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The social repercussion of cultivated (cell-based) meat

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Abstract
This document addresses the different perspectives about the social repercussion of cultivated meat. This topic is current and there are conflicting points of view related to it. Even though food culture is passed down over generations, it is continually changing due to the introduction of new food products in the market and changes in consumers' habits. Population projections indicate accelerated and continuous growth in the coming decades, which should increase the demand for food in general. Research is being developed in search of meat made of animal cells or plants with the sensory characteristics of the bovine product, mainly in the United States, Israel, European Union and China. We suggest some objectives and variables that would be interesting to measure to monitor the impacts of this theme in South America. The initial idea is to suggest to studies with different approaches to build broad knowledge, in the first moment. Obviously, that can be done with many adaptations and qualifications. This document presents initial ideas designed to contribute to and support productive diversification and food sovereignty. It is a document that suggests ideas and discussions, based on the literature with quality results.
Keywords: animal welfare; development of cellular meat; sustainability.

A repercussão social da carne cultivada (à base de células)

Resumo
Esta nota técnica aborda as diferentes perspectivas sobre a repercussão social da carne celular. Este tema é atual e há pontos de vista conflitantes. Embora a cultura alimentar seja transmitida ao longo das gerações, ela está em constante mudança devido à introdução de novos produtos alimentares no mercado e às mudanças nos hábitos dos consumidores. As projeções populacionais indicam crescimento acelerado e contínuo nas próximas décadas, o que deve aumentar a demanda por alimentos em geral. Pesquisas estão sendo desenvolvidas em busca de carnes feitas de células animais ou vegetais com as características sensoriais do produto bovino, principalmente nos Estados Unidos, Israel, União Europeia e China. Sugerimos alguns objetivos e variáveis que seriam interessantes de mensurar e avaliar para monitorar os impactos desse tema na América do Sul. A ideia inicial é sugerir estudos com diferentes abordagens para construir um conhecimento amplo, nesse primeiro momento. Obviamente, essas sugestões podem ser abordadas após discussões, adaptações e qualificações. Portanto, esse documento apresenta ideias iniciais com o intuito de contribuir com a ciência e apoiar a discussão sobre diversificação produtiva e soberania alimentar. É um documento que propõe ideias, reflexões e discussões, baseado na literatura.
Palavras-chave: bem estar animal; desenvolvimento de carne celular; sustentabilidade.

Before addressing the interest in cellular meat development, its consumption and the social impacts it generates, it is necessary to understand the discussion regarding the emergence of this type of food. This document addresses the different perspectives of the social repercussion of cultivated meat, which is a

current topic with conflicting opinions concerning it.

Throughout history, society has faced challenges related to food in such a way that beliefs, moral values, pillars of sustainability, new lifestyles, and other elements have outlined distinct food cultures (PHILIPPON, 2018). The act of consuming is no longer considered as a neutral action with no repercussions (Chávez-Dulanto *et al*., 2021), as consumption has increasingly become a way of expressing oneself; it influences the society and nations' economy. Thus, even though food culture is passed down over generations, it is continually changing due to the introduction of new food products in the market, changes in consumers' habits, and individual preferences (BEKKER *et al*., 2017).

Actually, it is known that food not only satisfies hunger and provides the essential nutrients, but also improves human well-being and health (BETORET *et al*., 2011). In this context, meat is an essential part of human diet in many cultures, and because of the increasing population growth, the meat industry cannot meet consumers' needs worldwide. Population projections indicate accelerated and continuous growth in the coming decades, which should increase the demand for food in general (ROHR *et al*., 2019). Research is being developed in search of meat made of animal cells or plants with the sensory characteristics of bovine product, mainly in the United States, Israel, European Union and China.

Different types of meat are found in the marketplace (VAN DER WEELE *et al*., 2019; KUHN, 2020). There are currently over thirty four corporations worldwide involved in supplying cell-based meat. Brazil is one of the largest meat producers in the world (CARDOSO; MALAFAIA, 2018), with the second-largest cattle herd-232 million head—and its production is largely based on grass. Increased beef demand worldwide has stimulated increased production and productivity gains. In 2018, Brazil reached its highest level of beef production at 9.9 million metric tons (USDA, 2019). However, the country also has opposition to the consumption of products related to animal slaughter.

Animal-free food products (hereafter: animal-free food) are known by many names, including 'in-vitro' (STEPHENS *et al*., 2010), 'lab-grown', 'cultured', 'synthetic', 'clean' and 'products of cellular agriculture' (MOUAT; PRINCE, 2018). Currently, the technical process of creating cellular meat is a multi-step process, which begins with cells being extracted harmlessly from a real animal and then induced to divide and reproduce themselves infinitely (SPECHT; LAGALLY, 2017).

Also, products based on vegetable protein are being developed to replace red meat. Since this technology does not rely on animal "sacrifice" to produce food, it would also be more acceptable from the ethical point of view regarding animal well-being (ZIDARIČ *et al*., 2020). Furthermore, there are debates related to consumption and the environment that emphasize the need to make goods and services more efficient and less polluting. Despite some negative debates about "conventional" meat, animal production in general does not have detrimental effects on our environment and acceleration of climate change. In fact, what harms climate change is the incorrect use of land in general (DALL-ORSOLETTA *et al*., 2016), both to produce food such as grains and cereals, and for livestock (VASCONCELOS *et al*., 2018). Adequate grazing management is the key strategy to improve animal production and reduce environmental impact (SOUZA FILHO *et al*., 2019).

According to Zycherman (2008), beef is crucial in the development of human beings and in their nutrition, causing some concerns that need to be analyzed and studied. However, there are a number of people who do not consume meat, which makes for a niche of 'sustainable' cultivated (cell-based) meat. This type of sustainable meat is still in an early development stage, but it seeks to deliver products that require significantly reduced animal involvement (STEPHENS *et al*., 2018). The Good Food Institute and many non-profit organizations like New Harvest are working to support and coordinate scientific research related to cellular meat and provide rigorous academic evidence for policy and cultural goals (KIM, 2017).

Research to find the determinants of public acceptance on emerging technologies in the agri-food sector is used with frequency (FREWER *et al*., 2011) but little is known about the potential implications of the new cultivated meat technology for emerging countries.

In that sense, we suggest some measure-worthy objectives and variables in order to monitor the impacts of this matter in South America. Initially, we suggest working with different approaches to build broad knowledge, which is possible via adaptations and

qualifications. This document presents initial ideas designed to support and contribute to productive diversification and food sovereignty.

Table 1. Initial themes and objectives (version zero) of the study proposal*.

Sequence	Thematic	General objective
i	Consumer perception.	Quantify the studied audience in the present study: meat consumers(bovine, sheep, pork) vegan public, vegetarians and other groups of eating habits (or food habits) and ideologies. To know if this public knows partially,no or in depth the theme of cultivated (cell-based) meat.
ii	Media, Marketing and Digital Influencers.	Changes in habits "inspired" by marketing in general.
iii	Decision makingin relation to consumption.	To understand consumers stimuli directly related to consumption andpurchase.
iv	Bibliographic compilation from research, study and readings.	Elaborate a bibliographic compilation of the world results related tothe Sensory Analysis and biochemical characteristics of cultivated (cell-based) meat and compare with the animal production data.
v	Sociocultural issues.	Assess the impact of cultivated (cell-based) meat on cultural issuesrelated to meat consumption.
vi	Animal welfare; Sustainability; Climate change.	Study and evaluate whether the emergence of this new food source is related to this theme and what are the criticisms and discontent involved. Additionally, possible improvements in the short term.

*Elaborated by the author.

First, we need to know if i) meat consumers (meat of cattle, pig, sheep), vegans or vegetarian and other groups of eating habits and ideologies know what is cultivated (cell-based) meat. It is crucial to assess whether they have heard of the subject or whether they have an in-depth knowledge of the topic. There could be a relationship with the public's economic class, gender, school level and ideologies. ii) Furthermore, a very important factor to be understood is the role the media might play in driving social change in this area.

iii) It would be interesting to evaluate the perception of food consumers in general about cultivated (cell-based) meat. For example: a) Are they willing to taste cultivated meat? b) are they willing to be potential consumers? c) After consuming it, will they publish positive results about it or d) Would they want to consume food produced in the laboratory?

Taking advantage of this subject, two researchers compared four international sites (UK, US, China and Brazil) in relation to meat consumption, behavior and media environment. They concluded that the key determining factors include assessments of trust and credibility regarding scientists and other experts, perceptions of the role of government and questions of individual versus collective responsibility (HAPPER; WELLESLEY, 2019).

In this kind of work, generally, the social representations and the profile of the individuals (sample characterization) are identified and later the specific issues of each theme are reported. Additionally, you can include Opinion Research, Motivation Research and Documentary Research, which directly fit into this stage of the study.

Also, in order to qualify the research, some data can be extracted by means of external platforms, for example the Brazilian Association of Meat Exporting Industries (ABIEC), Brazilian Institute of Geography and Statistics (IBGE), National Rural Learning Service (SENAR), Organization United Nations Food and

Agriculture Organization (ONU and FAO), World Health Organization, among other bases and institutions.

This work aims iv) to elaborate a bibliographic compilation of the world results related to the Sensory Analysis of this new product. It is interesting to compare the biochemical characteristics of cultivated (cell-based) meat with meat from slaughtered animals (pigs, cattle, sheep and poultry) and to relate it to human nutritional needs. For example: can laboratory meat provide the high concentration of collagen in beef, vitamin B complex , in particular B12 and omega-3 fatty acids (BOBECK, 2018; CARR; MAGINI, 2017) that largely benefit human health?

With regard to the socio-cultural issue, in many regions of Brazil, there is a tradition of consuming beef and sheep made of fuel wood or charcoal, the famous barbecue (RIBEIRO; CORÇÃO, 2013). This happens in other countries as well and is a form of socializing and personal satisfaction. Meat in general is in the daily lives of many families.

v) In this context, it would be interesting to analyze the impact of cultivated (cell-based) meat in these cultural issues - which have been striking since the Paleolithic era.

One hypothesis that should be studied is whether meat from animals will continue to be consumed, but additionally; with the option of cultivated (cell-based) meat, resulting in an increase in people consuming "meat" in general. In other words, it would not decrease animal production (beef production). Or, would people decrease or replace their consumption of beef with cultivated meat?

vi) Finally, it is of paramount importance to understand whether the emergence of this new food source is related to climate change, low meat supply in the world, decreased use of water, meat with less cholesterol, impossibility of land expansion or criticism and discontent related to animal production and animal welfare.

There are many authors that published articles that penalize animal production, influencing people. As mentioned in the introduction, the problem is the incorrect use of the soil by a number of producers and not the production itself. The livestock sector is a major driver of climate change, accounting for 14.5% of anthropogenic greenhouse gas emissions (HAPPER; WELLESLEY, 2019). Moreover, according to the study of Reis (2020), alternative protein source such as cultivated (cell-based) meat is potentially associated with improvements in important issues related to intensive industrial livestock production: animal welfare, environmental impact, food safety and the low efficiency of conventional meat production.

To execute this plan, we aim to submit a project to ethics committees of renowned universities in the area.

The methodology suggested in this first document is not described in depth, i.e. many advances and adjustments have not been addressed. This document is only an initial plan, written based on our affinity with the topic and experience in this area in the aim of stimulating some discussion among the scientific community on this contemporary technology.

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