

University Students' Decision-Making Model in Consuming Alternative-Protein Meatballs: A Gender Perspective

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Abstract. Healthy and sustainable diets play a crucial role in addressing global challenges, including climate change, food security, and public health. This study focuses on plant-based meatballs, analyzing their appeal as an environmentally friendly, resource-efficient, and healthy alternative protein source. Conducted among undergraduate students at Brawijaya University, the study examines the impact of innovation adoption characteristics on consumption intentions, with environmental concerns serving as a moderating factor. Utilizing an online survey distributed to 385 respondents, data were collected over two weeks in October 2024. Results reveal that plant-based meatballs received the highest average scores in compatibility (Attractiveness: 3.94, Safety: 3.81) and relative advantages (Environmentally Friendly: 3.84, Food Security: 3.28), as well as in consumption intention for Health Interest (3.88). Statistical analyses confirmed strong convergent validity, reliability, and predictive performance, with meatballs showing significant influence on consumption intention ($f^2 = 0.839$). This research highlights the strategic role of students as agents of change in promoting sustainable diets, providing actionable insights for developing marketing strategies and policies to support the adoption of plant-based alternatives. Emphasizing the environmental and health benefits of plant-based meatballs could drive their wider adoption and contribute to a more sustainable food system in Indonesia.

Keywords: consumption intention; environmental concerns; innovation adoption; plant-based meatball

INTRODUCTION

A healthy and sustainable diet is crucial in addressing global challenges, including climate change, food security, and public health. However, current dietary patterns dominated by excessive meat consumption contribute significantly to environmental degradation and health issues. Meat production requires extensive land, water, and resources, leading to deforestation, biodiversity loss, and high greenhouse gas emissions ([Röös et al., 2017](#); [Pimentel et al., 2020](#)). Plant-based proteins, derived from legumes, nuts, seeds, and vegetables, offer a sustainable alternative ([Ashar et al., 2024](#)). They require fewer resources and produce lower emissions compared to animal-based proteins, making them a viable solution to mitigate environmental and health impacts ([Poore & Nemecek, 2018](#)). Studies also highlight the health-related advantages of plant-based proteins, including reduced

perceived risks of heart disease, type 2 diabetes, and cancer ([Miller et al., 2022](#)).

As future leaders, university students play a crucial role in driving the adoption of sustainable diets. Their openness to innovation, combined with increased environmental and health awareness, makes them an ideal demographic for studying the adoption of alternative protein consumption. However, limited research exists on how IAC, such as perceived compatibility, relative advantage, and triability, affects consumer intentions to consume plant-based protein products in Indonesia. This study aims to bridge this gap by analyzing the relationship between IAC and the consumption intentions of university students toward plant-based protein products, including meatballs ([Amin & Prihantini, 2023](#)). It also examines the moderating role of environmental concerns and socio-demographic factors, offering insights into effective strategies for promoting the adoption of alternative proteins in Indonesia.



METHODS

This research employed a quantitative approach. This approach helps analyze a population demographically through measurements such as rankings, providing evidence for variables (Allen et al., 2014). Quantitative methods utilize statistics and mathematics, as highlighted by Walter & Andersen (2016). In the current study, numerical data were derived from questionnaires to describe variables. Quantitative research was employed to investigate the adoption of protein alternatives among students, as depicted in the previous path diagram. The research was conducted at Universitas Brawijaya using a purposive sampling method, which aligns with (Deviani et al., 2019). This location was selected due to its diverse student population, representing various backgrounds and regions, making it easier to gather representative data. The focus was on alternative protein innovations such as vegetable meatballs. The study was conducted in October 2024 over a one-month

period to identify indicators underlying the adoption of these innovations.

The sampling process started with a defined target population, described as a group residing in a specific place that allows for generalizations (Taherdoost, 2018). The population in this study consisted of Universitas Brawijaya students who were expected to adopt alternative protein innovations, such as plant-based meatballs (Winpenny et al., 2018; Pusparini & Wardana, 2023). Based on Uma Sekaran's sampling, a total population of 62,415 undergraduate students and 1,426 applied bachelor students can be represented with a sample size of 382 respondents (Sekaran & Bougie, 2016). The sample was collected through an online survey distributed via the official student email system, all@student.ub.ac.id, ensuring accessibility to the active student population. Online surveys were chosen for their efficiency, flexibility, and ability to increase respondent participation (Lavidas et al., 2022). This method adheres to good survey practices by ensuring equal access across the target population.

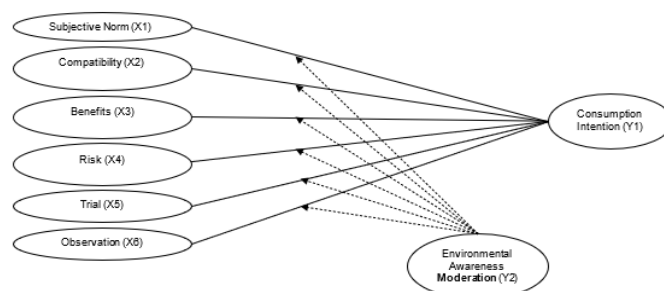


Figure 1. Inner Model of Innovation Adoption Characteristics (IAC)

Data was collected using an online questionnaire distributed via the official student email system to ensure accessibility and validity, following Taherdoost et al., (2016). The questionnaire, designed using Google Forms, contained items measuring subjective norms, perceived relative advantage, compatibility, trialability, and observability for four types of plant-based protein alternatives, including meatballs. A total of 72 indicators were developed, with 18 indicators assigned to each type of protein

alternative, adapted from consumer behaviour studies (Wang & Scrimgeour, 2023). This research employed an experimental design to assess the impact of independent variables on dependent variables and to gather perceptions of preferences for protein alternatives. Data was collected through closed-ended questions to ensure systematic and measurable results.

The measurement model was evaluated for validity and reliability using factor loading, Cronbach's Alpha, and Average

Variance Extracted (AVE). The structural model tested causal relationships between latent variables, hypothesis testing, and the moderating effect of environmental awareness. Trust was assessed as a mediator variable between Innovation Adoption Characteristics (IAC) and consumption intention. Descriptive analysis summarized respondent data, identifying patterns in the intention to consume plant-based meatballs. Data was segmented by gender to highlight preferences among different demographic categories.

The inner model in this study, as described in [Figure 1](#), illustrates the structural relationships between latent variables. The independent variables (X) include subjective norm, compatibility, benefits, risk, trialability, and observation, which represent various factors that influence consumption intention (Y₁). Environmental awareness acts as a moderating variable, indicating that the level of environmental awareness can strengthen or weaken the relationship between variable X and Y₁. Conversion of a path diagram to a system of equations. explanation of the inner model equation and outer model equation ([Solimun 2017](#)), as shown in inner model equation (Equation 1).

$$\eta_1 = \beta_1 \eta_1 \dots \dots \dots (1)$$

Description:

- η_1 = Student consumption intention
- γ = The coefficient of influence of exogenous variables on endogenous variables
- ξ_1 = Subjective norm variable
- ξ_2 = Compatibility variable
- ξ_3 = Variable relative advantages
- ξ_4 = Perceive risk variable
- ξ_5 = Trial variable
- ξ_6 = Observation variable

The outer model in SEM-PLS ensures the validity and reliability of measurement indicators. Key evaluations include convergent validity, indicators must have loading factors ≥ 0.5 (ideally ≥ 0.7), and AVE ≥ 0.50 to confirm that the construct explains more than half the variance of its indicators. Discriminant validity ensures that each indicator has higher correlations with its

associated construct than with any other construct. Internal consistency reliability is achieved if Composite Reliability (CR) ≥ 0.70 and Cronbach's Alpha is within 0.60–0.90, ensuring consistency without redundancy. The inner model examines causal relationships between variables, including the mediating effect of trust and the moderating effect of environmental awareness on consumption intention for plant-based protein alternatives. The following is a research hypothesis:

1. H₁: Student decisions have a positive and significant effect on the intention to consume plant-based *meatballs*.
H₀: $\gamma_1 = 0$ (student decisions do not have a positive and significant effect on the intention to consume plant-based *meatballs*).
H₁: $\gamma_1 \neq 0$ (student decisions have a positive and significant effect on the intention to consume plant-based *meatballs*).
2. H₁: Student decisions have a positive and significant effect on the intention to consume plant-based *meatballs* moderated by environmental awareness variables.
H₀: $\gamma_1 = 0$ (student's decision does not have a positive and significant effect on the intention to consume plant-based *meatballs* moderated by environmental awareness variables).
H₁: $\gamma_1 \neq 0$ (student decisions have a positive and significant effect on the intention to consume plant-based *meatballs* moderated by environmental awareness variables)

After hypothesis testing, the results obtained will provide more understanding of the relationship between student decisions on the intention to consume protein alternatives moderated by environmental concerns ([Wasono et al., 2024](#)).

RESULTS AND DISCUSSION

This study involved 385 active students from Universitas Brawijaya (Academic Year 2024/2025) who met the respondent criteria.



Figure 2. Beyond Meat Product
Sources: <https://pin.it/34bGIKkDV>

Among them, 353 respondents reported having tried alternative protein as a food source, while 32 respondents expressed no interest in trying alternative protein. Data collection was conducted through an online questionnaire distributed via email using Google Forms. Before entering the results and discussion, [Figure 2](#) is an example of

alternative protein, especially plant-based meat.

1. Respondent's Characteristics

The respondents' characteristics, including gender, were analyzed to provide a representative picture of students' preferences and potential interest in alternative protein sources. The research was carried out over two weeks in October 2024.

Based on the data in [Table 1](#), 58.9% of respondents were female (227 students) and 41.1% were male (158 students). This aligns with [Gilbert \(2015\)](#), who attributes the higher number of female respondents to the increasing enrollment of females in Indonesian universities and their tendency to actively participate in academic activities and online surveys.

Table 1. Composition of Respondents Based on Gender

Gender	Number (Person)	Percentage (%)
Male	158	41.1
Female	227	58.9
Total	385	100

Source: Primary Data Processed (2024)

Table 2. Interpretation of Mean Value

Average Value	Criteria
1 - 1.8	Very Low
1.8 > - 2.6	Low
2.6 > - 3.4	Medium
3.4 > - 4.2	High
4.2 >	Very High

Source: [Solimun, \(2017\)](#)

2. Descriptive Statistical Analysis

Statistical analysis is conducted to provide an overview of the characteristics of data obtained from respondents, focusing on understanding the distribution of answers and the average value of each research indicator and variable.

Based on [Solimun, \(2017\)](#) interpretation guide in [Table 2](#), the average value helps assess the tendency of respondents' answers and evaluates the level of response inclination toward specific indicators or variables. Descriptive statistics, such as minimum, maximum, mean, and standard deviation, are

presented to facilitate observation and enhance the analysis process, offering insights into the patterns and tendencies of the collected data.

A. Statistical Analysis of Subjective Norm Variables

This section assesses respondents' perceptions of subjective norms, which reflect the influence of social pressures or expectations on their decision to consume alternative proteins. Statistical analysis involves calculating descriptive metrics, such as the mean, standard deviation, and frequency, to understand the tendency and variability of responses related to subjective

norms. These insights reveal the extent to which peer, family, or societal expectations

shape consumption intentions in the context of plant-based protein alternatives.

Table 3. Statistical Analysis of Plant-based Meatball Subjective Norm Variables

	Variables	Min.	Max.	Mean	Std. Deviation
X ₁	Subjective Norm				
X _{1.1}	Family role	1	5	3.18	1.23
X _{1.2}	Family encouragement	1	5	2.83	1.20
X _{1.3}	The role of friends	1	5	3.17	1.19
X _{1.4}	Friend encouragement	1	5	2.80	1.23

Source: Primary Data Processed (2024)

Table 4. Statistical Analysis of Plant-based Meatball Compatibility Variables

	Variables	Min.	Max.	Mean	Std. Deviation
X ₂	Compatibility				
X _{2.1}	Interest	1	5	3.94	0.93
X _{2.2}	Suitability	1	5	3.17	1.18
X _{2.3}	Security	1	5	3.81	0.96

Source: Primary Data Processed (2024)

The analysis of the subjective norm variable for plant-based meatballs, as shown in Table 3, falls in the good category. The highest mean (3.18) is attributed to family role (X_{1.1}), while the lowest (2.80) comes from friend encouragement (X_{1.4}). This highlights that family plays a stronger role in shaping attitudes and behaviors toward alternative protein consumption, serving as a key source of support (Pratama et al., 2022). However, friends also contribute, albeit to a lesser extent, in influencing consumption decisions (Chen et al., 2024; Niinimäki et al., 2020; Ravikumar et al., 2022).

B. Statistical Analysis of Compatibility Variables

Statistical analysis of compatibility variables involves examining the relationships and interactions between different variables to determine how well they align or influence each other. This analysis is crucial in identifying patterns, correlations, or discrepancies that can impact the outcomes of a study or model.

The analysis of the mean and standard deviation for the compatibility variable on plant-based meatballs, as shown in Table 4, falls in the good category. The highest average value is 3.94 for X_{2.1}, indicating a strong interest in plant-based meatballs due to

factors such as innovation, taste, or health-related advantages (Audina & Pradana, 2024; Hadini et al., 2017). However, lower suitability scores suggest that not all respondents find the product fully aligned with their preferences or consumption habits, possibly due to a lack of integration with traditional flavors or limited accessibility (Andriyanty & Wahab, 2019).

C. Statistical Analysis of Relative Advantage Variables

Statistical analysis of relative advantage variables examines how the perceived relative advantages of a product or service influence consumer preferences and decisions. This analysis helps identify the key advantages that make a product more appealing compared to alternatives.

The analysis of plant-based meatballs shows in Table 5 that most variables fall in the good category. The highest average value, 3.84, is for the X_{3.1} (environmentally friendly) indicator, reflecting a strong belief in the product's contribution to sustainability. However, the lowest score of 3.28 is for X_{3.2} (food security), suggesting some respondents are unsure about the role of plant-based meatballs in addressing food supply instability (Blanco et al., 2020). Limited knowledge about their long-term impact or

food security relative advantages may explain this lower score.

D. Statistical Analysis of Perceived Risk Variables

Statistical analysis of perceived risk variables assesses the potential concerns or uncertainties that consumers associate with a product, enabling the identification of factors that may hinder its acceptance or adoption. This analysis is crucial for understanding barriers to consumer decision-making.

The perceived risk analysis of plant-based meatballs shows in [Table 6](#) that sensory

attributes have the highest average score of 3.41, indicating that taste, texture, shape, and appearance meet consumer expectations, highlighting the importance of sensory quality in alternative protein acceptance ([Miao et al., 2023](#)). However, the availability aspect received the lowest score of 2.96, with some studies suggesting that scarcity may enhance product appeal by creating exclusivity ([Bryant & Barnett, 2018](#)). This issue needs to be addressed to boost alternative protein consumption ([Springmann et al., 2018](#))

Table 5. Statistical Analysis of Plant-based Meatball Relative Advantage Variables

	Variables	Min.	Max.	Mean	Std. Deviation
X ₃	Relative advantages				
X _{3.1}	Environmentally friendly	1	5	3.84	1.00
X _{3.2}	Food security	1	5	3.28	1.07
X _{3.3}	Care	1	5	3.52	1.12

Source: Primary Data Processed (2024)

Table 6. Statistical Analysis of Plant-based Meatball Perceived Risk Variables

	Variables	Min.	Max.	Mean	Std. Deviation
X ₄	Perceive risk				
X _{4.1}	Availability	1	5	2.96	1.17
X _{4.2}	Nutrient content	1	5	3.22	0.99
X _{4.3}	Sensory attributes	1	5	3.41	0.99

Source: Primary Data Processed (2024)

Table 7. Statistical Analysis of Plant-based Meatball Trialability Variables

	Variables	Min.	Max.	Mean	Std. Deviation
X ₅	Test Run				
X _{5.1}	Willingness to try	1	5	4.01	0.91
X _{5.2}	Try before you consume	1	5	4.07	0.90
X _{5.3}	Receive information	1	5	3.74	0.94

Source: Primary Data Processed (2024)

Table 8. Statistical Analysis of Plant-based Meatball Observation Variables

	Variables	Min.	Max.	Mean	Std. Deviation
X ₆	Observation				
X _{6.1}	Consumption confidence	1	5	3.79	0.92
X _{6.2}	Product description	1	5	3.29	1.09

Source: Primary Data Processed (2024)

E. Statistical Analysis of Trialability Variables

Statistical analysis of trial variables examines how consumers' willingness to

experiment with a product influences their acceptance and potential adoption. This analysis helps identify key factors that encourage or discourage trying new products.

The analysis of trialability variables on plant-based meatballs, as shown in Table 7, reveals that the highest average value, 4.07, corresponds to indicator X_{5.2} (try before consuming), indicating that consumers prefer to taste the product before deciding on regular consumption (Herawati et al., 2024). This reflects the importance of direct experience in building confidence, as noted by Gerbens-Leenes et al. (2014). The lowest mean score, 3.74, is for indicator X_{5.3} (receiving information), suggesting that consumers value personal experience more than receiving additional information, aligning with Carvalho et al. (2022), who emphasized the need for more information to boost product consumption.

F. Statistical Analysis of Observation Variables

Statistical analysis of observation variables examines how consumers' observations and perceptions of a product influence their attitudes and behavior. This analysis helps identify visual or experiential cues that impact product acceptance and decision-making.

In Table 8, for plant-based meatballs, indicator X_{6.1} (consumption confidence) has the highest value of 3.79, showing that consumers feel confident in consuming the product. This reflects successful confidence-building, which is crucial for adoption (Blanco et al., 2020). In contrast, X_{6.2} (product explanation) has the lowest mean value of 3.29, indicating that consumers are unsure how to explain the product to others. This may be due to a lack of clear information, aligning with Desiderio et al. (2024), who emphasized the need for effective communication to boost consumer understanding and acceptance.

G. Statistical Analysis of Student Environmental Awareness Variables

Statistical analysis of student environmental concern variables evaluates students' awareness, attitudes, and understanding of environmental issues. This analysis identifies key factors influencing their support for sustainable practices, particularly in adopting environmentally friendly products, such as alternative proteins.

Table 9. Statistical Analysis of Student Environmental Awareness Variables for Plant-based Meatballs

	Variables	Min.	Max.	Mean	Std. Deviation
Y ₂	Environmental Awareness				
Y _{2.1}	Environmental impact awareness	1	5	3.77	0.97
Y _{2.2}	Environmental understanding	1	5	3.80	0.93
Y _{2.3}	Environmental impact considerations	1	5	3.66	0.97
Y _{2.4}	Reduce meat consumption	1	5	3.37	1.09
Y _{2.5}	Diet	1	5	3.38	1.16
Y _{2.6}	Farm animals	1	5	2.86	1.17

Source: Primary Data Processed (2024)

Table 10. Statistical Analysis of Student Consumption Intention Variables on Plant-based Meatballs

	Variables	Min.	Max.	Mean	Std. Deviation
Y ₁	Consumption Intention				
Y _{1.1}	Consume protein alternatives	1	5	3.63	1.07
Y _{1.2}	Interest in the environment	1	5	3.75	0.99
Y _{1.3}	Interest in health	1	5	3.88	0.95

Source: Primary Data Processed (2024)

In Table 9, the environmental concern variable for plant-based meatballs indicates Y

2.2 (environmental understanding), with the highest score of 3.80, reflecting a strong

awareness of the environmental advantages of alternative proteins (Langyan et al., 2022). Meanwhile, Y_{2.6} (farm animals) recorded the lowest score of 2.86, indicating a limited understanding of the environmental impact of livestock. This highlights the need for better education on issues like greenhouse gas emissions and resource overuse linked to animal protein consumption (de Oliveira et al., 2022).

H. Statistical Analysis of Consumption Intention Variables

Statistical analysis of consumption intention variables examines the factors influencing consumers' willingness and

motivation to purchase and consume a product. This analysis helps identify the drivers and barriers to adopting alternative proteins or other innovative products.

In Table 10, the consumption intention variable for plant-based meatballs shows indicator Y1.3 (interest in health) with the highest score of 3.88, highlighting health relative advantages as a key driver for consumption intention. In contrast, Y1.1 (alternative protein consumption) scored the lowest at 3.63, indicating moderate interest in trying alternative proteins, possibly influenced by habits or limited availability. Enhancing health awareness and product accessibility could boost consumption intention further.

Table 11. Output Combined Loadings and Cross-Loadings of Plant-based Meatballs

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	Y ₁	Y ₂	P-values
X _{1.1}	(0.639)	-0.008	0.042	-0.107	0.062	-0.043	0.060	-0.017	<0.001
X _{1.2}	(0.623)	0.026	-0.066	0.229	-0.002	0.061	-0.077	-0.023	<0.001
X _{1.3}	(0.643)	0.023	0.013	-0.218	0.138	-0.045	-0.048	0.066	<0.001
X _{1.4}	(0.637)	-0.034	0.006	0.098	-0.181	0.028	0.053	-0.023	<0.001
X _{2.1}	-0.073	(0.592)	0.029	-0.043	0.111	-0.083	0.142	-0.041	<0.001
X _{2.2}	0.192	(0.537)	-0.134	0.011	-0.143	-0.088	0.010	0.129	<0.001
X _{2.3}	-0.131	(0.531)	0.121	0.042	0.025	0.208	-0.192	-0.099	<0.001
X _{3.1}	0.021	0.053	(0.499)	-0.147	0.211	0.162	0.020	-0.045	<0.001
X _{3.2}	-0.011	0.023	(0.649)	0.056	-0.239	-0.007	-0.034	-0.129	<0.001
X _{3.3}	-0.002	-0.074	(0.529)	0.042	0.154	-0.121	0.029	0.212	<0.001
X _{4.1}	0.084	0.008	-0.061	(0.651)	-0.108	0.064	-0.157	-0.028	<0.001
X _{4.2}	0.000	0.000	0.107	(0.571)	-0.025	-0.194	0.083	0.015	<0.001
X _{4.3}	-0.076	-0.006	-0.054	(0.533)	0.123	0.141	0.057	0.010	<0.001
X _{5.1}	0.056	0.106	-0.108	-0.052	(0.568)	0.261	-0.088	0.001	<0.001
X _{5.2}	-0.129	0.037	0.126	-0.150	(0.600)	-0.252	0.134	0.019	<0.001
X _{5.3}	0.068	-0.132	-0.017	0.186	(0.520)	-0.008	-0.043	-0.019	<0.001
X _{6.1}	-0.116	0.191	-0.037	0.036	0.192	(0.521)	-0.034	-0.033	<0.001
X _{6.2}	0.095	-0.156	0.030	-0.029	-0.157	(0.561)	0.028	0.027	<0.001
Y _{1.1}	0.014	0.171	-0.147	0.156	-0.029	0.041	(0.494)	0.001	<0.001
Y _{1.2}	0.021	-0.071	0.054	-0.062	-0.051	-0.055	(0.523)	0.000	<0.001
Y _{1.3}	-0.038	-0.069	0.068	-0.066	0.088	0.029	(0.503)	0.000	<0.001
Y _{2.1}	0.010	-0.041	0.351	-0.052	0.083	0.339	-0.063	(0.468)	<0.001
Y _{2.2}	-0.025	-0.014	0.110	-0.084	0.272	0.087	0.038	(0.478)	<0.001
Y _{2.3}	0.083	0.031	0.086	-0.185	-0.071	0.001	0.571	(0.485)	<0.001
Y _{2.4}	-0.068	0.037	-0.126	0.035	-0.013	-0.135	-0.079	(0.609)	<0.001
Y _{2.5}	0.009	-0.090	-0.135	0.107	-0.024	-0.033	-0.068	(0.590)	<0.001
Y _{2.6}	0.024	0.073	-0.084	0.053	-0.162	-0.107	-0.170	(0.655)	<0.001

Source: Primary Data Processed (2024)

3. SEM-PLS Measurement and Structural Model Analysis

This study employed the SEM-PLS method, utilizing WarpPLS software, to examine the relationships between variables

in the research model. This method enables the simultaneous testing of direct, indirect, and moderating effects (Hair et al., 2024). Consumption intention, as the dependent variable, is influenced by consumer behavior, with environmental concern as a moderating factor to assess its role in sustainability-related decisions. Here is the following outer model (measurement model evaluation). The outer model evaluates the validity and reliability of indicators through tests for convergent validity, discriminant validity, and reliability using loading factors, AVE, and composite reliability (Hair et al., 2024).

A. Convergent Validity

Convergent validity ensures that indicators measuring the same construct are strongly correlated. According to Solimun (2017), factor loadings ≥ 0.30 are acceptable. Table 11 confirms that all loadings for plant-

based meatballs exceed this threshold, validating the indicators for their respective constructs.

B. Discriminant Validity

Discriminant validity ensures that each construct is distinct and does not overlap with other constructs. Solimun (2017) states that this validity can be evaluated at two levels, the indicator level and the construct level. The indicator level, validity is achieved when the indicator's loading on its latent variable is greater than its cross-loading on other indicators. As shown in Table 12, all indicators of plant-based meatballs have higher loadings on their respective constructs, confirming that each indicator represents its own construct more strongly. Therefore, discriminant validity at the indicator level is fulfilled.

Table 12. Output Combined Loadings and Cross-Loadings of Plant-based Meatballs

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X _{6.1}	-0.116	0.191	-0.037	0.036	0.192	(0.521)	-0.034	-0.033	<0.001
X _{6.2}	0.095	-0.156	0.030	-0.029	-0.157	(0.561)	0.028	0.027	<0.001
Y _{1.1}	0.014	0.171	-0.147	0.156	-0.029	0.041	(0.494)	0.001	<0.001
Y _{1.2}	0.021	-0.071	0.054	-0.062	-0.051	-0.055	(0.523)	0.000	<0.001
Y _{1.3}	-0.038	-0.069	0.068	-0.066	0.088	0.029	(0.503)	0.000	<0.001
Y _{2.1}	0.010	-0.041	0.351	-0.052	0.083	0.339	-0.063	(0.468)	<0.001
Y _{2.2}	-0.025	-0.014	0.110	-0.084	0.272	0.087	0.038	(0.478)	<0.001
Y _{2.3}	0.083	0.031	0.086	-0.185	-0.071	0.001	0.571	(0.485)	<0.001
Y _{2.4}	-0.068	0.037	-0.126	0.035	-0.013	-0.135	-0.079	(0.609)	<0.001
Y _{2.5}	0.009	-0.090	-0.135	0.107	-0.024	-0.033	-0.068	(0.590)	<0.001
Y _{2.6}	0.024	0.073	-0.084	0.053	-0.162	-0.107	-0.170	(0.655)	<0.001

Source: Primary Data Processed (2024)

The correlation value of latent variables with the square roots of AVEs, at the construct level, discriminant validity is tested by comparing the square root of the Average Variance Extracted (AVE) with the correlation between the latent variables. If the square root of the AVE is higher than its correlation with other constructs,

discriminant validity is considered met. This ensures each construct explains more variance in its own indicators than in relationships with other constructs. [Table 13](#) shows that the AVE value for the plant-based meatball construct is greater than its correlation with other constructs, confirming that discriminant validity has been met.

Table 13. Value of Correlations Latent Variables with Square Roots of AVEs Plant-based Meatball

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	Y ₁	Y ₂
X ₁	(0.835)	0.516	0.442	0.503	0.393	0.382	0.445	0.466
X ₂	0.516	(0.774)	0.482	0.526	0.549	0.593	0.646	0.524
X ₃	0.442	0.482	(0.812)	0.484	0.499	0.518	0.575	0.695
X ₄	0.503	0.526	0.484	(0.812)	0.448	0.607	0.536	0.520
X ₅	0.393	0.549	0.499	0.448	(0.796)	0.594	0.621	0.461
X ₆	0.382	0.593	0.518	0.607	0.594	(0.865)	0.656	0.527
Y ₁	0.445	0.646	0.575	0.536	0.621	0.656	(0.909)	0.660
Y ₂	0.466	0.524	0.695	0.520	0.461	0.527	0.660	(0.815)

Source: Primary Data Processed (2024)

Table 14. Composite Reliability and Alpha Cronbach Value of Plant-based Meatballs

Variables	Composite Reliability coefficients	Cronbach's Alpha coefficients
Value Standard	≥ 0,70	> 0,6
X ₁	0.902	0.856
X ₂	0.817	0.663
X ₃	0.853	0.740
X ₄	0.852	0.740
X ₅	0.838	0.709
X ₆	0.857	0.665
Y ₁	0.935	0.895
Y ₂	0.922	0.899

Source: Primary Data Processed (2024)

C. Reliability

The reliability test measures the suitability of the questionnaire using Composite Reliability (CR) and Cronbach's Alpha (α). A model meets reliability standards if $CR \geq 0.70$ and $\alpha > 0.60$, reflecting the internal consistency of the items. [Table 14](#) shows that the composite reliability and Cronbach's alpha for all plant-based meatball variables meet these criteria, confirming that the questionnaire is reliable and consistent in measuring the constructs.

4. Inner Model (Measurement Model Evaluation)

The evaluation of the Structural Model (Inner Model) assesses the relationships

between latent variables in accordance with the study's assumptions and theories. It utilizes indicators such as R-squared, Q-squared, Effect Size (f^2), and goodness-of-fit model (GoF) to evaluate how well the model explains the relationships and fits the data. This step ensures the model provides valid and accurate results.

A. R-Squared (Coefficient of Determination) and Q-Squared

R-squared indicates the proportion of variance in the dependent variable explained by the independent variables. A higher R-Squared value reflects a better model fit. In this study, the R-squared value for consumption intention (Y1) is 0.685, which is

classified as strong. This means 68.5% of the variability in consumption intention is explained by the model, while the remaining 31.5% is influenced by other factors not included in the analysis. Q-Squared assesses the predictive validity or relevance between exogenous (independent) and endogenous (dependent) variables. A positive Q-Squared value (>0) indicates that the model has good predictive relevance. This measure is crucial to evaluate how well the exogenous variables contribute to predicting the endogenous variable. In Table 15, the Q-Squared value for consumption intention (Y_1) is 0.618, which exceeds the threshold for prediction relevance. This indicates that the model possesses significant predictive power, demonstrating that the exogenous variables make a meaningful contribution to explaining the endogenous variable.

B. Effect Size (f^2)

Effect size (f^2) measures in Table 16 the magnitude of the influence of exogenous (independent) variables on endogenous (dependent) variables. The f^2 value is categorized as follows: > 0.02 (small), > 0.15 (medium), and > 0.35 (large). This helps assess how much the exogenous variables contribute to explaining the variability in the endogenous variables. Table 16 shows the largest effect size of 0.839 (large) for the relationship between consumption intention (Y_1) and environmental concern (Y_2), and the smallest effect size of 0.619 for the relationship between compatibility (X_2) and environmental concern (Y_2). Additionally, the moderating effect of environmental concern (Y_2) on the other variables is very large ($f^2 = 1.00$).

Table 15. R-Square Value of Plant-based Meatball

Indicator	Y_1
R-Squared	0.685
Q-Squared	0.618

Source: Primary Data Processed (2024)

Table 16. Effect Size Value (f^2) Plant-based Meatballs

Latent Variables	Y_2
X_1	0.677
X_2	0.619
X_3	0.651
X_4	0.654
X_5	0.640
X_6	0.750
Y_1	0.839
Y_2	0.664
$Y * X_{21}$	1.000
$Y * X_{22}$	1.000
$Y * X_{23}$	1.000
$Y * X_{25}$	1.000
$Y * X_{26}$	1.000

Source: Primary Data Processed (2024)

C. Goodness of Fit Model (GoF)

Goodness of Fit (GoF) evaluates how well the research model fits the data using WarpPLS. This study uses Average Path

Coefficient (APC), Average R-Squared (ARS), Average Block VIF (AVIF), Tenenhaus Goodness of Fit (TGoF), and R-Squared Contribution Ratio (RSCR) to assess different aspects of the model's performance.

APC assesses the relationship strength, ARS evaluates variability explained, AVIF checks multicollinearity, TGoF measures overall performance, and RSCR ensures R-Squared contribution.

[Table 17](#) shows the model's GoF results: APC = 0.100 (P=0.01), ARS = 0.685

(P<0.001), both accepted as significant. However, AVIF = 5.965 exceeds acceptable limits, indicating potential multicollinearity. TGoF = 0.750 (high) and RSCR = 0.959 (acceptable) suggest the model performs well overall, with the exception of multicollinearity concerns.

Table 17. Goodness of Fit (GoF) Evaluation of Plant-based Meatballs

<i>Goodness of Fit</i>	<i>Fit Criteria</i>	<i>Results</i>	<i>Description</i>
Average Path Coefficient (APC)	P=0.05	0.100 (P=0.01)	Accepted
Average R-Squared (ARS)	P<0.05	0.685 (P<0.001)	Accepted
Average Block VIF (AVIF)	Accepted if ≤ 5 Ideal if ≤ 3	5.965	Rejected
Tenenhaus Goodness of Fit (GoF)	Low ≥ 0.1 Medium ≥ 0.25 High ≥ 0.36	0.750	High
r-squared Contribution Ratio (RSCR)	Accepted if ≥ 0.9 Ideal if = 1	0.959	Accepted

Source: Primary Data Processed (2024)

5. Hypothesis Testing Results

Hypothesis testing evaluates the significance of relationships between variables in the proposed research model. It involves comparing statistical results, such as p-values and t-values, against predefined thresholds to determine whether to accept or

reject hypotheses. Significant results indicate that the hypothesized relationship is supported, while non-significant results suggest no evidence for the proposed connection. This process ensures the validity of the theoretical framework and strengthens the study's conclusions.

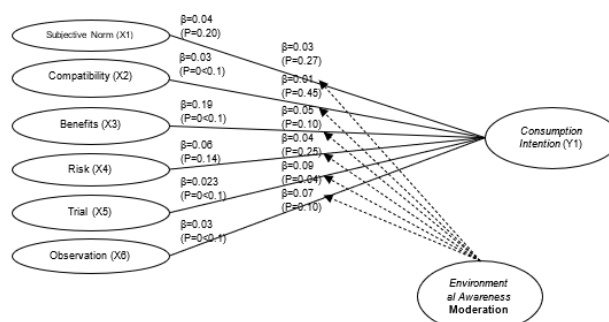


Figure 3. Meatball Hypothesis Testing Model

The hypothesis testing model evaluates the variable relationships in [Figure 3](#) at different significance levels, including 0.10, 0.05, and 0.01. At the 0.10 level (alpha 10%), the relationship is weakly significant, still acceptable, but not strong. At the 0.05 level (5% alpha), the relationship is significant, with a 95% confidence level. At the 0.01 level

(1% alpha), the relationship is highly significant, showing a 99% confidence level, indicating a strong and reliable connection.

The test results in [Table 18](#) show that compatibility, relative advantage, trialability, and observation have a significant positive effect on consumption intention (p-value < 0.01), thus H₁ is accepted and H₀ is rejected.

However, subjective norm and perceived risk are not significant (p -value > 0.1), so H_0 is accepted and H_1 is rejected. This indicates that internal factors and experience play a

more dominant role than social norms or perceived risk perception in influencing consumption intention.

Table 18. Variable Hypothesis Testing Results on Plant-based Meatball

No.	Relationship between Variables (Explanatory Variable - Response Variable)		Coef. Path	P-value
1	Subjective Norm	Consumption Intention	0.045 ^{ts}	0.198
2	Compatibility	Consumption Intention	0.265***	<0.001
3	Relative Advantage	Consumption Intention	0.187***	<0.001
4	Perceive risk	Consumption Intention	0.056 ^{ts}	0.145
5	Test Run	Consumption Intention	0.228***	<0.001
6	Observation	Consumption Intention	0.235***	<0.001

Notes: *** = significant at $\alpha=0.01$ (*highly* significant); ** = significant at $\alpha=0.05$ (significant); * = significant at $\alpha=0.10$ (*weakly* significant);^{ts} = not significant.

Table 19. Hypothesis Testing Results of Moderating Variables on Plant-based Meatballs

No.	Relationship between Variables (Explanatory Variable - Response Variable)		Coef. Path	P-value
1	Subjective Norm	Environmental Awareness	0.032 ^{ts}	0.271
2	Compatibility	Environmental Awareness	0.006 ^{ts}	0.453
3	Relative Advantage	Environmental Awareness	0.052 ^{ts}	0.161
4	Perceive risk	Environmental Awareness	0.035 ^{ts}	0.252
5	Trialability	Environmental Awareness	0.091**	0.042
6	Observation	Environmental Awareness	0.067*	0.100

Notes: *** = significant at $\alpha=0.01$ (*highly* significant); ** = significant at $\alpha=0.05$ (significant); * = significant at $\alpha=0.10$ (*weakly* significant);^{ts} = not significant.

[Table 19](#) shows that only the trial has a significant effect on the consumption intention of plant-based meatballs moderated by environmental concern ($p = 0.042$, $p < 0.05$), so H_1 is accepted. Other variables, including subjective norms, compatibility, benefits, risks, and observations, did not significantly influence consumption intention ($p > 0.05$), meaning H_0 is accepted for these variables. Therefore, trial is the only factor that moderates the relationship between students' decisions and their consumption intentions of plant-based meatballs.

CONCLUSION

This study investigates factors influencing alternative protein consumption intentions, focusing on subjective norms, compatibility, relative advantage, perceived risk, trialability, observations, and environmental awareness as a moderating

variable. Results reveal that subjective norms, compatibility, and relative advantage significantly influence intentions, while perceived risk inhibits them; however, trials and observations mitigate these concerns. Environmental awareness amplifies the impact of key drivers, highlighting the importance of sustainability in consumer decisions. These findings contribute to an understanding of consumer behavior, offering practical insights for promoting alternative proteins through awareness campaigns, product innovation, and pricing strategies. Future research should investigate the long-term environmental impacts, cultural differences, and other potential moderating factors.

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