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Sensory quality, price sensitivity, and perceived value as determinants of pigeon pea noodle purchase decisions

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ABSTRACT

Understanding factors that drive consumer purchasing decisions is crucial for promoting value-added food products. This study investigated the influence of sensory attributes, perceived value, and price sensitivity on consumers' willingness to pay (WTP) for pigeon pea-based noodles (PPBN) in Ruangwa and Nachingwea districts, Lindi region, Tanzania. A total of 107 consumers evaluated PPBN attributes and propose their preferred price. The mean household food expenditure was 13,625 ± 1653.8 TZS/week during the harvesting season and 25,176 ± 5485.8 TZS/week during the lean season. Consumers (52%) spent between 2,500 and 10,000 TZS/day on household food. The majority of consumers (86%) showed willingness to buy the developed PPBN at a median price of 2,000 TZS (IQR = 1,500–2,200) per 1000 g. Expenditure per day, package size, and price significantly influenced willingness to pay (χ^2 = 27.402, $p < 0.005$) for the developed noodles. The colour, taste, and aroma of PPBN were perceived to be good, with differences in mouthfeel scores among samples. Sensory attributes, perceived value, and price sensitivity significantly influenced consumers' willingness to pay for pigeon pea-based noodles. To enhance adoption and market acceptance, producers should focus on improving sensory quality, offering competitively priced and appropriately packaged products, and increasing consumer awareness. These strategies can boost consumption and support nutrition efforts in pigeon pea-producing communities.

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1. Introduction

Pigeon pea (*Cajanus cajan*) is a most drought-tolerant legume (Sharma et al., 2011) that plays an important role in enhancing food and nutrition security, particularly in low- and middle-income countries. It is a rich source of protein, vitamins, and minerals, making it a valuable dietary component for many households (Abate, 2022; Cheboi et al., 2019; Miano et al., 2020). Dried pigeon pea contains about 16.7 and 26.7 g of protein (Abate, 2022; Cheboi et al., 2019; Eltayeb et al., 2010; Miano et al., 2020), 9.76 g of tryptophan, 35.56 g of histidine, 71.30 g of leucine, 70.09 g of lysine, 22.70 g of methionine and cysteine (Abate, 2022). It is also rich in minerals and vitamins. It contains 23–54 mg of zinc, 24.52–31.98 mg of iron, 1.31–10.8 g of calcium, 7.28–20.8 g of potassium, 0.1–2.62 g of phosphorus, 0.48–5.5 g of magnesium and 16.7 to 24.9 mg of manganese. Pigeon pea contains 21.3–45.15% of fibres (Abate, 2022; Miano et al., 2020). Despite its nutritive value, pigeon peas also contains anti-nutritional factors such as phenols that affect its quality (Cheboi et al., 2019). Therefore, it is very important to process it to reduce its effects on the human diet.

In Tanzania, pigeon pea ranks as the third most important legume after beans and groundnuts and serves both as a staple food and a source of income (Simtowe et al., 2011). Despite its potential to improve food and nutrition security, its utilization in value-added food products remains limited. This underutilization highlights the need for developing innovative value-added products to enhance its

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consumption and market potential. This article is part of a larger study on the development and consumer acceptance of value-added pigeon pea-based noodles (PPBN).

The development of value-added product such as pigeon pea-based offer opportunity to enhance utilization and diversify the consumption of nutrient-rich legumes. Previous work (Majili et al., 2023) evaluated the sensory qualities and consumer preferences of different PPBN formulations, identifying two preferred products PPBN 718 and PPBN 193) which were selected based on favorable evaluations of their color, mouthfeel, aroma and previously documented formulation and proximate nutritional profiles showing high protein (41.0–58.2 g/100 g dry matter) and micronutrient content, including iron (e.g. 26.4 mg/100 g in PPBN193) and zinc (Majili et al., 2023).

2. Literature review

Understanding consumer behavior toward value-added food products requires integrating theoretical perspectives with product-specific evidence. In the context of innovative foods such as pigeon pea-based noodles, consumers' willingness to pay is shaped by a combination of economic, sensory, and psychological factors

2.1. Theoretical framework of consumer willingness to pay and food choice

Willingness to pay (WTP) is a behavioral measure that reflects consumers' valuation of a product based on a range of attributes and perceived benefits (Tully & Winer, 2014). It provides insight into price preferences that indicates the maximum amount a consumer is prepared to pay for a product of interest. The Random Utility model, suggest that consumers will maximize utility by selecting products that offers the highest satisfaction at a lowest cost based on both observable factors (price, income, size) and un-observable preferences (beliefs, behaviour, attitude) (Gorton & Barjolle, 2013).

Consumer preference models emphasize that utility maximization is influenced by four elements including available income to purchase a particular product, price of the product, taste, consumer preferences and behavioural approximation (Weddepohl & Weddepohl, 1970). Similarly, the Attribute model (Lancaster model) suggest that product choice is influenced by the product attributes and the individual consumer values (Gwin & Gwin, 2003). This model has been used in food industries to assess consumer preferences on food attributes and their willingness to pay based on the set of attributes (Yiridoe et al., 2005). Factors such as consumers' knowledge, household income, household size and product attributes have been shown to influence the willingness to pay (Aryal et al., 2009).

In addition, consumer value theory (CVT) suggested that consumers purchase decisions are based on perceived tradeoff between benefits and costs, whereas product-embedded cues such as sensory quality and price act as signals of value. The Stimulus Organism Response (SOR) model explains the way sensory attributes and price affect perceived value and attitudes, that lead to behavioral response i.e. willingness to pay and purchase intention (Shahzad et al., 2024; Tortosa-Edo et al., 2025). For instance, exposure to favorable sensory attributes such as color, aroma, and texture can enhance perceived value and stimulate purchase decisions. Similarly, when consumers are informed about the nutritional benefits may lead consumer to interpret price in relation to perceived health value rather than cost alone.

Empirical evidence supports these theoretical linkages, indicating that WTP for food products are influenced by factors such as product knowledge, perceived quality attitudes, ability to pay, physical appearance and price sensitivity (Hughner et al., 2007; Mirabi et al., 2015; Sobal et al., 2006; Suzuki et al., 2019; Xiao et al., 2018). Moreover, studies on innovative and value-added foods demonstrate that perceived value mediates the relationship between product attributes, price sensitivity, and willingness to pay, particularly for foods positioned as healthier or more sustainable alternatives (Shahzad et al., 2024; Tortosa-Edo et al., 2025).

2.2. Market potential of pigeon pea-based noodles

Consumer willingness to pay of innovative food products, particularly plant-based and alternative protein products is largely influenced by sensory appeal, particularly taste and texture, together with perceived

functional and nutritional benefits (Grasso et al., 2024; Siegrist & Hartmann, 2023). Despite the growing interest in value-added legume product, the economic valuation of the developed products in terms of consumers' willingness to pay, perceived value, and the purchasing drivers has not yet been established. Understanding the way these factors (sensory attributes, perceived value, and price sensitivity) influence purchasing decisions is therefore critical. These factors collectively provide an indication of the market potential of the product, including its likelihood of acceptance, scalability, and competitiveness within existing food markets. In addition, assessing consumers' willingness to pay offers insights into potential pricing strategies and demand, which are essential for successful commercialization. Thus, the current study aims to assess the key factors influencing consumers' willingness to pay for the two most preferred PPBN samples (PPBN718 and PPBN193), focusing on (i) consumers' willingness to pay for PPBN (ii) the role of perceived value of PPBN in shaping purchase decisions and (iii) the key drivers influencing consumers' intention to purchase the developed PPBN products.

3. Methods and study approach

3.1. Study design, location and participants

A cross-sectional consumer survey was conducted to assess the likelihood to buy the developed value-added pigeon peas-based noodles. The study involved different consumers in Nachingwea and Ruangwa districts in Lindi region Tanzania to explore the market potentials across different consumer categories. The area has been chosen as it is the 2nd leading producer of pigeon pea in the country (URT, 2012) and 80% of the households produce pigeon peas that contributes nearly 50% of the national total production (Mponda et al., 2014). Also, it is mostly consumed compared to other regions that grow PP. Nachingwea District is the first producer of PP in the region followed by Ruangwa, Lindi Rural, Kilwa, Liwale and Lindi Urban (URT, 2012).

A total of 107 consumers aged above 20 years were involved. This sample constituted a sub-sample drawn from a larger consumer study ($n = 303$) conducted as part of the broader research on the development and evaluation of value-added pigeon pea products (Majili et al., 2020). The sub-sample was selected to represent different residential settings and consumer categories relevant to the study objectives. The resulting sample size is consistent with prior consumer acceptance and sensory evaluation research, which indicates that sample size ranging from 75 to 150 consumers is adequate for exploratory analyses of consumer preferences, willingness to pay, and market potential for new developed food products, particularly when the objective is to generate preliminary insights rather than population-level estimates (Hough et al., 2006; Lawless & Heymann, 2010; Wangcharoen et al., 2005). In addition, recent methodological reviews emphasize that consumer affective and preference tests commonly employ sample sizes from several dozen to a few hundred participants, with the final number guided by study objectives, product novelty, and practical feasibility (Drake et al., 2023). Practical considerations such as resource availability and field logistics therefore also contributed to the final sample size selection.

A stratified purposive sampling approach was employed to ensure representation from residential settings with differing levels of market-access which were expected to influence exposure to, familiarity with, and purchasing behavior toward value-added food products. Specifically, consumers were drawn from (i) hamlets in remote areas, (ii) village centers of Mitumbati and Mibure, and (iii) central areas of Nachingwea and Ruangwa districts. This approach allows systematic comparison across relevant consumer subgroups rather than population level inference.

3.1.1. Pigeon peas-based noodle formulation

Pigeon pea-based noodles were formulated using linear programming (simplex method) in Microsoft Excel Solver to determine optimal combinations of pigeon pea, wheat, and orange-fleshed sweet potato flours. The model was designed to simultaneously minimize formulation cost while maximizing nutrient content, with ingredient proportions treated as decision variables. Nutritional constraints were based on recommended nutrient intakes (RNI) for protein, iron, zinc, and provitamin A to ensure that the developed products met at least 50% of daily requirements (protein, iron, zinc, and provitamin A) for adults. These nutrients were prioritized due to their public health significance in addressing protein-energy

malnutrition and prevalent micronutrient deficiencies, as major problems in most low and middle-income countries.

A total of eight noodle formulations were generated by varying ingredient combinations and processing methods to enhance sensory acceptability. Among these, sample PPBN718 was formulated using roasted pigeon pea flour and wheat flour only, while PPBN193 included blanched pigeon pea flour combined with wheat and orange-fleshed sweet potato flours; both were selected as the most preferred based on sensory evaluation. The detailed formulation procedures, model structure, and parameterization have been described previously (Majili et al., 2023).

3.2. Data collection

Data were collected from March 2019 to August 2022, starting with identification and prioritization of product to be develop, followed by developing the product and profiling of its attributes for sensory, acceptance and willingness to pay test. The data were initially analyzed and presented in the dissertation between August and December 2022, and subsequently re-analyzed in 2024 to support the preparation of this manuscript.

Stated Preference Method was used to assess consumers' willingness to pay, perceived value, and purchasing decisions for the developed products specifically for two samples of noodles. This method is suitable for capturing consumer preferences and trade-offs in situations where actual market behavior cannot be observed such as with new developed value-added food products (Dhungel et al., 2026; Irie et al., 2024; Louviere et al., 2000). The two samples were selected for evaluation as they were previously identified as the most preferred by consumers based on sensory quality attributes (Majili et al., 2023, 2024).

The samples were cooked and prepared under controlled conditions to ensure uniformity. Specifically, the noodles were boiled in water until fully cooked; salt and sugar were added, and the noodles were partially fried in cooking oil to enhance flavor and texture. Each sample was then packed in clean, food-safe containers and labeled with anonymous unique identification codes to avoid bias during consumer evaluation.

Before the evaluation, a detailed description of each specification (package size, price) was presented to the consumers. Participants were then asked to test the sample and complete a structured questionnaire covering their socio-demographic characteristics, willingness to buy, perceived value, and price preference for each sample. Consumers were asked to evaluate the attributes by rating the choice of their preference and willingness to buy on a 5-point scale (1= definitely will not buy, 2=will not buy, 3=neither nor will buy, 4=will buy and 5=definitely will buy).

Consumers also proposed the maximum price they would be willing to pay for identified weight of each noodle sample, providing direct input on price sensitivity. Single-item indicators adapted from previous validated consumer preference studies were used to measure key constructs such as perceived value and price as used in pretesting with a small subset of participants to ensure clarity and comprehension (Drake et al., 2023; Hough et al., 2006; Lawless & Heymann, 2010; Wangcharoen et al., 2005).

Data were collected on the product attributes (taste, aroma, packaging, price, and nutritional value), and external drivers (household size, income, and food expenditure). These data served as the foundation for developing a consumer preference model.

3.3. Estimation of the production cost of the developed PPBN

The cost of producing pigeon pea-based noodles was estimated to provide a benchmark for interpreting consumer willingness to pay in relation to potential market viability. The total production cost was calculated by summing up the cost of ingredients, manufacturing, packaging, labelling, marketing, and estimated profit margin. Since actual production cost for manufacturing, packaging and marketing were not established during product development, estimated proportions from prior literature were used. Following the approach by Gilbert and Prusa (2021), it was assumed that manufacturing costs would account for 55% of the ingredient cost, the profit margin would constitute 20%, marketing and advertisement would take up 4%, and packaging and labelling would contribute 15% of the ingredient cost. These values were used to estimate a hypothetical retail price range, which was later compared to the consumers' proposed

WTP values. This comparison helped evaluate whether the PPBN products could be priced competitively while remaining economically viable for producers.

4. Data analysis

Data were analysed using SPSS version 25. Descriptive statistics such as means and standard deviations were used to summarize continuous variables such as age, income expenditure and price preferences. Frequencies were used to summarize preference ratings of the samples, buying interest and factors to consider when buying developed noodles. The Chi-square test was used to determine the association between categorical variables, such as consumer socio-demographic characteristics and sample preferences.

A binary logistic regression model was applied to identify the predictors of consumers' willingness to pay for the developed noodles. The dependent variable was willingness to pay, coded as 1 = Yes and 0 = No. Categorical independent variables were converted into dummy variables prior to analysis (Table 1). Continuous variables such as age, price, and daily food expenditure were log-transformed (using natural logarithms) to improve comparability and model fit. The model allows estimation of the effect of multiple socio-demographic and product-related factors on the probability of purchasing the developed noodle while controlling for heterogeneity across participants.

The logit model assumes the independence of irrelevant alternatives (IIA), meaning the odds of choosing one option over another are unaffected by additional alternatives. Multicollinearity among explanatory variables was assessed using variance inflation factors (VIF), with all variables found to be within acceptable limits (<5), ensuring reliable parameter estimates. Odds ratios and marginal effects, were calculated to show the multiplicative change in odds of willingness to pay and the estimated change in probability of willingness to pay associated with a one-unit change in each predictor variable helping non-technical readers understand the regression results.

The logistic regression model was as follows:

$$\ln\frac{P_i}{(1-P_i)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \ldots \beta_n X_n$$

where P_i = 1 if individual is willing to pay for a developed product and P_i = 0 if individual is not willing to pay for a developed product, β = Parameter estimates, X_1 = Age in years, X_2 = Gender of the consumer, X_3 = Education level, X_4 = Marital status, X_5 = Expenditure per day, X_6 = Package size, X_7 = Price of the product, X_8 = Taste, X_9 = Colour, X_{10} = mouthfeel and X_{11} = Aroma

Table 1. Dummy variables used in the logit model (independent categorical data).

Variables	Response choices	Dummy variables
Sex	1 = female, 2 = male	0 = female 1 = male
Marital status	1 = Married, 2 = Single/widowed/ divorced	0 = Married 1 = Single
Residence	1 = Far from village centre 2 = Village centre 3 = District centre	0 = Village 1 = Other residential area
Education	No formal education Primary school education Secondary school education College/University education	0 = Primary school education 1 = Other education levels
Occupation	1 = Farmer 2 = Public servant 3 = Self employed	0 = Farmer 1 = Other occupation
Package size	250g 500g 1000g	0 = 500 g package size 1 = Other package size
Colour	1 = Yes; 2 = No	1 = Yes; 0 = No
Taste	1 = Yes; 2 = No	1 = Yes; 0 = No
Aroma	1 = Yes; 2 = No	1 = Yes; 0 = No
Mouthfeel	1 = Yes; 2 = No	1 = Yes; 0 = No

4.1. Ethical approval

Ethical approval for this study was obtained from the Tanzania National Institute for Medical Research (NIMR) Ethical Committee (Reference No. NIMR/HQ/R.8a/Vol. IX/3040) prior to the recruitment of any participants. Additional permission to conduct the research was obtained from Sokoine University of Agriculture and the Ruangwa and Nachingwea District Councils; no separate reference numbers were issued by these local institutions. The NIMR Ethical Committee acted as an independent review board overseeing study compliance with ethical standards within the country and is mandatory for any researcher to apply. Participation in the study was entirely voluntary, and all participants provided written informed consent after receiving detailed information about the study objectives, procedures, potential benefits, risks, and their right to withdraw at any time without penalty. Confidentiality and privacy were strictly maintained through secure data storage and anonymization of personal identifiers. To ensure special care was taken to protect vulnerable populations and minimize potential harm or discomfort all preparations were done in collaboration with community members. All study procedures were conducted in accordance with the principles outlined in the Declaration of Helsinki, ensuring respect for participant autonomy, beneficence, non-maleficence, justice, and scientific integrity.

5. Results

5.1. Consumer characteristics

The mean age of consumers was 38.79 ± 11.9 (SD) years. About 61% of the consumers were aged between 20 to 40 years, 78% were married, 64% had school primary education, and 69% were farmers (Table 2). The average household size was 3.52 ± 1.46 (SD) people and 70% of households had 3–5 people. Average household expenditure for food was 13 625 ± 1653.8 (SD) TZS/week during harvesting season and 25 176 ± 5485.8 (SD) TZS/week during lean season. A day before the interview 52% of the consumers reported to have spent between 2500 and 10 000 TZS on household food while 31% of them reported to have spent an amount less than 2500 TZS (Table 2).

5.2. Preferences for the products

About 53% and 47% of consumers preferred samples PPBN193 and PPBN718 respectively. There was no significant difference in preference for the products between age groups (χ^2 = 1.086, p = 0.581), sex (χ^2 = 2.692, p = 0.101), marital status (χ^2 = 0.010, p = 0.920), education (χ^2 = 5.572, p = 0.134), source of income (χ^2 = 5.895 p = 0.052) and amount of money spent per week (χ^2 = 2.772, p = 0.250). About 92% and 94% of consumers choose samples PPBN718 and PPBN193 respectively, because the taste for the products was the most preferred (Figure 1). There was a significant difference in the reason for their choices in terms of age, however, there was no significant difference in preference that was observed between sex, education level and marital status. More than 50% of consumers aged 20–40 years selected taste as a reason for their choice.

5.3. Perceived value

Table 3 indicates the perceived value of noodles. About 58% and 60% of the consumers perceived that colour of noodles was good for samples PPBN718 and PPBN193 respectively. More than 70% of consumers also agreed that the taste and aroma of noodles were good for both samples. However, a significant difference was observed in mouthfeel between samples at $p < 0.05$. About 40% of consumers perceived that the mouthfeel of sample PPBN718 was not appealing while 48% of consumers perceived that the mouthfeel of sample PPBN193 was appealing. About 62% of consumers, who selected sample PPBN718, agreed that the existing price of noodles in the market was within their purchasing capacity and more than 50% of consumers reported that cooking noodles was simple and takes short time to prepare.

Table 2. Characteristics of consumers who participated in the consumer survey.

Characteristics	$n = 107$	%
Area of residence		
Far from the village	17	15.9
Village centre	50	46.7
District centre	40	37.4
Sex		
Female	53	49.5
Male	54	50.5
Age groups		
20–40 years	65	60.7
41–50 years	37	34.6
More than 50 years	5	4.7
Marital status		
Married	83	77.5
Single/widowed/divorced	24	22.4
Education		
No formal education	7	6.5
Primary school	68	63.5
Secondary school	12	11.2
College/University	20	18.7
Source of livelihood		
Farming	74	69.2
Public service	24	22.4
Self-employment	9	8.4
Average amount of money spent a day before survey		
Less than 2500/=	34	31.8
2500–10,000/=	56	52.3
More than 10,000/=	17	15.9
Amount of money used a day before survey, compared to normal		
Very low	42	39.3
Rather low	16	15.0
Sufficient	26	24.3
Rather high	12	11.2
High	11	10.3

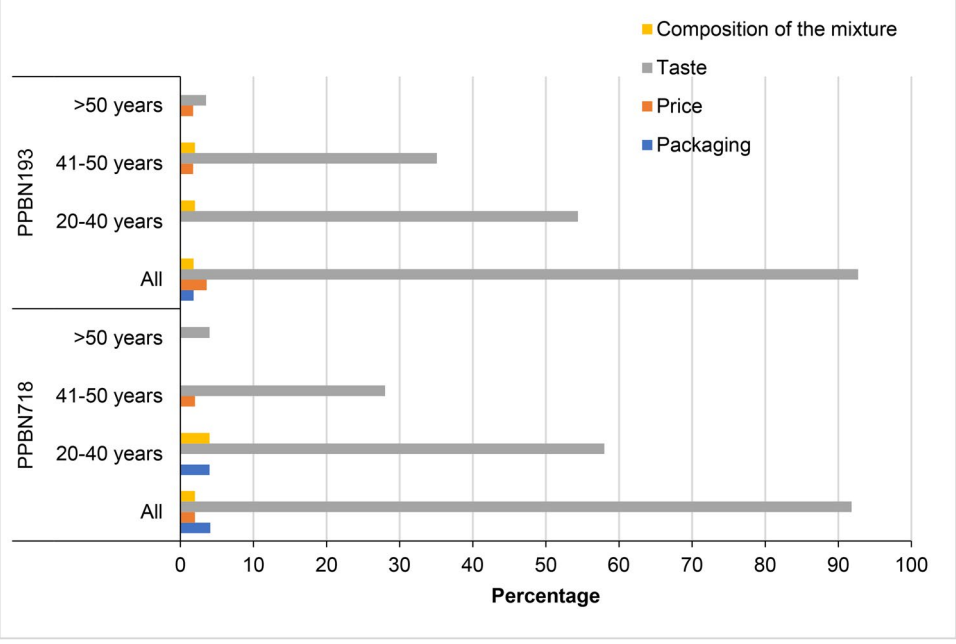

Figure 1. Reasons for choosing the noodles samples.

5.4. Consumer willingness to pay for developed pigeon peas-based noodles

The majority of consumers reported their willingness to buy the developed PPBN (86%) (Table 4). Among them, 39% were from the village centres, 40% were female, 41% were aged 20–40 years, 67% were

Table 3. Perceived value of noodles samples.

	Sample PPBN718			Sample PPBN193		
Perceived values	Disagree *n* (%)	I don't know *n* (%)	Agree *n* (%)	Disagree *n* (%)	I don't know *n* (%)	Agree *n* (%)
The colour of the noodles is not good	29(58)	4(8)	17(34)	34(59.6)	2(3.6)	21(36.9)
The taste of the noodles is good	3(6.0)	6(12.0)	41(82.0)	3(5.3)	5(8.8)	49(86)
The aroma of noodles is good	6(12.0)	7(14.0)	32(74.0)	3(5.3)	4(7.0)	49(86)
The mouthfeel of noodles in not appealing	19(38.0)	11(22)	20(40.0)	28(49.1)	11(19)	18(31.6)
The price of noodles in the market is within the purchasing capacity	9(18.0)	10(20.0)	31(62.0)	19(33.3)	7(12.3)	28(51)
Preparation of noodles before cooking is hard	28(56.0)	13(26)	9(18)	34(59.6)	11(19.3)	12(21.1)
Cooking noodles takes too long time before is ready for consumption	28(56)	12(24)	10(20)	36(63.2)	10(17.6)	11(19.3)

Table 4. Willingness to pay for developed noodles.

Consumer characteristics	Definitely will not buy		Will not buy		Will buy		Definitely will buy	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**
PPBN	14	13	1	1	57	54	34	32
Area of residence								
Remote area	1	1	0	0	12	11	4	4
Village centre	7	7	1	1	31	29	11	10
District centre	6	6	0	0	14	13	19	18
Sex								
Female	8	8	1	1	29	27	14	13
Male	6	6	0	0	28	26	20	19
Age groups								
20–40 years	8	8	0	0	35	33	21	20
41–50 years	5	5	1	1	19	18	12	11
More than 50 years	1	1	0	0	3	3	1	1
Marital status								
Married	11	10	0	0	46	43	25	24
Single/widowed/ divorced	3	3	1	1	11	10	9	8
Education								
no formal education	0	0	0	0	6	6	1	1
Primary school education	9	8	1	1	46	44	19	18
Secondary school	2	2	0	0	3	3	6	6
College/University	3	3	0	0	8	8	9	8
Source of livelihood								
Farmer	9	8	1	1	45	42	19	18
Public servant	3	3	0	0	10	9	11	10
Self-employed	2	2	0	0	2	2	4	4
Expenditure per day								
less than 2500/=	2	2	1	1	20	19	11	10
2500–10000/=	5	5	0	0	30	28	20	19
More than 10,000/=	7	7	0	0	7	7	3	3

married, 62% had attained primary education, 60% were farmers and 47% were among those who have reported to spent 2500–10,000 TZS per day in household food.

It was noted from about 94% and 92% of consumers reported that price and availability of the small package size, respectively were among the key drivers that influence their buying decision (Figure 2). Other key drivers were colour, availability of different varieties of flavour, cooking time, ability to stay longer without deterioration, convenience in preparation, taste and nutritional value.

Table 5 shows the lowest and highest prices reflecting of consumers' willingness and not willingness to pay for the product across different package sizes for the products. For a package size of 1000 g, the median price reflecting consumers willingness to pay was Tanzanian shillings 2000 (IQR = 1500, 2200)

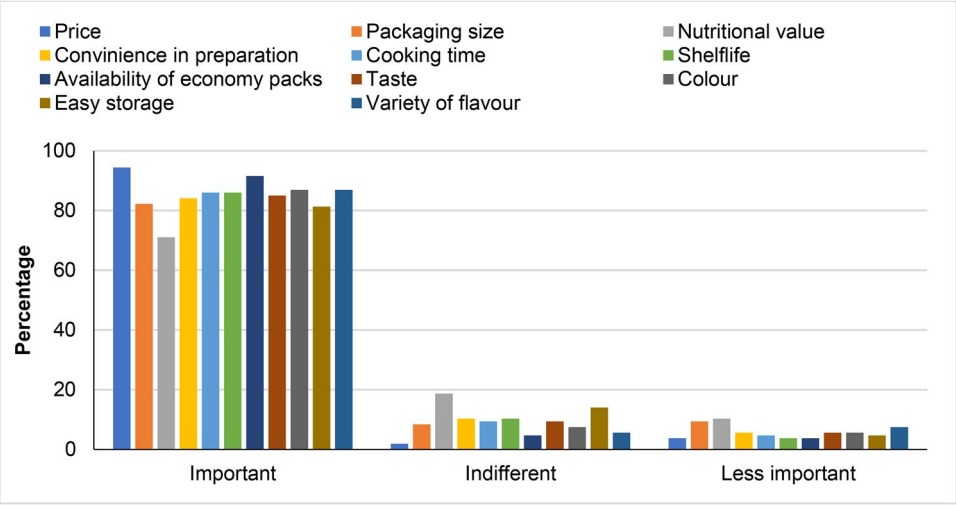

Figure 2. Drivers for buying decision.

Table 5. Price preference for noodles.

	Price will buy (TZS)			Price will not buy (TZS)		
Package size (g)	Lowest $\bar{x}$ (SD)	Highest $\bar{x}$ (SD)	Median (IQR*)	Lowest $\bar{x}$ (SD)	Highest $\bar{x}$ (SD)	Median (IQR)
250	554.21 (295.57)	842.52 (355.20)	600 (500,887.5)	274.02 (167.82)	1448.60 (767.85)	500 (250,1200)
500	1170.56 (397.45)	1633.64 (593.32)	1300 (1000,1600)	568.22 (382.17)	2442.99 (748.75)	1450 (500,2500)
1000	1623.36 (480.93)	2300.93 (1032.24)	2000 (1500,2200)	762.15 (288.69)	3307.48 (1104.68)	1500 (800,3000)

IQR = Interquartile range (25%,75%).

Table 6. The estimated cost for production of developed noodles (PPBN).

Cost items	PPBN718	PPBN193
Ingredients	1068.00	1860.00
Manufacturing (55%)	587.4	1023.00
Profit (40%)	213.6	372
Packaging and labelling (15%)	160.2	279
Marketing (4%)	42.72	74.4
Total production cost per 1000 g	**2071.92**	**3608.40**

TZS. On other hand, it was noted that the consumers will not buy PPBN if the median price will exceed 1500 (IQR = 800, 3000) TZS for 1000 g of noodles.

Results also indicated that the estimated price for samples PPBN718 and PPBN193 was 2071.92 TZS/kg and 3608.40 TZS/kg, respectively when the manufacturing cost was set at 55%, with addition of 20% profit, 15% packaging and 4% marketing (Table 6).

The logistic regression model was statistically significant (χ^2 27.402, $p < 0.005$), indicating that the set of predictors reliably distinguished between consumers willingness and not willingness to pay for the developed PPBN. The Nagelkerke R^2 value of 0.332 explained that approximately 33.2% of the variability in willingness to pay for the developed products was explained by the model. Table 7 shows the estimated coefficients, odds ratio and 95% confidence intervals for predictors. Expenditure per day, package size and price were significant contributor to consumers' willingness to pay. Consumers who spent less than 2500 TZS per day showed lower willingness to pay compared to those spending more than 2500 TZS per day (OR = 0.455, 95% CI 0.235–0.881). The marginal effect indicates that lower daily food expenditure decreased the probability of willingness to pay by approximately 10 percentage points, indicating a substantial affordability constraint among-low expenditure household.

The consumers who preferred package size of 500 g showed higher willingness to buy the developed PPBN than those who preferred package sizes of 250 g and 1000 g (OR = 11.226, 95% CI 1.390–90.646).

Table 7. Contribution of each independent variable to the model.

Variables	β	SE	Sig.	Exp(β)	95% CI		Marginal effect
				Odds ratio	Lower	Upper	(Δ*P*)
Constant	1.738	0.271	0.009	5.687	–	–	–
Age	−2.595	1.406	0.065	0.075	0.005	1.175	−0.331
Sex	0.724	0.713	0.310	2.062	0.510	8.333	0.092
Marital status	−0.836	0.795	0.293	0.433	0.091	2.056	−0.107
Occupation	−1.876	1.670	0.261	0.153	0.006	4.042	−0.239
Residence	1.531	1.010	0.129	4.624	0.639	33.457	0.195
Education	0.841	1.532	0.583	2.319	0.115	46.696	0.107
Expenditure	−0.787	0.337	0.019*	0.455	0.235	0.881	−0.100
Package size	2.418	1.066	0.023*	11.226	1.390	90.646	0.308
Price	−0.001	0.000	0.043*	1.001	1.000	1.002	−0.0001
Colour	−0.135	0.795	0.865	0.874	0.184	4.154	−0.017
Mouthfeel	−0.784	0.783	0.316	0.456	0.098	2.117	−0.100

*Significance was considered at $p < 0.05$.

The marginal effect suggests that choosing the 500 g package increased the probability of willingness to pay by approximately 31 percentage points, highlighting the strong role of package size in shaping purchase decisions.

Price was negatively associated with willingness to pay (OR = 1.001, 95% CI: 1.000–1.002), meaning that the as price increased, with the likelihood of buying the developed noodles to decrease. The marginal effect indicates that each one unit increase in price reduced the probability of willingness to pay by approximately 0.01 percentage points, emphasizing consumer sensitivity to prices, even when absolute effect is small. Other variables, including age, sex, marital status, occupation, residence, education, colour, and mouthfeel, were not statistically significant predictors of willingness to pay, indicating no strong evidence that these factors influenced purchase decisions in this sample.

6. Discussion

6.1. Preferences and perceived value of PPBN

Consumers' preferences for the two samples of noodles were not significantly different in terms of choice, likely due to the comparable formulation of pigeon peas in both products. This similarity in preference may also reflect a familiarity bias, whereby consumers favor products that align with familiar sensory experiences, such as the taste and aroma profiles of traditional noodles. Taste emerged as the primary reason behind consumer choices, underscoring its pivotal role in food acceptance. Taste is a critical sensory attribute that influences consumer liking and plays an important role in food selection (Liem & Russell, 2019). Notably, age differences were observed to influence taste preferences. More than half of consumers aged 20–40 years shows a stronger preference for sweetness)which aligns with the patterns is sensory psychology indicating that taste sensitivity and hedonic responses to sucrose decreases as an individual become older (Fukunaga et al., 2005; Mojet et al., 2001).

Both samples were generally perceived to have good taste, color, and aroma, with the exception of mouthfeel. In this context, mouthfeel refers to the textural and tactile sensations remaining in the mouth after chewing and swallowing. This may influence perceived quality and trust in the product, as consumers often interpret smooth and consistent textures as indicators of freshness and skillful processing. The observed difference in mouthfeel between the samples was attributable to the specific composition of ingredients. Although both contained pigeon peas and wheat flour, sample PPBN193, which received higher ratings for mouthfeel, also included orange-fleshed sweet potato flour. The addition of cooking oil during preparation act as flavor carrier, enhancing sensory satisfaction and perceived product value. Similar findings have been reported previously, emphasizing that fat acts as a flavor carrier and enhances mouthfeel, as stipulated in consumer psychology research indicating that multi-sensory cues reinforce positive purchase intentions (Abdolmohamad Sagha et al., 2022; Korese et al., 2021; Lyu & Huang, 2024; Soria-Hernández et al., 2015).

Additionally, consumers perceived that the price of existing commercial noodles was within their purchasing capacity and appreciated the convenience of preparation. These perceptions enhance the market potential of PPBN as a value-added, time-saving food product, especially when formulated to align with

familiar sensory cues. These findings reflect utilitarian motivations in consumer decision-making whereas consumers value products that reduce effort and time, highlighting the interplay between preference and functional drivers in shaping perceived value and willingness to pay (Li et al., 2024).

6.2. Willingness to buy the developed noodles

Consumers expressed willingness to pay for the developed noodles, with price preferences varying based on package size. The positive response to smaller packages among lower-expenditure consumers indicates a risk mitigation behavior, where smaller quantities reduce perceived financial and consumption risk. The proposed price for PPBN718 was lower than that of current market products, which are priced at approximately 2,400 TZS per 1,000 g making it accessible to a broad consumer base. Based on the median price data, most consumers could afford PPBN718, particularly when daily food expenditure exceeded 2,500 TZS. This supports the notion that perceived affordability interacts with sensory satisfaction to reinforce purchase decisions, consistent with the Stimulus-Organism-Response model which posits that external cues (such as price and sensory quality) influence internal evaluations (e.g. attitudes, perceived value), ultimately shaping behavioral responses (such as purchase intention) (Baek & Choe, 2025; Un, 2025).

Conversely, consumers with lower daily expenditures were less inclined to purchase larger package sizes but showed interest in smaller packaging options. This suggest that consumption decisions are influenced not only by price but also by financial constraints and convenience considerations. This emphasizes the importance of offering a range of packaging sizes to accommodate diverse income levels and increase market accessibility. Offering smaller packages may also serve as a low-risk trial size for new consumers, thereby encouraging product adoption.

6.3. Drivers for buying decision for developed noodles

The main key drivers for consumer buying decisions for developed noodles were price, package size, product appearance (colour), convenience of preparation, taste, and flavour variety. Existing noodle products in the market are priced between 1,000 and 1,500 TZS for a 500 g package, and this range was found to be within consumers' purchasing capacities. Studies have indicated that as product price increases, demand generally decreases especially when substitute products are available (Levrini & Dos Santos, 2021; Zhao et al., 2021). Interestingly, while some consumers equate low price with low quality, others associate high price with better quality, revealing the complex role of price perception in food choice (Levrini & Dos Santos, 2021). Price perceptions were also closely tied to packaging size. Smaller packages naturally command lower prices, offering flexibility for price-sensitive consumers. Price sensitivity reflects economic reasoning, while taste, aroma, and appearance reflect preference valuation and trust in product quality (Garber et al., 2000; Luo et al., 2019).

The colour of the developed noodles was well received by more than half of the consumers. This favorable perception was due to the ivory-like color of the noodles, which closely resembled the reference product (Santa Lucia pasta). Appearance is a critical factor in food acceptance, and color in particular has been shown to influence consumer expectations and purchasing behavior (Luo et al., 2019). Moreover, colour is often associated with the flavour and quality attributes of the food product (Garber et al., 2000). In contrast, a deviation in color such as a grey hue might have led to negative quality associations, including concerns about spoilage or mold. In consumer psychology, visual cues serve as quality signals, and congruence with familiar products can reduce cognitive effort in evaluating novel foods (Chonpracha et al., 2020; Schnurr et al., 2017; Su & Wang, 2023)

Taste also emerged as a major driver of purchase intent. The preferred taste of PPBN may be was attributed to the natural sweetness imparted from orange-fleshed sweet potato added to increase content of pro vitamin A to meet at least 50% of daily nutrient intake for adults. This aligns with earlier findings where sweet potatoes enhanced the sensory appeal of complementary food products (Tumuhimbise et al., 2019). The natural sweetness from orange-fleshed sweet potato aligns with preference motivations, providing immediate sensory satisfaction, which strengthens perceived product value and purchase likelihood. Convenience of preparation was another important consideration, with more

than three quarters of consumers highlighting this factor. This reflects utilitarian value consumers weigh functional benefits (quick cooking) alongside preference benefits (taste and mouthfeel) when making purchase decisions. PPBN requires approximately 10 min to cook, a duration comparable to that of similar products on the market. This quick preparation time meets the needs of urban consumers with busy lifestyles.

Consumers also reported that the nutritional value of the noodles was among the important drivers in purchasing decision. This was due to awareness created on the effect of poor eating behaviour. Due to increase in number of people suffering from diet related disease. Prior studies have confirmed that nutritional attributes increasingly influence consumer preferences, particularly in health-conscious populations (Udomkun et al., 2018). From a behavioral perspective, this aligns with the health-conscious consumer segment, where perceived functional benefits can justify higher willingness to pay and enhance adoption of innovative products as health-conscious consumers often exhibit greater WTP for foods with perceived health benefits and clear health information (Alsubhi et al., 2023; Nazzaro et al., 2025; Su et al., 2023). The inclusion of pigeon peas and sweet potatoes not only improves taste and texture but also enhances the product's nutritional profile, offering an increase on the perceived value through both preference and utilitarian pathways.

6.4. Implications

6.4.1. Practical implications

Consumers positively evaluated developed noodles based on sensory attributes, affordability, convenience, and perceived nutritional value. The study highlights that taste and mouthfeel and package size are key primary drivers of preference, while price sensitivity and packaging options shape willingness to pay. Appearance, especially product color, strongly influences initial acceptance and trust in product quality. These findings emphasize the potential of pigeon pea-based noodles as a viable alternative in the local market. These findings suggest that producers should prioritize improving sensory quality, particularly taste and mouthfeel, while aligning product characteristics with consumer preferences. To enhance market penetration, producers should consider flexible packaging strategies, competitive pricing, and targeted communication of the product's health and nutritional benefits. This multi-faceted approach will cater to both sensory expectations and economic realities of diverse consumer segments.

6.4.2. Theoretical implications

This study contributes to the existing literature on consumer behavior and food choice theories by empirically applying and integrating the Random Utility Model, Consumer Value Theory, and the Stimulus Organism Response framework within the context of value-added legume-based products. The findings indicate that consumers' willingness to pay is influenced not only by price, but by a combination of sensory qualities, perceived value, and individual economic conditions. The finding also support that perceived value serves as a mediating construct between product attributes (e.g. taste, aroma, and appearance) and willingness to pay, hence strengthening the significance of Consumer Value Theory in food choice behavior.

In addition, the observed impact of sensory attributes on purchasing decisions aligns with the SOR model, whereas external stimuli are cognitively processed to shape behavioral responses. By demonstrating the way sensory quality, price sensitivity, and perceived benefits interacted to influence consumer decisions, this study provides a conceptual basis for future research on the adoption and economic valuation of novel food products.

6.4.3. Policy implications

From a policy perspective, pigeon pea is an affordable, nutritious, and environmentally adaptable crop that can improve dietary quality and address protein-energy and micronutrient deficiencies. Results of this study make important contribution to the development of relevant interventions to mitigate macro and micronutrients problems in the country as crucial aspects to policy-making. The Tanzania National Nutritional Strategy (2011/12–2015/16) highlighted dietary improvement to reduce vitamin and mineral

deficiencies, including promoting food processing techniques that enhance nutrient bioavailability. This study applies pigeon pea processing methods to improve vitamin and mineral absorption using affordable, locally available foods, providing a practical example for nutrition stakeholders to support dietary improvement.

Further, the National Multisectoral Nutrition Action Plan (2021/22–2025/26) emphasizes home gardens and small animal keeping but lacks focus on pulses and their processed products. This study highlights the potential of processing pulses, particularly pigeon peas, soybeans, and bio-fortified beans, to improve dietary quality, reduce protein–energy malnutrition, and address micronutrient deficiencies. Incorporating processed pigeon peas into school meals and snacks, such as porridge, bread, chapati, and donuts, can enhance children's nutrient intake. The findings also align with the Tanzania National Agriculture Policy (2013) and Agricultural Marketing Policy (2008), supporting value addition, reduction of post-harvest losses, development of processing units, and improved marketing opportunities. Overall, promoting pigeon pea-based products can strengthen the food value chain, increase dietary diversification, enhance nutrition outcomes, and contribute to achieving Sustainable Development Goal 2 on ending malnutrition.

7. Conclusion

The use of pigeon peas to enrich noodles enhance dietary diversity and nutrition while remaining affordable and acceptable to consumers. This potentially strengthen agricultural value chains, expand farmer incomes, and promote cultivation of a climate-resilient, soil-enriching crop. Generally assessing the influence of sensory attributes, perceived value, and price sensitivity on consumers' willingness to pay (WTP) for pigeon pea-based noodles, offers a sustainable pathway to better nutrition and community wellbeing due to its interconnection between food science, agriculture, environment, and public health.

8. Recommendations

Several recommendations are made from this study: Developers of pigeon pea-based noodles should consider offering the product in a range of package sizes (e.g. 100 g, 250 g, 500 g, and 1000 g) to accommodate varying consumer purchasing capacities. This is particularly important given the observed influence of daily food expenditure on willingness to pay.

Also, A comprehensive cost analysis including manufacturing, profit margins, packaging, labelling, and marketing should be conducted to establish a sustainable and competitive market price for the developed products. This will help ensure affordability while maintaining profitability.

Lastly, targeted promotion and consumer education initiatives should be implemented to raise awareness of the developed noodles' nutritional value, convenience, and sensory appeal. Such efforts can enhance product acceptance and increase market demand, especially among younger consumers and low-income households.

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Availability of data

The datasets used and/or analysed during the current study will be available from the corresponding author on reasonable request.

Authors' contributions

Z.S. M. design the study, collect data, and performed the statistical analysis; as well as wrote the first draft of the manuscript. Other authors (C.R) critically reviewed, refined the manuscript and approved the final manuscript.

Disclosure statement

The authors declare that this manuscript is an original work that has not been published previously and is not under consideration for publication elsewhere, in whole or in part. All authors have read and approved the final manuscript and have contributed significantly to the work. The research was conducted in accordance with ethical standards, and informed consent was obtained from all participants involved in the study. On behalf of all authors, the corresponding author states that there is no conflict of interest

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