Frontiers in Life Sciences and Related Technologies 7(1) (2026) 58-63

Contents lists available at Dergipark

Frontiers in Life Sciences and Related Technologies

Journal homepage: http://dergipark.org.tr/en/pub/flsrt

Research article

Influence of spice enrichment on consumer acceptance of plant-based meat alternatives

Aleyna Okcu[1], Ilayda Ozturk Altuncevahir*[2]

[1] *Bahcesehir University, Graduate School, Department of Nutrition and Dietetics, 34353, Istanbul, Türkiye*
[2] *Bahcesehir University, Faculty of Health Sciences, Department of Nutrition and Dietetics, 34353, Istanbul, Türkiye*

Abstract

The growing interest in plant-based meat alternatives has intensified the need to optimize their sensory properties to improve consumer acceptance. This study investigated the effect of spice enrichment on the sensory evaluation of plant-based meatball formulations during consumer testing. Additionally, the influence of socio-demographic characteristics and perception-related variables on sensory evaluations were examined. A total of 113 undergraduate students evaluated two formulations: a plain product and a spice-enriched variant. Sensory attributes were assessed using a 5-point hedonic scale, and statistical analyses included paired-samples t-tests, group comparisons, and correlation analyses. Spice enrichment significantly improved aroma-related attributes, particularly spiced aroma, which demonstrated a large effect size. Significant differences were also observed for colour, shape, homogeneity, and umami taste. However, no statistically significant difference in overall liking was found between the two formulations. Nutrition and Dietetics students scored higher on several attributes than Gastronomy students. Gender-based differences were observed primarily in food-choice motivations rather than in consistent sensory patterns. Correlation analyses revealed small to moderate associations between selected sensory attributes and participants' perceptions of plant-based meat alternatives, particularly regarding taste balance and sustainability beliefs. Overall, spice enrichment appears to be an effective strategy for enhancing aroma perception in plant-based meat alternatives; however, improvements in overall consumer acceptance may require broader formulation adjustments beyond flavor optimization. These findings provide practical insights for developing more acceptable plant-based products.

Keywords: *Aroma; consumer acceptance; plant-based meat alternatives; spice enrichment*

1. Introduction

The environmental and health impacts of animal-based food production have intensified interest in sustainable dietary alternatives. High greenhouse gas emissions, excessive water use, and land conversion associated with livestock production, together with the established links between red and processed meat consumption and chronic diseases, have accelerated the search for alternative protein sources (Richi et al., 2016; Fiorentini et al., 2020). As a result, plant-based meat alternatives (PBMAs) have emerged as promising substitutes that mimic the sensory properties of conventional meat while offering environmental and potential health benefits (Kumar et al., 2017; Boukid, 2021). Recent studies further indicate that innovation in ingredients and processing can improve sensorial qualities, although sensory gaps and consumer-acceptance barriers remain substantial (Chen et al., 2025; Munialo et al., 2025; Navarre et al., 2025).

Despite their sustainability potential, consumer acceptance of PBMAs largely depends on sensory characteristics such as taste, aroma, texture, and overall liking (Tuorila and Hartmann, 2020). Previous studies have shown that PBMAs often receive

* Corresponding author.
E-mail address: ilaydahaj@gmail.com (I. Ozturk Altuncevahir).
https://doi.org/10.51753/flsrt.1917826 Author contributions
Received 28 March 2026; Accepted 08 June 2026
Available online 20 September 2026
2718-062X © 2026 This is an open access article published by Dergipark under the CC BY license.

lower sensory scores compared to meat products, particularly due to legume-like off-flavors, artificial taste perceptions, and texture-related issues (Godschalk-Broers et al., 2022; Pointke et al., 2022). Therefore, formulation strategies aimed at improving flavour profiles, including the effective use of spices and aroma components, are considered essential to enhance product acceptance. Recent empirical work also suggests that familiarity, product information, and consumer expectations can meaningfully shape acceptance of PBMAs and related plant-based alternatives (Flint et al., 2025; Petrescu et al., 2025; Broad and Ruby, 2026; Varghese et al., 2026).

Consumer responses to PBMAs are also influenced by selected socio-demographic characteristics and food consumption preferences. Gender differences, prior experience with plant-based products, and nutrition-related awareness have been shown to affect attitudes and sensory evaluations (Pohjolainen et al., 2016; Alcorta et al., 2021; Inguscio et al., 2025). However, studies directly examining the impact of spice enrichment on the consumer acceptance of PBMAs within a Turkish sample remain limited.

Accordingly, the present study compares the sensory evaluations of two plant-based meatball formulations with similar base ingredients, one enriched with spices and aroma, and the other remaining plain. This study primarily aimed to investigate the influence of spice enrichment as a flavor-enhancement strategy on consumer-based sensory acceptance and to determine whether acceptance patterns differ according to socio-demographic characteristics and consumption-related variables.

2. Materials and methods

2.1. Study design and participants

This cross-sectional study was conducted between February and April 2025 using quantitative research design. A total of 113 undergraduate students enrolled in the Gastronomy and Culinary Arts (n=58) and Nutrition and Dietetics (n=55) programs at a university in Istanbul, Türkiye. Students from the Nutrition and Dietetics and Gastronomy and Culinary Arts programs were specifically selected because both groups are expected to have relatively high awareness of food-related sensory characteristics, although from different educational perspectives. Eligibility criteria include being 18 years of age and providing informed consent. Participants were excluded if they reported allergies or intolerances to the test products, smoking habits that could affect taste perception, taste or olfactory disorders, or non-compliance with the study protocol.

Sample size was determined using G*Power software. Based on an assumed effect size of 0.30 (Fisher's Z), a significance level of α=0.05, and a statistical power of 0.80, the minimum required sample size was calculated as 92 participants. A total of 113 participants were included in the final analysis.

The study protocol was approved by the Non-Interventional Research Ethics Committee of Bahcesehir University (Decision No: 2024-06/01; Decision Date:25.12.2024). Written informed consent was obtained from all participants prior to participation.

2.2. Product formulations and preparation

Two plant-based meatball formulations were developed: (i) a plain version without added spices and (ii) a spice-enriched formulation.

The ingredient quantities described below refer to the total batch prepared for each formulation. Both formulations contained chestnut mushrooms (*Agaricus brunnescens*, 300 g), boiled red beans (200 g), pea protein (30 g), nutritional yeast (5 g), psyllium husk powder (5 g), and vegetable oil (20 mL) as base ingredients. The spice-enriched formulation additionally included black pepper (5 g), cumin (5 g), allspice (5 g), thyme (5 g), garlic powder (5 g), cinnamon (5 g), and tomato paste (30 g). In the spice-enriched formulation, all spices were added in standardized amounts to ensure consistency across prepared samples. Both formulations contained equal amounts of salt (approximately 5 g per batch) to minimize differences in sodium-related taste perception. Mushrooms were sautéed, and red beans were briefly baked at 180°C before mixing. All ingredients were blended until a homogeneous mixture was obtained. The mixture was portioned, refrigerated for 30 minutes, and baked at 180°C for 30 minutes.

The estimated nutritional composition of the spice-enriched and plain formulations was calculated using BeBis 9 Nutrition Information System software on the standardized ingredient quantities. As shown in Table 1, both formulations demonstrated comparable nutrient profiles, with minor differences primarily attributable to the addition of spices. Nutritional values are presented for descriptive purposes only, as the primary focus of the study was sensory evaluation.

Table 1
Estimated nutrient composition of the formulations (100 g).

Nutrient	Spice-Enriched	Plain
Energy (kcal)	120.2	117.8
Protein (g)	8.3	8.1
Fat (g)	4.4	4.4
Carbohydrate (g)	10	9.7
Fiber (g)	5	4.8
Sodium (mg)	327.9	307.9

2.3. Consumer-based product evaluation procedure

The evaluations were conducted in quiet classroom environments under standardized serving conditions regarding sample quantity, serving temperature, and evaluation procedure. Each participant received 10 g samples of both formulations in single-use containers. Participants evaluated both formulations within the same session. Samples were coded, and presentation order was randomized to minimize order and carry-over effects. A 5-minute interval was provided between samples, and water was supplied for palate cleansing. Participants were informed about the general product category (plant-based product), whereas specific information regarding the formulations was not disclosed during the evaluation.

All products were prepared under hygienic conditions, transported in sealed containers, and maintained under cold chain conditions until service. Serving equipment was disinfected after each use. Sensory attributes were evaluated using a 5-point hedonic scale ranging from 1 "disliked very much" to 5 "liked very much", consistent with commonly used sensory acceptance testing approaches in food research (Fiorentini et al., 2020).

2.4. Measures

Participant characteristics: Participants provided

information on age, body mass index (BMI), gender, income level, marital status, frequently consumed food groups, and prior experience with plant-based meat alternatives. These variables were used in descriptive analyses and group comparisons.

Food choice motivations: Food choice motivations were assessed using the Single-Item Food Choice Questionnaire (SIFCQ), originally developed by Onwezen et al. (2019) and validated in Turkish by Haydaroglu et al. (2024). The instrument evaluates the perceived importance of eleven dimensions, including health, emotional state, convenience, sensory appeal, naturalness, price, weight control, familiarity, environmental sustainability, animal welfare, and fair trade. Each item is rated on a 7-point Likert scale (1=not important at all; 7=very important). Internal consistency in the present study was acceptable (Cronbach's α=0.832).

2.5. Statistical analysis

Statistical analyses were performed using IBM SPSS version 25. Descriptive statistics were calculated for all variables. Internal consistency of the scales was evaluated using Cronbach's alpha. Pearson correlation analyses were used to examine relationships between variables. Sensory differences between the two formulations were analysed using paired-samples t-tests. Group comparisons were conducted using independent-samples t-tests, Mann-Whitney U tests, or Kruskal-Wallis tests, depending on data distribution. Statistical significance was set as $p<0.05$.

3. Results

A total of 113 undergraduate students participated in the study. 51.3% of the participants were enrolled in the Gastronomy and Culinary Arts program and 48.7% in the Nutrition and Dietetics program. The majority of participants were female (59.3%), while 40.7% were male. Most participants reported a middle socio-economic status. Regarding food consumption preferences, 41.6% reported frequent consumption of red meat, 40.7% poultry, and 17.7% plant-based foods. Detailed descriptive characteristics of the sample are presented in Table 2.

Table 2
Participant characteristics of the study sample.

Variable	n	%
Program		
Nutrition and Dietetics	55	48.7
Gastronomy and Culinary Arts	58	51.3
Gender		
Female	67	59.3
Male	46	40.7
Relationship Status		
Single	72	63.7
In a relationship	41	36.3
Income		
Low	9	8.0
Middle	83	73.5
High	21	18.6
Frequently Consumed Food Group		
Red meat	47	41.6
Poultry	46	40.7
Plant-based foods	20	17.7
Total	113	100

Mean scores of the Single-Item Food Choice Questionnaire (SIFCQ) dimensions ranged from 4.48 to 5.85 across evaluated domains. Sensory appeal received the highest mean score, indicating that taste, aroma, texture, and appearance were among the most important determinants of food choice among participants. Comparisons between students from the Nutrition and Dietetics program and those from the Gastronomy and Culinary Arts program revealed a statistically significant difference only for the "convenience" dimension. Nutrition and Dietetics students reported higher scores (Mean=5.73, Standard Deviation=1.19) compared to Gastronomy students (Mean=5.22, Standard Deviation=1.44, $t(111)=2.107$) ($p=0.046$). Gender-based analyses demonstrated that female participants assigned significantly greater importance to health, weight control, environmental sustainability, and animal welfare dimensions compared to male participants ($p<0.05$). Relationship status was associated only with the fair-trade dimension, with participants in a relationship reporting higher scores ($p<0.05$). Similarly, socioeconomic status showed a significant association only for the price dimension, whereas no statistically significant differences were observed for the remaining SIFCQ dimensions ($p>0.05$). Examination of skewness and kurtosis values indicated approximate normality for the primary continuous variables.

Comparisons between students from the Nutrition and Dietetics program and those from the Gastronomy and Culinary Arts program revealed several statistically significant differences in sensory evaluations (Tables 3A and 3B). For the spice-enriched formulation, Nutrition and Dietetics students reported significantly higher scores for homogeneity ($p=0.015$), consistency ($p=0.019$), juiciness ($p=0.002$), plant-based odor ($p=0.004$), umami taste ($p=0.001$), taste balance ($p=0.014$), and overall liking ($p<0.001$). No significant differences were observed between groups for color, shape, surface texture, or spiced aroma ($p>0.05$) (Table 3A).

For the plain formulation, significant differences were observed for homogeneity ($p=0.039$), consistency ($p=0.013$), umami taste ($p=0.016$), and overall liking ($p=0.006$), with Nutrition and Dietetics students again reporting higher mean scores. No statistically significant group differences were found for color, shape, surface texture, plant-based odor, spiced aroma, juiciness, or taste balance ($p>0.05$) (Table 3B). Overall, students from the Nutrition and Dietetics program tended to assign higher sensory scores compared to Gastronomy students across selected texture-, flavor-, and acceptance-related attributes.

Table 3A
Comparison of sensory scores for the spice-enriched formulation by academic program.

Sensory Attribute	Nutrition & Dietetics (n=55) Mean±SD	Gastronomy (n=58) Mean±SD	*p*	Cohen's d
Homogeneity	3.38±1.01	2.93±0.93	0.015	0.47
Consistency	3.24±0.86	2.86± 0.81	0.019	0.46
Juiciness	3.16±0.86	2.59±1.03	0.002	0.60
Plant-based odor	2.82±0.80	2.33±0.96	0.004	0.55
Umami taste	3.56±0.83	2.98±0.93	0.001	0.66
Taste balance	3.49±0.88	3.05±0.98	0.014	0.47
Overall liking	3.86±1.03	3.19±0.93	<0.001	0.68

$p<0.05$

Gender-based comparisons revealed several statistically significant differences in food choice motivations. Female

participants reported significantly higher importance scores than male participants for health (Mean=5.08±1.37 vs. 4.39±1.42, p=0.012), weight control (Mean=4.73±1.60 vs 4.11±1.66, p=0.048), environmental sustainability (Mean=4.84±1.49 vs 4.04±1.59, p=0.008), and animal welfare (Mean=5.00±1.61 vs 3.96±1.71, p=0.001). No statistically significant gender differences were observed for the remaining food choice motivation dimensions (p>0.05).

Table 3B
Comparison of sensory scores for the plain formulation by academic program.

Sensory Attribute	Nutrition & Dietetics (n=55) Mean±SD	Gastronomy (n=58) Mean±SD	*p*	Cohen's d
Homogeneity	3.44±0.96	3.05±1.00	0.039	0.40
Consistency	3.16±0.86	2.74±0.93	0.013	0.46
Umami taste	3.27±0.95	2.83±0.98	0.016	0.46
Overall liking	3.69±0.92	3.21±0.91	0.006	0.52

p<0.05

Gender-based comparisons revealed several statistically significant differences in selected sensory attributes. Female participants reported higher scores than males for color and shape in the spice-enriched formulation (p<0.05), as well as for juiciness and spiced aroma. In the plain formulation, females also reported significantly higher scores for shape, consistency, juiciness, umami taste, taste balance, and overall liking (p<0.05).

No consistent gender-related differences were observed across all sensory dimensions.

Comparison based on relationship status revealed a statistically significant difference only for the fair-trade dimension. Participants who reported being in a relationship assigned higher importance to fair trade (Mean=5.68±1.37) compared to those not in a relationship (Mean=4.99±1.77), p=0.032. No statistically significant differences in sensory evaluation scores were observed between participants who reported being in a relationship and those who did not (p>0.05 for all comparisons).

A significant difference across socioeconomic groups was observed only for the price dimension ($\chi^2(2)=7.49$, p=0.024). Participants in the middle socioeconomic group had higher mean rank scores than those in the low and high socioeconomic groups. No statistically significant differences were identified for the remaining food choice motivation dimensions (p>0.05). No statistically significant differences in sensory evaluation scores were observed across socioeconomic groups, except for the spiced aroma of the plain formulation ($\chi^2(2)=8.52$, p=0.014).

Several significant correlations were observed between sensory evaluation scores and participants' perceptions of plant-based meat alternatives. Notably, taste balance of the plain formulation showed positive correlations with prior consumption experience (r=0.253, p<0.05), perceived health knowledge (r=0.276, p<0.05), environmental sustainability beliefs (r=0.254, p<0.05), taste perception (r=0.440, p<0.05), and the importance of flavor in consumption decisions (r=0.312, p<0.05).

Environmental sustainability beliefs were positively correlated with umami perception in both the spice-enriched (r=0.213, p<0.05) and plain formulations (r=0.310, p<0.05). In addition, overall liking of the plain formulation was positively associated with sustainability beliefs (r=0.204, p<0.05) and taste perception (r=0.214, p<0.05).

Although several additional correlations reached statistical significance, most effect sizes were small to moderate. Therefore, these findings should be interpreted cautiously, given the number of comparisons conducted. Detailed correlation coefficients are presented in Table 4.

Table 4
Pearson correlations between sensory attributes and perceptions of plant-based meat alternatives.

Sensory Attribute	S1	S2	S3	S4	S5
Shape (enriched)	0.211*	–	–	–	–
Shape (plain)	0.205*	–	–	0.203*	0.229*
Homogeneity (enriched)	–	–	–	–	0.300*
Homogeneity (plain)	–	–	–	–	0.305*
Spiced aroma (plain)	–	-0.190*	–	–	–
Umami (enriched)	–	–	0.213*	–	–
Umami (plain)	–	–	0.310*	–	–
Taste balance (plain)	0.253*	0.276*	0.254*	0.440*	0.312*
Overall liking (enriched)	–	0.209*	–	0.190*	–
Overall liking (plain)	–	–	0.204*	0.214*	–

S1=Prior consumption experience, S2=Health knowledge, S3=Environmental sustainability belief, S4=Taste perception, S5=Importance of flavor, p<0.05. Only statistically significant correlations are displayed.

Paired-samples t-tests were conducted to compare sensory evaluations of the spice-enriched and plain formulations (Table 5). Significant differences were observed for color (p<0.001, d=0.46), shape (p=0.016, d=0.09), homogeneity (p=0.049, d=0.09), spiced aroma (p<0.001, d=0.92), and umami taste (p=0.007, d=0.24). Among these, the largest effect was found for spiced aroma (d=0.92), indicating a substantial perceptual difference between formulations. No statistically significant differences were identified for surface texture, consistency, juiciness, plant-based odor, taste balance, or overall liking (p>0.05).

Table 5
Comparison of sensory attributes between spice-enriched and plain formulations.

Sensory Attribute	Enriched Mean±SD	Plain Mean±SD	*p*	Cohen's d
Color	3.40 ± 0.81	3.03 ± 0.80	<0.001*	0.46
Shape	3.20 ± 1.11	3.10 ± 1.13	0.016*	0.09
Surface texture	3.04 ± 0.92	2.97 ± 0.95	0.238	–
Homogeneity	3.15 ± 0.99	3.24 ± 0.99	0.049*	0.09
Consistency	3.04 ± 0.85	2.95 ± 0.92	0.086	–
Juiciness	2.87 ± 0.99	2.89 ± 0.93	0.682	–
Spiced aroma	3.51 ± 0.94	2.69 ± 0.87	<0.001*	0.92
Plant-based odor	2.57 ± 0.92	2.55 ± 0.89	0.798	–
Umami taste	3.27 ± 0.93	3.04 ± 0.99	0.007*	0.24
Taste balance	3.27 ± 0.95	3.20 ± 0.89	0.439	–
Overall liking	3.51 ± 1.03	3.44 ± 0.94	0.456	–

*p<0.05

4. Discussion

The present study examined the influence of spice

enrichment on consumer-based sensory evaluations of plant-based meat alternatives (PBMAs), while also exploring the role of sociodemographic characteristics and individual perceptions. The findings indicate that spice enrichment primarily enhanced aroma-related attributes rather than overall hedonic acceptance.

The most pronounced effect was observed for spiced aroma, which demonstrated a large effect size. This finding aligns with previous research highlighting the importance of flavor masking and aromatic enhancement strategies in improving the sensory perception of PBMAs (Michel et al., 2021). Plant-based raw materials often contain legume-related off-flavors, which may limit consumer acceptance; therefore, incorporating spices can contribute to a more balanced aroma profile. Although aroma and umami perception improved significantly, no statistically significant difference in overall liking was observed between formulations. This suggests that enhancing specific sensory attributes does not necessarily translate into higher overall hedonic evaluation. Overall liking is a multidimensional construct influenced not only by aroma and taste, but also by texture, familiarity, expectations, and cognitive attitudes towards plant-based foods. This finding may also indicate that aroma enhancement is insufficient to overcome broader sensory expectations associated with meat analogues. Consumers may evaluate PBMAs holistically, integrating texture, mouthfeel, familiarity, and cognitive expectations alongside flavor-related attributes. Consistent with earlier studies (Graca et al., 2015; Alcorta et al., 2021; Jahn et al., 2021), participants assigned the highest importance to sensory appeal in food choice motivations. This finding reinforces the idea that despite the frequently emphasized health and sustainability advantages of PBMAs, sensory satisfaction remains a primary determinant of consumer acceptance and repeat purchase behavior. Accordingly, formulation strategies should prioritize flavor balance and textural optimization, alongside sustainability-oriented messaging.

Exploratory subgroup analyses indicated that differences between academic programs may shape food perception. Students from the Nutrition and Dietetics program tended to evaluate both formulations more positively than Gastronomy students, although the specific sensory attributes showing significant differences varied by formulation. This pattern may reflect greater health awareness, greater openness to alternative proteins, or attitudinal predispositions toward sustainability concerns. In contrast, Gastronomy students may hold higher sensory expectations due to culinary training, leading to more critical evaluations. These findings highlight the potential influence of cognitive and professional orientation on sensory judgments and product positioning strategies.

Gender-based analyses indicated that female participants placed greater emphasis on health, environmental sustainability, and animal welfare motivations, consistent with previous findings suggesting that women tend to be more receptive to ethically and health-oriented food choices (Pohjolainen et al., 2016; Knaapila et al., 2022). Although selected sensory differences were observed between genders, no consistent pattern emerged across all attributes. Therefore, these results should be interpreted cautiously.

Income status and relationship status showed limited and isolated associations with food choice motivations and sensory evaluations. In particular, price sensitivity varied across socioeconomic groups, consistent with research indicating that cost considerations can influence the adoption of alternative proteins among certain consumer segments. However, given the relatively small sizes of some subgroups and the number of statistical comparisons, these findings should be interpreted with caution. The largely non-significant findings across most SIFCQ dimensions suggest that food choice motivations showed relatively limited variations across participant subgroups, although selected differences related to convenience, health orientation, sustainability, and price sensitivity were observed.

Correlation analyses revealed small to moderate associations between selected sensory attributes and participants' perceptions of PBMAs. Notably taste balance of the plain formulation demonstrated moderate correlations with taste perception and sustainability beliefs, suggesting that cognitive evaluations may shape sensory judgments. This aligns with literature emphasizing the role of expectations and attitudes in influencing food perception and acceptance (Hoek et al., 2011; Caputo et al., 2023; Sogari et al., 2023). Although several significant correlations were identified, most effect sizes were small to moderate in magnitude and should be interpreted cautiously.

Several limitations should be acknowledged. The study was conducted under consumer testing conditions rather than in a laboratory-based descriptive sensory analysis, and full blinding was not used. In addition, instrumental texture analyses were not performed, limiting the objective evaluation of structural product properties. The sample consisted of university students from a single institution, which may limit generalizability. Additionally, participants' prior familiarity with plant-based products may have influenced sensory evaluations and acceptance patterns. Finally, because multiple statistical comparisons were performed, the possibility of Type I error should be considered when interpreting isolated statistically significant findings.

Despite these limitations, the results have practical implications for PBMA formulation. Spice enrichment appears to be an effective strategy for improving aroma perception and certain flavor-related attributes; however, enhancing overall liking may require broader optimization of texture and structural properties. Therefore, future formulation efforts should integrate flavor enhancement with textural refinement to achieve greater consumer acceptance. Recent formulation-focused reviews also emphasize that ingredient innovation and processing advances can improve sensorial quality, but acceptance gaps remain a major barrier (Chen et al., 2025; Munialo et al., 2025; Navarre et al., 2025).

5. Conclusion

This study demonstrates that spice enrichment can substantially improve aroma perception and selected flavor-related attributes in plant-based meat alternatives during consumer testing. However, enhancements in specific sensory dimensions did not translate into significant improvements in overall liking, highlighting the multidimensional nature of hedonic acceptance. Educational background and individual attitudes were found to influence sensory evaluations, suggesting that cognitive and contextual factors influence product perception.

Although several associations were identified between sensory attributes and perception variables, most were small to moderate in magnitude. Overall, these findings indicate that successful formulation strategies for plant-based meat alternatives should integrate aroma optimization with improvements in textural and structural properties to achieve

broader consumer acceptance.

Conflict of interest: The authors declare that they have no conflict of interests.

Informed consent: The authors declare that informed consent forms were collected from all participants. Ethical approval was obtained from the Bahcesehir University Ethics Committee on 25 December 2024 (2024-06/01).

References

Alcorta, A., Porta, A., Tarrega, A., Alvarez, M. D., & Vaquero, M. P. (2021). Foods for plant-based diets: Challenges and innovations. *Foods, 10*(2), 293.

Boukid, F. (2021). Plant-based meat analogues: from niche to mainstream. *European Food Research and Technology*, *247*(2), 297-308.

Broad, G. M., & Ruby, M. B. (2026). Consumer perceptions of plant-based meat innovation: A focus group study on food technology. *Frontiers in Sustainable Food Systems, 10*, 1800499.

Caputo, V., Sogari, G., & Van Loo, E. J. (2023). Do plant-based and blend meat alternatives taste like meat? A combined sensory and choice experiment study. *Applied Economic Perspectives and Policy*, *45*(1), 86-105.

Chen, L., Lin, X., & Xia, Y. (2025). Plant-based meat alternatives: Advancements in ingredients, processing, consumer perception, and future directions. *Journal of Future Foods*.

Fiorentini, M., Kinchla, A. J., & Nolden, A. A. (2020). Role of sensory evaluation in consumer acceptance of plant-based meat analogs and meat extenders: A scoping review. *Foods*, *9*(9), 1334.

Flint, M., Leroy, F., Bowles, S., Lynn, A., & Paxman, J. R. (2025). 'Meating' consumer expectations: More work required to improve acceptability of plant-based meat alternative products. *International Journal of Gastronomy and Food Science, 39*, 101102.

Godschalk-Broers, L., Sala, G., & Scholten, E. (2022). Meat analogues: Relating structure to texture and sensory perception. *Foods*, *11*(15), 2227.

Graca, J., Oliveira, A., & Calheiros, M. M. (2015). Meat, beyond the plate. Data-driven hypotheses for understanding consumer willingness to adopt a more plant-based diet. *Appetite*, *90*, 80-90.

Haydaroglu, M., Dikmen, D., & Bilgic, P. (2024). Adaptation and validation of the Turkish version of a Single-item Food Choice Questionnaire. *Hacettepe University Faculty of Health Sciences Journal*, *11*(1), 232-246.

Hoek, A. C., Luning, P. A., Weijzen, P., Engels, W., Kok, F. J., & De Graaf, C. (2011). Replacement of meat by meat substitutes. A survey on person-and product-related factors in consumer acceptance. *Appetite*, *56*(3), 662-673.

Inguscio, B. M. S., Carcaterra, G., Cherubino, P., Rossi, D., Madini, G., Fraccascia, L., ... & Cartocci, G. (2025). Neuroscience meets food choice: Implicit and explicit consumer responses to plant-based vs animal-based foods. *Current Research in Food Science,* 101288.

Jahn, S., Furchheim, P., & Strassner, A. M. (2021). Plant-based meat alternatives: Motivational adoption barriers and solutions. *Sustainability*, *13*(23), 13271.

Knaapila, A., Michel, F., Jouppila, K., Sontag-Strohm, T., & Piironen, V. (2022). Millennials' consumption of and attitudes toward meat and plant-based meat alternatives by consumer segment in Finland. *Foods*, *11*(3), 456.

Kumar, P., Chatli, M. K., Mehta, N., Singh, P., Malav, O. P., & Verma, A. K. (2017). Meat analogues: Health promising sustainable meat substitutes. *Critical Reviews in Food Science and Nutrition*, *57*(5), 923-932.

Michel, F., Hartmann, C., & Siegrist, M. (2021). Consumers' associations, perceptions and acceptance of meat and plant-based meat alternatives. *Food Quality and Preference*, *87*, 104063.

Munialo, C. D., Baeghbali, V., & Acharya, P. (2025). Plant-based alternatives to meat products. *Foods*, *14*(8), 1396.

Navarre, A., Musto, L., & Nazareth, T. (2025). Beyond meat substitution: A multifaceted review of plant-based and alternative proteins, from environmental impact to analytical technologies. *Foods*, *14*(13), 2312.

Onwezen, M. C., Reinders, M. J., Verain, M. C. D., & Snoek, H. M. (2019). The development of a single-item Food Choice Questionnaire. *Food Quality and Preference*, *71*, 34-45.

Petrescu, D. C., Petrescu-Mag, R. M., Aras, M., Bota, M., & Sut, A. (2025). Perceived environmental impact of meat alternatives: Effects of a sustainability label and product type. *Current Research in Food Science*, 101254.

Pohjolainen, P., Tapio, P., Vinnari, M., Jokinen, P., & Rasanen, P. (2016). Consumer consciousness on meat and the environment-Exploring differences. *Appetite*, *101*, 37-45.

Pointke, M., Albrecht, E. H., Geburt, K., Gerken, M., Traulsen, I., & Pawelzik, E. (2022). A comparative analysis of plant-based milk alternatives part 1: composition, sensory, and nutritional value. *Sustainability*, *14*(13), 7996.

Richi, E. B., Baumer, B., Conrad, B., Darioli, R., Schmid, A., & Keller, U. (2016). Health risks associated with meat consumption: a review of epidemiological studies. *International Journal for Vitamin and Nutrition Research*.

Sogari, G., Caputo, V., Petterson, A. J., Mora, C., & Boukid, F. (2023). A sensory study on consumer valuation for plant-based meat alternatives: What is liked and disliked the most?. *Food Research International*, *169*, 112813.

Tuorila, H., & Hartmann, C. (2020). Consumer responses to novel and unfamiliar foods. *Current Opinion in Food Science*, *33*, 1-8.

Varghese, C., Sosa, C., Maique, J., Curutchet, A., & Arcia, P. (2026). Beyond taste: unpacking consumer perceptions of plant-based cheese alternatives in uruguay through sensory, ınformation, and expectation analysis. *Plant Foods for Human Nutrition*, *81*(2), 55.

Cite as: Okcu, A., & Ozturk Altuncevahir, I. (2026). Influence of spice enrichment on consumer acceptance of plant-based meat alternatives. *Front Life Sci RT*, *7*(1), 58-63.