

Consumer Awareness, Perception, and Acceptance of Moringa-Infused Probiotic Products and Their Perceived Role in Metabolic Health

Abstract:

Background

Moringaoleifera and probiotics are well known for their health-promoting characteristics and possible uses in functional foods. The combination of both of these substances may bring synergy to metabolic health benefits; nevertheless, consumer awareness and acceptance of such products have not been investigated sufficiently yet.

Objective

To investigate consumer awareness, perceptions, acceptance, and purchasing intention of moringa-infused probiotic products and their possible benefits to metabolic health.

Methods

A questionnaire was employed to conduct a cross-sectional study using 100 adult participants. Data analysis involved descriptive statistics, Cronbach's alpha test, chi-square test, independent sample t-test, one-way ANOVA, correlation, and regression.

Results

The findings revealed a moderate level of awareness of moringa (60.0%) and probiotics (58.6%) but poor scientific understanding of their health benefits. Consumers had positive attitudes toward moringa-infused probiotic products and perceived them as health and wellness products. High purchase intention (98.0% of definite and probable purchasing) has been recorded. Previous awareness and consumption of probiotic foods correlated significantly with the health benefit perception score ($p < 0.05$). Positive attitudes, metabolic health benefits perception, and consumer-choice factors have been associated significantly with purchase intention.

Conclusion

Consumers had positive perceptions and acceptance toward the moringa-infused probiotics even without scientific understanding about their benefits. It indicates a bright future ahead of such kinds of food products. Increased consumer knowledge and awareness through evidence-based information can lead to better acceptance and adoption of these products.

Keywords

Moringaoleifera; Probiotics; Functional Foods; Consumer Awareness; Consumer Perception; Purchase Intention; Metabolic Health; Functional Nutrition.

Introduction

Functional foods offer not only nutritive benefits but also health benefits, which occur due to their consumption apart from their nutritional value. Functional foods are those that have biologically active components that confer additional health benefits when consumed within a balanced diet [1]. The prevalence of metabolic disorders like obesity, diabetes, cardiovascular diseases, and improper glycemic management has made the role of diet crucial to health [2]. Diet is considered an important modifiable risk factor in metabolic health. In the process of metabolic regulation, it is not enough to just take into account the number of calories consumed; one must also consider the quality of diet [3].

The interconnection between diet and metabolic conditions is affected by numerous factors. The condition of health in a person depends on a variety of factors related to his/her nutrition. The fact is confirmed by the science that there is a relationship between unbalanced nutrition and development of chronic diseases in relation to people's lifestyles such as obesity, type 2 diabetes mellitus, and cardiovascular disease [4]. There is a link between high consumption of refined carbohydrates, saturated fat, and ultra-processed food, and the development of oxidative stress, inflammation, insulin resistance, and lipid metabolism. In addition, the consumption of ultra-processed food and sugar-sweetened drinks can result in the growth of body fat and BMI. Diet restrictions are important to make sure that there will be enough food for the maintenance of metabolic needs without overeating [5].

Moringa oleifera falls into one of the largest families of plants known as Moringaceae. *Moringa oleifera*, which is often referred to as "The Miracle Tree" owing to its multiple uses, nutritional content, and nutraceutical content, is extensively used [6]. Moringa, full of all necessary nutrients including vitamins, minerals, and proteins, serves as a good illustration of sustainable nutrition. Due to the high number of antioxidants including beta-carotene and vitamin C, moringa is useful for the creation of an effective shield from oxidation and free radicals. It should be noted that, in addition to moringa's nutritional properties, this plant can also be used as an anti-inflammatory agent and an antitumor substance. The antibacterial property of moringa may enable it to protect the body from dangerous infections, hence making moringa more medicinal [7]. Moringa is not just a cooking ingredient, but it can also be added to

other products such as bakery items, snack foods, beverages, milk products, and many more to add to their health value [8].

The word “probiotic” comes from Greek and means “for life.” Lilley and Stillwell created it. Probiotics are helpful for microorganisms that do not lead to illness in their hosts [9]. Probiotics, such as lactic acid bacteria, are beneficial for non-pathogenic microorganisms that promote health in the host when provided in sufficient amounts. The strains that are commonly used belong to the divergent group of *Bifidobacterium* and *Lactobacillus*, which exert a considerable influence on health through a variety of actions. They detoxify environmental toxins and foreign substances, bio-transform mycotoxins found in food, produce folate, riboflavin, and vitamin K, and ferment undigested fiber in the colon [10]. The probiotic sector is seeing the development of new types of microbiome-modulating interventions, such as prebiotics, symbiotics, postbiotics, microbial consortia, live biotherapeutic products, and genetically modified organisms, along with a resurgence of interest in polyphenols, fibers, and fermented foods to promote human health [11].

Moringa and probiotics together may offer a new strategy for creating functional foods that have complementary health advantages. Moringa could play a role in plant-based bioactive compounds, whereas probiotics might aid in maintaining intestinal microbial activity and physiological equilibrium. The prebiotic effects observed in moringa leaves may be attributed to the presence of prebiotics such as oligosaccharides and polysaccharides [12]. For a successful product launch and the creation of marketing strategies in the burgeoning functional foods market, it is essential to grasp the elements that affect consumer acceptance and the relationships among these elements [13]. To maintain life and promote well-being, the human body has a fundamental physiological requirement for food. The nutrient content of food is significant, but consumer perception plays a role in food choice [14].

Analyzing consumer perception helps us understand the market preparation, barriers, and factors affecting consumer acceptance for these functional foods. This may help the food industry as well as nutritionists develop products according to the consumers' expectations and preferences and motivate consumers to make healthy choices. The objective of this research is to evaluate how aware consumers are of moringa-infused probiotic products, how they perceive and accept them, and how likely they are to buy them, as well as to assess these products' perceived importance for adults' metabolic health.

Methodology

Research Design

A cross-sectional quantitative survey design was used to assess consumers' awareness, knowledge, perceptions, acceptance, and purchase intention regarding moringa-infused probiotic products.

Study Population

The subjects used for the study were adults (aged ≥ 18).

Study Area

The study involved consumers in the selected study location (Faisalabad, Pakistan) via online and offline surveys.

Sample Size

It was planned to recruit about 100 participants to acquire accurate statistical results.

Sampling Technique

Participants meeting the inclusion criteria were selected through a convenience sampling method.

Research Instrument

The research employed the use of a structured questionnaire that was developed using Google Forms. The purpose of the questionnaire was to evaluate the levels of awareness, knowledge, attitude, perception, acceptance, and purchase intention towards probiotics produced from moringa among consumers using demographic and five-point Likert scale questions. The reliability of the questionnaire was tested by an expert panel.

Validity and Reliability

An expert panel comprising nutritionists, food scientists, and consumer behavior specialists evaluated the content validity of the questionnaire. A pilot study including 30-50 participants was conducted. The reliability test was conducted using Cronbach's alpha, wherein values above 0.70 were considered acceptable.

Data Collection Procedure

The link for the questionnaire was posted through online sites and/or through personal contact with participants. Participants in the research were voluntary, and informed consent was obtained prior to data collection.

Data analysis

SPSS was employed to analyze data. The data were described through frequency, percentage, mean, and standard deviation. Reliability was examined through Cronbach's alpha. The chi-square test, t-test/ANOVA, correlations, and regression analysis were performed to investigate the linkages between awareness, perception, and purchase intention. The statistical significance level was set to be $p\text{-value} < 0.05$.

Ethical consideration

The purpose of the study was to communicate with the participants. The identification details were not provided, and all answers were kept private. All participation was voluntary, and the subjects had the liberty to leave at anytime.

RESULTS

The findings from the survey conducted through the use of the questionnaire completed by 100 participants were presented in this chapter. The chapter is divided into the reliability of the scales used in measuring the variables of the study, socio-demographic characteristics of respondents, awareness and knowledge on moringa and probiotics, descriptive statistics for the attitude and perception measures, purchase intentions and willingness to pay, bivariate correlations (chi-square test, independent samples t-test and one-way ANOVA), correlation analysis, and multiple regression analysis on factors affecting purchase intentions towards moringa-infused probiotic products. All statistical analysis was conducted at the $p < 0.05$ level of significance.

Reliability of the Measurement Scales

Before proceeding to any further analysis, the reliability of the three multi-dimensional scales utilised in the survey, namely attitudes and perceptions, perceived metabolic health benefits and factors affecting consumer choices, was tested through Cronbach's alpha. As presented in Table 1 below, all three scales obtained alpha scores way above the generally acceptable threshold of

0.70, which is indicative of strong internal consistency of the measurement and confirming that the items within each construct reliably measured the same underlying concept.

Table 1 Reliability statistics concerning the measurement scales (N = 100)

Scale	No. of Items	Cronbach's Alpha	Interpretation
Attitudes and Perceptions (Section D)	6	.912	Excellent
Perceived Metabolic Health Benefits (Section E)	5	.893	Excellent
Factors Affecting Consumer Choice (Section F)	7	.973	Excellent

Socio-Demographic Profile of Respondents

Table 2 contains the socio-demographic details of 100 participants who have already completed the survey. As far as age is concerned, most of the respondents belong to the age group of 25-34 years (29.0%), followed by age groups of 18-24 years (27.0%), 34-44 (6.0%), 45-54 years (20.0%) and 55 years and older (18.0%). As for the gender variable, women make up the largest group (55.0%) of respondents, followed by men (28.0%), while 17.0% of respondents did not state their gender. The educational background of the respondents can be considered fairly good since 43.0% of them have got master's degrees and above, 41.0% have bachelor's degrees, whereas 16.0% of them have intermediate level of education. Lastly, as for the employment status of respondents, the majority are unemployed (31.3%), followed by self-employed (23.2%), employed (21.2%), retired (16.2%), and students (8.1%). Regarding the place of residence, the majority of respondents reside in urban areas (71.0%) compared to 29.0% in rural areas.

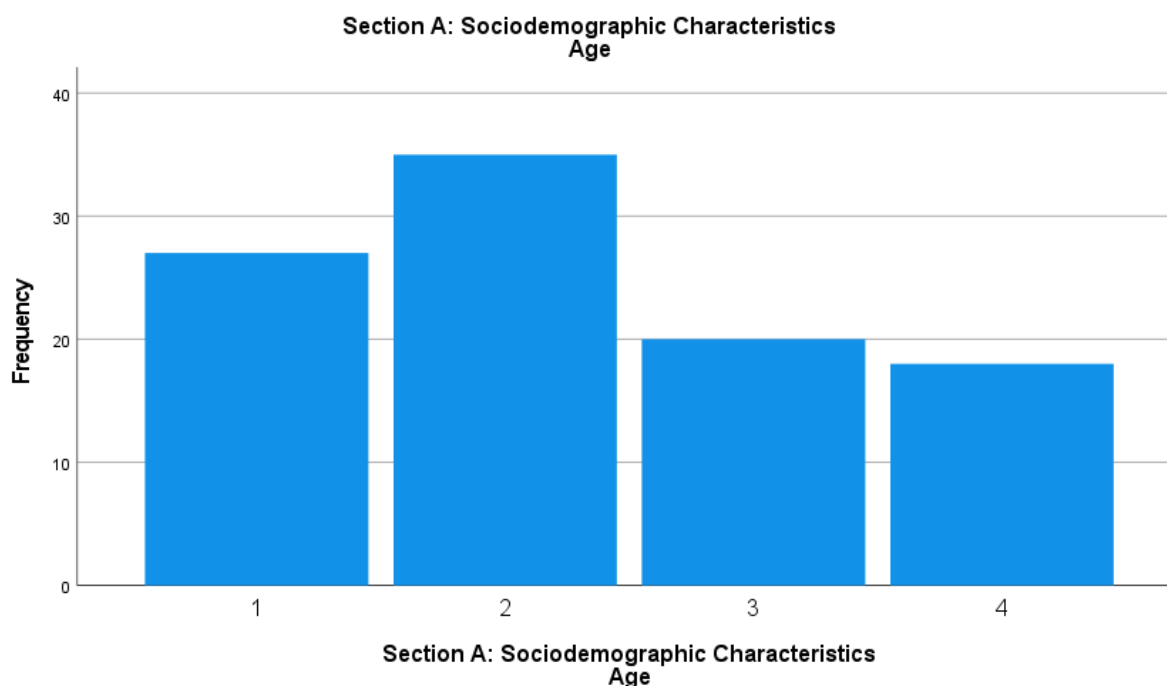
Table 2 Socio-Demographic Profile of Respondents (N = 100)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age	18–24 years	27	27.0
	25–34 years	29	29.0
	34-44 years	6	6.0
	45–54 years	20	20.0
	55 years or above	18	18.0
Gender	Female	55	55.0

	Male	28	28.0
	Prefer not to say	17	17.0
Education Level	Bachelor's Degree	41	41.0
	Master's Degree or above	43	43.0
	Intermediate	16	16.0
Employment Status	Employed	21	21.0
	Self-employed	23	23.0
	Unemployed	31	31.0
	Retired	16	16.0
	Student	9	9.0
Residence	Urban	71	71.0
	Rural	29	29.0

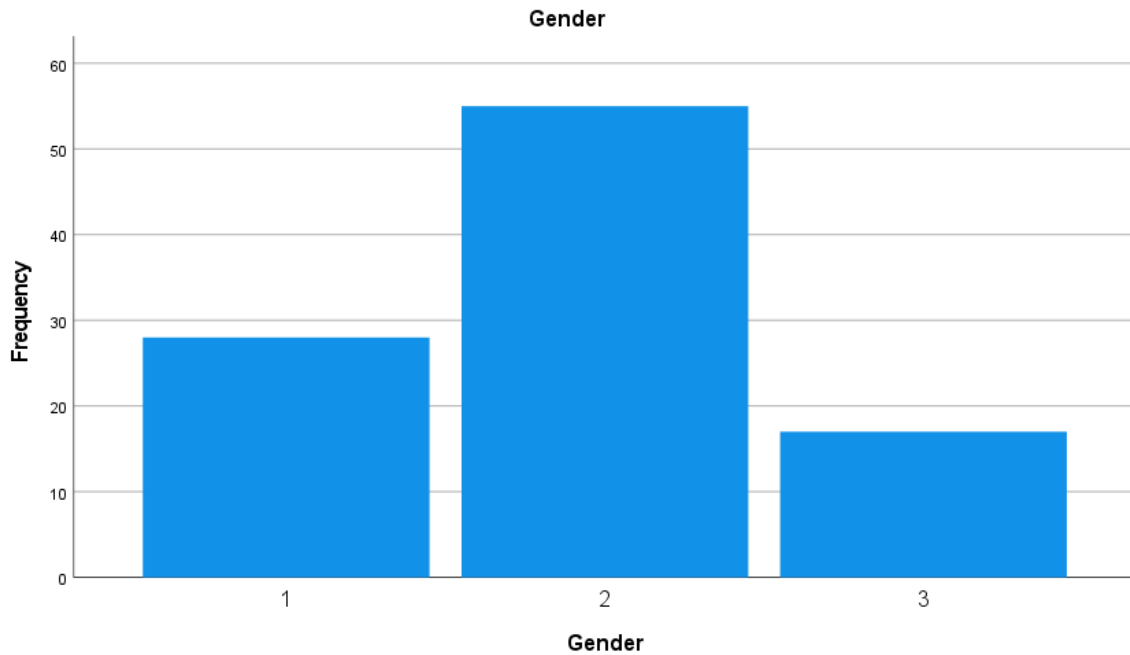
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173 The relevant SPSS bar graphs for the five main demographic variables are shown below in
 174 Figures 1 to 5. These are the actual pictorial representations of the distribution of the respondents
 175 according to their age, gender, education, employment, and residence.



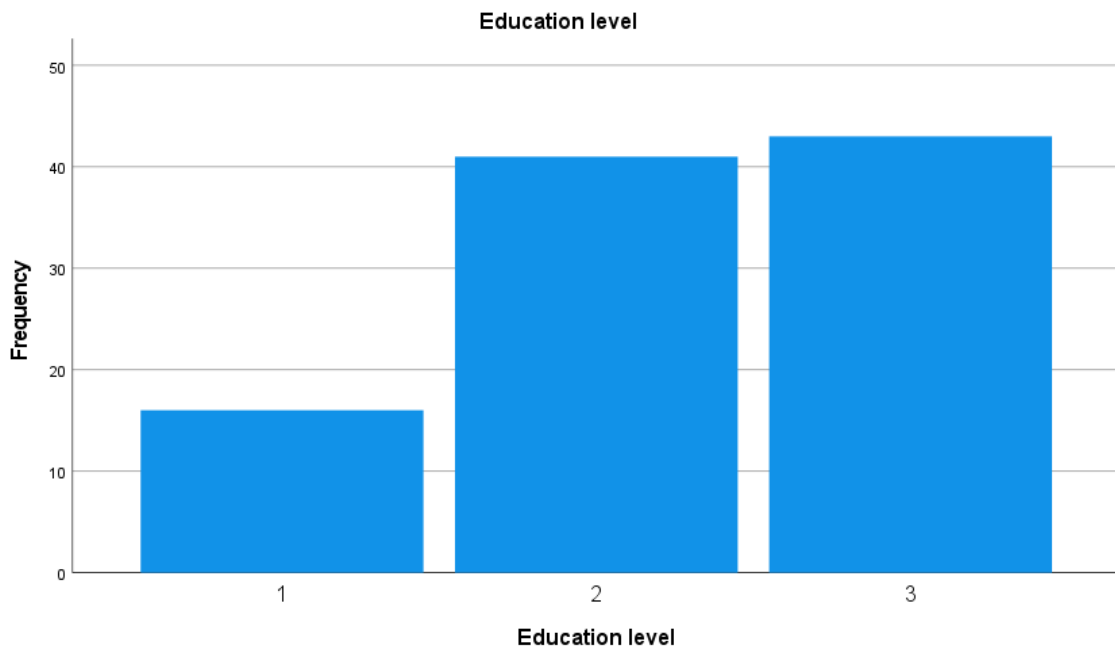
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177 *Figure 1 Distribution of Respondents by Age*



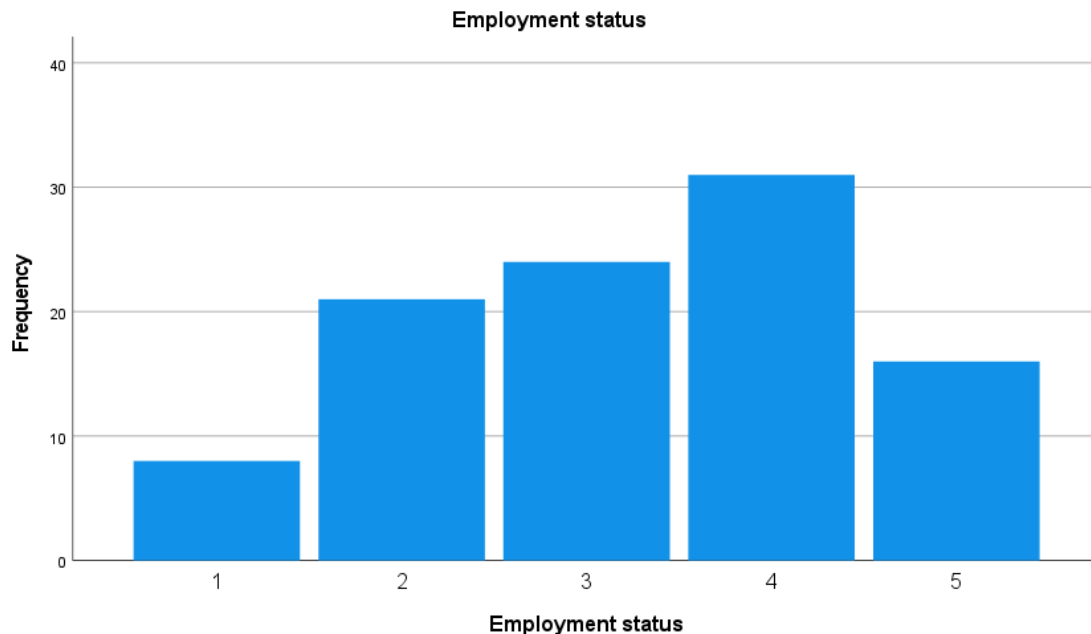
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179 *Figure 2 Distribution of Respondents by Gender*



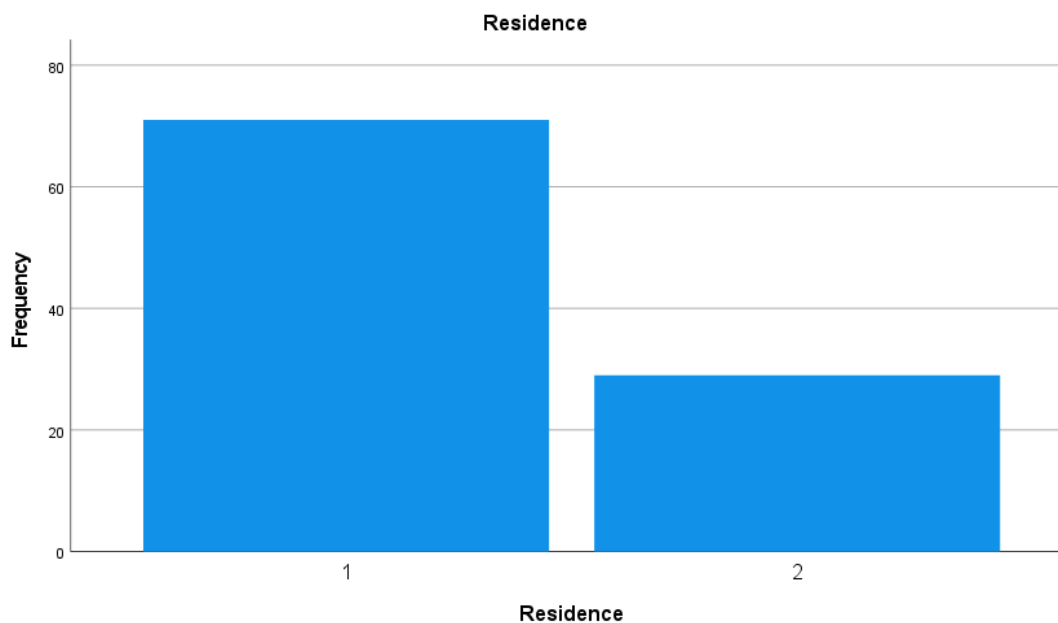
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181 *Figure 3 Distribution of Respondents by Education Level*



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183 *Figure 4 Distribution of Respondents by Employment Status*



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185 *Figure 5 Distribution of Respondents by Residence*

186 **Awareness and Knowledge of Moringa and Probiotics**

187 Table 3 illustrates the respondents' prior knowledge of moringa, probiotics, and moringa-based
 188 probiotics. More than half of the respondents (60.0%) have heard about moringa before, and an
 189 equally high number of people (58.0%) have had probiotics before. Additionally, 58.6% of the

respondents have heard about probiotics in general, and 59.6% have heard about moringa-based probiotics. This implies that there is a moderate level of prior product-category awareness despite the fact that the product is new to the market.

Table 3 Prior Awareness of Moringa, Probiotics and Moringa-Infused Probiotic Products

Awareness Item	Yes (%)	No (%)
Have you heard of moringa?	60.0	40.0
Have you consumed probiotic foods?	58.0	42.0
Have you heard of probiotics?	58.6	41.4
Have you previously heard of moringa-infused probiotic products?	59.6	40.4

However, the level of objective knowledge about the science behind it was quite low, as 88.0% of the participants selected "Don't know" in response to the question about the main benefit of moringa, whereas only 43.0% could define probiotics as "beneficial microorganisms" and the rest 56.0% did not know what a probiotic is. Similarly, only 47.0% knew that gut microbiota could impact metabolic well-being as well as know that diet could affect glucose and lipid levels in the blood, and 51.0% responded "Don't know" to both questions. It shows that there is a mismatch between general awareness of the product categories and knowledge of the science behind them, which directly affects product promotion.

Consumer Attitudes and Perceptions

Illustrated in Table 4 are the summary statistics regarding the six statements used to measure the consumer's attitudes and perceptions on functional foods based on a five-point Likert scale where 1 represents strongly disagree while 5 represents strongly agree. First of all, one could see that there was proof of having a positive attitude towards functional foods (Composite M=3.78, SD=.59). The statements, "I would consider buying foods that contain moringa" and "I would prefer buying foods that have natural ingredients than the artificial ones" had the highest rating of M=3.92. On the contrary, the statement "I would be willing to try new functional foods" had the lowest M=3.55.

Table 4 Descriptive Statistics for Attitudes and Perceptions (5-point scale)

Attitude Statement	Mean	SD
I am interested in trying innovative, functional foods.	3.55	0.59
I believe natural ingredients can contribute to a healthy diet.	3.63	0.56
I think probiotics are beneficial for digestive health.	3.83	0.68
I would consider purchasing foods containing moringa.	3.92	0.77
Product safety is an important factor in purchasing decisions.	3.85	0.85
I prefer foods with natural ingredients over synthetic additives.	3.92	0.77
Composite (Overall Attitudes and Perceptions)	3.78	0.59

Perceived Metabolic Health Benefits

Participants also revealed fairly positive attitudes regarding the metabolic health benefits associated with the use of moringa-based probiotics (mean = 3.74, SD = 0.58), as seen in Table 5. In regard to the two areas with the greatest level of consensus, the first one was the consumers' interest in learning the product's effects on metabolism (mean = 3.82), and the second was the overall wellness effects of the product (mean = 3.81), but the digestion effects of the product received relatively lower levels of consensus (mean = 3.56).

Table 5 Descriptive Statistics for Perceived Metabolic Health Benefits (5-point scale)

Perceived Benefit Statement	Mean	SD
These products could support digestive health.	3.56	0.61
These products could contribute to a balanced diet.	3.70	0.64
They may have potential benefits for overall wellness.	3.81	0.72
More scientific research is needed regarding their health effects.	3.79	0.74
I would be interested in learning more about their role in metabolic health.	3.82	0.72
Composite (Overall Perceived Metabolic Health Benefits)	3.74	0.58

Factors Affecting Consumer Choice

Table 6 presents the ratings of the importance of seven variables that were taken into account when purchasing functional foods (1= Not Important; 5= Very Important). All seven variables were assessed as being rather significant, which resulted in a relatively narrow range of mean scores (3.54 to 3.68), as well as the composite mean score of M= 3.60 (SD= 0.78). It turned out that health advice is the most important feature (M=3.68), while nutritional value and science

(M=3.61-3.62) took second place; on the other hand, taste proved to be the least important criterion (M=3.54). However, there is only a slight gap between the two.

Table 6 Descriptive Statistics for Factors Affecting Consumer Choice (5-point scale)

Factor	Mean	SD
Taste	3.54	0.78
Price	3.58	0.82
Nutritional value	3.62	0.86
Scientific evidence	3.61	0.86
Brand reputation	3.58	0.84
Availability	3.57	0.84
Healthcare recommendations	3.68	0.87
Composite (Overall Factors Affecting Consumer Choice)	3.60	0.78

Purchase Intention and Willingness to Pay

There was an overall strong interest in the purchasing of moringa-based probiotic products because 70.0% of the respondents said that they would “Definitely” buy the products, while another 28.0% responded with “Probably yes.” This accounted for 98.0% of the total number of respondents. The number of those who were not willing to pay extra costs accounted for 34.3%, while 22.2% were willing to pay an additional cost of 5%, 19.2% were willing to pay 6% to 10% more, 17.2% of the sample agreed to pay 11% to 20% extra cost, and 7.1% were ready to pay an extra cost greater than 20%. Only 1.0% of each respondent chose “Probably not” and “Definitely not.” The respondents showed a high level of interest in obtaining additional information about the products because 97.0% of them answered “Yes.”

Table 7 Purchase Intention, Willingness to Pay and Information-Seeking Behavior

Response Category	Percentage (%)
Purchase Intention — Definitely yes	70.0
Purchase Intention — Probably yes	28.0
Purchase Intention — Probably not	1.0
Purchase Intention — Definitely not	1.0
Willingness to Pay — Nothing extra	34.3
Willingness to Pay — Up to 5% more	22.2
Willingness to Pay — 6–10% more	19.2
Willingness to Pay — 11–20% more	17.2

Willingness to Pay — More than 20% more	7.1
Would like more product information — Yes	97.0

Association between Demographic/Awareness Variables and Purchase Intention

Chi-square tests of independence were conducted to examine whether purchase intention was associated with gender, education level, residence, or prior awareness of moringa and probiotics (Table 8). None of the relationships were found to be statistically significant at the 0.05 level, meaning that the highly positive purchase intent measured in this sample was quite uniform among the demographic and awareness categories, rather than being focused in any specific category. A weak correlation was found between the gender of participants and their prior knowledge about moringa ($\chi^2 = 5.65$, $df = 2$, $p = .059$). Even though there was no statistically significant relationship ($p < .05$), this finding implies a potential trend that deserves to be explored in future research.

Table 8 Chi-Square Tests of Association (N = 100)

Association Tested	χ^2	df	p-value	Decision
Gender $\times$ Purchase Intention	2.807	6	.833	Not significant
Education Level $\times$ Purchase Intention	3.915	6	.688	Not significant
Residence $\times$ Purchase Intention	0.853	3	.837	Not significant
Heard of Moringa $\times$ Purchase Intention	3.869	3	.276	Not significant
Consumed Probiotic Foods $\times$ Purchase Intention	5.876	3	.118	Not significant
Heard of Probiotics $\times$ Purchase Intention	5.786	3	.123	Not significant
Gender $\times$ Heard of Moringa	5.653	2	.059	Marginal

Group Comparisons: Independent Samples t-Test and One-Way ANOVA

Independent samples of t-tests were used to compare the composite attitudes, benefits perceived, and factors of scores based on gender, residence, and awareness Group. As presented in Table 9, people who were aware of moringa, had consumed probiotic foods or aware of probiotics scored significantly higher on perceived metabolic health benefits scale than people who were unaware of these things (all $p < .05$). Consumption of probiotic foods in the past and awareness of probiotics were also significantly correlated with high scores on Factors Affecting Consumer Choice. There was no statistically significant difference between genders and places of residence

259 regarding any of the three composite scores, and also there was no difference in Attitudes and
 260 Perceptions between awareness groups.

261 **Table 9 Selected Significant Independent Samples t-Test Results**

Comparison (Grouping Variable)	Composite Outcome	t	p-value	Result
Heard of Moringa (Yes vs No)	Perceived Benefits	2.08	.040	Significant
Consumed Probiotic Foods (Yes vs No)	Perceived Benefits	2.48	.015	Significant
Heard of Probiotics (Yes vs No)	Perceived Benefits	2.55	.013	Significant
Consumed Probiotic Foods (Yes vs No)	Factors Affecting Choice	2.41	.019	Significant
Heard of Probiotics (Yes vs No)	Factors Affecting Choice	2.21	.031	Significant
Gender (Male vs Female)	Attitudes	0.20	.841	Not significant
Residence (Urban vs Rural)	Attitudes	0.92	.363	Not significant

262 Another one-way ANOVA analysis was carried out to show differences among age, education,
 263 and employment status. As shown in Table 10 below, there is a statistically significant difference
 264 between education and factors affecting consumer choice ($F = 6.21$, $p = .003$), where the
 265 respondents having a bachelor's degree ($M = 3.74$) and a master's degree or above ($M = 3.68$)
 266 perceive the influencing factors as being more important than those respondents having an
 267 intermediate level of education ($M = 3.00$). There is a marginal statistical difference between
 268 education and Perceived Metabolic Health Benefits ($F = 3.00$, $p = .055$). There are no significant
 269 differences in any of the composite measures with respect to age group and employment status.

270 **Table 10 One-Way ANOVA Results across Age, Education and Employment**

Grouping Variable	Composite Outcome	F	p-value	Result
Education Level	Factors Affecting Choice	6.213	.003	Significant
Education Level	Perceived Benefits	2.998	.055	Marginal
Education Level	Attitudes	2.114	.126	Not significant
Age Group	Attitudes / Benefits / Factors	0.99 / 0.46 / 0.24	.402 / .712 / .868	Not significant
Employment Status	Attitudes / Benefits / Factors	0.75 / 1.13 / 1.47	.564 / .348 / .217	Not significant

Correlation Analysis

The correlation coefficients for Pearson correlations between the three constructs and purchase intention have been computed (Table 11). The three constructs, namely, attitudes and perceptions, perceived metabolic health benefits, and factors affecting consumer choice, were positively inter-correlated ($r = .570$ to $.621$, $p < .001$) suggesting that those who had favorable attitudes had the perception of higher health benefits and considered choice factors to be more important. The three variables mentioned above were found to have positive and significant correlations with purchase intention ($r = .240$ to $.266$, $p < 0.05$). This implied that attitude towards the brand, perception of the advantages of choosing it and the importance of these choice factors in making the decision had a bearing on the likelihood of purchase.

Table 11 Pearson Correlation Matrix (N = 100). * $p < .05$, ** $p < .01$

Variable	Attitudes	Perceived Benefits	Factors Affecting Choice	Purchase Intention
Attitudes and Perceptions	1.000			
Perceived Metabolic Health Benefits	.570**	1.000		
Factors Affecting Consumer Choice	.580**	.621**	1.000	
Purchase Intention	.245*	.240*	.266**	1.000

Regression Analysis: Predictors of Purchase Intention

Multiple regression analysis was performed in order to investigate the effect of attitudes and perceptions, perceived metabolic health benefits, and factors affecting consumer choice on purchase intention. According to Table 12, it is possible to note that the separate introduction of each of the three composite predictors resulted in the statistically significant models; however, the Attitudes and Perceptions predictor explained 6.0% of the variance in purchase intention ($R^2 = .060$, $F(1,98) = 6.27$, $p = .014$, $\beta = .265$, $p = .014$), the perceived metabolic health benefits predictor explained 5.7% of the variance ($R^2 = .057$, $F(1,98) = 5.97$, $p = .016$, $\beta = .267$, $p = .016$), and the factors affecting consumer choice explained 7.1% of the variance ($R^2 = .071$, $F(1,98) = 7.44$, $p = .008$, $\beta = .218$, $p = .008$) and was the most statistically significant among the three predictors. All in all, the regression model with all three independent variables was found to be

statistically significant ($R^2 = .087$, $F(3,96) = 3.05$, $p = .033$), but none of the predictors met the requirement of statistical significance. This fact can be explained by relatively high correlations between all three constructs identified earlier in this research.

Table 12 Regression Models Predicting Purchase Intent (Dependent Variable = Purchase Intent)

Model	Predictor(s)	R ²	F	p (model)	β (Sig.)
Model 1	Attitudes and Perceptions	.060	6.27	.014	.265 (.014)
Model 2	Perceived Metabolic Health Benefits	.057	5.97	.016	.267 (.016)
Model 3	Factors Affecting Consumer Choice	.071	7.44	.008	.218 (.008)
Model 4	All three predictors combined	.087	3.05	.033	n.s. individually

Summary of Findings

A sample population that is mostly female, lives in urban areas, is well-educated, and comes from the age group of 18-34 years old with moderate knowledge about moringa and probiotics and limited understanding of how they work scientifically. The internal consistency of the measurement scales used in this study for all three concepts turned out to be excellent. Positive attitude, perceptions about the benefits for metabolism, and consumer-choice criteria were all highly correlated and had very positive ratings, and consumers' purchase intention towards products with moringa and probiotics was highly positive (98.0% "Definitely" or "Probably" yes), although one-third of the surveyed respondents were not ready to pay an extra price for the product. Exposure to probiotics and probiotic foods beforehand was consistently associated with more positive perception, and educational level was significantly related to the importance of consumer-choice criteria. Regression results showed that attitudes, perceptions about the benefits, and consumer-choice criteria were significant, positive but moderately important determinants of purchase intention, collectively pointing to a receptive but not yet fully informed consumer base for this novel functional food category.

Discussion

The research investigated consumer awareness, perceptions, acceptance, and purchase intention towards moringa-enriched probiotics and the possible benefits of these products on metabolic health. The results indicated that there was moderate awareness of both moringa and probiotics by the respondents, yet low scientific knowledge about the health benefits of these substances. This has been seen in other research where other consumers had knowledge about functional foods yet lacked sufficient information about their functioning and the health effects. The results indicated that the respondents had positive perceptions towards moringa-enriched probiotics and perceived the products to be beneficial in improving metabolic health. This may be due to the increasing demand from consumers towards natural, plant-based, and health-promoting foods. The high purchase intention observed in this study further suggests a favorable market potential for such products. Awareness and consumption of probiotics before the study were found to be significantly correlated with high health benefits perception scores, showing that awareness about the components used in functional foods can contribute positively to the acceptance of these foods. Respondents who had higher education levels emphasized scientific information and nutrition as important elements when deciding to purchase functional foods. The correlation and regression analysis showed that attitudes, metabolic health benefits perceptions, and consumers' choices were significantly related to the purchase intentions of the participants. These findings show that increased consumer knowledge and awareness can lead to further acceptance of probiotics with moringa.

Limitations

There are various limitations to this research. First, the sample size used was relatively small, with the sample population being chosen using the convenience sampling method. Second, the results obtained depended on the self-reported data, which is prone to recall and response biases. Third, the scientific knowledge of moringa and probiotics among the participants used was relatively low. Future research studies need to incorporate larger and diversified sample populations.

Conclusion

Based on the findings of this study, it can be concluded that consumer perceptions of moringa-based probiotic products are mostly positive, and their willingness to purchase such products is high despite low levels of scientific knowledge regarding their health impacts. Awareness levels

of both moringa and probiotics were moderate while attitudes towards natural and functional foods were positive. Metabolic health benefits perception and consumer attitudes had significant impacts on purchase intentions. Thus, moringa-infused probiotics hold great promise as functional foods, and any form of education concerning the benefits that they bring can increase consumer acceptance.

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