

The Public Health Value of Cultivated Meat: Nutrition, Safety, and Public Perception

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Abstract. As an emerging achievement in food technology, artificial meat has significant advantages in nutritional optimization, food safety assurance, and environmental sustainability. This article explores the nutritional structure, microbial and antibiotic control capabilities of plant-based meat and cultured meat, as well as consumers' current understanding of artificial meat. Through a comprehensive evaluation of the adjustability of nutritional components, safety control ability, and public acceptance of artificial meat, this article found that artificial meat is superior to traditional meat in terms of nutritional supplementation and food safety, especially in reducing saturated fatty acids, enhancing trace element supply, and reducing pathogen contamination and antibiotic use, demonstrating unique advantages. In addition, cultured meat is produced in a sterile environment, effectively controlling microbial risks, while plant-based meat has a positive role in chronic disease prevention due to its high content of dietary fiber. However, consumers' acceptance of artificial meat is still influenced by factors such as price, taste, and safety, and public concerns about its "unnaturalness" still exist. Research shows that a sound regulatory framework and targeted science education will be the key path to promoting the future development of artificial meat, which is expected to enhance its social acceptance and promote the construction of a healthy and sustainable food system.

Keywords: Cultivated meat, plant-based meat, cell-cultured meat, food safety, nutritional value.

1. Introduction

According to reports, only 38% to 47% of people will continue to support research on cultivated meat, with the majority believing that, aside from those who support its research, it will not be widely accepted by consumers in the future [1]. This reflects the public's skepticism towards cultivated meat and concerns about emerging industries. The Italian government once considered legislating to ban its production and sale due to safety concerns, highlighting that public acceptance and trust in cultivated meat largely depend on assurances of its safety. In contrast, the Singaporean government actively supports and promotes the cultivated meat industry, viewing it as a key strategy to enhance national food security and drive food technology innovation. In 2020, Singapore became the first country to approve the sale of cell-cultured meat products [2]. The varying perceptions of cultivated meat among different countries directly impact its local development, with consumer attitudes also differing significantly. As technology progresses and consumers become more concerned about sustainability issues, the development of cultivated meat and more details will continue to emerge in the public eye.

This paper will explore the food safety risks in the production process of cultivated meat and how regulation and standard-setting can ensure its safety. It will also analyze the nutritional value and public perception of cultivated meat to comprehensively assess its public health value, enhance public awareness, and promote its acceptance and use in society, providing scientific evidence and policy recommendations for the future development of cultivated meat.

2. Nutritional Value of Cultivated Meat

Cultivated meat is seen as an important part of the future food industry, with significant potential in addressing global nutritional imbalances. Compared to traditional meat, cultivated meat offers

great controllability in nutritional components, which can be adjusted through bioengineering technology or raw materials to regulate fat content, protein quality, and levels of trace elements, meeting daily human needs and specific nutritional requirements.

2.1. Characteristics, Advantages, and Limitations of Cell-Cultured Meat

The production of cell-cultured meat relies on the proliferation and differentiation of stem cells. By adjusting the components of the culture medium, the direction of cell differentiation can be controlled. Adding specific fatty acids to the culture medium can promote the differentiation of cells into fat cells, thereby increasing the fat content in cell-cultured meat and reducing the content of saturated fatty acids to lower the risk of cardiovascular diseases and improve cardiovascular health [3]. Additionally, through biofortification, trace elements such as iron and zinc, as well as essential nutrients like vitamin B12 and vitamin B6, can be added to cell-cultured meat, significantly optimizing its nutritional characteristics [4]. This has important public health significance for regions with nutritional deficiencies and can positively impact human health.

However, while cell-cultured meat theoretically offers superior nutritional components, it is a promising but early-stage technology facing key technical challenges, including cell sources, culture media, simulating *in vivo* myogenesis, and the use of animal-derived and synthetic materials. Due to differences in cell types and growth conditions, there may be nutritional disadvantages such as high sodium content and lack of specific amino acids, necessitating further nutritional assessment and technical optimization in the future.

2.2. Nutritional Characteristics, Advantages, and Limitations of Plant-Based Meat

Plant-based meat, another important category of cultivated meat, primarily uses plant sources such as soy and wheat protein as its base. Through processing technology, it simulates the taste and nutritional characteristics of traditional meat. Its advantage lies in its rich protein content. Upgraded extrusion expansion technology and extrusion cooking processes can highly reproduce the flavor and texture of traditional meat while maintaining the healthy advantage of being rich in unsaturated fatty acids. Additionally, plant-based meat contains dietary fiber, which plays a positive role in gut health and the prevention of chronic diseases. According to reports, the dietary fiber content of general plant-based meat products is about 3-6g/100g, while traditional meat almost does not contain dietary fiber [5].

Overall, the nutritional components of cultivated meat are quite considerable and are expected to become more mature with future technological development and testing.

2.3. Food Safety of Cultivated Meat

Food safety is one of the most critical issues in the promotion of cultivated meat technology. Compared to traditional meat, cultivated meat has significant advantages in reducing the risk of foodborne pathogen contamination and antibiotic residues.

In traditional animal husbandry, meat products may be contaminated by foodborne pathogens such as *Salmonella*, *Escherichia coli*, and *Listeria monocytogenes*, especially during the slaughtering and processing processes. These pathogens are one of the main causes of food poisoning and other food safety problems [3]. However, the production process of cell-cultured meat is usually carried out under strictly controlled sterile conditions, thereby minimizing the risk of microbial contamination. Compared to traditional breeding methods, the production of cell-cultured meat is usually conducted in a bioreactor, where conditions (such as temperature, pH value, and oxygen concentration) can be precisely regulated to ensure healthy cell growth. This environmental control not only includes the regulation of temperature, pH value, and oxygen concentration but also involves sterile filtration of the culture medium, strict sterilization of instruments and working environments, and a fully enclosed operating system. These measures collectively create a nearly sterile culture environment, effectively blocking the invasion of external pathogens such as bacteria, viruses, and fungi, thereby significantly enhancing the food safety of the product. Therefore, under ideal sterile conditions, the risk of

microbial contamination in cell-cultured meat can be reduced to the lowest level, significantly decreasing the likelihood of pathogen transmission and infection.

In traditional animal husbandry, antibiotics are widely used to prevent diseases and promote growth. The long-term misuse has led to antibiotic resistance becoming a global public health problem. In contrast, the production environment of cell-cultured meat is more controllable, and the cell-cultured meat production system is adjustable, eliminating the need for antibiotics to complete production. During the production process of cell-cultured meat, cells grow in a controlled bioreactor, and cell growth in the laboratory environment does not depend on large-scale breeding, thus avoiding the disease transmission and infection problems that may arise from the dense breeding of animals in traditional breeding. This reduces the risk of antibiotic resistance and improves food safety [6, 7].

Additionally, to monitor actual operations and provide data-driven test reports to the public, a strict quality monitoring system and real-time detection mechanism are crucial for the hygiene and safety of cultivated meat. Currently, regulatory agencies such as the US Food and Drug Administration (FDA) and the European Food Safety Authority (EFSA) have begun to assess the safety of cultivated meat, focusing on cell line stability, production processes, and potential allergens [8].

Overall, while cultivated meat has significant food safety advantages over traditional meat, it also brings new challenges, including culture media and long-term health safety. These need to be ensured through future strict regulatory frameworks, quality control systems, and toxicological studies to ensure the stability and safety of cultivated meat.

3. Public Perception and Acceptance

Public perception and acceptance of cultivated meat directly influence its market promotion speed. Studies have shown that consumers' attitudes towards cultivated meat are mainly influenced by food safety, nutritional value, and environmental impact.

According to reports, some consumers have a positive attitude towards cultivated meat due to environmental and animal welfare factors, but most people still hold reservations or refuse to try it, especially in regions with more conservative cultural traditions, where people prefer traditional meat [9]. Figure 1 shows the survey results on consumer acceptance of cultivated meat products.

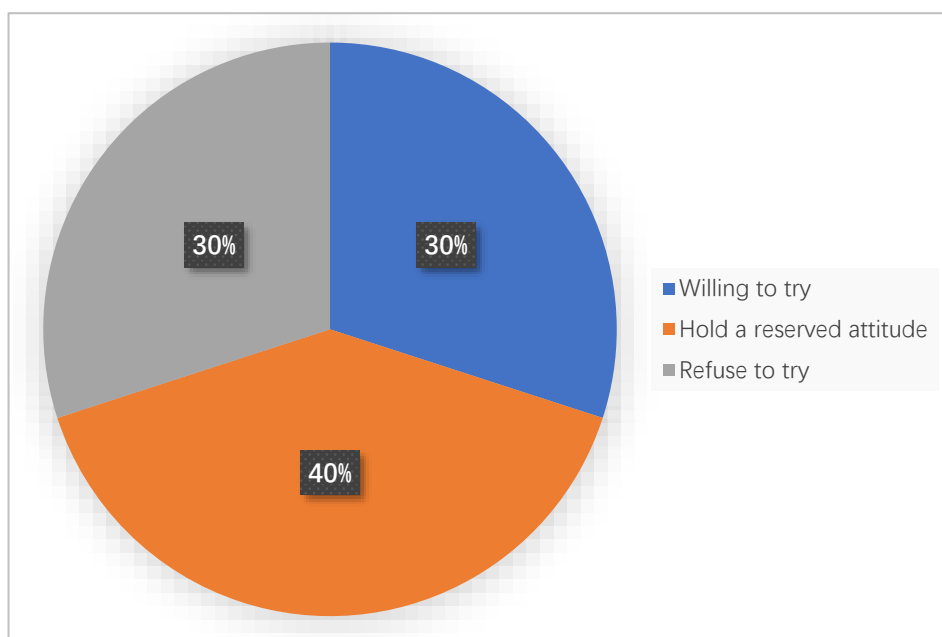


Figure 1. Survey Results on Consumer Acceptance of Cultivated Meat Products [9]

Many consumers have a certain degree of skepticism about cultivated meat, especially worrying about its safety and long-term health effects. Consumers generally consider cultivated meat to be “unnatural” and are uneasy about its biotechnological background, thinking it is similar to genetically

modified food and poses unknown health risks [10]. However, when consumers learn that cultivated meat can optimize fat content and reduce the content of saturated fatty acids through technological optimization, their interest in cultivated meat will significantly increase [3]. Factors such as price and taste also affect consumers' acceptance of cultivated meat, as shown in Table 1.

Table 1. Factors Affecting Consumers' Acceptance of Cultivated Meat and Their Importance Percentage

Influence factor	Important percentage (%)	Reference
Price	75	[11]
Taste	68	[1]
Environmental impact	62	[11]
Security information transparency	55	[12]

Currently, global regulation of cultivated meat is still in its infancy. The US Food and Drug Administration (FDA) and the US Department of Agriculture (USDA) have jointly established a framework for cultivated meat, focusing mainly on the safety of cell sources and the traceability of production processes [13]. The completion of a regulatory framework is conducive to enhancing consumers' trust in the safety of cultivated meat and its acceptance, and provides a basis for the large-scale commercialization of cultivated meat.

Overall, consumers' perception and acceptance of cultivated meat are influenced by a variety of factors. Optimizing prices and implementing strict regulatory policies can effectively enhance public awareness of cultivated meat, enabling more accurate judgments and greater trust in it, thereby promoting its marketization process.

4. Conclusion

Cultured meat is a very important innovation for the future of the food industry. It has great potential to optimize nutritional value and improve food safety. Its advantage over traditional meat is that it can control pathogens and prevent the abuse of antibiotics, reflecting the progress of human technology and serving as a major innovation in food technology. Cultured meat. It has great potential to ensure nutritional structure and food security, and to address public health challenges. However, its promotion still faces many challenges, such as insufficient public understanding, low cultural acceptance and imperfect regulatory policies. The future can pass. Technological optimization, strict supervision and scientific popularization can enhance the acceptability and trust of cultured meat in society, which will lay a more solid foundation for human health and future development and a sustainable food system, although the technology and public popularization of cultured meat are still in the early stages. Cultured meat is expected to become an integral part of future diets. Driven by both scientific research and policies, it will provide new ideas for the development of human diet.

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