucosio
 - Lattato



[13] Harsini and Swartz, Trends in cultivated meat scale-up and bioprocessing, GFI, 2023

Sfide del futuro – Carne coltivata nello Spazio?



[14] https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/ESA_investigates_cultured_meat_as_novel_space_food/?2

[15] https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/On_the_road_to_cultured_meat_for_astronauts_and_Earthlings

Quale futuro per la carne coltivata?

1. Sicurezza: un atto di equilibrio

2. Semantica: affrontare neologismi e neofobia alimentare e tecnofobia

3. Salvaguardare la correttezza dell'informazione

4. Abbracciare la tecnologia

5. I potenziali impatti

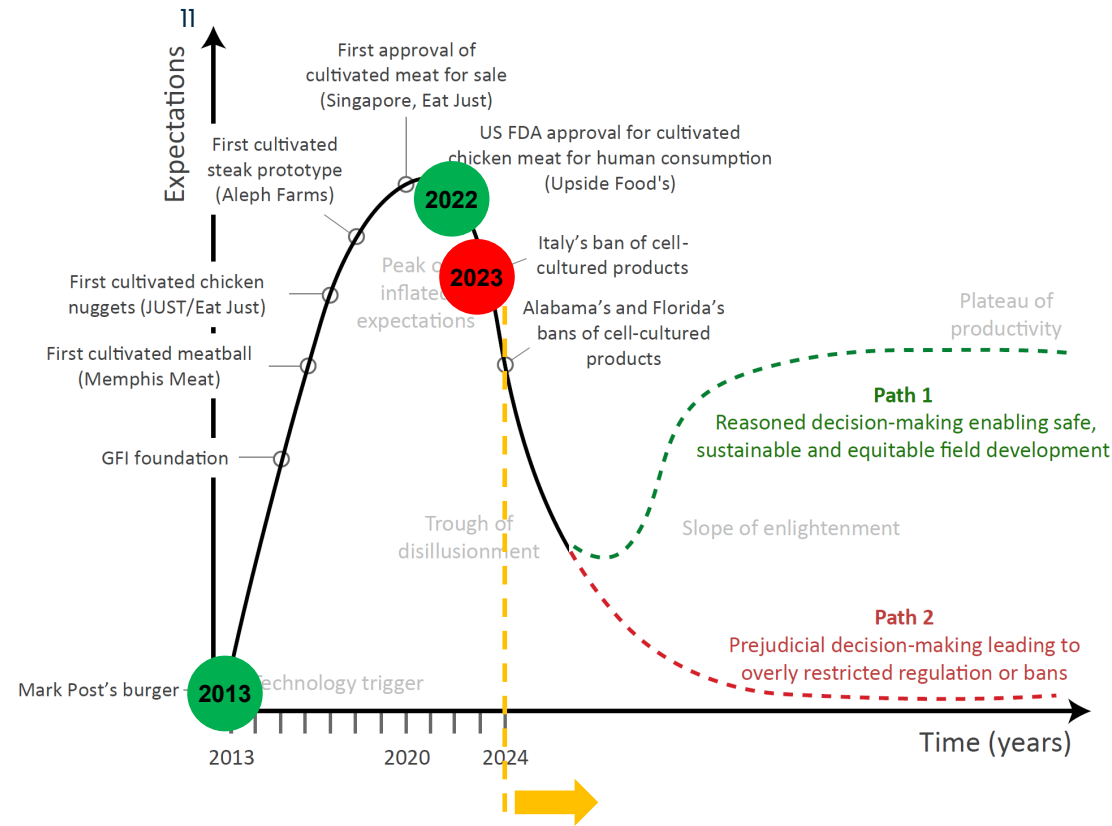
6. Avere fiducia nella valutazione dei novel foods

7. Proprietà intellettuale e rischi di monopolio

8. Garantire la stabilità normativa

9. Preservare la libertà individuale nelle scelte alimentari

10. Salvaguardare la libertà nella ricerca e nell'impresa

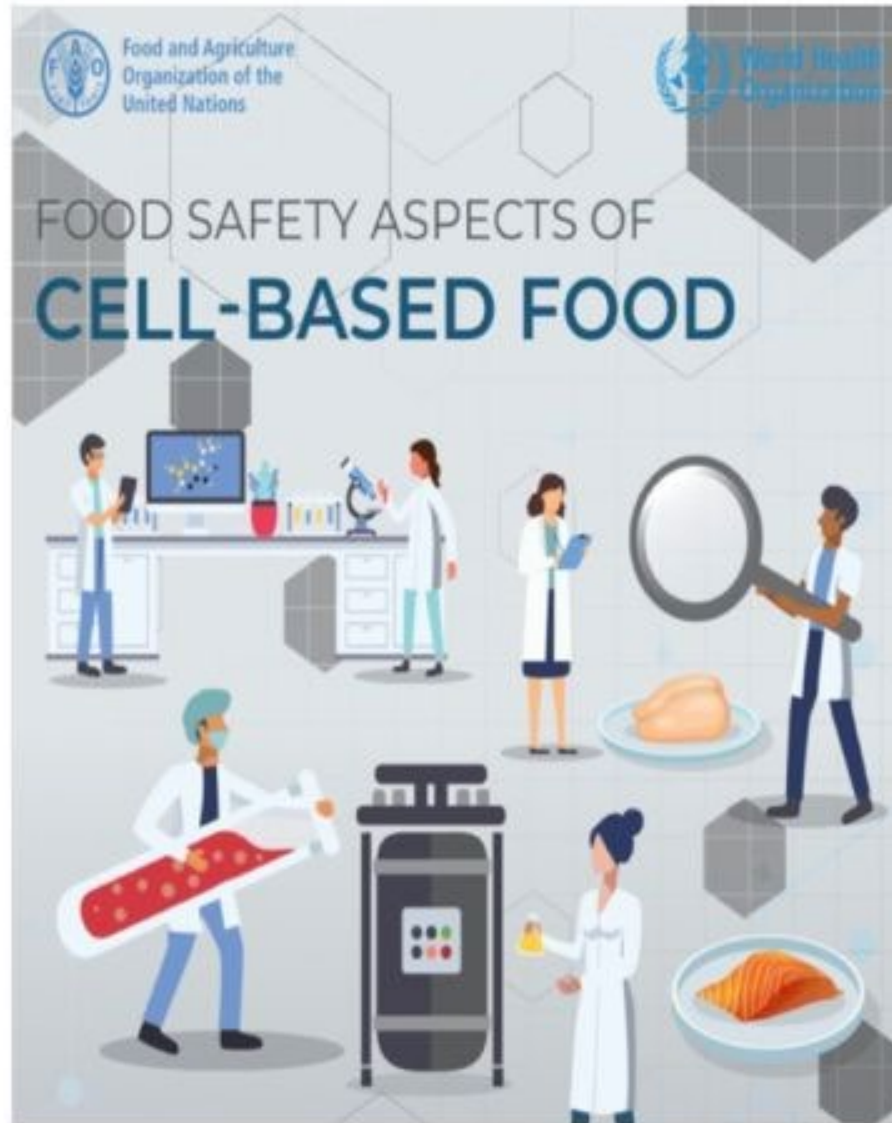


Università di Scienze Gastronomiche di Pollenza



[11] Fino et al., *Nature Food* (submitted)

La carne coltivata è sicura per la salute?



THE STRAITS TIMES | SATURDAY, APRIL 8, 2023

UN report says lab-grown meat is safe, cites Singapore as case study

Shahana Begum

Singapore is the only country in the world where consumers can buy cell-cultured chicken, but how safe are such laboratory-grown meats for consumption?

Two United Nations (UN) agencies released a global report to address this issue, in efforts to bring more of such foods to the dining table and assure consumers that they are safe to eat.

Traces of antibiotics in the meat product, pathogens in the animal cells that can spread to humans and possible genetic changes in cells as they multiply were identified as some of the potential hazards of cell-based meats in the report.

Put together by the Food and Agriculture Organisation (FAO) and the World Health Organisation (WHO), the report cited Singapore, which approved cell-cultured chicken for sale in 2020, as a case study in the regulation of such meats.

The report concluded that many of the hazards identified in cell-based foods already exist in conventionally produced foods and livestock agriculture, and hence the meats are safe for consumption if produced and han-

the source animals to ensure they are disease-free. Testing for pathogens can also be done before banking the cells, said the report.

The use of antibiotics to prevent the cells from being contaminated by bacteria was also identified as an issue as residual antibiotics in the meat products could be a health hazard and contribute to antimicrobial resistance.

The report recommended that limited amounts of antibiotics should be used. Washing can help remove or reduce the concentration of contaminants in the final product.

Mutations from changes to the genes as the cells multiply could build up and create novel toxins. However, the mutations alone will not pose any significant problems to consumers, said Professor William Chen, director of Nanyang Technological University's Food Science and Technology programme.

"DNA from meat, with or without mutations, will be degraded in our digestive system, and thus they have a low possibility of integrating into our genes and leading to any potential health risks," said Prof Chen. He is the vice-chair of the panel of international experts who gathered in Singapore in November.



with couscous and fried chicken salad. Each dish costs \$8.50.

Other cell-cultured meats, such as beef and fish, are still being developed, while some firms abroad are seeking approval from the Singapore Food Agency (SFA) to sell their slaughter-free thin-cut steaks and minced pork items here.

Currently, there are more than 100 cell-based food start-ups around the world.

Cell-based meat is made by taking cells from a cow, chicken or fish through a biopsy and then growing the cells in a nutrient broth and media. The tissues are harvested, prepared and packaged into meat products.

Such meats generated from cells may combine different cell types like muscle and fat cells to replicate the structure and texture of meat. Extrusion techniques and 3D printing, as well as

The document also noted that cell-based meats are an "alleged sustainable alternative" to conventional livestock, and more work is needed to prove that such meats are indeed greener.

The report concluded that hazard identification is only the first step of the formal risk assessment process for cell-based food, and more scientific data, insights and the sharing of information are needed to further the safety and trust in these future foods.

Prof Chen, who is also a consultant to FAO on alternative and novel foods, said: "The report would help cell-based meat companies align themselves with the global standard and harmonise their processes. This in turn would enhance food safety and boost consumer confidence."

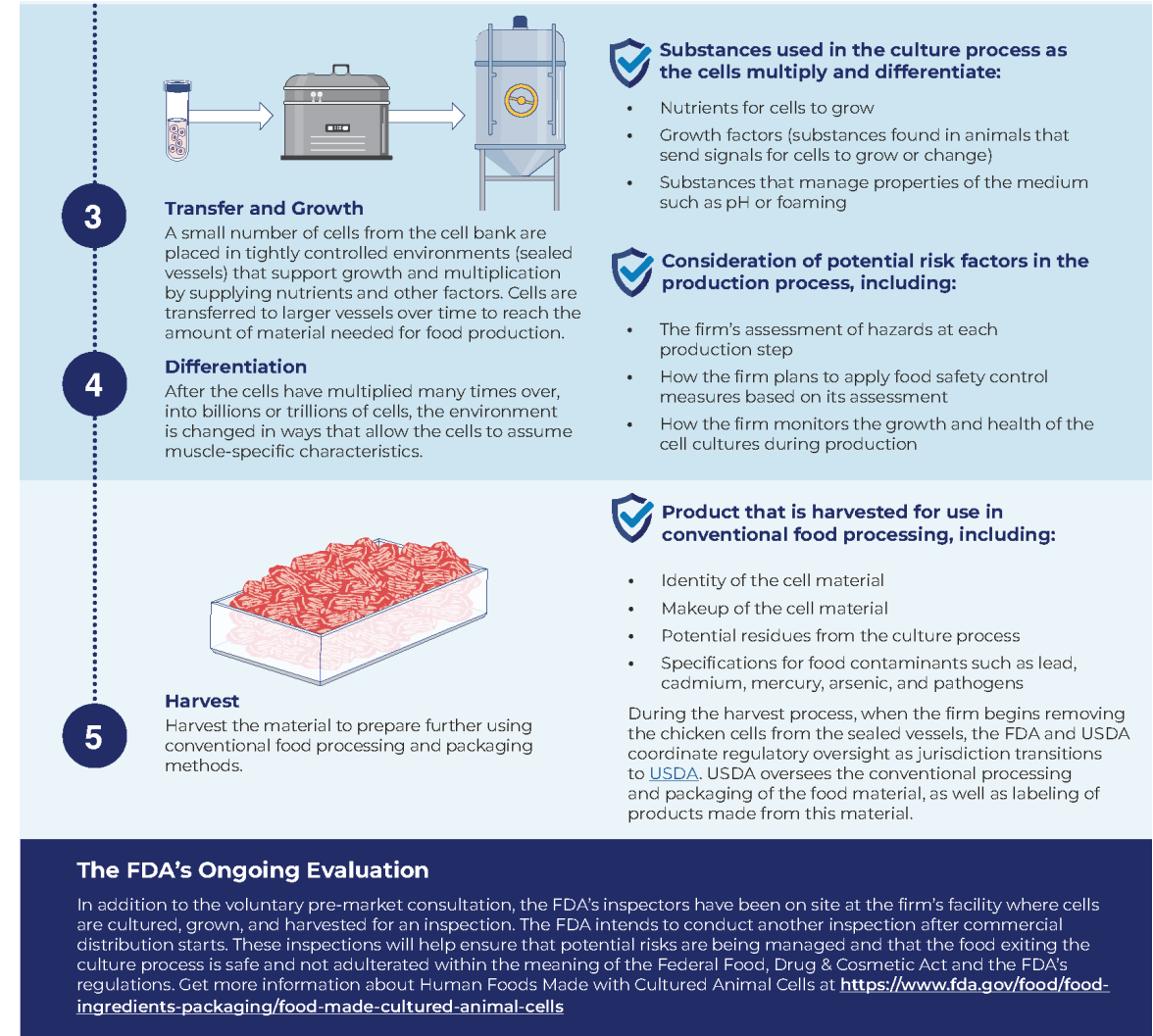
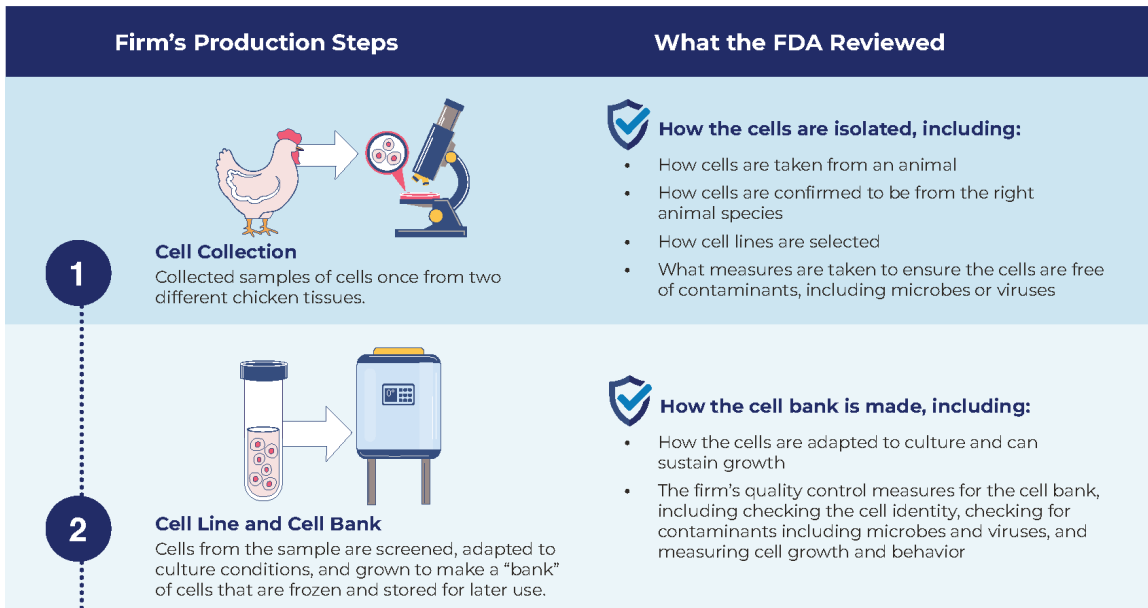
ns@shab@sp.com.sg

La carne coltivata è sicura per la salute?

What the FDA Evaluated During the First Completed Pre-Market Consultation



The complex process of taking a small number of live cells from livestock, poultry, seafood, or other animal species and growing them in a controlled environment to create a food can be broadly summarized in a few steps. Below is an example of what we reviewed at each production step during the firm's pre-market consultation:



The FDA's Ongoing Evaluation

In addition to the voluntary pre-market consultation, the FDA's inspectors have been on site at the firm's facility where cells are cultured, grown, and harvested for an inspection. The FDA intends to conduct another inspection after commercial distribution starts. These inspections will help ensure that potential risks are being managed and that the food exiting the culture process is safe and not adulterated within the meaning of the Federal Food, Drug & Cosmetic Act and the FDA's regulations. Get more information about Human Foods Made with Cultured Animal Cells at <https://www.fda.gov/food/food-ingredients-packaging/food-made-cultured-animal-cells>