The Effect of New Concepts Used for Meat on Neophobia

Recep PALAMUTOĞLU[1*], Merve İNCE PALAMUTOĞLU[1], İrem Şevval YÜCEL[1], Kübra ORDU[1], Merve ÇINAR[1]

[1]Afyonkarahisar Health Sciences University, Health Sciences Faculty, Department of Nutrition and Dietetics, Turkey.

[*]*Corresponding author:* receppalamutoğlu@hotmail.com

[*]*ORCID: 0000-0002-1168-081X*

Abstract

The objective of this research is to examine the responses of students enrolled in the Faculty of Health Sciences at Afyonkarahisar University of Health Sciences when asked with meat substitutes which suggested as an alternative to traditional meat products. The study involved 294 participants who were randomly selected from the student population. These participants have an average age of 21.3 ± 7.66 years. The majority of the participants are women, accounting for 86.1% of the sample. Among the students, the Nutrition and Dietetics Department is the most heavily represented, making up 61.6% of the participants. The research explores participants' perceptions of novel meat substitutes and their reactions to these alternatives. A significant portion of the participants expressed the belief that these new meat concepts are unnatural. Interestingly, when comparing the responses across different academic departments, there were no noticeable differences in attitudes toward these novel meat concepts, and this finding was statistically significant ($p < 0.05$). The study also delves into the participants' level of food neophobia, which refers to the fear or reluctance to try new foods. The average score on the food neophobia scale was found to be 35.46 ± 5.646. This score serves as an indicator of the participants' overall attitude towards trying unfamiliar foods. Notably, there was no significant difference in the degree of food neophobia when considering the participants' academic fields.

Keywords: Artificial Meat, Meat, New Food Phobia, Purchasing.

INTRODUCTION

Protein is a component that is the basic building block of cells and is very necessary for life, it is one of the most important building blocks that make up the human body. Proteins, which have a high number of important activities in living metabolism, are found in foods of plant and animal origin.

Proteins are important macronutrients for life. The protein rate in the body of an adult is around 16% and the amount of storage is very small. It is recommended that 10-20% of the energy used daily should come from protein (TÜBER, 2019).

In recent years, with the increasing human population and differentiating consumer orientations, there has been an increase in different research and studies on alternative protein sources. The world population is expected to be around 10 billion people by 2050. It is foreseen that with the increase in population, the need for meat consumption will increase and meat production will be at the highest level. Among different foodstuffs, some products of animal origin, such as meat and dairy products, consume more natural resources than foods of plant origin (Molfetta et al., 2022). For this reason, it was foreseen that the classical method would not be able to respond to the increasing meat consumption need and it was thought that the production cost would increase even more. Therefore, it is seen that meat consumption is a luxury need (Pandurangan and Kim, 2015). In addition to having a large ecological footprint, meat production, and consumption, another important reason for reducing meat consumption, especially red meat consumption, is directly related to the potential negative effects of this consumption on human health. For example, associations have been reported between red and processed meat consumption and an increased risk of developing colon, breast, pancreatic, and prostate cancers, and a high prevalence of chronic diseases. Recently, epidemiological evidence has concluded that it is strong enough to confirm that red meat or processed meat intake increases cancer risks, and more specifically, colorectal cancer risk. Although the exact mechanisms underlying the relationship between meat consumption and the risk of developing cancer are still not clarified, red meat consumption, in general, should be reduced to less than 50 g/day to avoid an increased risk of prostate cancer, breast cancer, or colorectal cancer (González et al., 2020). In 2019, a consortium of researchers from 42 universities or research centers in 8 European countries launched the SYSTEMIC project (an integrated approach to the challenge of sustainable food systems: adaptive and mitigating strategies to address climate change and malnutrition). The project aims to develop ways to transform a food system that is climate-resilient and capable of meeting societal challenges. Provides information on proven options that provide sustainable and nutritious food, such as alternative protein-rich foods (e.g., vegetables, fibrous fungi, algae, microalgae, and other microorganisms, insects, and "cultured" meat) that could possibly replace meat (SYSTEMIC, 2023).

Meat substitution is still rather murky as a concept that may relate to the historical development of the need to provide protein and later meat substitution. Terms used for meat substitutes should be outlined. "Meat alternative" is a general term denoting any source of protein (plant, animal, fungal, or microalgae) that can be used as a meat substitute in a meal. The protein sources used as the first choice instead of meat are plants and mushrooms. Insects are also one of the important protein sources with a very high protein content. In addition, it forms the basis of protein sources in laboratory-produced meat or artificial meat, as well as algae. However, various meat analogs on the market do not include insects, microalgae, and other meat bases (Smetana et al., 2023). One proposed solution to reduce our consumption of animal meat is the development and use of cultured meat that can be grown from animal cells without the need for slaughter. In addition to eliminating the need for slaughter, cultured meat is much less harmful to the environment in terms of greenhouse gas emissions and land and water use. Cultured meat may become commercially available within a few years. In recent years, research on consumer acceptance of cultured meat has increased, but there is no technique yet to achieve this (Bryant, 2020). The term "cultured meat" will be used here as it seems to be the most widely used and accepted term, but alternative terms include "synthetic meat", "in vitro meat", "lab-grown meat", "cured meat" and sometimes "artificial meat".

The two main stem cells considered most suitable for meat culture are embryonic stem cells and satellite cells (Reddy et al., 2022). Artificial meat made from stem cell cultures has a different production process among meat options. Artificial meat is like normal meat not only in appearance and form but also in content. For lab-grown meat, stem cells from a live cow are harvested and fed in the lab to build muscle tissue. Lab-grown meat is not yet available to consumers as the technology remains cost-prohibitive but is expected to be available in the coming years. Besides the technical feasibility challenge of successfully producing large quantities of affordable lab-grown meat, another major challenge is consumer acceptance of new products. For these reasons, more development and promotion work will be needed for artificial meat (Van Loo et al., 2020).

Food choice is based on social, cultural, and individual factors of which to eat or avoid. Today's consumers are increasingly acquainted with a variety of food options as a result of advances in food production, marketing, and transportation (Okumus et al., 2021). While new and different foods are mostly attracted by individuals, some individuals may approach these new and different foods cautiously for different reasons. Firstly, it is the sensory attitudes (disliking the features such as the appearance and smell of the food), second, the expectations about whether the consumption of the food will be beneficial or harmful in the long run, and third, the information that may cause the food to be evaluated positively or to be called disgusting (Kol and Akçil Ok, 2020). This situation is explained by the term "Neophobia". neophobia; It is used to characterize fear and similar reactions to the novelty of something. This fear may arise against new objects, places, sounds, and other types of impulses. If this new resource is food, it is described as "food neophobia", that is, "Fear of Innovation in Food" (Dağ and Tabak, 2021). In the study of Pliner and Hobden (1992), the concept of food neophobia is defined as "avoidance of new food or foods" (Pliner and Hobden, 1992). Food neophobia has been defined as a personal reluctance to accept and/or enjoy new or unfamiliar foods (Rabadán and Bernabéu, 2021). Factors affecting food choices can be both innate and learned. That is, although neophobia is largely hereditary, it can also be a result of the environment in which individuals grow up. Imitation of parents or peers and parent's educational practices can be given as examples of environmental factors (Soylu et al., 2021). Food neophobia causes a decrease in the variety of food consumed and the inability to provide people with as much nutrition as they need. The excess of unconsumed foods or the long duration of this process can negatively affect the health of people (de Oliveira Torres et al., 2020). In the study, it was aimed to evaluate university students' knowledge and preference of the concept of artificial meat and food neophobia against this concept.

MATERIAL and METHOD

Participants

The research is a descriptive type of observational study. The population of the research consists of 2137 students studying at Afyonkarahisar Health Sciences University Faculty of Health Sciences (AFSU, 2023). The data of the study were obtained from the online questionnaire form applied to 294 students who attended school between January and May of the 2022-2023 academic year and agreed to participate in the study. Written informed consent was obtained from the participants before starting the study. Clinical Research Ethics Committee of Afyonkarahisar Health Sciences University granted approval for the study with the code 2023/1 and the date 06.01.2023. Since it was aimed to reach high participation in the study, the sample was not selected, and all students studying at the faculty were tried to be reached. In the research, 13.8% of the population was reached.

Measure

As a data collection tool, a questionnaire developed as a result of the researchers' literature review was used (Duman et al., 2020; Gençel, 2021). The developed questionnaire consists of three main parts. In the first part, the socio-demographic and economic characteristics of the students were examined, then the meat consumption habits and purchasing characteristics and the factors affecting them were analyzed. In the second part, the "Food Neophobia Scale" was used to describe the avoidance, fear, or avoidance of the students towards food items that they have not encountered before or are unfamiliar with. The Food Neophobia Scale (FNS) questionnaire was developed by Pliner and Hobden in 1992 (Pliner and Hobden, 1992), and its Turkish adaptation was done by Duman et al. in 2020 (Duman et al., 2020). The Food Neophobia Scale was evaluated with a single factor and 10-item 5-point Likert scale. The options are as follows: "Totally Agree" is 5 points, "I agree" is 4 points, "Neither agree nor disagree" is 3 points, "Disagree" is 2 points, and "Totally Disagree" is 1 point (Gençel, 2021). Items 2, 3, 5, 7, 8 and 9 of the scale are evaluated as "trust in new foods", and items 1, 4, 6 and 10 are reverse scored and evaluated as "willingness to try new foods" (Uçar, 2018). Total scores can vary between 10 and 50 due to the use of a 5-point Likert scale for scoring. Participants were divided into two separate groups neophiliac and neophobic. High scores between 33 and 50 obtained from the Food Neophobia Scale indicate food neophobia (fear of food), and low scores between 10 and 25 indicate food neophilia (enjoyment of foods) (Gençel, 2021). In the third part, a 7-question survey prepared by the researchers was used to measure the attitudes of the participants towards different concepts used for artificial meat (Ede and Yalçın, 2023).

Statistical analysis

In the evaluation of the data, standard deviation ($X \pm SD$), frequency, and percentage values were used as descriptive statistical methods. Whether the relationship between categorical variables was significant was evaluated with the Chi-square test. For non-normally distributed variables, the Kruskal-Wallis test was used to examine differences between groups. To test the likely correlation between independent variables, the bivariant Pearson correlation was used ($p < 0.05$). While examining the hypothesis tests, $\alpha=0.05$, and accordingly the confidence interval was determined as 95%, and the significance was evaluated at the $p<0.05$ level. Statistical analysis of the data was performed in the SPSS v26 (IBM Inc., Chicago, IL, USA) package program.

RESULTS and DISCUSSION

The study involved a total of 294 participants, comprising 86.1% females (n=253) and 13.9% males (n=41). The participants' average age was 21.3 ± 7.66 years. Among the participants, a significant portion, 61.6% (n=181), were enrolled in the nutrition and dietetics department. Regarding their living arrangements, 41.5% (n=122) of the respondents reported residing in dormitories, 35.0% (n=103) lived in homes with their families, 13.9% (n=41) in student housing, and 5.4% (n=16) stated that they lived alone. When considering monthly income levels, 42.5% (n=125) of the participants reported having incomes between 0-1500 TL. Among those with these monthly incomes, 48.6% (n=143) allocated 25-50% of their income towards food expenditures, while 33.3% (n=98) allocated 50-75%, as shown in Table 1.

Table 1. Distribution of their descriptive characteristics of the participants

Variable	Categories	n (294)	% (100)
Age	18-21	141	48.0
	21-26	134	45.6
	26+	19	6.5
Mean ($\overline{X}\pm$ SD)		21.3 ± 7.66	
Sex	Male	41	13.9
	Female	253	86.1
Education Department	Nutrition and Dietetics	181	61.6
	Physical Therapy and Rehabilitation	32	10.9
	Nursing	51	17.3
	Healthcare Management	30	10.2
Household	At home with family	103	35.0
	At dorm with friends	122	41.5
	Apartment	16	5.4
	At home with friends	41	13.9
	Alone	12	4.1
Monthly income	0-1500	125	42.5
	1501-3000	78	26.5
	3000 and above	91	31.0
What percent of your monthly food expenses income	%0-%25	38	12.9
	%25-%50	143	48.6
	%50-%75	98	33.3
	%75-%100	15	5.1

n: Frequency, %: percent, $\overline{X}$: Mean, SD: Standard deviation.

Table 2. Distribution table of participants' thoughts on new meat concepts

	Artificial Meat		In-vitro Meat		Cultured Meat		Non-animal meat	
	n	%	n	%	n	%	n	%
Tasty	12	4.1	6	2.0	55	18.7	6	2.0
Disgust	24	8.2	14	4.8	12	4.1	42	14.3
Not tasty	19	6.5	27	9.2	33	11.2	53	18.0
Unnatural	151	51.4	93	31.6	73	24.8	77	26.2
Anxious	19	6.5	48	16.3	46	15.6	42	14.3
Pose a threat to health	66	22.4	61	20.7	42	14.3	53	18.0
Other	3	1.0	45	15.3	33	11.2	21	7.1
Total	294	100	294	100	294	100	294	100

n: Frequency, %: percent

As presented in Table 2, participants were queried about their opinions on various meat-related concepts, including artificial meat, in-vitro meat, cultured meat, and meat produced without animals. The findings indicate that the participants largely perceive these products as unnatural. Specifically, 51.4% (n=151) find artificial meat to be unnatural, while 31.6% (n=93) feel the same way about in-vitro meat. For cultured meat, 15.6% (n=73) consider it unnatural, and for meat produced without animals, 26.2% (n=77) share this perspective.

As depicted in Table 3, participants were surveyed about their viewpoints on different meat concepts—artificial meat, in-vitro meat, non-animal meat, and cultured meat—based on their academic departments.

However, the analysis indicates that the participants' opinions regarding these novel meat concepts did not exhibit any statistically significant differences across the various departments they were enrolled in ($p > 0.05$). The findings demonstrate that, regardless of the academic department, all participants share the perception that the concepts of artificial meat, in-vitro meat, cultured meat, and non-animal meat are characterized as unnatural forms of meat.

Table 3. Distribution of thoughts on new meat concepts according to the section read by the participants.

Education Department		Nutrition and Dietetics		Physical Therapy and Reh.		Nursing		Healthcare Man.		Total		p
		n	%	n	%	n	%	n	%	n	%	
Artificial Meat	Tasty	7	3.9	1	3.1	3	5.9	1	3.3	12	4.1	
	Disgust	14	7.7	2	6.3	3	5.9	5	16.7	24	8.2	
	Not tasty	13	7.2	2	6.3	3	5.9	1	3.3	19	6.5	
	Unnatural	95	52.5	19	59.4	23	45.1	14	46.7	151	51.3	0.883 $\chi2=11.253$
	Anxious	13	7.2	2	6.3	2	3.9	2	6.7	19	6.5	
	Pose a threat to health	36	19.9	6	18.8	17	33.3	7	23.3	66	22.4	
	Other	3	1.6	0	0	0	0	0	0	3	1.0	
In-vitro meat	Tasty	3	1.7	0	0	3	5.9	0	0	6	2.0	
	Disgust	9	5.0	1	3.1	2	3.9	2	6.7	14	4.8	
	Not tasty	20	11.0	1	3.1	3	5.9	3	10.0	27	9.2	
	Unnatural	55	30.4	10	31.2	17	33.3	11	36.6	93	31.6	0.436 $\chi2=18.306$
	Anxious	34	18.8	8	25.0	4	7.9	2	6.7	48	16.3	
	Pose a threat to health	32	17.7	6	18.8	15	29.4	8	26.7	61	20.8	
	Other	28	15.4	6	18.8	7	13.7	4	13.3	45	15.3	
Cultured meat	Tasty	35	19.3	6	18.8	9	17.7	5	16.6	55	18.7	
	Disgust	6	3.3	1	3.1	3	5.9	2	6.7	12	4.1	
	Not tasty	17	9.4	6	18.8	8	15.7	2	6.7	33	11.2	
	Unnatural	47	26.0	8	25.0	12	23.5	6	20.0	73	24.8	0.906 $\chi2=10.723$
	Anxious	28	15.5	5	15.6	5	9.8	8	26.7	46	15.7	
	Pose a threat to health	26	14.4	4	12.5	7	13.7	5	16.6	42	14.3	
	Other	22	12.1	2	6.2	7	13.7	2	6.7	33	11.2	
Non-animal meat	Tasty	4	2.2	1	3.1	1	2.0	0	0.0	6	2.0	
	Disgust	24	13.2	6	18.8	7	13.7	5	16.7	42	14.3	
	Not tasty	35	19.3	8	25.0	7	13.7	3	10.0	53	18.0	
	Unnatural	41	22.7	5	15.6	22	43.1	9	30.0	77	26.2	0.281 $\chi2=20.971$
	Anxious	30	16.6	3	9.4	4	7.9	5	16.7	42	14.3	
	Pose a threat to health	32	17.7	5	15.6	8	15.7	8	26.6	53	18.0	
	Other	15	8.3	4	12.5	2	3.9	0	0.0	21	7.2	

n: Frequency, %: percent, *$p<0.05$

When the new food fear level of the participants was evaluated, a minimum of 18 and a maximum of 48 points were determined, and the average was determined as neophobic with 35.46 ± 5.646. New food fear levels according to the departments studied by the participants; The states of being neophiliac, neutral, or neophobic are shown in Table 4. When the levels of neophobia (fear of new foods) were investigated in relation to the academic department the participants were enrolled in; it was determined that neophobic, that is, afraid to try new food, with the highest rate in all departments. The relationship between the department they read, and their new food fear levels was not found statistically significant ($p > 0.05$).

Table 4. Distribution of Participants' New Food Fear Levels

Education Department	Neophiliac (10-25)		Neutral (26-32)		Neophobic (33-50)	
	n	%	n	%	n	%
Nutrition and Dietetics	5	50.0	45	62.5	131	61.8
Physical Therapy and Rehabilitation	3	30.0	8	11.1	21	9.9
Nursing	1	10.0	12	16.7	38	17.9
Healthcare Management	1	10.0	7	9.7	22	10.4
Total	10	3.4	72	24.5	212	72.1

p=0.649 $\chi2$=4.205
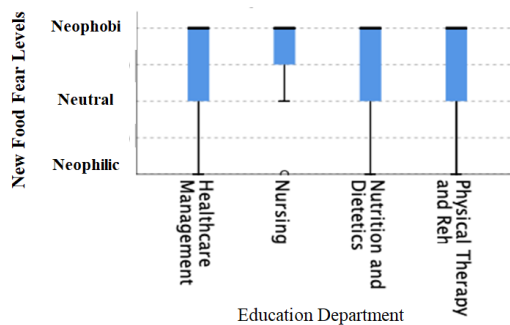
Figure 1. New Food Fear Level Distribution by Education Department

Bryant and Barnett (2019) examined familiarity and attitudes towards terms such as 'cultured meat', Neophilic it', 'lab-raised meat' and 'animal free meat'. They found that the term 'clean meat' is less well known than other terms. They concluded that 'non-animal meat' led to more positive attitudes towards meat in-vitro. The term 'lab grown meat' has had negative connotations (Bryant and Barnett, 2019). Hocquette et al. (2015) found in their study that more than 50% of the participants believed that "artificial meat" technology was realistic. Younger women and older men have been found to be more positive towards this technology than they are. Many of the respondents argued that there are environmental, animal welfare and productivity issues in the meat industry.

Gómez-Luciano et al. (2019) conducted research focusing on consumer perceptions and preferences for a variety of alternative protein sources, including plant-based proteins, cultured meat, and insect-based proteins, covering various countries. It revealed that participants' beliefs about the nutritional benefits of alternative protein sources differed between countries. The belief that alternative proteins can match the benefits of meat has been found to range from low percentages in some countries to higher percentages in others. British respondents felt that meat was less important for a balanced diet compared to respondents from other countries. A negative correlation was found between the belief that meat provides essential nutrients and the belief that alternative proteins can match the benefits of meat. It has been observed that participants from different countries perceive various features of protein sources differently. The UK, Spain and Brazil have found insect-based proteins to be healthier, safer, and more sustainable than cultured meat. However, the Dominican Republic has been found to prefer plant-based proteins. The research highlights the complex interplay between cultural, perceptual, and practical factors when it comes to consumer preferences for alternative protein sources.

De Oliveira Padilha et al. (2022), in an Australian study, found that plant-based meat alternatives were consumed less than once a month. While 31% of the participants stated that they had never heard of the term meat produced in the laboratory, 5% of them heard the term but knew little or nothing about it.

After the concept of lab-grown meat was explained, about a quarter of consumers indicated that they were willing to eat lab-raised chicken or lab-raised beef. When comparing conventionally raised chicken to Lab-raised chicken and plant-based meat alternatives, consumers rated conventionally raised chicken as the healthiest, most affordable, and enjoyable to eat, but least animal-friendly. Plant-based products scored the highest among protein alternatives as animal-friendly and environmentally friendly. In the study of Slade (2018), consumers were given the option to buy burgers made from beef, plant-based protein, or cultured meat, and found that consumers prefer beef burgers even if they all taste the same. Preferences are linked to age, gender, views on food technologies, and environmental attitudes. He stated that if the prices were equal, 65% of the consumers would buy the meat burger, 21% would buy the veggie burger, 11% would buy the cultured meat burger, and 4% would not buy it at all (Slade, 2018).

Bryant and Sanctorum (2021) conducted a study to identify Belgian consumer attitudes in 2019 and 2020, and respondents were asked online questions about their diet, their attitudes towards available plant-based meat alternatives, and their attitudes towards cultured meat. They found increased satisfaction with plant-based alternatives on a yearly basis. There was no significant change in attitudes towards cultured meat. While plant-based products are more attractive to women and vegetarians; it has been determined that cultured meat is more interesting to men.

Hartmann et al. (2015) reported that developing familiarity with Western cultures is crucial for overcoming behavioral barriers such as negative taste expectations and neophobic responses through taste training and placing insects as a food source. The major challenge to insect consumption has been noted to be the public's strong, socio-culturally defined prejudice against insects. Insect-based foods and dishes that are Westernized and adapted to European taste profiles, textural preferences, and food aesthetics are more likely to enter consumers' diets, as evidenced by the widespread adoption of other ethnic foods.

Dupont and Fiebelkorn (2020) investigated the acceptance of insect-based foods and cultured meat in German children and adolescents. It has been determined that German children are more willing to consume cultured beef instead of insect burgers. Similar rated for insect-based food and cultured meat. Attitude toward insect burgers and food neophobia were the two most important determinants of the desire to consume insect burgers, while age was also identified as an influencing factor. In addition, it was observed that the attitude towards meat type and food neophobia affect preferences. Research by Gravel and Doyen (2020) concluded that edible insects can be a source of protein for the global population. Insect protein can be concentrated as an alternative protein in food formulation. Comparative studies on insect protein functionality are needed and it is thought that it can replace expensive, environmentally harmful conventional proteins in the future. In summary, studies investigate consumers' perceptions of alternative meat sources; familiarity, attitudes, and factors affecting preferences are emphasized.

CONCLUSION

The current study, students' perceptions of alternative meat concepts and food neophobia levels were examined. It was found that the participants largely thought these concepts were unnatural and exhibited varying degrees of food neophobia.

The research contributes to understanding consumer acceptance of alternative foods by shedding light on students' attitudes toward new protein sources. Traditional livestock farming requires significant amounts of land, water, and feed. Artificial meat production requires significantly fewer resources, potentially helping to reduce pressure on land and aquatic ecosystems. Traditional livestock farming causes greenhouse gas emissions and water pollution.

In addition, reduced reliance on traditional livestock can put less pressure on natural ecosystems, helping to conserve biodiversity. So artificial meat can significantly reduce these negative environmental impacts. As the world population continues to increase, there are concerns about meeting the increasing demand for meat. Artificial meat production could offer a way to produce more food with fewer resources. Alternative meat sources will minimize dependence on land and water resources and make it a sustainable food source. However, the technology you mentioned is still in its infancy. There is a need for study in terms of production, technology, and preferability.

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