ARTICLES
Archives of Veterinary Science
UFPR
https://www.ufpr.br/

The interest of Brazilian professionals and students in learning cellular agriculture

Submitted: *18/11/2024*
Accepted: *11/07/2025*

Jennifer Cristina Biscarra-Bellio[1], Gabriel Mendes[2], Carla Forte Maiolino Molento[3]*

[1]Cellular Animal Science Laboratory, Federal University of Paraná, Rua dos Funcionários, 1540, 80035-050 Curitiba, Paraná, Brazil, ORCID 0000-0003-3760-9488
[2]Cellular Animal Science Laboratory, Federal University of Paraná, Rua dos Funcionários, 1540, 80035-050 Curitiba, Paraná, Brazil, ORCID 0009-0002-6686-3653
[3]Cellular Animal Science Laboratory and Animal Welfare Laboratory Coordinator, Full Professor of Animal Welfare in the Department of Animal Science, Federal University of Paraná, Rua dos Funcionários, 1540, 80035-050 Curitiba, Paraná, Brazil, ORCID 0000-0003-1408-7891

*Author for correspondence: Jennifer Cristina Biscarra-Bellio – jenniferbiscarra@gmail.com

Abstract: The development of alternative protein production systems requires strategic planning, and education plays a key role in creating new job opportunities, unlocking the potential of cellular agriculture to address various socioeconomic, environmental, and ethical objectives. This study aimed to explore the interest in learning about cellular agriculture among Brazilians. An online questionnaire was distributed between February 2022 and February 2023, yielding 387 responses from 382 participants, as five individuals responded both as professionals and students. Of the total, 201 (51.9%) were professionals and 186 (48.1%) undergraduate students, with 76 (19.6%) agrarian sciences professionals, 125 (32.2%) professionals from other fields, 138 (35.6%) agrarian sciences students, and 48 (12.4%) students in different fields. Of the total respondents, 281 (73.6%) expressed a desire to learn about cellular agriculture, motivated by the benefits of cultivated meat and the opportunity to access innovative knowledge. Interest was particularly strong among those in agrarian sciences, who saw this area as a promising career entry. Among participants, 305 (79.8%) had heard of cultivated meat, 290 (75.9%) expressed interest in trying it, and 141 (36.9%) believed that consuming it would have an impact on their personal lives. Notably, 43 (18.9%) participants expressed a willingness to adopt a diet in which cultivated meat would be the only type of meat consumed. This study highlights the growing interest in cellular agriculture among professionals and undergraduate students, including their perceptions of innovation and potential benefits of cultivated meat. It indicates a demand for a deeper understanding and new job opportunities in the field.
Keywords: Cellular animal science. Education. Opinion. Learning.

1. Introduction

Concerns about the ethics and environmental consequences of conventional animal production have driven the expansion of research into alternative proteins (AP) (Godfray et al., 2018). The output of AP is particularly praised for its greater environmental sustainability (Poore and Nemecek, 2018) and benefits for animals (Soccol et al., 2024). Alternative proteins (AP) encompass food products developed as analogs or actual cell-based animal products, which do not rely on traditional systems of raising and slaughtering animals to produce meat, eggs, milk, and their processed derivatives (GFI, 2022). They are made using various methods, which can be broadly categorized into three main types: (1) plant-based products, (2) precision fermentation products, and (3) cultivated products (Soccol et al., 2024). Cultivated meat, produced by cultivating animal cells under controlled conditions (Post et al., 2020), offers a significant reduction in environmental impact, with 78-96% less greenhouse gas (GHG) emissions, 99% less land use, and 82-96% less water consumption (Tuomisto & Mattos, 2011). However, the environmental impact of cultivated meat production also depends on factors such as bioreactor energy consumption, for which the benefits to conventional production systems are less clear, as well as the ingredients required to produce culture media for the cells (Tuomisto & Ryynänen, 2024). Additionally, the technological challenges within such new production are substantial, encompassing cell selection, medium optimization, and the end consumers' acceptance (Post et al., 2020). There are also social, economic, regulatory, and institutional hurdles (Stephens et al., 2018; van der Weele et al., 2019; Nobre, 2022).

Despite the existing challenges, there is a growing belief that AP production methods will eventually become mainstream. In Tubb and Seba's (2020) words, we are witnessing a second domestication, the domestication of microorganisms and animal cells to produce food, unlocking exponentially higher productivity potential. The plant-based meat market in Brazil has experienced rapid growth, surpassing R$1 billion in retail sales in 2023, according to The Good Food Institute Brazil (GFI). This follows a 42% revenue increase in 2022, when the sector generated R$821 million. The growth is driven by shifting consumer habits focused on health, sustainability, and reduced consumption of animal products. The entry of major food companies has also boosted the sector by expanding product availability and accessibility. The plant-based meat industry is set to more than double in value by 2030, according to Plant-based News (2025). In 2024, the industry's value was US$9.57 billion, according to Globe Newswire (2025). By 2030, it is expected to be worth $21.81 billion, with a compound annual growth rate (CAGR) of 14.72%. This growth will be driven by increased investment in the sector, product innovation, demand for clean-label foods, and growing environmental concerns.

Morais-da-Silva et al. (2022) reported that the introduction of AP products in Brazil requires planning to maximize the benefits and mitigate the disadvantages for the country's development since Brazil is the largest exporter and the second largest producer of meat in the world (Economic Research Service, 2021), mainly in the poultry and pork markets. Within such planning, investment in the training and development of people seems essential to create new employment opportunities (Heidemann et al., 2020; Morais-da-Silva et al., 2022). Supporting education and dialogue among universities is crucial for people to access knowledge and new job opportunities within AP production chains, as cellular agriculture has vast potential to promote various socioeconomic goals (Soccol et al., 2024; Mugabe et al., 2024). Cellular agriculture may enable production and access to proteins in diverse locations and

environments, stimulating economic development and job creation (Stephens et al., 2018). Thus, this innovative approach to food production appears to be a key piece in building a more sustainable and inclusive food system. To achieve this goal, the active involvement of students in learning programs focused on agricultural technology and innovation is required (Newell and Glaros, 2024). Although the cultivated meat production chain remains mostly at initial levels of technological readiness, it seems relevant to consider how education can enhance job opportunities.

The cultivated meat sector requires higher levels of education and specific skills (Spiros et al., 2023). According to Stout et al. (2024), dedicated education and training programs for building the future cellular agriculture workforce will draw on expertise from various fields. The topic of AP has been advancing significantly in industry and media. Still, it remains an emerging area in academia, and the field may benefit from an increase in academic research and specialized professional training (GFI, 2022). For this to materialize, initiatives within universities are required, as they are recognized as central players and important actors in economic development, and their contribution towards sustainability efforts at the local level can be substantial (Leal Filho et al., 2019).

An important aspect of academic achievement is a match between university initiatives and students' interests. Although students in higher education tend to value innovation (Stout et al., 2024), their stance regarding new food protein production chains remains unclear, particularly when considering the relevant differences that may exist between various fields of knowledge and their initial reactions to AP. This study aimed to assess the interest of Brazilian professionals and students in learning about cellular agriculture.

2. Material and methods

An online questionnaire with 10 questions (Table 1) was administered using the Google Forms platform, and it was available from February 2022 to February 2023. The survey questions were developed based on a previous study in Southern Brazil (Valente et al., 2019), adapted to emphasize the impacts of cultivated meat production and consumption in both personal and professional contexts.

Number	Question	Answers
1.	How old are you?	open-ended compulsory
2.	Where do you reside? (City/state)	open-ended compulsory
3.	What is your occupation?	open-ended compulsory
4.	If you are currently pursuing an undergraduate degree, what is your major?	open-ended compulsory
5.	Have you ever heard about cultivated meat?	yes/no compulsory
6.	Would you be interested in learning about this technology? Please justify your response.	yes/no compulsory
7.	Do you believe this new technology could impact your professional success in your current field? Please justify your response.	yes/no/maybe compulsory
8.	Would you be open to trying cultivated meat if you knew its origin and quality of preparation? Please justify your response.	yes/no/maybe compulsory
9.	Do you think consuming this type of food would affect any aspect of your personal life? Please justify your response.	yes/no/maybe compulsory
10.	What are your opinions on cultivated meat?	open-ended non-compulsory

Table 1 – Questions content and format of the online questionnaire, which was available from February 2022 to February 2023, on the Google Forms platform, in Portuguese, with recruiting of Brazilian participants.

The sociodemographic data (questions 1 to 4) collected information on age, city, professional activity, and, if applicable, the respondents' undergraduate program. Questions 5 to 9 were multiple-choice, with questions 6 to 9 also requiring justifications. Question 10 was open-ended and the only non-compulsory one. The rationale for questions 6 to 9 and the responses to the open-ended question 10 were analyzed by two researchers, who individually synthesized the responses into preliminary central ideas using the Collective Subject Discourse (CSD) method (Duarte et al., 2009).

The results of the individual analyses were then combined to define the final categorization for central ideas. The results were then presented in the form of an infographic for question 7 and as word clouds for questions 9 and 10. The tables presenting the descriptive results for questions 5 to 10 are shown in absolute numbers and percentages.

All results were analyzed using a descriptive approach, organized in the Microsoft Excel Program.

3. Results

The results are based on responses from 382 participants across various regions of Brazil (Table 2). Five participants, comprising both professionals and undergraduate students, are presented in two groups, with their responses accordingly.

Groups of respondents	Region (%)				Age (%)			Total (%)
	PR	MG	SP	Other	18 to 29 years old	30 to 49 years old	50 or older	
Professionals agricultural sciences	58 (14.9)	4 (1.0)	3 (0.7)	11 (2.8)	18 (4.6)	42 (10.8)	16 (4.1)	76 (19.6)
Other professionals	74 (19.1)	7 (1.8)	18 (4.6)	26 (6.7)	28 (7.2)	62 (16.0)	35 (9.0)	125 (32.2)
Undergraduate students/agric. sciences	100 (25.8)	31 (8.0)	1 (0.2)	6 (1.5)	125 (32.2)	11 (2.8)	2 (0.5)	138 (35.6)
Undergraduate students/other areas	34 (8.7)	2 (0.5)	2 (0.5)	10 (2.5)	38 (9.8)	9 (2.3)	1 (0.2)	48 (12.4)
Total	266 (68.7)	44 (11.3)	24 (6.2)	53 (13.6)	209 (54.0)	124 (32.0)	54 (13.9)	387

Table 2 – Demographic data based on 387 responses from 382 respondents to an online questionnaire about the intention to learn cellular agriculture, Brazil, from February 2022 to February 2023.

When asked if they had ever heard of cultivated meat, 382 participants provided 387 responses (Table 3).

Answers	General	Professionals agrarian sciences	Other professionals	Undergraduate students agrarian sciences	Undergraduate students in other areas	Total of responses
Yes	305 (78.8)	68 (17.5)	85 (68.0)	123 (89.1)	32 (66.7)	308 (79.5)
No	77 (19.8)	8 (2.0)	40 (32.0)	15 (10.9)	16 (33.3)	79 (20.4)
Total	382	76 (19.6)	125 (32.3)	138 (35.6)	48 (12.4)	387

Table 3 - Responses to the question 5, "Have you ever heard of cultivated meat?" from 387 answers provided by 382 respondents in an online questionnaire in Brazil, from February 2022 to February 2023.

Of all respondents, 286 (73.9%) expressed interest in learning about cellular agriculture (Table 4), with the majority of "yes" responses coming from undergraduate students in agrarian sciences aged between 18 and 29 years (41.6%). Overall, 200 (69.9%) responses were justified. The main ideas in the justifications (Table 5) were grouped into four themes: i) benefits, with phrases such as "it is a technology that may reduce the number of animals raised for meat production", "this technology produces meat without the slaughter of animals", and "it will bring benefits to society"; ii) knowledge, with phrases such as "acquire knowledge about this new area", "knowledge is never in excess", "to form an opinion about cultivated meat", and "it is important to be informed"; iii) innovation, with phrases such as "curricular bases should follow innovations", "innovation drives the world", and "it is important to understand innovations thoroughly to apply them safely"; iv) opportunity, with phrases such as "it is important to have a competitive edge in the job market, to work where there are few professionals", and "it has significant potential for professional activity because it is a field with vast growth potential" (Figure 1).

Groups of respondents	Age	Answers		Total
		Yes (%)	No (%)	
Professionals in agrarian sciences	18 to 29 years old	16 (5.6)	2 (0.7)	18 (6.3)
	30 to 49 years old	39 (13.8)	3 (1.0)	42 (14.8)
	50 or older	13 (4.6)	3 (1.0)	16 (5.6)
Total		68 (17.5)	8 (2.0)	76 (19.5)
Other professionals	18 to 29 years old	12 (4.2)	16 (5.6)	28 (9.8)
	30 to 49 years old	33 (11.7)	29 (10.3)	62 (22.0)
	50 or older	15 (5.3)	20 (7.1)	35 (12.4)
Total		60 (15.5)	65 (16.7)	125 (32.2)
Undergraduate students in agrarian sciences	18 to 29 years old	117 (41.6)	8 (2.8)	125 (44.4)
	30 to 49 years old	9 (3.2)	2 (0.7)	11 (3.9)
	50 or older	2 (0.7)	0	2 (0.7)
Total		128 (33.0)	10 (2.5)	138 (35.5)

Groups of respondents	Age	Answers		Total
		Yes (%)	No (%)	
Undergraduate students in other areas	18 to 29 years old	22 (7.8)	16 (5.6)	38 (13.4)
	30 to 49 years old	7 (2.4)	2 (0.7)	9 (3.1)
	50 or older	1 (0.3)	0	1 (0.3)
Total		30 (7.7)	18 (4.6)	48 (12.4)
General total		286 (73.9)	101 (26.1)	387

Table 4 – Demographic data by group based on 387 responses to the question 6, "Would you be interested in learning about cellular agriculture?" from 385 respondents in an online questionnaire on the Google Forms platform in Brazil, from February 2022 to February 2023.

	Professionals agrarian sciences	Other professional	Undergraduate students agrarian science	Undergraduate students in other area	Total
Benefits	2 (0.6)	24 (8.3)	8 (2.7)	3 (1.0)	18 (6.2)
Knowledge	17 (5.9)	24 (8.3)	43 (15.0)	12 (4.1)	95 (33.2)
Innovation	5 (1.7)	5 (1.7)	17 (5.9)	0	27 (9.4)
Opportunities	14 (4.8)	5 (1.7)	35 (12.2)	6 (2.0)	60 (20.9)
Total justified "yes" answers	38 (13.2)	39 (13.6)	103 (36.0)	21 (7.3)	200 (69.9)

Table 5 – Justifications for the "yes" responses to question 6, "Would you be interested in learning about cellular agriculture?" provided by 200 respondents in an online questionnaire in Brazil, from February 2022 to February 2023.

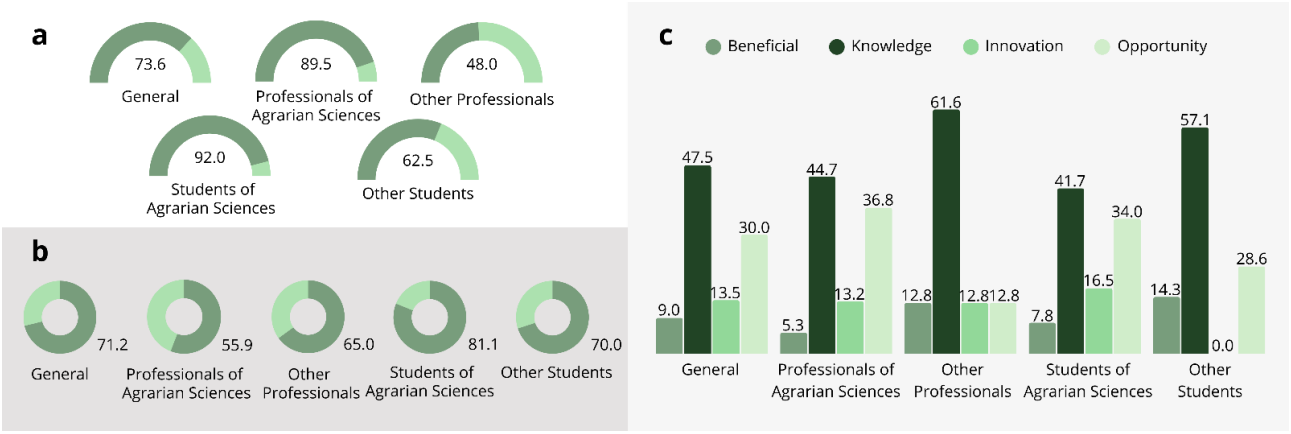

Figure 1 – General and group percentage responses from 382 participants regarding question 6, "Would you be interested in learning about cellular agriculture?" (a); participants who provided justifications for their answers (b); and reasons for learning about cellular agriculture (c), in Brazil, from February 2022 to February 2023.

When asked if this recent technology would interfere with their professional success, 51 (13.4%) of the total respondents answered yes, 254 (66.5%) answered no, and 77 (20.1%) answered maybe. Of the total, 180 (47.1%) respondents provided justifications for their answers to this question (Table 6). The main ideas in the rationale for responses were grouped into i) ignorance, with phrases such as "I do not know how to comment on it", "I cannot be certain about the answer", and "I am unfamiliar with it"; ii) disinterest, with phrases such as "it is outside my field of expertise", "I do not need it to perform my professional activities", and "I do not work in that area"; iii) neophobia, with phrases such as "the production sector is at risk, many people could lose their income", and "it is going to limit the activities of various professionals"; iv) opportunities, with phrases such as "it could create job opportunities" and "I believe it is a great opportunity for my professional success, potentially opening new avenues for success".

Answers		General	Professionals agrarian sciences	Other professional	Undergraduate students agrarian sciences	Undergraduate students in other areas
Yes		51 (13.4)	24 (31.6)	31 (24.8)	66 (47.8)	20 (41.7)
No		254 (66.5)	28 (36.8)	51 (40.8)	49 (35.5)	9 (18.7)
Maybe		77 (20.1)	24 (31.6)	43 (34.4)	23 (16.7)	19 (39.6)
Justified answers		180 (47.1)	37 (48.7)	66 (52.8)	52 (37.7)	25 (52.1)
Main ideas for justifications	Ignorance	12 (6.6)	1 (2.7)	5 (7.6)	5 (9.6)	1 (4.0)
	Disinterest	105 (58.3)	18 (48.7)	47 (71.2)	24 (46.2)	16 (64.0)
	Neophobia	8 (4.4)	4 (10.8)	0	4 (7.7)	0
	Opportunities	55 (30.5)	14 (37.8)	14 (21.2)	19 (36.5)	18 (32.0)

Table 6 – Responses and justifications to the question 7, "Could this new technology impact your professional success?" from 382 respondents in an online questionnaire in Brazil, from February 2022 to February 2023.

When the interviewers were asked if they would be open to trying cultivated meat, provided the origin and quality of its preparation were known, 290 (75.9%) answered yes, 33 (8.6%) no, and 59 (15.5%) maybe. In addition, 295 (77.2%) provided open justifications for their answers. The main ideas in the justifications for responses were grouped into: i) alternatives, with phrases such as "I believe it will be an alternative to traditional meat consumption"; ii) animal welfare, with phrases such as "I would love to be able to consume meat without it involving the death of animals"; iii) knowledge, with phrases such as "to know it so that I can form an opinion"; iv) disinterest, with phrases such as "I would not go back to eating meat"; v) doubts, with phrases such as "I do not know"; vi) innovation, with phrases such as "I am in favor of new technologies"; v) environmental, with phrases such as "to continue sustainably consuming animal protein"; vi) neophobia, with phrases such as "I am somewhat apprehensive, everything new brings some hesitation"; vii) health, with phrases such as "I believe it would not harm my health"; viii) food security, with phrases such as "it could potentially be a solution to food scarcity". The percentages of the responses are shown in Table 7.

Answers		General	Professionals agrarian sciences	Other professional	Undergraduate students agrarian sciences	Undergraduate students in other areas
Yes		290 (75.9)	60 (78.9)	80 (64.0)	115 (83.3)	38 (79.2)
No		33 (8.6)	6 (7.9)	16 (12.8)	7 (5.1)	4 (8.3)
Maybe		59 (15.4)	10 (13.2)	29 (23.2)	16 (11.6)	6 (12.5)
Justified answers		295 (77.2)	59 (77.63)	93 (74.4)	113 (81.8)	32 (66.6)
Main ideas for justifications	Alternative	37 (12.5)	5 (8.4)	12 (12.9)	16 (14.1)	4 (12.5)
	Animal welfare	27 (9.1)	5 (8.4)	5 (5.3)	12 (10.6)	5 (15.6)
	To know	116 (39.3)	27 (45.7)	32 (34.4)	4 (3.5)	10 (31.2)
	Disinterest	30 (10.1)	5 (8.4)	11 (11.8)	10 (8.8)	4 (12.5)
	Doubts	26 (8.8)	4 (6.7)	14 (15.0)	5 (4.4)	3 (9.3)
	Innovation	29 (9.8)	4 (6.7)	10 (10.7)	11 (9.7)	4 (12.5)
	Environmental	6 (2.0)	2 (3.8)	2 (2.1)	2 (1.7)	1 (3.1)
	Neophobia	12 (4.0)	4 (6.7)	4 (4.3)	0	2 (6.2)
	Health	9 (3.0)	3 (5.0)	2 (2.1)	3 (2.6)	0

Table 7 – Responses and justifications to the question 8, "Would you be open to trying cultivated meat?" from 382 respondents in an online questionnaire on the Google Forms platform in Brazil, from February 2022 to February 2023.

Of all respondents, 141 (36.9%) answered that consuming this type of food would affect some aspects of their personal lives, 135 (35.3%) responded that it would not, and 106 (27.8%) answered maybe; 227 (59.4%) provided justifications (Table 8). Among the justifications there were i) cultivatism, with phrases such as "I would prefer to eat cultivated meat rather than meat from slaughtered animals"; ii) disinterest, with phrases such as "I am vegetarian" and "I am vegan"; iii) alternative, with phrases such as "my family members still consume meat from slaughter, and it would be an alternative to them"; iv) animal welfare, with phrases

such as “it would reduce animal exploitation”; v) cost, with phrases such as “high cost”; vi) doubt, with phrases such as “I am in doubt”; vii) health, with phrases such as “better nutritional qualities”(Figure 2).

Answers		General	Professionals agrarian sciences	Other professionals	Undergraduate students agrarian sciences	Undergraduate students in other areas
Yes		141 (36.9)	24 (31.6)	31 (24.8)	66 (47.8)	20 (41.7)
No		135 (35.3)	28 (36.8)	51 (40.8)	49 (35.5)	9 (18.8)
Maybe		106 (27.8)	24 (31.6)	43 (34.4)	23 (16.7)	19 (39.5)
Justified answers		227 (59.4)	38 (50.0)	71 (56.8)	90 (65.2)	28 (58.3)
Main ideas for justifications	Cultivatism	43 (18.9)	5 (13.2)	10 (14.1)	22 (24.4)	6 (21.4)
	Disinterest	38 (16.7)	3 (7.9)	16 (22.5)	14 (17.8)	3 (10.7)
	Alternative	34 (15.0)	3 (7.9)	7 (9.7)	20 (22.2)	4 (14.3)
	Animal welfare	26 (11.5)	6 (15.8)	6 (8.5)	11 (12.2)	3 (10.7)
	Costs	22 (9.7)	8 (21.1)	6 (8.5)	8 (8.9)	0
	Doubts	18 (7.9)	4 (10.5)	6 (8.5)	4 (4.4)	4 (14.3)
	Unfamiliarity	15 (6.6)	3 (7.9)	10 (14.1)	0	2 (7.1)
	Health	13 (5.7)	1 (2.6)	6 (8.5)	1 (1.1)	5 (17.9)
	Culture	7 (3.1)	1 (2.6)	0	6 (6.7)	0
	Environment	7 (3.1)	4 (10.5)	2 (2.8)	0	1 (3.6)
	Personal values	4 (1.8)	0	2 (2.8)	2 (2.2)	0

Table 8 – Responses and justifications to the question 9, "Would consuming this type of food affect any aspect of your personal life?" from 382 respondents in an online questionnaire on the Google Forms platform in Brazil, from February 2022 to February 2023.

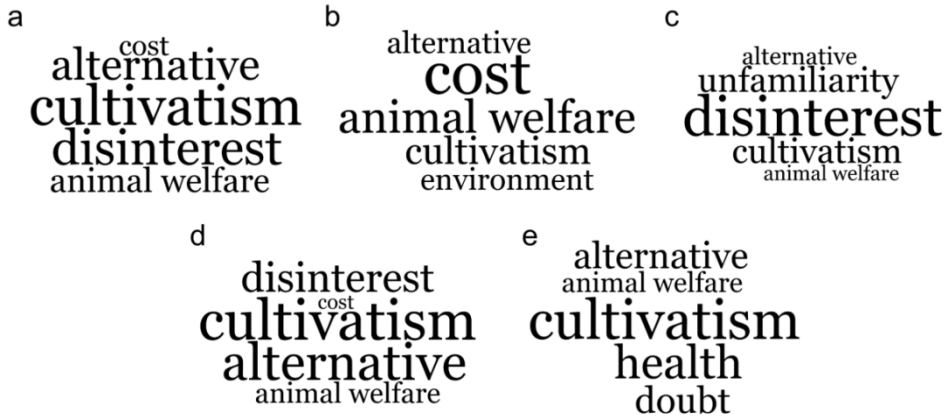

Figure 2 - Word clouds representing the ideas expressed by 227 respondents of an online questionnaire between February 2022 and February 2023, who provided justifications regarding question 9, “Would consuming this type of food affect any aspect of your personal life” (a); words reflecting the ideas of 38 professionals in agrarian sciences (b), 71 professionals from in other fields (c), 90 undergraduate students in agrarian sciences (d), and 28 students from other areas (e).

When asked about their personal opinions on cultivated meat, 317 (82.9%) respondents expressed their views, and the main ideas in the responses were: i) animal welfare, with phrases such as “it would be interesting to reduce animal suffering”; ii) one welfare, with phrases such as “a new opportunity to protect the planet, animals, and humans” and “reduction of environmental impacts in the world”; iii) nice, with phrases such as “It is cool,” and “I am optimistic”; iv) unfamiliarity, with phrases such as “I do not know”; v) doubt, with phrases such as “maybe, I am not sure yet”; vi) innovation, with phrases such as “I believe it is an innovative technology that will bring significant advancements in various fields”; vii) unnecessary, with phrases such as “I think it

is unnecessary"; viii) neophobia, with phrases such as "I find it strange" and "I find it repulsive"; ix) food security, with phrases such as "it is an option since the demand for food is increasing" (Figure 3). The percentages of the responses are shown in Table 9.

Answers	General	Professionals agrarian sciences	Other professional	Undergraduate students agrarian sciences	Undergraduate students in other areas
Animal welfare	78 (24.6)	7 (11.3)	17 (17.0)	44 (37.6)	10 (25.6)
One welfare	54 (17.0)	10 (16.1)	11 (11.0)	26 (22.2)	7 (17.9)
Nice	67 (21.1)	17 (27.4)	19 (19.0)	23 (19.7)	8 (20.5)
Unfamiliarity	47 (14.8)	10 (16.1)	28 (28.0)	6 (5.1)	3 (7.7)
Doubt	40 (12.6)	8 (12.9)	11 (11.0)	12 (10.3)	9 (23.1)
Innovation	29 (9.1)	6 (9.7)	5 (5.0)	17 (14.5)	2 (5.1)
Neophobia	10 (3.2)	2 (3.2)	4 (4.0)	2 (1.7)	2 (5.1)
Food security	6 (1.9)	0	2 (2.0)	4 (3.4)	0
Unnecessary	11 (3.5)	3 (4.8)	6 (6.0)	2 (1.7)	0
Total	317 (83.0)	62 (81.6)	100 (80.0)	117 (84.8)	39 (79.6)

Table 9 - The percentage distribution of 317 responses to the question 10, "What are your opinions on cultivated meat?" from 382 respondents in an online questionnaire on the Google Forms platform in Brazil, from February 2022 to February 2023.

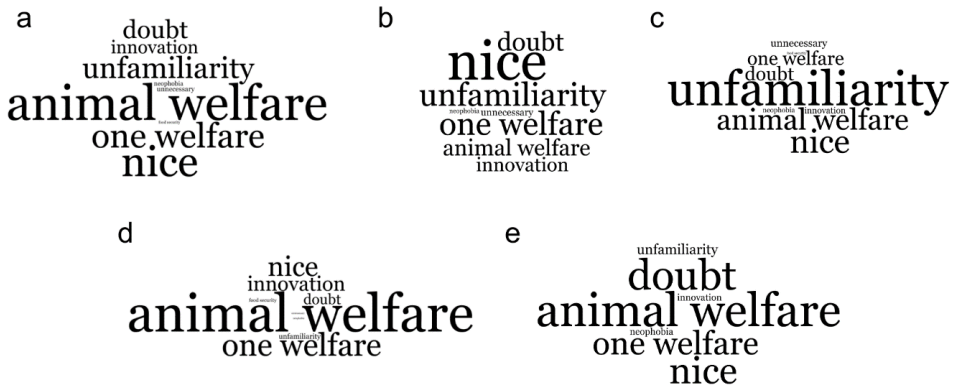

Figure 3 – Words representing the ideas expressed by 317 respondents of an online questionnaire between February 2022 and February 2023, who shared their opinions about cultivated meat (a); including 62 professionals in agrarian sciences (b), 100 professionals in other fields (c), 117 undergraduate students in agrarian sciences (d), and 39 students from other areas (e).

4. Discussion

The data indicate that a significant percentage of Brazilian students and professionals are familiar with cultivated meat, particularly those in the agricultural sciences. Prior knowledge about this type of food was a principal factor in the acceptance of cultivated meat in a German study with 713 participants, showing that 38.0% of them had already heard of cultivated meat and demonstrated greater acceptance (Weinrich et al., 2020). In Brazil, research on cultivated meat has been conducted before, yielding variable results. Valente et al. (2019) described a knowledge rate of 81.9% among 626 participants with high educational levels from the Southern region of Brazil. Heidemann et al. (2020) observed resistance to cultivated meat from veterinarians (76.8%; 209/272) and animal scientists (23.2%; 63/272), due to a lack of knowledge. Lack of familiarity is known to be a significant factor correlated with resistance, including the idea that as contact with cultivated meat increases, it becomes more normal (van der Weele and Driessen, 2019). This has been confirmed in data from the cities of São Paulo and Salvador, in Brazil, where higher acceptance was correlated with higher levels of knowledge regarding cultivated meat (Mendes et al, 2025). Overall, the level of knowledge is embedded in dynamic sets of information and, as such, it is likely to improve rapidly as news about cultivated meat becomes increasingly frequent (Valente et al., 2019). According to Bogueva and Marques et al. (2023), knowledge about new products and their distribution chains is essential for actors to engage in diversification that may enable participation in new systems. Moreover, since technology is currently under development, completely new roles may emerge as the new chain matures (Heidemann et al., 2020). The importance of promoting the dissemination of new technologies, as well as opportunities for professional knowledge

was restated by the views of most of the participants; however, it is not sufficient to attain educational goals robustly, and the relevance of public policies must be highlighted (Herrero et al., 2020; Soccol et al., 2024).

Participants expressed interest in learning about cellular agriculture, primarily undergraduate students in agrarian sciences (veterinary medicine, animal science, or agronomy) aged between 18 and 29 years old from Paraná. The reasons presented for this intention to learn were the benefits of cultivated meat for animals, the environment, and human health, as well as the opportunity to acquire knowledge in this innovative field. Cultivated meat is more attractive to young people in Brazil (Chriki et al., 2021), which may be related to the fact that younger consumers with higher levels of education, wealthier, and politically progressive leaning are generally found to hold more positive views towards adopting novel food technologies (Cattaneo et a., 2019; Onwezen et al., 2021). Conversely, individuals from various fields expressed a lack of interest in pursuing a career in this domain, citing concerns about job loss and feeling inadequately informed about the topic, as seen in the first analysis of the perceptions of veterinarians and animal scientists regarding cultivated meat in Brazil, when Heidemann et al. (2020) found resistance to the topic in 2020. Currently, in North America, job opportunities are expanding, driven by technological advancements and shifting consumer preferences, making it an increasingly attractive field for those seeking impactful careers that contribute to animal welfare and sustainable food systems. There have been notable increases in positions in Food Safety, Food Science, and marketing and sales in the United States of America (Altproteinpartners, 2024).

The data indicate that the recognition of certain professionals' roles tends to grow alongside the advancement of cellular agriculture in the country. Brazilian professionals are optimistic about the potential of plant-based and cultivated meat production to create new job opportunities (Morais-da-Silva et al., 2022).

While some workers may be able to transition to other agricultural activities, such as growing ingredients for new alternative meat chains, most job opportunities will require higher qualifications (Morais-da-Silva et al., 2022; Stout et al., 2024). Approximately 15% of individuals working in Brazilian agribusiness, including activities in agriculture and livestock production, processing, and other agri-services, have higher education, whether incomplete or complete (CEPEA, 2023). A classic argument in labor sociology and labor economics is that technological upgrading objectively causes workers to lose their jobs; however, the actual historical experience since the Industrial Revolution suggests that it does not lead to large-scale structural unemployment (Zhang, 2023). However, there are risks if educational activities are not carefully fostered. The intention rates of learning about cellular agriculture among agrarian students and professionals in Brazil are valuable, as these individuals, being on-field professionals, are likely to interact with farmers and others who may also benefit from learning about cellular agriculture.

The respondents in this study were inhabitants of urban areas, which may explain their low resistance to cultivated meat and cellular agriculture in general. Positive impacts are likely evident to urban dwellers, with higher densities of high-skilled jobs in biotechnology and engineering (Newel and Glaros, 2024), as well as increased exposure to new developments. On the other hand, negative consequences may fall upon rural communities (Soccol et al., 2024). According to Tubb and Seba (2020), jobs in animal feed and production activities are most likely to be affected, representing up to 23% of the jobs in the conventional meat chain. Therefore, public policies are necessary to safeguard rural communities and facilitate just transitions across various production systems. Training and retraining programs can both develop the next generation of scientists capable of tackling technological hurdles and create employment in areas where animal agriculture might decline (Stout et al., 2024).

A majority of respondents believed that new technologies would not interfere with their professional success, justified by a lack of knowledge, doubts, or disinterest in the topic, either because they did not wish to work professionally in the field or, as consumers, found them unnecessary or experienced a form of neophobia. According to Finistrella et al. (2024), neophobia is the fear of the new and unknown. Thus, disinterest and resistance justified by neophobia are likely to be attenuated by education. Furthermore, neophobia tends to decrease as cultivated meat becomes more familiar to society at large. As put by van der Weele and Driessen (2019), normal meat may become stranger as cultivated meat becomes more normal.

Some respondents expressed confidence that the arrival of this innovative technology would not negatively impact their professional success, as they understand that this area enables the production of complementary AP, thus adding to conventional production systems instead of replacing them. They referred to a logical phenomenon, which may be driven by the interplay of various factors, such as the increasing demand for meat, comparative characteristics between traditional and cell-based products, and the degree of environmental and animal ethics awareness among consumers, with cost arguably leading the way. The costs of cellular products are recognized as an essential challenge to be overcome. Current production technologies yield low results, leading to economic projections that hinder the scalability of cultivated meat (Hubalek et al., 2022). More recently, Pasitka et al. (2024) conducted a techno-economic analysis for a theoretical production facility of 50,000 L, showing that the cost of cultivated chicken can drop to the range of organic meat, at US$6.20 per pound, by utilizing perfusion technology. However, such theoretical predictions remain to be proven in practice. Examining the history of disruptive innovations, initial cellular agriculture costs appear prohibitive, but they tend to drop dramatically within the first 15 years of development (Tubb and Seba, 2020).

Along with the costs, the cultural context determines the place that different foods occupy in people's lives (Giacolone et al., 2023). Valente et al. (2019) observed that 63.6% of the 626 participants declared they would eat cultivated meat. Gomez-Luciano et al. (2019) reported, in a survey of 216 respondents, that the willingness to purchase cultivated meat alternatives in Brazil may increase if perceptions of their healthiness, safety, and nutritional value improve. According to a survey conducted by Chriki et al. (2021) with 4471 respondents, 46.6% of Brazilians consider cultivated meat as a promising and acceptable option, and 66% were willing to try it. A later survey with 225 respondents confirms that Southeastern Brazilians are eager to consume cultivated meat,

with 80.9% of respondents indicating a willingness to try it (de Oliveira et al., 2021). In Porto Alegre, Rio Grande do Sul, Southern Brazil, a survey with 538 respondents demonstrated that six out of ten people were willing to try cultivated meat alternatives (Fernandes et al., 2021). A recent Brazilian study confirmed significant variations in the intention to consume cultivated meat, with São Paulo showing the highest rate at 46.6% among 419 respondents. Salvador showing 24.4% among 390 respondents, in a survey conducted with a total of 809 participants (Mendes et al., 2025) Thus, the studies seem to indicate a positive outlook for the arrival of cultivated meat in Brazil, as confirmed by a relevant proportion of respondents, which is also reflected in our results. However, further research is needed to better understand whether it may become a regular part of consumers' diets in the country, as most studies have only investigated willingness to try.

Most respondents believed that their personal lives could be changed if they started consuming cultivated meat exclusively. The frequency of such answers required a new terminology, here designated "cultivatism", to indicate a preference for consuming animal products originating from cellular agriculture. This positioning may suggest that cultivated meat is perceived by many as a solution for mitigating pre-existing cognitive dissonance, where individuals enjoy eating meat but are troubled by the harm caused to animals in its production (Hopwood and Bleidorn, 2019). According to Loughnan et al. (2014), it is necessary to provide a novel perspective on everyday, naturalized actions, such as eating meat, which are not commonly conceptualized as moral choices, to address the meat paradox. As the many benefits of meat alternatives become clearer and the paradoxes associated with conventional meat consumption are alleviated, the trend toward the acceptance of alternative meat products is likely to soar. In addition to animal welfare, some participants noted that AP could help alleviate existing difficulties in accessing food worldwide. Cultivated meat is an innovation that is likely to enhance food security (Nobre, 2022), especially as reducing the consumption of conventional animal products may contribute to achieving this goal (Alexandre et al., 2017). Given the wide variety of formulations and blends, AP can meet the nutritional demands of many. Furthermore, some waste from the food industry can be upcycled to create novel ingredients. Such practices not only support food security but also contribute to the goal of establishing a sustainable global food supply system (Malila et al., 2024).

In summary, the flourishing of cellular agriculture depends on the training of its potential workers at all levels and related areas. Although our study relies on a small, non-stratified sample of the total population involved in food production in the country, it indicates that structuring education in cellular agriculture is well-received by many, as there appears to be curiosity and awareness of job opportunities in this emerging field in the studied region. Although it may not be of high interest to all, innovations are commonly adopted by a few who tend to become leaders, and our results show that sufficient interest in building such leadership is currently available.

As limitations of this work, Brazil's diversity highlighted the need for more research with greater stratification of respondents, allowing for a more accurate characterization of Brazilians' views across different areas. The "other" category reflected this variety and may have limited the interpretation of the data. Interpreting our results also requires attention to a bias towards higher positive perceptions from respondents in the agrarian field, as cellular agriculture research and teaching in the agricultural sector in the State of Paraná, where most respondents live, is atypically higher than in other Brazilian States. Additionally, the research instrument used proved insufficient for exploring the reasons and logic behind the responses. To gain a deeper understanding of participants' opinions, it would be ideal to conduct more research using semi-structured interviews, which can reveal essential nuances that were not captured in the current format. When interpreting the comments left by our respondents, it is critical to consider that individuals with a more positive outlook on the topic may be more motivated to leave additional comments, as the request for opinions about cultivated meat was not mandatory. Therefore, a bias toward a higher proportion of positive comments is likely in our study. Another issue is the limited interaction with respondents who showed disinterest in the topic. If predictions are fulfilled, it is plausible that the development of cellular agriculture will change their lives. This issue warrants further attention to ensure that transitions "do not leave anyone behind" (United Nations, 2023).

5. Conclusion

The data showed that Brazilian undergraduate students and professionals are interested in learning about cellular agriculture, to acquire the skills and competencies necessary to seize the opportunities in this emerging field. This suggests a demand for the development of educational programs and infrastructure to prepare professionals who already have some knowledge of the subject but wish to deepen their understanding. Despite its limitations, our study underscores the importance of investigating the views and opinions of current and future workforce members in food production regarding AP. Further research involving professionals and students from various fields across different regions of Brazil is needed.

Acknowledgments: The authors would like to thank all the anonymous participants who gave their time to complete the questionnaire for this study. Jennifer Cristina Biscarra Bellio was the recipient of a doctorate scholarship from the Coordination for the Improvement of Higher Education Personnel (CAPES); Gabriel Mendes was the recipient of a laboratory technician scholarship from Fundação Araucária, Paraná, Brazil, under the New Research and Innovation Arrangements in Alternative Proteins (NAPI PA). Carla Forte Maiolino Molento was the recipient of a productivity grant from the National Council for Scientific and Technological Development (CNPQ). The grammar and spellcheck were significantly enhanced by using Gemini and Microsoft Word.

Informative notes: This research was approved by the Ethics Committee on Research Involving Humans at the Federal University of Paraná, protocol number 5.009.067.

6. References

Alexander P, Brown C, Arneth A, Dias C, Finnigan J, Moran D, Rounsevel MDA. Could Consumption of Insects, Cultured Meat or Imitation Meat Reduce Global Agricultural Land Use? Global Food Security, 15;22-32, 2017. https://doi.org/10.1016/j.gfs.2017.04.001.

AltProteinPartners. Alt Protein Job Market. July 2024. Retrieved from: https://www.altproteinpartners.com/post/state-of-the-alt-protein-job-market-july-2024.

Barber B. Resistance by Scientists to Scientific Discovery: This Source of Resistance Has Yet to Be Given the Scrutiny Accorded Religious and Ideological Sources. Science, 134;596-602, 1961. https://doi.org/10.1126/science.134.3479.596.

Biscarra-Bellio JC, Oliveira GB, Marques MCP, Molento CFM. Demand Changes as Meat Reshapes Demand: The Great Meat Revolution. Meat Science, 196;109040, 2023. https://doi.org/10.1016/j.meatsci.2022.109040.

Bogueva D, Marques MCP, Molento CFM, Marinova D, Phillips CJC. Will The Cows and Chickens Come Home? Perspectives Of Australian and Brazilian Beef and Poultry Farmers Towards Diversification. Sustainability, 15;12380, 2023. https://doi.org/10.3390/su151612380.

Cattaneo C, Lavelli V, Proserpio C, Laureati M, Pagliarini E. Consumers' attitude towards food by-products: the influence of food technology neophobia, education and information. Int J Food Sci Technol, 54;679-87, 2019. https://doi.org/10.1111/ijfs.13978

Cepea. Boletim Mercado De Trabalho Do Agronegócio Brasileiro: 4º Trimestre De 2023. Retrieved from: https://www.cepea.esalq.usp.br/br/mercado-de-trabalho-do-agronegocio.aspx.

Chriki S, Payet V, Pflanzer SB, Ellies-Oury MP, Liu J, Hocquette E, Rezende-De-Souza JH, Hocquette JF. Brazilian Consumers' Attitudes Towards So-Called "Cell-Based Meat". Foods, 10 (11): 2588, 2021. https://doi.org/10.3390/foods10112588.

De Oliveira GA, Domingues CHF, Borges JAR. Analyzing The Importance of Attributes for Brazilian Consumers to Replace Conventional Beef with Cultured Meat. PlosOne, 16:(5);E0251432, 2021. https://doi.org/10.1371/journal.pone.0251432.

Duarte SJH, Mamede MV, Andrade SMO. Opções Teórico-Metodológicas Em Pesquisas Qualitativas: Representações Sociais E Discurso Do Sujeito Coletivo. Saúde E Sociedade São Paulo, 18:(4);620-626, 2009. https://doi.org/10.1590/s0104-12902009000400006.

Economic Research Service - USDA. Brazil Once Again Becomes the World's Largest Beef Exporter. Amber Waves, 21 Jul. 2019. Retrieved from: https://www.ers.usda.gov/amber-waves/2019/july/brazil-once-again-becomes-the-world-s-largest-beef-exporter/.

Fernandes AM, Costa LT, Teixeira OS, Santos FV, Revillion JPP, De Souza ARL. Consumption Behavior and Purchase Intention of Cultured Meat in The Capital of the "State of Barbecue", Brazil. British Food Journal, 123:(9);3032-3055, 2021. https://doi.org/10.1108/bfj-08-2020-0698.

Finistrella V, Gianni N, Fintini D, Menghini D, Amendola S, Donini LM, Manco M. Neophobia, Sensory Experience, And Child's Schemata Contribute to Food Choices. Eating and Weight Disorders, 29;25, 2024. https://doi.org/10.1007/s40519-024-01657-5.

Gfi. Plano De Ensino Para Disciplinas Em Proteínas Alternativas. The Good Food Institute. Brasil, 2022. Retrieved from: https://gfi.org.br/resources/plano-de-ensino-para-disciplinas-em-proteinas-alternativas-modelo-conceitual/.

Gfi. The Alternative Protein Project. The Good Food Institute, 2024. Retrieved from: The Alt Protein Project | Gfi Brasil.

Giacalone D, Jaeger SR. Consumer Acceptance of Novel Sustainable Food Technologies: A Multi-Country Survey. Journal of Cleaner Production, 408, 137119, 2023. https://doi.org/10.1016/j.jclepro.2023.137119.

Globe Newswire. Plant-Based Meat Market Research 2025: A $21.81 Billion Industry by 2030, Driven by Growing Investments, New Product Launches, Clean Labeling Demand, and Environmental Concerns. 2025. https://www.globenewswire.com/news-release/2025/03/05/3037450/0/en/Plant-Based-Meat-Market-Research-2025-A-21-81-Billion-Industry-by-2030-Driven-by-Growing-Investments-New-Product-Launches-Clean-Labeling-Demand-and-Environmental-Concerns.html

Godfray CJ, Aveyard P, Garnett T, Hall JW, Key TJ, Lorimer J, Pierre Humbert RT, Scarborough P, Springmann M, Jebb SA. Meat Consumption, Health, And the Environment. Science, 361; Eaam5324, 2018. https://doi.org/10.1126/science.aam5324.

Gómez-Luciano CA, De Aguiar LK, Vriesekoop F, Urbano B. Consumers' Willingness to Purchase Three Alternatives to Meat Proteins in The United Kingdom, Spain, Brazil, and The Dominican Republic. Food Quality and Preference, 78;103732, 2019. https://doi.org/10.1016/j.foodqual.2019.103732.

Heidemann MS, Taconeli CA, Reis GG, Parisi G, Molento, CFM. Critical Perspective of Animal Production Specialists on Cell-Based Meat in Brazil: From Bottleneck to Best Scenarios. Animals: An Open Access Journal from MDPI, 10 (9);1678, 2020. https://doi.org/10.3390/ani10091678.

Herrero A, Thornton P, Mason-D'croz D, et al. Innovation Can Accelerate the Transition Towards a Sustainable Food System. Nature Food, 1:(4);266-272, 2020. https://doi.org/10.1038/s43016-020-0074-1.

Hopwood CJ, Bleidorn W. Psychological Profiles of People Who Justify Eating Meat as Natural, Necessary, Normal, Or Nice. Food Quality and Preference, 75;10-14, 2019. https://doi.org/10.1016/j.foodqual.2019.02.004.

Hubalek S, Post MJ, Moutsatsou P. Towards Resource-Efficient and Cost-Efficient Cultured Meat. Current Opinion in Food Science, 47;100885, 2022. https://doi.org/10.1016/j.cofs.2022.100885.

Loughnan S, Bastian B, Haslam N. The Psychology of Eating Animals. Current Directions in Psychological Science, 23:(2);104-108, 2014. https://doi.org/10.1177/0963721414525781.

MalilaY, Owolabi IO, Chotanaphuti T, Sakdibhornssup N, Elliott CT, Visessanguan W, Karoonuthaisiri N, Petchkongkaew A. Current Challenges of Alternative Proteins as Future Foods. Science Of Food, 8;53, 2024. https://doi.org/10.1038/s41538-024-00291-w

Mendes G, Biscarra-Bellio JC, Heidemann MS, Taconeli C, Molento CFM. How much do opinions regarding cultivated meat vary within the same country? The cases of São Paulo and Salvador, Brazil. Plos One, 20;2, 2025. https://doi.org/10.1371/journal.pone.0317956

Morais-Da-Silva RL, Villar EG, Reis GG, Sanctorum H, Molento CFM. The Expected Impact of Cultivated and Plant-Based Meats on Jobs: The Views of Experts from Brazil, The United States, And Europe. Humanities and Social Sciences Communications, 9 (297), 2022. https://doi.org/10.1057/s41599-022-01316-z

Mugabe D, Hanley L, Newman L, Newman K, Fraser EDG. The Potential for Cellular Agriculture to Advance Sustainable Development Goals. In: Cellular Agriculture: Technology, Society, Sustainability and Science, 361-377, 2024. https://doi.org/10.1016/b978-0-443-18767-4.00020-2

Newell R, Glaros A. Chapter 3 - Sustainable Food Systems, Development Paths, And Scenarios for Cellular Agriculture. In: Fraser, E. D. G.; Kaplan, D. L.; Newman, L.; Yada, R. Y. (Eds.). Cellular Agriculture, 29-45. Academic Press, 2024. https://doi.org/10.1016/b978-0-443-18767-4.00022-6

Nobre, Farley Simon. Cultured Meat and The Sustainable Development Goals. Trends In Food Science & Technology, 124;140-153, 2022. https://doi.org/10.1016/j.tifs.2022.04.011

Onwezen MC, Bouwman EP, Reinders MJ, Dagevos H. A systematic review on consumer acceptance of alternative proteins: Pulses, algae, insects, plant-based meat alternatives, and cultured meat. Appetite. 159;105058, 2021. https://doi.org/10.1016/j.appet.2020.105058

Pasitka L, Wissotsky G, Ayyash M, Yarza N, Rosoff G, Kamiinker R, Nahmias Y. Empirical Economic Analysis Shows Cost-Effective Continuous Manufacturing of Cultivated Chicken Using Animal-Free Medium. Nature Food, 5;693-702, 2024. https://doi.org/10.1038/s43016-024-01022-w

Plant-based News. Plant-Based Meat Market 'To More Than Double in Value' By 2030. Consumer preferences for clean label and sustainable products are helping drive growth. 2025. https://plantbasednews.org/news/alternative-protein/plant-based-meat-market/

Poore J, Nemecek T. Reducing Food's Environmental Impacts Through Producers and Consumers. Science, 360 (6392): 987-992, 2018. https://doi.org/10.1126/science.aaq0216.

Post MJ, Levenberg S, Kaplan DL, Genovese N, Fu J, Bryant CJ, Negowetti NE, Verzijden K, Moutsatsou P. Scientific, Sustainability, And Regulatory Challenges of Cultured Meat. Nature Food, 1;403-415, 2020. https://doi.org/10.1038/s43016-020-0112-z

Soccol, CR, Molento CFM, Reis GG, Karp SG. Cultivated Meat: Technologies, Commercialization and Challenge. Springer, 2024. https://doi.org/10.1007/978-3-031-55968-6_18

Spiros K, Hall S, Darling J, Benami M (Eds.). Modern Meat: The Next Generation of Meat from Cells. 1. Ed. Cellular Agriculture Society, 2023. https://ora.ox.ac.uk/objects/uuid:6dd61d4b-781a-4ccb-bcd6-9029728348fe

Stephens N, Silvio LD, Dunsford I, Ellis M, Glencross A, Sexton A. Bringing Cultured Meat to Market: Technical, Socio-Political, And Regulatory Challenges in Cellular Agriculture. Trends In Food Science & Technology, 78;155-166, 2018. https://doi.org/10.1016/j.tifs.2018.04.010.

Stout AJ, Yuen J, John SK, Saldana YT, Fraser EDG, Kaplan D. Education and Training. In: Cellular Agriculture: Technology, Society, Sustainability and Science, 487-513, 2024. https://doi.org/10.1016/b978-0-443-18767-4.00004-4.

Tubb C, Seba T. Rethinking Food and Agriculture 2020–2030: The Second Domestication of The Cow, And the Collapse of Industrial Livestock Farming. Rethink x, 2020. Retrieved from: https://www.rethinkx.com/food-and-agriculture.

Tuomisto H, Mattos J. Environmental Impacts of Cultured Meat Production. Environmental science & technology. 45;6117-23, 2011. https://doi.org/10.1021/es200130u

Tuomisto H, Ryynänen T. Environmental impacts of cultivated meat. In: Soccol CR, Molento CFM, Reis GG, Karp SG, editors. Cultivated meat. Springer Nature; Cham: 2024. https://doi.org/10.1007/978-3-031-55968-6_14.

United Nations (UN). Sustainable Development Group. Leave No One Behind. 2023. Available online: https://unsdg.un.org/resources/leaving-no-one-behind-unsdg-operational-guide-un-country-teams.

Valente JPS, Fiedler RA, Heidemann MS, Molento CFM. First Glimpse on Attitudes of Highly Educated Consumers Towards Cell-Based Meat and Related Issues in Brazil. Plos One, 14:(8); E0221129, 2019. https://doi.org/10.1371/journal.pone.0221129.

Van Der Weele C, Driessen C. How Normal Meat Becomes Stranger as Cultured Meat Becomes More Normal: Ambivalence and Ambiguity Below the Surface of Behavior. Frontiers In Sustainable Food Systems, 3;69, 2019. https://doi.org/10.3389/fsufs.2019.00069.

Leal Filho W, Vargas VR, Salvia AL et al. The Role of Higher Education Institutions in Sustainability Initiatives at The Local Level. Journal Of Cleaner Production, 233;1004-1015, 2019. https://doi.org/10.1016/j.jclepro.2019.06.059

Weinrich R, Strack M, Neugebauer F. Consumer acceptance of cultured meat in Germany. Meat Science; 1:107924, 2020. http://doi.org/10.1016/j.meatsci.2019.107924.

Zhang Z. The Impact of The Artificial Intelligence Industry on The Number and Structure of Employment in The Digital Economy Environment. Technological Forecasting and Social Change, 197;122881, 2023. https://doi.org/10.1016/j.techfore.2023.122881.