Scientific Research Publishing

Food and Nutrition Sciences, 2024, 15, 151-169
https://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

# Investigation of the Acceptability of Cultured Meat in University Students

**Merve Kumru, Hulya Demir***

Nutrition and Dietetic Department, Health Science Faculty, Yeditepe University, İstanbul, Türkiye
Email: *hdemir40@gmail.com

**How to cite this paper:** Kumru, M. and Demir, H. (2024) Investigation of the Acceptability of Cultured Meat in University Students. *Food and Nutrition Sciences*, **15**, 151-169.
https://doi.org/10.4236/fns.2024.152009

**Received:** January 19, 2024
**Accepted:** February 26, 2024
**Published:** February 29, 2024



## Abstract

**Background**: Over the past 20 years, cultured meat has drawn a lot of public attention as a potential solution to issues with animal husbandry, including inadequate use of natural sources, improper animal welfare practices, and possible risks to public health and safety. The novel method of producing meat through culture reduces the need for animals to produce muscle fiber, thereby obviating the necessity for animal slaughter. Apart from its ethical advantages, cultured meat presents a possible way to fulfill the expanding need for food among growing populations. The purpose of this research was to find out whether Turkish students would be willing to pay for and accept cultured meat. Technique: **Method**: 371 university students who willingly consented to fill out a questionnaire and provide demographic data make up the research sample. Questions from previous studies on the acceptability of cultured meat were compiled to create the survey. The research's data collection took place in March and April of 2022. The research was completed in June 2022 after the data had been processed and analyzed. **Results**: The results showed that the majority of participants were female and had omnivorous eating habits. Based on the results of the Bonferroni correction test, students with a higher intention to purchase and consume cultured meat were those who received economics and business education. Students with two years of university education had a higher overall survey score than those with four years of education ($p < 0.05$). Furthermore, it is discovered that there is a negative correlation between the participants' ages and their Factor 2 (using cultured meat as an alternative to industrial meat) and Factor 3 (consuming and purchasing it) section points ($r = -109$, $p = 0.036$) ($r = -0.121$, $p = 0.019$). In conclusion, university students generally have a negative outlook on health-related issues, such as eating cultured meat as an alternative.

## Keywords

Cultured Meat, University Students

## 1. Introduction

Cultured meat is defined as new novel food obtained by proliferating and differentiating stem cells taken by biopsy from live animals under anesthesia in the laboratory environment [1]. They are also named artificial meat, cell culture meat, in vitro meat, lab meat, synthetic meat, and clean meat [2]. This innovative method requires few or without any animals to produce muscle fiber. Therefore this technique eliminates the slaughter of animals [1]. Furthermore, according to FAO (Food and Agricultural Organization), the need for food in the human population, which will reach approximately 9 billion people in 2050, is expected to increase by 70%, and 2 billion people are expected to add to the 815 million people who are at the hunger limit [3]. Industrial livestock production, on the other hand, is insufficient to meet the increasing population and food consumption needs, contradicting the principle of sustainability due to its inefficient use of resources like land, energy, and water [4]. Two-thirds of agricultural areas and one-third of the land on earth are devoted to industrial livestock [5]. 40% of the grains in the world are harvested to feed animals and it is known that even half of this rate is sufficient to solve the hunger problem [6]. Moreover, it is observed that the area destruction not only reduces biodiversity but also threatens wildlife habitat [7]. The livestock industry's significant contribution to environmental issues is the depletion of natural sources, leading to habitat loss and decreased biodiversity.

However, the technology of cultured meat may be able to address this problem with livestock [8]. There is a health risk associated with traditional livestock farming because it is known that meat is the source of about 22% of pathogens that cause numerous diseases [9]. Since the production system is regulated and human-animal interaction is restricted, it is anticipated that cultured meat can lower the risk of zoonosis and other animal diseases [10]. Unfortunately, it is well known that since cultured meat is a novel product, it is challenging to draw firm conclusions regarding its potential effects on health. Unexpected biological processes, such as unchecked cell proliferation, might be present during the culture process [11]. Institutions in charge of regulations must maintain control over this situation to assure consumers that cultured meat is safe [12]. In the past two decades, cultured meat has become more and more popular as a novel topic in cellular agriculture [13].

The general public's perception of cultured meat is largely responsible for its widespread adoption. It is well known that a consumer's acceptance of a product can be influenced by several factors, including the product's taste, price, viewed naturalness, and food neophobia—the fear or aversion to trying new foods [14]. Another way to achieve success in the consumption of cultured meat is to imitate real meat in terms of structure, appearance, nutritional value and taste [15].

To the best of our knowledge, no other research has been done on Turkish university students' perceptions of cultured meat. To close this gap, this research examined a sample of Turkish students' perceptions and their willingness to try,

purchase, and pay for cultured meat.

## 2. Materials and Methods

### 2.1. Type of Research

This research was conducted as a descriptive and cross-sectional research.

### 2.2. Time and Place of Research

This research was conducted with the participation of university students in Hakkari/Türkiye. After ethics committee approval, data collection was initiated in March 2022 and completed in April 2022. The research was concluded in June 2022 with the processing and analysis of the data.

### 2.3. The Subjects and Sample of the Researh

This research was carried out on students at Hakkari University in Hakkari. The inclusion criteria of the research are, being a student in Hakkari, aged 18 or older and voluntarily participating in the research. Subjects who meet the criteria are involved in our research without any randomization.

To determine the sample size of the research, the calculation (d-value) method developed by Cohen was used to calculate the effect size. To determine the effect size index d, Mancini MC. and Antonioli F. in 2019, the findings of a research investigating the attitudes of consumers towards cultured meat in Italy [16]. In this research, the rate of willingness to consume cultured meat was determined as 46%. In the calculation we made for this consumption demand difference, the effect size was found to be d = 0.146 (small effect). In this context, Chi-Square tests to be used to determine the difference in meat consumption desire between groups ($\chi^2$_) for; d = 0.146 (small effect size), $\alpha = 0.05$ (margin of error), $1 - \beta = 0.80$ (power), accompanied by the specified criteria *G-power* (*version 3.1*). With the help of the package program, a total of 369 participants was calculated.

### 2.4. Data Collection Tools

Before taking part in the research, participants had to sign a consent form. The participants were informed about the research and its purpose was outlined in the voluntary consent form. A questionnaire was used to gather the data. Questions from previous studies on the acceptability of cultured meat were compiled to create the survey [2] [17] [18] [19]. The purpose of this questionnaire was to ascertain the participants' knowledge, opinions, attitudes, and purchasing habits toward cultured meat. There are 23 items total in 5 sections of the questionnaire. Except for the first section, responses to the Likert-style questionnaire are expected to range from 1 (least) to 5 (most). The participants were asked to provide demographic details in the first section, including age, gender, education level, and eating habits. The degree of familiarity with cultured meat is examined in the second section. following that, the participants received verbal and written

instructions on how to correctly complete the remaining sections. The third section seeks to examine the participants' opinions regarding cultured meat by asking comparison questions between the industrial use of animal husbandry and cultured meat. They were required to respond to questions regarding whether they would try cultured meat and whether they would substitute cultured meat for conventional meat in their diet in the fourth section. The final section looked at how people bought cultured meat.

The survey formula was created by gathering the questions and using more resources. After processing the data, factor analysis was carried out, separating the factors that connected the variables and storing them under the relevant sections. A close eye was kept on the factor loading for the ratios of their relationships with the distributions, and inter-item and total distribution ratios were maintained among their distributions. The survey's factor analysis allowed for the creation of a streamlined and trustworthy measurement tool. Accepting the response provided in the Likert-type survey as 1 point was how the survey was scored.

### 2.5. Data Assessment

The statistical analysis for the research was executed using IBM Corp.'s (Armonk, NY, USA) SPSS version 25.0 software. The research data were assessed using descriptive statistical techniques (mean, standard deviation, number, percentage, etc.). The Kolmogorov-Smirnov test was used to assess the data's normal distribution. The Mann-Whitney U test was used to compare the two groups' quantitative data because the Kolmogorov-Smirnov test indicated that the data was not distributed normally. The Kruskal-Wallis test was applied when comparing more than two groups. To ascertain which groups the difference stems from, the Bonferroni test was employed. The relationship between the descriptive factors was ascertained using the Spearson test. It was determined that the difference in the 95% confidence interval was noteworthy.

### 2.6. Ethical Approval

There was no objection to the conduct of this research by the scientific publication and ethics committee of the University of Hakkari/Türkiye. The research was approved by the board dated 21.02.2022, session number 2022/28.

## 3. Results

### 3.1. Demografic Features of Participants

The Republic of Türkiye (TC) constituted the sample for the Young People's Cultured Meat Perception Survey (YCMPS) with 371 students from TC enrolled in various programs at a public university. The research's sample of students ranged in age from 18 to 34 years old, with a mean age of 22.35 ± 2.71. Of the participants, 62.5% (N = 232) were female and 37.5% (N = 139) were male. Of the students, 65% (n = 241) were enrolled in undergraduate programs and 35%

(n = 130) were in associate degree programs. When the distribution of the occupational groups in which the students receive education was examined, 66.8% (n = 248) of the students receive education in education, 20.2% (n = 75) in health, 8.1% (n = 30) in business-economics and 4.9% (n = 18) in engineering or technical occupations. In terms of dietary habits, 93.3% (n = 346) of the students were omnivores, 2.7% (n = 10) were semi-vegetarians, 2.7% (n = 10) were vegetarians and 1.3% (n = 5) were vegan (Table 1).

### 3.2. Findings Related to Item Analysis and Factor Structure of YCMPS

The principal components factor analysis method was used to analyze the scores of 371 students' responses to the 5-point Likert-type items using the varimax rotation method to determine the factor structure of the questionnaire. Barlett's test values for sample size and Kaiser-Meyer-Olkin (KMO) for sampling adequacy were computed. Principal components factor analysis yielded a Kaiser-Meyer

Table 1. Demographic characteristic of participants.

| Features | N | % | Mean ± SD | Min. - Max. |
|---|---|---|---|---|
| Age | 371 | 100 | 22.35 ± 2.71 | 18 - 34 |
| Group of Age | | | | |
| 18 - 20 | 81 | 21.8 | | |
| 21 - 24 | 239 | 64.4 | | |
| ≥25 | 51 | 13.7 | | |
| Sex | | | | |
| Female | 232 | 62.5 | | |
| Male | 139 | 37.5 | | |
| Type of Education | | | | |
| Two years | 130 | 35.0 | | |
| Four years | 241 | 65.0 | | |
| Occupation Groups | | | | |
| Education | 248 | 66.8 | | |
| Health | 75 | 20.2 | | |
| Business- economy | 30 | 8.1 | | |
| Engineering | 18 | 4.9 | | |
| Dietary Habits | | | | |
| Omnivore | 346 | 93.3 | | |
| Semi vegetarian | 10 | 2.7 | | |
| Vegetarian | 10 | 2.7 | | |
| Vegan | 5 | 1.3 | | |

Olkin (KMO) value of 0.913, which was deemed to be within an acceptable range. According to the analysis of Bartlett's Test of Sphericity (Bartlett's Test of Sphericity Test), $\chi^2 = 3266.556$ is highly significant ($p \leq 0.001$). To reach the appropriate factor analysis model, 7 of the 23 items of the survey, items with item-total correlation values below 0.30, items with factor loading values below 0.45, or overlapping items were removed from the scale to determine the appropriate factor analysis model. Three factors were obtained as a result of the factor analysis conducted using items numbered 3, 4, 5, 5, 6, 6, 7, 7, 8, 8, 9, 9, 10, 10, 11, 11, 14, 15, 16, 20, 21, 22 and 23. 16 items with eigenvalues greater than 1 were collected. When the eigenvalue line graph was examined, 3 factors were found to be related to the survey (Figure 1). According to the chart, the first factor contributed 45.404%, the second contributed 10.898%, and the third contributed 8.219% to the explanation of the survey variation. Following the third a factor, the graph's trajectory was essentially horizontal, with no discernible downward trend.

Three factors in the final questionnaire clarified 64.521% of the questionnaire variation when the information in Table 2 were analyzed. Given that it was greater than 50%, this ratio was deemed adequate. The questionnaire's item correlations ranged in value from 0.52 to 0.76. The range of factor loadings for the questionnaire's items was 0.57 to 0.95. The 16-item scale's item numbering was redone, and it is now shown in Table 1 as the "scale item number". The items were rearranged such that factors 1 through 7 are placed under factor 1, factors 2 through 12 under factor 2, and factors 13 through 16 under factor 3. Upon conducting a thorough analysis of the items gathered under each factor, it was ascertained that the first factor's items were associated with "Health-Taste", the second factor with "Being an Alternative", and the third factor with "Consumption". Table 2 shows that the questionnaire's overall reliability value was determined to be 0.92.

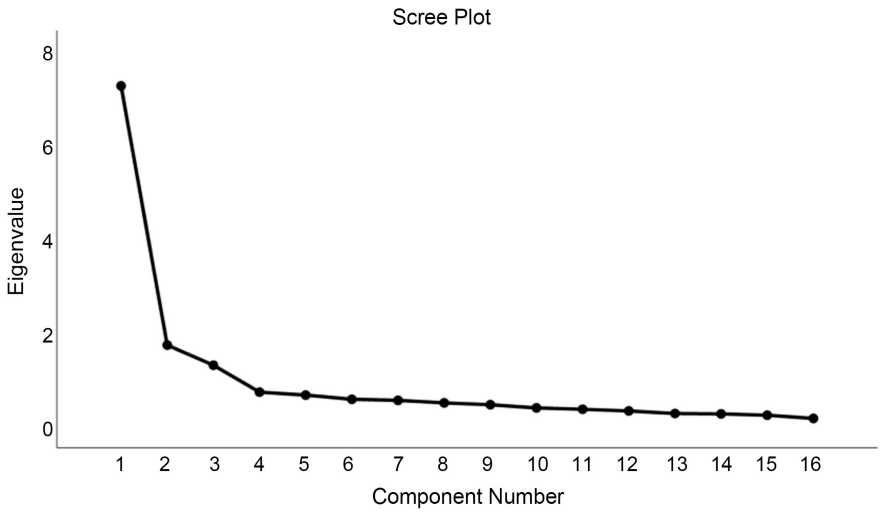


Figure 1. Scree plot.

**Table 2.** Results of factor analysis of YCMPS.

| Subdimension | Item No | Survey Item No | Survey Items | ITCS* | Factor Load | Cronbach Alpha($\alpha$) | Explaind Variance (%) |
|---|---|---|---|---|---|---|---|
| Health-Taste (1st Factor) | 3 | 1 | Cultured meat is healthier than industrial meat. | 0.647 | 0.946 | 0.898 | 45.404 |
| | 4 | 2 | Cultured meat is more natural than industrial meat. | 0.628 | 0.919 | | |
| | 5 | 3 | Cultured meat is more environmental-friendly than meat. | 0.707 | 0.709 | | |
| | 7 | 4 | Cultured meat is ethical than industrial meat. | 0.731 | 0.656 | | |
| | 9 | 5 | Cultured meat is ethically right than industrial meat. | 0.760 | 0.643 | | |
| | 8 | 6 | Cultured meat is more tasty than industrial meat. | 0.638 | 0.636 | | |
| | 6 | 7 | Cultured meat could reduce GG emission from agriculture. | 0.614 | 0.567 | | |
| Being an Alternative (2nd Factor) | 15 | 8 | Cultured meat may be an alternative industrial meat. | 0.551 | 0.868 | 0.819 | 10.898 |
| | 14 | 9 | Cultured meat may be a solution to scarcity. | 0.542 | 0.862 | | |
| | 16 | 10 | Cultured meat replaced with industrial meat in the future. | 0.557 | 0.746 | | |
| | 11 | 11 | Cultured meat has less risk tranmitted disease animal to human compared to industrial meat. | 0.517 | 0.617 | | |
| | 10 | 12 | Eating cultured meat improves animal welfare. | 0.633 | 0.588 | | |
| Consumption (3rd Factor) | 23 | 13 | I buy cultured meat regularly. | 0.536 | 0.831 | 0.843 | 8.219 |
| | 22 | 14 | Intend to pay more money than industrial meat in order to consume cultured meat. | 0.519 | 0.815 | | |
| | 20 | 15 | I eat cultured meat instead of industrial meat. | 0.598 | 0.745 | | |
| | 21 | 16 | I suggest to omnivore person to eat cultured meat | 0.656 | 0.711 | | |
| | | | Sum | - | - | 0.919 | 64.521 |
| | | | Kaiser-Meyer-Olkin (KMO) | 0.913 | | | |
| | | | Barlett's Sphericity Test Chi-Square Value ($\chi^2$) | 3266.556 | | | |
| | | | Significancy (Sig.) | < 0.001 | | | |

*ITCS: Item Total Correlation Score.

**Table 3** presents the students' level of participation based on the YCMPS items. The students' highest score was "In the future, cultured meat could offer

Table 3. Participants' participation rates and mean scores for the statements of the YCMPS.

| | YCMPS | I strongly disaggre | I disaggre | Undecided | I aggre | I strongly agree | $\bar{X}$ ± SD |
|---|---|---|---|---|---|---|---|
| | ITEMS | n (%) | n (%) | n (%) | n (%) | n (%) | |
| 1st Factor | Cultured meat is healthier than industrial meat. | 119 (32.1) | 111 (29.9) | 85 (22.9) | 40 (10.8) | 16 (4.3) | 2.25 ± 1.14 |
| | Cultured meat is more natural than industrial meat. | 150 (40.4) | 90 (24.3) | 75 (20.2) | 43 (11.6) | 13 (3.5) | 2.13 ± 1.17 |
| | Cultured meat is more environmental-friendly than meat. | 82 (22.1) | 58 (15.6) | 98 (26.4) | 93 (25.1) | 40 (10.8) | 2.87 ± 1.31 |
| | Cultured meat is ethical than industrial meat. | 94 (25.3) | 75 (20.2) | 108 (29.1) | 62 (16.7) | 32 (8.6) | 2.63 ± 1.26 |
| | Cultured meat is ethically right than industrial meat. | 99 (26.7) | 83 (22.4) | 104 (28.0) | 62 (16.7) | 23 (6.2) | 2.53 ± 1.22 |
| | Cultured meat is more tasty than industrial meat. | 120 (32.3) | 70 (18.9) | 140 (37.7) | 32 (8.6) | 9 (2.4) | 2.30 ± 1.09 |
| | Cultured meat could reduce GG emission from agriculture. | 52 (14.0) | 49 (13.2) | 149 (40.2) | 99 (26.7) | 22 (5.9) | 2.97 ± 1.10 |
| 2nd Factor | Cultured meat may be an alternative industrial meat. | 42 (11.3) | 38 (10.2) | 113 (30.5) | 134 (36.1) | 44 (11.9) | 3.27 ± 1.15 |
| | Cultured meat may be a solution to scarcity. | 43 (11.6) | 44 (11.9) | 119 (32.1) | 117 (31.5) | 48 (12.9) | 3.22 ± 1.17 |
| | Cultured meat replaced with industrial meat in the future. | 56 (15.1) | 54 (14.6) | 113 (30.5) | 104 (28.0) | 44 (11.9) | 3.07 ± 1.23 |
| | Cultured meat has less risk tranmitted disease animal to human compared to industrial meat. | 59 (15.9) | 56 (15.1) | 116 (31.3) | 91 (24.5) | 49 (13.2) | 3.04 ± 1.25 |
| | Eating cultured meat improve animal welfare. | 63 (17.0) | 58 (15.6) | 101 (27.2) | 103 (27.8) | 46 (12.4) | 3.03 ± 1.27 |
| 3rd Factor | I buy cultured meat regularly. | 148 (39.9) | 95 (25.6) | 102 (27.5) | 21 (5.7) | 5 (1.3) | 2.03 ± 1.01 |
| | I intend to pay more money than industrial meat in order to consume cultured meat. | 134 (36.1) | 107 (28.8) | 91 (24.5) | 34 (9.2) | 5 (1.3) | 2.11 ± 1.04 |
| | I eat cultured meat instead of industrial meat. | 120 (32.3) | 84 (22.6) | 118 (31.8) | 30 (8.1) | 19 (5.1) | 2.31 ± 1.15 |
| | I suggest to omnivore person to eat cultured meat. | 97 (26.1) | 81 (21.8) | 126 (34.0) | 49 (13.2) | 18 (4.9) | 2.49 ± 1.15 |
| | | 1st factor | 2 st factor | 3st factor | Sum | | |
| | $\bar{X}$ ± SD | 17.69 ± 6.55 | 15.63 ± 4.62 | 8.94 ± 3.60 | 42.26 ± 12.59 | | |
| | Median (Min. - Max.) | 18 (7 - 35) | 16 (5 - 25) | 9 (4 - 20) | 43 (16 - 79) | | |

an alternative to industrial meat" (Mean = 3.27 ± 1.15), while the lowest score was "I regularly buy cultured meat" (Mean = 2.03 ± 1.01). Merely 7% of the respondents expressed their willingness to regularly purchase cultured meat. It is evident that 64.9% of respondents, a sizable majority, oppose spending more money on cultured meat as opposed to industrial meat. Merely 15.1% of the respondents chose to agree or completely concur with the argument that meat from cultures is more natural than meat from industrial sources. In factor 1, it was discovered that this statement had the lowest mean score. The majority of participants (62%, 51.2%) thought that cultured meat was tasteless and unhealthy, as shown by the results in Table 3. Furthermore, 35.9% of participants be-

lieve that cultured meat is better for the environment than 37.7% do not. Of the 371 participants, 49% did not think that cultured meat was ethical, and 28% were unsure.

The majority of participants (62%, 51.2%) thought that cultured meat was tasteless and unhealthy, as shown by the results in Table 3. Furthermore, 35.9% of participants believe that cultured meat is better for the environment and 37.7% do not. Of the 371 participants, 49% did not think that cultured meat was ethical, and 28% were unsure.

### 3.3. YCMPS Scores According to Students' Descriptive Characteristics

The age of the students showed a negative correlation that was statistically significant with their Factor 2 ($r = -109$, $p = 0.036$) and Factor 3 ($r = -0.121$, $p = 0.019$) scores. Students who received a two-year education had mean scores that were statistically significantly higher than those of students who attended a four-year university ($p < 0.05$). Furthermore, comparing students who studied for two years to those who studied for four years, the former group's Factor 3 scores were statistically significantly lower ($p < 0.05$).

The results showed that the third factor's mean scores varied statistically significantly depending on the occupational group (K-W$\chi^2 = 14.881$, $p = 0.002$). The groups of students who obtained instruction for careers in economics and business were found to differ from one another, as indicated by the results of the Bonferroni correction test. Table 4 shows that there was not a statistically significant distinction ($p > 0.05$) in the students' YCMPS scores based on their dietary styles and gender.

Table 4. Total and Subscale Score Averages of YCMPS according to participants' descriptive characteristics.

| | | | Young People's Culture Meat Perception Survey (YCMPS) | | | |
|---|---|---|---|---|---|---|
| | | | 1st Factor | 2st Factor | 3st Factor | Sum |
| Features | Category | N | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD |
| Age | R | | −0.046 | −0.109 | −0.121 | −0.033 |
| | P | | 0.381 | 0.036* | 0.019* | 0.527 |
| Groups of Age | 18 - 20 | 81 | 18.36 ± 6.19 | 16.22 ± 4.34 | 8.14 ± 3.39 | 42.72 ± 10.79 |
| | 21 - 24 | 239 | 17.61 ± 6.17 | 15.56 ± 4.53 | 9.06 ± 3.49 | 42.23 ± 12.22 |
| | ≥25 | 51 | 17.02 ± 8.56 | 15.04 ± 5.43 | 9.61 ± 4.25 | 41.67 ± 16.57 |
| | K-W$_{\chi 2}$ | | 1.561 | 1.653 | 5.652 | 0.470 |
| | P | | 0.458 | 0.438 | 0.059 | 0.791 |
| Sex | Male | 232 | 17.89 ± 6.48 | 15.58 ± 4.43 | 8.99 ± 3.54 | 42.46 ± 12.06 |
| | Female | 139 | 17.36 ± 6.67 | 15.72 ± 4.94 | 8.85 ± 3.71 | 41.93 ± 13.45 |
| | Z | | −1.008 | −0.590 | −0.491 | −0.469 |
| | P | | 0.313 | 0.555 | 0.623 | 0.639 |

**Continued**

| | | | | | | |
|---|---|---|---|---|---|---|
| Type of Education | Two Years | 130 | 18.47 ± 6.15 | 15.93 ± 4.14 | 9.74 ± 3.44 | 44.14 ± 11.39 |
| | Four Years | 241 | 17.27 ± 6.73 | 15.47 ± 4.87 | 8.50 ± 3.62 | 41.25 ± 13.10 |
| | Z | | −1.856 | −0.483 | −3.289 | −1.978 |
| | P | | 0.063 | 0.629 | 0.001* | 0.048* |
| Groups of Occupation | Education | 248 | 17.21 ± 6.63 | 15.42 ± 4.84 | 8.50 ± 3.62 | 41.13 ± 12.88 |
| | Health | 75 | 18.01 ± 6.45 | 16.03 ± 4.20 | 9.45 ± 3.33 | 43.49 ± 11.85 |
| | Business | 30 | 19.83 ± 5.62 | 15.80 ± 3.98 | 10.27 ± 3.07 | 45.90 ± 10.04 |
| | Engineering | 18 | 19.44 ± 6.65 | 16.67 ± 4.24 | 10.61 ± 4.19 | 46.72 ± 13.59 |
| | K-W$_{\chi 2}$ | | 7.217 | 0.785 | 14.881 | 6.928 |
| | P | | 0.065 | 0.853 | 0.002* | 0.074 |
| Dietary Habits | Omnivores | 346 | 17.67 ± 6.54 | 15.63 ± 4.60 | 8.90 ± 3.57 | 42.21 ± 12.63 |
| | Others | 25 | 17.96 ± 6.79 | 15.72 ± 5.03 | 9.36 ± 4.13 | 43.04 ± 12.23 |
| | Z | | −0.091 | −0.074 | −0.258 | −0.053 |
| | P | | 0.928 | 0.941 | 0.796 | 0.958 |

## 4. Discussion

For Turkish consumers, cultured meat is a novel concept. The literature lacks a research on consumers' opinions of cultured meat in Türkiye, even though numerous studies have examined this topic [2] [16] [17]. Because it is a first, this research is probably going to add something to the literature. The purpose of our research is to ascertain the attitudes of university students in a province of Türkiye regarding the consumption of cultured meat as well as the factors that influence the stages at which students make decisions regarding this type of meat. In our questionnaire, the statement "Cultured meat is more natural than industrial meat" was determined to have the lowest score within its factor. Consumers in the food technologies industry assess products based on the naturalness criterion. Consumer acceptance of cultured meat is strongly correlated with naturalness perception [20]. Out of the 371 participants in our research, only 15.1% checked the "agree" and "strongly agree" options. Most respondents believed that cultured meat was artificial. Segrist *et al.* (2018) stated that the findings of the research may vary depending on whether the characterization of cultured meat in the survey is technical or not to measure the natural consumption of meat. According to this idea, the use of technical terminology in the definition of cultured meat has changed people's perception of the naturalness of meat and reduced their desire to consume it. It was determined that a non-technical definition of cultured meat with favorable results could alter consumers' perceptions of naturalness and boost their propensity to buy the product. The fact that the description of meat that is cultured in the questionnaire utilized may have included technical terms, contributing to the negative opinion that this type of meat is not natural as was reported in this research. Because the definition of

cultured meat includes information about the production process, it is believed that the students' views on the meat have shifted and their sense of its naturalness has been impacted [21].

Analysis of the research participants' willingness to purchase cultured meat reveals that the majority (64.9%) do not plan to pay more for cultured meat than industrial meat. The statement "I regularly purchase cultured meat" has the lowest mean of all the statements, though, concurrently. Merely 7% of the respondents indicated that they would be inclined to regularly purchase cultured meat. Researchers in the United States found that while two-thirds of participants wanted to try cultured meat, this percentage dropped to one-third when participants made regular purchases [19]. Our findings are consistent with the participants' unwillingness to spend extra money on cultured meat. In a research conducted in France, 50.6% of the participants were willing to try cultured meat, but 79.7% of the participants did not want to buy cultured meat regularly. Only 8.7% of the participants stated that they would pay more money to consume cultured meat than today's meat [22]. The findings of our research in terms of the percentage of intention to pay more money to buy cultured meat than industrial meat are consistent with Hacquette *et al.* (2022) [23].

Two-thirds of participants said they would prefer a beef burger when asked about their preferences as consumers if a burger made of cultured meat and beef were offered at the same price, according to Slade. Only 17 percent of respondents supported cultured meat out of the options for both cultured meat and beef burgers. There is a belief that by lowering the cost, cultured meat can gain market share and people's propensity to make purchases could rise [24]. According to Palmieri *et al.*'s research, consumers who were open to trying cultured meat were willing to pay the same or more for it than they would for a regular hamburger [18]. In the related research, it was noted that those who refused to taste the cultured meat said they could eat a cultured meat hamburger if it was less expensive than a regular hamburger. Nonetheless, a compelling argument for preference is the product's widespread use. Popularity also reflects a product's perceived quality in the eyes of the buyer. As cultured meat becomes more widely available at reasonable prices, it is anticipated that consumer behavior based on research findings will diverge from actual consumer behavior [25].

It is also evident that consumers face ethical dilemmas when they believe that cultured meat wasn't natural. From the perspective of the customer, something that is out of the ordinary may also be immoral. Customers believe that depending on the cost of cultured meat, there may be more injustice and inequality between the rich and the poor. Furthermore, some believe that the destruction of farm animal husbandry caused by cultured meat could result in the eradication of farmers [26]. According to Verbeke *et al.*'s research, participants expressed worries about the decline of rural life, the vanishing of farm animals, and the shift in food culture [27]. According to this thesis research, 28% of the 371 participants were unsure about the ethics of eating cultured meat, and 49% of them did not think it was unethical compared to modern meat. The similar concerns

of the people in the region can help to explain this. The similar concerns of the people in the region can help to explain this. The provinces of Eastern Anatolia, where Hakkari is situated, make significant contributions to the animal husbandry industry. The province's goat population, which is primarily associated with ovine husbandry, makes up 1.81% of all goats in Türkiye and roughly 12.79% of the Eastern Anatolia Region [28]. Animal husbandry plays a major social and economic role in the pasture-based animal husbandry system of Hakkari province [29]. Participants may view cultured meat as unethical due to their perspectives on animal husbandry, which are affected by a variety of social, cultural, and economic factors. Participants might also be concerned about the possibility that cultured meat will take the place of conventional animal husbandry. In the current research, a greater proportion of participants agreed than disagreed that cultured meat might eventually take the place of conventional animal husbandry. Furthermore, 39.9% of participants believe that in the future, cultured meat could replace traditional meat. According to Hocquette *et al.* (2015) among all the statements in the survey, the one with the highest mean was the statement that cultured meat will replace it in the future, participants thought that cultured meat technological advances were realistic and feasible, which is consistent with the results of our research [22]. Researchers aware of the negative aspects of the meat industry consider cultured meat, not a definitive solution to ethical problems [23]. The majority of participants (69.7%) in Tucker's research said they would cut back on their meat intake to help with the environmental issues the meat industry causes. A majority of the participants, specifically 55%, held a negative view of the consumption of cultured meat [17]. According to Wang's research, participants who were concerned about social issues, like environmental issues, were more likely to buy and consume cultured meat [30]. According to findings from another Sri Lankan research, consumers think that eating meat that has been cultured can preserve animal welfare and enhance the efficient use of natural resources. Furthermore, it was noted that 75% of consumers accepted eating meat that had been cultured [31]. According to our survey, 35.9% of college students believed that cultured meat was environmentally friendly, while 37.7% disagreed. This research's findings indicate that most people believe cultured meat to be neither environmentally friendly nor capable of resolving environmental issues. It is believed that individuals who do not view cultured meat as a way to solve environmental issues might view it more negatively, which could lower the amount of people who accept it.

Taste and health are significant determinants of consumption as well. The majority of participants in the Hocquette *et al.* (2015) research said that cultured meat was unhealthy and tasteless, and they rejected its consumption [23]. According to Wilks *et al.* (2017) taste perception is the main thing that could stop people from accepting cultured meat. Merely 11% of respondents to our survey believed that cultured meat might taste better than conventional meat. 15.1% said they thought cultured meat was good for them [19]. Customers' misgivings regarding the product's nutritional value and the negative impact of considering

it to be unnatural on their health can be attributed to their lack of support for cultured meat's health benefits. Because of this, safety and health inspections ought to be completed prior to the sale of cultured meat [27]. Zhang *et al.* (2020) discovered a connection between client happiness and acceptance of cultured meat, which can be felt when food safety regulatory organizations are involved. It has been observed that when food authorities are involved, consumers' perceptions of the product's health benefits may alter. The null hypothesis of our research is that students' attitudes toward cultured meat are unaffected by factors such as 1) gender, 2) age, 3) type of education, 4) job-related team, and 5) dietary choices [32].

The gender of the students and the questionnaire's overall scores did not differ statistically significantly in our investigation ($p > 0.05$). This justifies the acceptance of our first hypothesis, H0, which claims that students' attitudes toward cultured meat are unaffected by their gender. One sociodemographic factor that is thought to have an impact on the propensity to buy cultured meat is gender. Numerous studies indicate that men have a more favorable opinion of cultured meat [19] [24] [33]. Furthermore, research suggests that men are more likely than women to eat foods that have undergone genetic modification [33] [34]. Men are more willing than women to try new foods, which helps to explain this [35]. Furthermore to their openness to novel experiences, women's greater neophobia than men can be demonstrated as a contributing factor [36]. Contrary to previous research, our research revealed no statistically significant difference between the gender of the students while their overall questionnaire scores ($p > 0.05$). The findings of this research are corroborated by Bryant *et al.* (2018), who found no connection between gender and willingness to eat cultured meat [25].

The age groups of the students in the current research showed a statistically significant negative correlation between their Factor 2 scores ($r = -109$, $p = 0.036$) and Factor 3 scores ($r = -0.121$, $p = 0.019$) ($p < 0.05$). As a result, our second hypothesis, H0, which contends that students' attitudes toward culture and meat are unaffected by their age, is rejected. The results of this research are in line with the numerous studies that have shown younger populations to have a more favorable attitude toward cultured meat [16] [17] [24]. Research on genetically modified foods revealed that younger demographics were more open to consuming them [33] [37] [38]. This could be explained by the inverse relationship between age and receptivity to new experiences. An increased attachment to habits may be seen in older adults [39]. It is also well known that issues like the global climate crisis and environmental challenges greatly interest and worry young people [40]. Young people may view biotechnological foods favorably and have a strong inclination to eat them as a result of these concerns.

Students who go on their two-year education at the university have statistically significantly higher mean scores on the questionnaire overall and for the third factor ($p < 0.05$), according to the results of the current research. Because of this, our third hypothesis, H0, which claims that there is no relationship between students' educational backgrounds and their opinions toward culture meat both

positive and negative is rejected.

Numerous studies show a positive correlation between education level and acceptance of biotechnology. Regression analysis revealed that the acceptance of cultured meat in consumers was correlated with higher educational levels in a research investigation comparing subjects at primary, secondary, and university levels [31]. Participants with university degrees and those with only a high school education were included in a Chinese research. It was discovered that those who had a favorable opinion of cultured meat were highly educated [30]. Another research carried out in China included education levels from junior high school and below, high school, university, and graduate school. The results of this research corroborate the favorable assessments of education level and attitude toward cultured meat made in other studies cited in this research [32]. The research covered a wider range of educational levels, including elementary school, high school, university, master's, and PhD degrees Slade's research found that having more education increases the likelihood of favored cultured meat [24]. Among the elderly with education levels determined to be tertiary level and below, those with higher education agree to consume a different or sustainable protein source at a rate of 33% - 41% according to a research by Grasso *et al.* (2019) [33]. There have been studies on genetically modified foods where positive correlations between people's educational attainment and propensity to buy the product have been found [33] [37]. Hossain *et al.* (2004) found that individuals with basic or intermediate knowledge of biotechnology were more likely to purchase biotechnological foods in their research of university and non-university students [33]. The research by Hocquette *et al.* contradicts other results reported in the literature by showing that educated people have a low acceptability of cultured meat. This research shows that informed consumers have little hope for cultured meat because they believe it lacks environmental scrutiny [22]. According to the findings, students pursuing a two-year degree at university are more likely to support the purchase and consumption of cultured meat than students pursuing a four-year degree.

In the research examining students' attitudes towards genetically modified foods, which are classified as biotechnological products, a relationship was found between the education levels of the participants and their agreement with the statement "I think the society is sufficiently informed about genetically modified foods". When undergraduate and associate degree graduates were compared, it was found that undergraduate students agreed less with this statement [38] [39]. This could be seen as a sign of undergraduate students' growing skepticism and lack of trust in biotechnological products. From this vantage point, it is clear that associate degree students are more likely to buy the product and have a favorable opinion of the consumption, health benefits, and other aspects of cultured meat. Furthermore, one of the factors contributing to the associate degree students' favorable perception of culture meat is their openness to innovation. An analysis of the innovativeness of each associate degree student revealed that, among those pursuing a degree in child development, 60% were

pioneers—willing to try new things, take calculated risks, and spread the word about innovations [40] [41].

According to the students' occupational group, there was a statistically significant difference in the third factor mean scores in our study ($K\text{-}W_{\chi^2} = 14.881$, $p = 0.002$). This led to the rejection of our fourth hypothesis, H0, which claims that there is no relationship between the occupational groups of students and their attitudes toward culture meat, both positive and negative. This difference was discovered between the student groups who received instruction in economics and business professions, as determined by the Bonferroni correction test. It is thought that the increasing public and industrial interest in the cultured meat sector explains why business and economic professionals have a more positive view of the factors affecting the decision to purchase cultured meat. Since the first hamburger was made with cultured meat, the number of businesses producing cultured meat has skyrocketed and continues to grow as investors and the media become more interested in cultured meat technology. Companies that produce cultured meat received funding totaling about USD 320 million between 2015 and 2020 [42]. The number of start-ups focused on cultured meat increased fourfold in 2019. Post was able to create hamburgers thanks to the support of public agencies, which are not typically involved in funding research [43]. Following the production of the first hamburger using cultured meat technology in 2013, a significant number of businesses entered this industry and broadened their operations to include the production of various species, including fish, chicken, beef, and pork. Memphis Meat and Mosa Meat are two of these businesses that hold the majority of the capital in the cultured meat market.

Memphis Meat earned $200 million in revenue, surpassing Mosa Meat with $85 million in revenue. The value of the cultured meat market was $1.64 million in 2021, but by 2025-2030 this market is predicted to grow to $2788.1 million [44].

In our study, the students' diet and overall scores on the survey did not show a statistically significant difference ($p > 0.05$). This leads to the acceptance of our fifth hypothesis, H0, which claims that there is no impact on students' dietary habits or attitudes towards cultured meat. It is believed that this is due to the low proportion of vegetarians among the respondents.

There are certain restrictions on this research. The study's findings cannot be applied to the entire country of Türkiye because the sample consisted of university students from a single province. Another drawback of the research is that participants with varying educational backgrounds were excluded, and only associate and undergraduate students were included as study participants. It is believed that this circumstance might have stopped the relationship between educational attainment from developing. Furthermore, the small percentage of vegetarian participants may mask the effect of diet type on the perception of cultured meat. The authors of the study recommend conducting multicenter studies in the future and using a sample of participants with different educational backgrounds to collect data on a national scale.

## 5. Conclusions

The following outcomes were attained within the constraints of this investigation:

The likelihood of purchasing cultured meat declines with age, as does the perception that it can be a substitute for conventional meat.

In contrast to students who continue their four-year education at the university, those who pursue a two-year program exhibit a more positive attitude toward cultured meat in terms of health, consumption, and alternatives.

It was discovered that students majoring in business and economics had a higher propensity to buy cultured meat.

It has been noted that when buying cultured meat, university students typically don't plan to spend more than the cost of meat today.

## Authors' Contributions

Conceptualization, Kumru M. and Demir H.; methodology, Kumru M.; software, Demir H.; validation, Kumru M.; formal analysis, Demir H.; investigation, Kumru M.; resources, Kumru M; data curation, Kumru M.; writing—original draft preparation, Demir H.; writing—review and editing, Demir H.; visualization, Demir H.; supervision, Demir H.; project administration, Demir H.; funding acquisition, Demir H. All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

## References

[1] Chriki, S., Ellies-Oury, M.-P. and Hocquette, J.-F. (2022) Is "Cultured Meat" a Viable Alternative to Slaughtering Animals and a Good Comprise between Animal Welfare and Human Expectations? *Animal Frontiers*, **12**, 35-42. https://doi.org/10.1093/af/vfac002

[2] Weinrich, R., Strack, M. and Neugebauer, F. (2020) Consumer Acceptance of Cultured Meat in Germany. *Meat Science*, **162**, Article No. 107924. https://doi.org/10.1016/j.meatsci.2019.107924

[3] Food and Agriculture Organization of the United Nations (2018) World Livestock: Transforming the Livestock Sector through the Sustainable Development Goals.

[4] Sabaté, J. and Soret, S. (2014) Sustainability of Plant-Based Diets: Back to the Future. *The American Journal of Clinical Nutrition*, **100**, S476-S482. https://doi.org/10.3945/ajcn.113.071522

[5] Steinfeld, H., Gerber, P.J., Wassenaar, T., Castel, V., Rosales, M. and De Haan, C. (2006) Livestock's Long Shadow: Environmental Issues and Options. Food and Agriculture Organization of the United Nations.

[6] Claus, L. (2003) Nutrition Ecology: The Contribution of Vegetarian Diets. *The American Journal of Clinical Nutrition*, **78**, S657-S659. https://doi.org/10.1093/ajcn/78.3.657S

[7] Maxwell, S.L., Fuller, R.A., Brooks, T.M. and Watson, J.E.M. (2016) Biodiversity: The Ravages of Guns, Nets and Bulldozers. *Nature*, **536**, 143-145. https://doi.org/10.1038/536143a

[8] Lee, S.Y., Kang, H.J., Kang, J.H., Ramani, S., Park, S. and Hur, S.J. (2021) Principal Protocols for the Processing of Cultured Meat. *Journal of Animal Science and Technology*, **63**, 673-680. https://doi.org/10.5187/jast.2021.e40

[9] Centers for Disease Control and Prevention (CDC) (2023) https://www.cdc.gov

[10] Bhat, Z.F. and Fayaz, H. (2011) Prospectus of Cultured Meat—Advancing Meat Alternatives. *Journal of Food Science and Technology*, **48**, 125-140. https://doi.org/10.1007/s13197-010-0198-7

[11] Post, M.J. and Hocquette, J.-F. (2017) New Sources of Animal Proteins: Cultured Meat. In: Purslow, P.P., Ed., *New Aspects of Meat Quality*, Woodhead Publishing, Cambridge, 425-441. https://doi.org/10.1016/B978-0-08-100593-4.00017-5

[12] Hocquette, J.-F. (2016) Is *in Vitro* Meat the Solution for the Future? *Meat Science*, **120**, 167-176. https://doi.org/10.1016/j.meatsci.2016.04.036

[13] Ng, E.T., Singh, S., Yap, W.S., Tay, S.H. and Choudhury, D. (2023) Cultured Meat—A Patentometric Analysis. *Critical Reviews in Food Science and Nutrition*, **63**, 2738-2748. https://doi.org/10.1080/10408398.2021.1980760

[14] Verbeke, W., Marcu, A., Rutsaert, P., Gaspar, R., Seibt, B., Fletcher, D. and Barnett, J. (2015) 'Would You Eat Cultured Meat?': Consumers' Reactions and Attitude Formation in Belgium, Portugal and the United Kingdom. *Meat Science*, **102**, 49-58. https://doi.org/10.1016/j.meatsci.2014.11.013

[15] Turp, G.Y., Eliküçük, Y. and Küçükyurt, F. (2022) *Yapay et: Üretim Yöntemleri, Teknolojik ve Etik Kısıtlamalar, Sürdürülebilirliğe Katkısı*, Sidas, İzmir.

[16] Mancini, M.C. and Antonioli, F. (2019) Exploring Consumers' Attitude towards Cultured Meat in Italy. *Meat Science*, **150**, 101-110. https://doi.org/10.1016/j.meatsci.2018.12.014

[17] Franceković, P., García-Torralba, L., Sakoulogeorga, E., Vučković, T. and Perez-Cueto, F.J. (2021) How Do Consumers Perceive Cultured Meat in Croatia, Greece, and Spain? *Nutrients*, **13**, Article 1284. https://doi.org/10.3390/nu13041284

[18] Palmieri, N., Perito, M.A. and Lupi, C. (2020) Consumer Acceptance of Cultured Meat: Some Hints from Italy. *British Food Journal*, **123**, 109-123. https://doi.org/10.1108/BFJ-02-2020-0092

[19] Wilks, M. and Phillips, C.J.C. (2017) Attitudes to *in Vitro* Meat: A Survey of Potential Consumers in the United States. *PLOS ONE*, **12**, e0171904. https://doi.org/10.1371/journal.pone.0171904

[20] Román, S., Sánchez-Siles, L.M. and Siegrist, M. (2017) The Importance of Food Naturalness for Consumers: Results of a Systematic Review. *Trends in Food Science & Technology*, **67**, 44-57. https://doi.org/10.1016/j.tifs.2017.06.010

[21] Siegrist, M., Sütterlin, B. and Hartmann, C. (2018) Perceived Naturalness and Evoked Disgust Influence Acceptance of Cultured Meat. *Meat Science*, **139**, 213-219. https://doi.org/10.1016/j.meatsci.2018.02.007

[22] Hocquette, A., Lambert, C., Sinquin, C., Peterolff, L., Wagner, Z., Bonny, S.P.F., *et al.* (2015) Educated Consumers don't Believe Artificial Meat is the Solution to the Problems with the Meat Industry. *Journal of Integrative Agriculture*, **14**, 273-284. https://doi.org/10.1016/S2095-3119(14)60886-8

[23] Hocquette, É., Liu, J., Ellies-Oury, M.P., Chriki, S. and Hocquette, J.F. (2022) Does the Future of Meat in France Depend on Cultured Muscle Cells? Answers from Dif-

ferent Consumer Segments. *Meat Science*, **188**, Article 108776. https://doi.org/10.1016/j.meatsci.2022.108776

[24] Slade, P. (2018) If You Build It, Will They Eat It? Consumer Preferences for Plant-Based and Cultured Meat Burgers. *Appetite*, **125**, 428-437. https://doi.org/10.1016/j.appet.2018.02.030

[25] Bryant, C. and Barnett, J. (2018) Consumer Acceptance of Cultured Meat: A Systematic Review. *Meat Science*, **143**, 8-17. https://doi.org/10.1016/j.meatsci.2018.04.008

[26] Laestadius, L.I. (2015) Public Perceptions of the Ethics of In-vitro Meat: Determining an Appropriate Course of Action. *Journal of Agricultural and Environmental Ethics*, **28**, 991-1009. https://doi.org/10.1007/s10806-015-9573-8

[27] Verbeke, W., Sans, P. and Van Loo, E.J. (2015) Challenges and Prospects for Consumer Acceptance of Cultured Meat. *Journal of Integrative Agriculture*, **14**, 285-294. https://doi.org/10.1016/S2095-3119(14)60884-4

[28] Türkiye Istatistik Kurumu (n.d.). Hayvancılık Istatistikleri. https://data.tuik.gov.tr/Bulten/Index?p=Hayvansal-Uretim-Istatistikleri-Haziran-2022-45594

[29] Ertuş, M.M. (2019) Hakkâri'de Sürdürülebilir Mera Kullanımı ve Yem Bitkileri Üretimi. *Doğu Fen Bilimleri Dergisi*, **2**, 47-53.

[30] Wang, O. and Scrimgeour, F. (2023) Consumer Segmentation and Motives for Choice of Cultured Meat in two Chinese Cities: Shanghai and Chengdu. *British Food Journal*, **125**, 396-414. https://doi.org/10.1108/BFJ-09-2021-0987

[31] Chandimala, U.R., Gunathilake, D.M.C.C., Vidanapathirana, N.P. and Rifnas, L.M. (2022) Perception of Cultured Meat among Sri Lankan Community. *Journal of Agro-Technology and Rural Sciences*, **1**, 21-26. https://doi.org/10.4038/atrsj.v1i2.33

[32] Zhang, M., Li, L. and Bai, J. (2020) Consumer Acceptance of Cultured Meat in Urban Areas of Three Cities in China. *Food Control*, **118**, Article 107390. https://doi.org/10.1016/j.foodcont.2020.107390

[33] Hossain, F., Onyango, B., Adelaja, A., Schilling, B. and Hallman, W. (2004) Consumer Acceptance of Food Biotechnology: Willingness to Buy Genetically Modified Food Products. *Journal of International Food & Agribusiness Marketing*, **15**, 53-76. https://doi.org/10.1300/J047v15n01_04

[34] Oğur, S., Aksoy, A. and Yılmaz, Z. (2017) Üniversite Öğrencilerinin Genetiği Değiştirilmiş Organizmalar ve Gıdalar Hakkındaki Bilgi Düzeyleri ve Tutumları: Bitlis Eren Üniversitesi Örneği. *Journal of Food and Health Science*, **3**, 97-108. https://doi.org/10.3153/JFHS17013

[35] Newcombe, M.A., McCarthy, M.B., Cronin, J.M. and McCarthy, S.N. (2012) "Eat Like a Man". A Social Constructionist Analysis of the Role of Food in Men's Lives. *Appetite*, **59**, 391-398. https://doi.org/10.1016/j.appet.2012.05.031

[36] Çınar, C., Karinen, A.K. and Tybur, J.M. (2021) The Multidimensional Nature of Food Neophobia. *Appetite*, **162**, Article 105177. https://doi.org/10.1016/j.appet.2021.105177

[37] Han, J.H. and Harrison, R.W. (2007) Factors Influencing Urban Consumers' Acceptance of Genetically Modified Foods. *Applied Economic Perspectives and Policy*, **29**, 700-719. https://doi.org/10.1111/j.1467-9353.2007.00382.x

[38] Magnusson, M.K. and Hursti, U.-K.K. (2002) Consumer Attitudes towards Genetically Modified Foods. *Appetite*, **39**, 9-24. https://doi.org/10.1006/appe.2002.0486

[39] McCrae, R.R., Costa, P.T., De Lima, M.P., Simões, A., Ostendorf, F., Angleitner, A.,

*et al.* (1999) Age Differences in Personality across the Adult Life Span: Parallels in Five Cultures. *Developmental Psychology*, **35**, 466-477. https://doi.org/10.1037/0012-1649.35.2.466

[40] United Nations (2023) Youth Stats: Environment and Climate Change. https://www.un.org/youthenvoy/environment-climate-change/

[41] Alagöz, N., Tarkoçin, S. and Taze, A. (2019) Çocuk Gelişimi Programi Ön Lisans Öğrencilerinin Bireysel Yenilikçilik Düzeylerinin Çeşitli Değişkenlere Göre İncelenmesi. *Akademik Matbuat*, **3**, 43-58.

[42] Choudhury, D., Tseng, T. W. and Swartz, E. (2020) The Business of Cultured Meat. *Trends in Biotechnology*, **38**, 573-577. https://doi.org/10.1016/j.tibtech.2020.02.012

[43] Dance, A. (2017) Engineering the Animal Out of Animal Products. *Nature Biotechnology*, **35**, 704-707. https://doi.org/10.1038/nbt.3933

[44] Ye, Y., Zhou, J., Guan, X. and Sun, X. (2022) Commercialization of Cultured Meat Products: Current Status, Challenges, and Strategic Prospects. *Future Foods*, **6**, Article 100177. https://doi.org/10.1016/j.fufo.2022.100177