

ATTITUDES OF CONSUMERS FROM BOSNIA AND HERZEGOVINA TOWARD CULTURED MEAT

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Abstract

Food consumption in the world has equaled the possibilities for its production. The production of protein food is in a particularly unenviable situation. To satisfy the need for meat and proteins of animal origin, it is necessary to significantly increase the number of animals from which meat is produced. According to current projections, meat production will need to be doubled by 2050. However, such a trend is considered unsustainable, as it may adversely affect the environment, animal welfare, and public health. To reduce this negative impact, the world is looking for new sources of protein. New protein sources should have nutritional and sensory characteristics similar to those of traditional meat. Recently, great progress has been made in cultured meat research. However, consumers' attitudes towards this issue are still not completely clear. Without changing the current repulsive attitude of consumers towards cultured meat, the results achieved during scientific research will not result in the industrial production of this type of protein product. The authors aimed to examine the attitudes of consumers in Bosnia and Herzegovina and the level of acceptability of cultured meat.

In the paper, an online survey was conducted during which data was collected on consumers' attitudes about the production and use of cultured meat. A previously designed questionnaire with 16 questions was used during this survey. At the end of the survey, 110 responses were collected. Descriptive statistical analysis and analysis of variance were applied during data analysis (mean, standard deviation, Chi-square test. For this purpose, the SPSS software package was used). Differences at $p < 0.05$ were considered significant.

The majority of respondents declared that they often (41.8%) or very often (24.5%) consume meat, while only 1.8% of people stated that they never eat meat. Only

11.8% of respondents have sufficient information about cultured meat, while 60.9% of them have not heard of this type of product. 36.6% of respondents would try cultured meat out of curiosity, 16.4% for ethical reasons, and 8.2% for environmental reasons, while 36.5% of them are not willing to try cultured meat. 50 respondents (45.5%) stated that they would definitely not consume, and 24 (25.5%) that they probably would not consume cultured meat. Only 7.2% of people said that they might try this type of product. As reasons for not trying cultured meat, the respondents state the following reasons: unnatural product, concern for their health, and sensory unacceptability (40%, 30.9%, and 9.1%, respectively). Some respondents (9.1%) stated that consuming cultured meat disgusts them.

The results of the survey showed that consumers in Bosnia and Herzegovina do not have enough information about cultured meat, but that they understand the need and importance of research in the search for meat alternatives (21.5 respondents).

Key words: *Cultured meat, Consumer perceptions, Survey, Bosnia and Herzegovina.*

1. Introduction

The number of inhabitants in the world is in great expansion and it is expected that by 2050 it will exceed 9 billion. Existing resources for food production are limited [1]. To meet the needs of the growing population according to the predictions of the Food and Agriculture Organization (FAO) until 2050, it will be necessary to produce 70% more food than the amount of food that is produced now [2]. Proteins are food ingredients that must be taken into the body. However, conventional production of animal-based food, which is rich in protein, is expensive and has a serious impact on the environment. The idea that

environmental issues can be solved by reducing meat consumption has been around for a long time, as this can help reduce the burden on the environment [3]. It is known that meat is a source of protein necessary in the human diet, which is why one should be careful with that proposal. It seems that research and production of alternative sources of protein with a lower negative impact on the environment contribute to the solution of the problem. Of all the alternatives currently being considered, the greatest advantage for use in the near future is "artificially cultured meat" (also called cultured, *in vitro*, synthetic, or laboratory-grown meat). The literature mentions the advantages of this product compared to other meat alternatives: similarity to conventional meat, improvement of animal welfare, saving of natural resources, reduction of greenhouse gas emissions, improvement of public health and food safety, provision of protein in an amount sufficient to meet the demand for food and meet the needs of a rapidly growing population [1]. Cultured meat, according to the advocates of its production, represents a sustainable alternative for consumers who want to be more responsible towards the environment, but at the same time, they are not ready and do not want to change their diet [4]. This technology will enable sustainable meat production for the population on planet Earth while reducing the suffering of animals used in meat production.

Cultured meat is made from the same types of cells arranged in the same or similar structure as animal tissues. Thus, the nutritional composition of animal meat and the ingredients that influence the formation of sensory properties are replicated. Cultivated meat has nothing to do with GMOs because it is produced without any genetic manipulation and without changes in the genetic material of the cells.

Cultured meat is a relatively new product, and enjoys the respect of consumers as a more sustainable meat option [5]. The results of several surveys on public perception of cultured meat have been published. A large number of studies have shown that consumers accept cultured meat or that they are willing to try it [5, 6, 7, 8, and 9].

Bryant and Barnett [10] found that consumers have certain reservations about the concept of cultured meat. According to the consumer statement, the reluctance to accept artificially grown meat stems from its alleged unnaturalness and concern for food safety. Many consumers react to the concept of cultured meat with disgust. They did not recognize personal benefit in the new product [6, 11]. On the other hand, many consumers recognize the raised meat's ethical and environmental potential benefits [12]. Changes related to meat alternatives can be found in consumer

motivation, increased demand and publicity, as well as technological and legislative developments in food production [5, 13].

The world's first restaurant serving cultured chicken "meat" opened in Singapore in December 2021 [22]. Acceptance of cultured meat by consumers is not the same in all countries. The following acceptance rates have been determined: in Belgium is between 23.9% and 42.5% [14], in Italy, it is 54% [15], in Germany 57% [16], in the Netherlands [17], in the United Kingdom and the Netherlands [18], and in the USA 65,3% [19]. The acceptability of artificial meat consumption by consumers in developing countries is lower than the acceptability in developed countries (for example, Brazil, India, and China) [3, 20, and 21]. Attitudes of Turkish consumers towards cultured meat were repulsive [3]. Respondents who considered cultured meat as a viable alternative to conventional meat believed that the new product was not ethical, natural, healthy, tasty, or safe.

Most research on the acceptability of artificial meat has been conducted in countries with developed economies, while data on consumer attitudes in developing countries is very scarce. As far as we know, such consumer research has not been published in the Balkan countries. Therefore, this paper aims to determine the behavior of consumers from Bosnia and Herzegovina regarding the acceptability of cultured meat.

2. Materials and Methods

To collect data on consumer perception, an online survey was conducted. For this survey, a questionnaire was designed based on questionnaires from similar surveys conducted in France and Brazil [12, 23, 24, and 25]. The questionnaire contained 16 questions, which were divided into several groups: demographic data, dietary preferences, opinions about cultured meat, factors, and reasons that can influence people to accept new meat alternatives. An information and communication technology expert improved the form of this questionnaire and formatted it using the Google Forms application.

In the introductory text, apart from the link to the survey, there was a short notice about the purpose and a statement that the results of the survey will be used exclusively for scientific purposes, that participation in the survey is completely voluntary, and that each participant is anonymous. By clicking on the link, the participants agreed to participate in the survey. Participants could withdraw at any stage of filling out the questionnaire. Finally, respondents were offered the option to confirm that their responses

could be recorded and used to calculate average values obtained from all responses. Only when the respondents confirmed it, the answers were recorded. If the respondents gave up at any stage of filling out the questionnaire, the answers they previously gave were not saved.

The survey questionnaire was distributed via e-mail from August to September 2022. The survey was conducted in two phases: a trial survey to evaluate the quality of the survey questionnaire and the main survey. In the e-mail message that was sent to the potential respondents, a brief introduction and context of the research was given. The first survey was conducted with a small number of respondents, who were close to the designers of this survey. This made it possible to obtain a preliminary external opinion. After that, minor adjustments were made to the questionnaire, and two new questions were added. In the second phase, the survey questionnaire was delivered via e-mail to more than 250 addresses. Students of the Medical School in Prijedor were asked to share the survey link with their contacts on social networks. Others interested in this topic could share the questionnaire further. This research was conducted under current regulations, which include the ethical approval of the Ethics Committee of the College of Health Sciences Prijedor (No.07-773/22, 08.09.2022).

In the end, 114 completed questionnaires were collected. 110 valid responses were used for data

analysis, while 4 were excluded due to incomplete responses. Descriptive statistical analysis and Chi-square test were applied during data analysis. For this purpose, the SPSS software package was used. Differences at $p < 0.05$ were considered significant.

3. Results and Discussion

The results of the research are presented in the Tables below. During the survey, 114 respondents answered. Due to incomplete data, the responses of four survey participants were excluded. 110 valid responses were used for further processing.

The first part of the survey questionnaire contains questions about the demographic data of the respondents (Table 1).

Men made up 21.8% of the participants in the survey, while women represented 78.2% of the total number of respondents. Regarding the age of the respondents, most respondents were between 18 and 24 years old (65.5%), then between 25 and 34 years old (20.9%), and the fewest respondents were in the category over 65 years old (1.8%). The largest number of participants in the survey were a student (52.7%), 22.7% of respondents had a university degree (diploma), and 17.3% of respondents had completed high school. 3.6% of respondents completed their master's studies. The smallest number of respondents had a doctorate (2.7%). Regarding the financial situation of the

Table 1. Demographic profile and dominant method of eating of respondents (N = 110)

	Parameters	N (%)*
Gender	Male	24 (21.8)
	Female	86 (78.2)
Age	18 - 24 years	72 (65.5)
	25 - 34 years	23 (20.9)
	35 - 44 years	3 (2.7)
	45 - 54 years	7 (8.4)
	55 - 64 years	3 (2.7)
	over 65 years	2 (1.8)
Education	PhD	3 (2.7)
	MSci.	4 (3.6)
	Bachelor/Master	25 (22.7)
	Middle school	19 (17.3)
The financial situation of the household	Student	58 (52.7)
	Very bad	0.00
	Bad	3 (2.7)
	Neither bad nor good	61 (55.5)
	Good	36 (32.7)
Dominant method of nutrition	Very good	10 (9.1)
	Omnivorous	92 (83.6)
	Semi-vegetarian	10 (9.1)
	Vegetarian	4 (3.6)
	Vegan	4 (3.6)

Legend: *N - number (proportion of responses concerning the total number of respondents, %).

households in which they live, the survey participants stated that they live in households whose finances are either good (32.7%) or average (55.5%). As for eating habits, the question was about restrictions on meat consumption. In the answers to that question, 83.6% of the respondents stated that they believe that they belong to the “Omnivorous” group, and 9.1% of the respondents said that they belong to the “semi-vegetarian” group. Four respondents (3.6%) stated that they belong to the group of vegetarians or vegans.

Young people were chosen as respondents. They are the biggest consumers of meat and are expected to experiment the most with their food choices. Teenagers’ diet is influenced by their parents. The diet of the elderly is fixed and they have a hard time accepting new foods (for example, cultured meat). In most of the available works, age, gender, level of education, and family income were used as the main indicators.

When respondents were asked about the frequency of meat consumption, all of them stated that they eat meat (Table 2).

Most of them said that they do it often (41.8%) and very often (24.5%). According to the respondents, 16.4% of them occasionally eat meat, while 11.8% of them eat meat all the time. Table 2 shows data on the habits of consumers to eat products based on plant proteins (soy, beans, peas, cereals, and/or nuts, etc.). The order of answers is as follows: occasionally, often, very often (46.4%, 21.8%, and 10.9%, respectable). No differences were observed between conditions for any of the socio-demographic variables. When the

consumption habits of meat and meat products were analyzed, the following p-values were obtained: Age ($p = 0.979$), Gender ($p = 0.362$), Education ($p = 0.974$), Financial status ($p = 0.740$). When the consumption habits of plant protein-based products were analyzed, the following p-values were obtained: Age ($p = 0.971$), Gender ($p = 0.164$), Education ($p = 0.998$), and Financial status ($p = 0.779$).

In a study carried out in Italy, eight percent of respondents declared that they do not eat meat. As the main reason for not consuming meat, they cited ethical reasons (negative impact of animal husbandry on the environment, animal welfare, and health) [26]. No significant differences were found in terms of age, gender, education, or place of residence.

A group of questions from the survey related to the perception and willingness of surveyed consumers to consume cultured meat (Table 3).

When asked if they wanted to try cultured meat, 78 of them (71.0%) answered that they did not want it (answers “Definitely NO” and “Probably NO”), 21.8% were not sure if they wanted it, while 7.3% of respondents stated that they want to try cultured meat (answers “Probably YES”). None of the respondents answered that they would accept cultured meat as an alternative to traditional meat.

The conducted statistical analysis showed that there is no significant influence of socio-demographic variables on the given answers. This is confirmed by the obtained significance values, whose values range between 0.116 and 0.457 (Table 3).

Table 2. Level of meat and foods based on vegetable protein consumption

Meat consumption habits	Answers	Gender		Age		Education		Financial situation	
	F (%)*	Chi-square	p	Chi-square	p	Chi-square	p	Chi-square	p
MEAT AND MEAT PRODUCTS									
Never	2 (1.8)								
Hardly	1 (1.8)								
Rarely	2 (1.8)								
Occasionally	18 (16.4)	6.579	0.362	16.426	0.979	16.914	0.974	13.839	0.740
Often	46 (41.8)								
Very often	27 (24.5)								
Every meal	13 (11.8)								
FOODS BASED ON VEGETABLE PROTEINS									
Never	2 (1.8)								
Hardly	7 (6.4)								
Rarely	11 (10.0)								
Occasionally	51 (46.4)	9.181	0.164	17.161	0.971	12.460	0.998	10.385	0.779
Often	24 (21.8)								
Very often	12 (10.9)								
Every meal	3 (2.7)								

Legend: *F - response frequency (Percentage of the total number).

Table 3. Perception and willingness of surveyed consumers to consume cultured meat

Consumer perception	Answers	Gender		Age		Education		Financial situation	
	F (%)*	Chi-square	p	Chi-square	p	F (%)*	Chi-square	p	Chi-square
Definitely NOT	50 (45.5)								
Probably NOT	28 (25.5)								
Not sure	24 (21.8)	2.598	0.458	14.919	0.457	11.604	0.709	14.192	0.116
Probably YES	8 (7.3)								
Definitely YES	0 (0.0)								

Legend: *F - response frequency (Percentage of the total number).

Many consumers believe that cultured meat is beneficial for society, but that it is risky for their health [10]. This is why consumers support cultured meat but do not consume it. Many studies have shown that young and educated consumers are more likely to accept cultured meat [13, 21, and 26].

Various factors influence respondents' willingness to try cultured meat. Thus, "Curiosity" would lead 36.4% of survey participants to try the product, 16.4% of respondents would do it for ethical reasons (improving animal welfare and reducing animal slaughter), and 8.2% for environmental reasons (Table 4).

30.9% of respondents see the consumption of cultured meat as a contribution to solving the problem of food shortage in the world. "Lesser risks of zoonoses" is not a sufficient reason for respondents to decide to taste cultured meat (1.8%). Chriki *et al.*, [25], state that curiosity is one of the reasons for Brazilian consumers to accept artificial meat, whereby 43.2% of respondents would be willing to eat it.

The conducted statistical analysis showed that there is a significant influence of the level of education of the respondents on the answers regarding the ethical issues of consuming cultured meat ($X^2 = 11.924$; $p = 0.036$), while in other cases there is no statistical

significance between the indicator and the socio-demographic profile of the respondents (Table 4).

The most common reasons why respondents do not want to try artificially grown meat: "Unnatural product" (39.6%) and "I worry about safety and health" (29.7%), while 9.0% of respondents think that cultured meat is not attractive /not tasty or they do not want to try a new product due to aversion (Table 5).

Siddiqui *et al.*, [27], analyzed several papers on the acceptability of cultured meat. Based on them, the authors list some behavioral perceptions that cause the limitation of the use of cultured meat: disgust, naturalness, cost, health and food safety concerns, cultural and demographical limitations, ethics, and lack of trust in science. Highly educated participants (current students along with respondents who hold university, master's, and doctoral degrees) showed a significantly higher appreciation of the 4 attributes of farmed meat (safety, taste, animal welfare, and sustainability) compared to less educated survey participants (respondents who completed basic and high school) [26]. Participants under the age of 24 expressed a more positive perception of cultured meat than other participants. Hocquette *et al.*, [23], find that educated consumers believe that "artificial meat will not necessarily reduce the needs of animals"

Table 4. Reasons that would lead respondents to try cultured meat

Reasons	F (%)*	Chi-square	Gender	Age	Education	Financial situation
A	34 (30.9)	X^2 p	0.624 0.429	2.981 0.703	1.573 0.814	6.2 0.185
B	18 (16.4)	X^2 p	2,551 0.279	8.522 0.202	11.924 0.036	5.07 0.407
C	2 (1.8)	X^2 p	0.796 0.672	3.934 0.686	2.561 0.767	2.834 0.726
D	9 (8.2)	X^2 p	3.402 0.182	3.624 0.727	10.243 0.069	8.203 0.145
E	40 (36.4)	X^2 p	0.09 0.956	3.592 0.732	1.529 0.91	2.604 0.761
F	40 (36.0)	X^2 p	0.592 0.744	6.822 0.338	2.776 0.735	0.491 0.992

Legend: A - Solution to the problem of lack of food in the world; B - Ethical issues (improving animal welfare and reducing animal slaughter); C - Lower risks of zoonoses; D - Ecological product; E - Curiosity; F - I am not willing to try this product; *F - response frequency (Percentage of the total number).

Table 5. Reasons why respondents do not want to try cultured meat

Food Attributes	F (%)*	Gender		Age		Education		Financial situation	
		Chi-square	p	Chi-square	p	F (%)*	Chi-square	p	Chi-square
An unnatural product	44 (39.6)								
Not attractive/not tasty	10 (9.0)								
I worry about safety and health	33 (29.7)								
Disgust/ aversion	10 (0.0)	2.252	0.895	21.513	0.871	18.414	0.782	9.217	0.995
Negative impact on agriculture	2 (1.8)								
Increased impact on the environment	2 (1.8)								
None of the above	5 (4.5)								

or dramatically reduce the carbon footprint of meat production. Positive consumer perception is not always a reliable indicator of the commercial success of a new product [26]. Most studies have found that meat-eaters are more willing to consume cultured meat than vegans. Wilks and Phillips [19]. found that vegetarians and vegans have a more positive perception of cultured meat, but less willingness to consume it. Such behavior of people who do not eat meat shows that they are not against cultured meat, but they are not interested in consuming it.

The conducted statistical analysis showed that there is no significant influence of socio-demographic variables on the given answer. This is confirmed by the obtained significance values, whose values range between 0.782 and 0.995 (Table 5).

During research in several countries (Belgium, Portugal, and the United Kingdom), survey participants indicated the unnaturalness of the new product and that they felt

disgusted with its consumption [14]. Hocquette *et al.*, [23], found that between 5% and 11% of respondents in their study said they would consume cultured meat.

Similar motivations for the acceptance of cultured meat exist among consumers in different countries of the world: safety, taste and balanced diet (China), environmental benefit and animal welfare (Belgium), livestock system problem (France), environmental protection and animal welfare (USA), health and ethical reasons for reducing animal muscle consumption (Italy), health, safety and nutrition (Brazil) [13, 6, 26, 28, 29, and 30].

In the following question, the respondents were asked to express their opinion on different sources of protein: (vegetable proteins and artificially raised meat). In the questionnaire, they were offered 6 possible answers: "Healthy", "Safe", "Affordable", "Pleasure while eating", "Environmentally friendly" and "Friendly towards animals" (Table 6).

Table 6. Respondents' beliefs regarding attributes for different sources of protein (N = 110)

Food Attributes	F (%)*	Gender		Age		Education		Financial situation	
		Chi-square	p	Chi-square	p	F (%)*	Chi-square	p	Chi-square
PLANT-BASED ALTERNATIVE									
Healthy	56 (50.9)								
Safe	9 (8.2)								
Affordable	12 (10.9)								
Eating enjoyability	6 (5.5)	9.734	0.083	30.811	0.195	15.948	0.726	15.146	0.441
Environmentally friendly	14 (12.7)								
Animal friendly	13 (11.8)								
CULTURED MEAT CULTURED MEAT									
Healthy	5 (4.5)								
Safe	3 (2.7)								
Affordable	17 (15.5)								
Eating enjoyability	4 (3.6)	15.603	0.010	30.292	0.214	18.932	0.526	7.718	0.935
Environmentally friendly	30 (27.3)								
Animal friendly	51 (46.4)								

Legend: *F - response frequency (percentage of the total number).

The largest number of respondents believe that vegetable proteins are healthy (50.9%), that they are ecologically and ethically acceptable (12.7% and 11.8%, respectively), and that they are affordable (10.9%). At the same time, respondents believe that cultured meat is “Ecologically acceptable” (27.3%) and “Animal-friendly” (46.4%).

The statistical analysis carried out showed that there is a significant influence of the gender of the respondents on the responses regarding pleasure while eating cultured meat ($p = 0.010$), while in other cases there is no statistical significance between the observed indicator and the socio-democratic profile of the respondents (Table 6).

Different language expressions are used in the literature to mark the product obtained by applying modern biotechnology. The terms used to describe a new biotech product form the basis on which consumers base their impressions of the product [1]. Califano *et al.*, [31], determined that the name of the cultured meat influences Italian consumers' intention to consume it.

This paper aimed to determine the perception of consumers in Bosnia and Herzegovina towards cultured meat. Various individual, social, and environmental factors influenced the answers obtained. The results show that consumers in Bosnia and Herzegovina have a perception about cultured meat, which is similar to the attitudes of consumers in other countries. Consumers formed their attitudes about cultured meat based on scarce information. They lack the experience of consuming this type of product to form a definitive opinion. According to Baybars *et al.*, [3], it is rather difficult to measure consumer attitudes toward a product that is not yet on the market.

People are unwilling to reduce their current meat consumption, even though they are aware of the negative consequences of meat production for personal health, social well-being, and environmental sustainability. Many people think that life without meat will be difficult, unpleasant, and expensive [32]. When it comes to accepting cultured meat, previous research shows that individual benefits are more important than social benefits [28, 33]. The attitudes of consumers from Bosnia and Herzegovina on this matter do not differ from the attitudes of consumers in other countries. However, it is expected that in the near future consumers will prioritize environmental and social benefits over individual benefits.

Like other similar research, this survey has some limitations. An online survey was conducted, so only individuals who use the Internet and computers

responded. In future research, the representativeness of the sample should be improved by using a questionnaire with a larger and more inclusive sample. Our sample consisted of people who were younger and more educated than the general population in Bosnia and Herzegovina. The research aimed to gather information from the generation of residents who are expected to better accept the new food. Given that artificial meat is not yet available on the market of Bosnia and Herzegovina and neighboring countries, survey participants based their answers on a hypothetical product. Those responses may differ from their behavior when purchasing the actual product.

4. Conclusions

- Based on the results obtained in this paper, it can be concluded that the level of education of the respondents affects their ethical attitudes regarding improving animal welfare and reducing animal slaughter and that respondents of different genders expressed their attitudes differently regarding satisfaction during the consumption of cultured meat (Eating enjoyment).
- The acceptability of cultured meat depends on the availability of other alternatives to meat (for example, plant proteins).

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