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Public Perception and Willingness to Pay for Progari in the Bono and Greater Accra Regions of Ghana

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Cassava is one of the most important staple crops in the tropics, ranking just behind rice and maize as a major source of calories. Its processed products are rich in carbohydrates, with gari being one of the most popular due to its extended shelf life. proGARI, a scientifically fortified version of gari, was developed under hygienic conditions at the Ghana Atomic Energy Commission (GAEC) to provide enhanced nutritional benefits. To assess consumer perception and willingness to pay for proGARI, a comprehensive survey was conducted in the Bono and Greater Accra Regions using structured questionnaires. The results revealed that nearly 70% of respondents expressed a willingness to purchase proGARI, but suggested improvements in the product's color to increase its visual appeal and marketability. Based on these findings, it is recommended to enhance proGARI's color, implement targeted marketing campaigns highlighting its nutritional value and hygienic production, and expand consumer awareness through education programs. Additionally, offering diverse packaging options, exploring broader regional markets, continuously improving the product based on consumer feedback, and collaborating with retailers to enhance distribution channels are essential strategies to boost proGARI's market presence and consumer demand.

Keywords: Cassava; Manihot esculenta; Progari; public perception; nutritional value; Ghana.

1. INTRODUCTION

Cassava (*Manihot esculenta Crantz*) is a vital food crop that was introduced to tropical Africa from the New World, and today it plays a significant role in global food security (Blench, 2014). Historically, cassava has been an important staple in the diets of various societies in the Americas, dating back to the 18th century (Charrier & Lefrèvre, 1994). As a woody perennial plant reaching heights of 1–3 meters, cassava belongs to the genus *Manihot* and the family Euphorbiaceae (Bombily, 1995). There are hundreds of cassava varieties cultivated worldwide, with Africa contributing nearly half of the global production (Laure, et al, 1998). Cassava is cultivated in over 40 African countries, making it one of the continent's most important crops. Cassava ranks as the third most important source of calories in the tropics after rice and maize, underscoring its importance to food security (Fakuda, 2015). Processed cassava products are rich in carbohydrates, particularly starch, and contain valuable minerals (Guira, 2017). Additionally, cassava leaves are a source of protein, vitamins A and C, and essential minerals (Latif et al., 2015). Industrially, cassava is used in a wide array of products, including ethanol, starch, biofuel, flour, and baked goods, making it a versatile and economically significant crop (Echebiri & Edaba, 2008). In many African countries, cassava is consumed in various forms, including *gari*, *attieke*, *tapioca*, and *lafun*, among others (Westby, 2002; Echebiri & Edaba, 2008; Diallo et al., 2013).

1.1 Scope of the Study

This study focuses on understanding public perception and willingness to pay for *proGARI*, a fortified gari (cassava-based staple) with enhanced nutritional value, in the Bono and Greater Accra regions of Ghana. The scope includes evaluating factors influencing consumer awareness, acceptance, and purchasing decisions for *proGARI*, examining regional differences, and identifying potential socioeconomic, cultural, and demographic factors that might shape these perceptions (Mensah et al., 2022). The study targets a cross-section of consumers within various communities, analyzing their familiarity with *proGARI*, the perceived benefits of fortified foods, and their willingness to pay a premium for a nutritionally enhanced product (Gockowski et al., 2013). Additionally, the study will consider the influence of public awareness campaigns, income levels, and local food preferences (Food and Agriculture Organization, 2019).

1.2 Challenges of the Study

Several challenges may impact this study. First, the novelty of *proGARI* as a fortified product may lead to limited consumer awareness or familiarity, making it difficult to assess perceptions accurately (Asante & Afful, 2020). Second, differing economic conditions in the Bono and Greater Accra regions could affect consumers' willingness to pay, with potential disparities in disposable income influencing responses (Ghana Statistical Service, 2021).

Third, social and cultural food preferences play a crucial role in shaping public perception and might hinder acceptance if fortified products are not widely trusted or understood (Agyemang et al., 2016). Moreover, data collection may be hampered by logistical issues, such as reaching remote communities or ensuring representative sampling (Owusu & Darko, 2018). Additionally, biases in responses due to participants' desire to provide socially acceptable answers or misunderstandings about fortification could pose challenges to accurately interpreting public sentiment (Adjei & Osei, 2015).

1.3 Need for the Study

Understanding public perception and willingness to pay for *proGARI* is critical for several reasons. First, consumer acceptance is essential for the success of any fortified food product, particularly in regions where malnutrition and micronutrient deficiencies are public health concerns (World Health Organization, 2017). *proGARI*, as a fortified staple, could play a significant role in improving dietary nutrition, but this potential will only be realized if it gains consumer trust and market acceptance (Gyasi et al., 2021). The study helps identify factors that motivate or deter consumer adoption, allowing producers and policymakers to tailor marketing strategies and public awareness campaigns effectively (Ofori et al., 2020). Additionally, assessing willingness to pay provides insight into the market viability of *proGARI* and helps inform pricing strategies that are both affordable and profitable (Jones & Andrews 2005). The findings could also contribute to broader policy discussions on food fortification in Ghana, supporting efforts to combat malnutrition and enhance food security through fortified staple foods (Food Fortification Initiative, 2018).

2. ECONOMIC IMPORTANCE OF CASSAVA

Cassava has long been a staple crop of significant economic importance, particularly in Africa, where it contributes billions of dollars in income to rural households and national economies. It is especially crucial for food security in many African nations, where it serves as a primary or secondary food staple (FAO, 2012). In Burkina Faso, for example, cassava has played a vital role in addressing household food insecurity during periods of drought and food shortages. The introduction of improved irrigation practices and adapted cassava varieties has allowed for year-round cultivation, increasing its availability (Guira, 2017). Additionally, the fermentation technologies used in processing cassava products, such as attieke, have expanded its utility, contributing to both local and regional economic growth (Mensah et al., 2022).

Historically, cassava has been a reliable food source during times of drought and food scarcity across Africa. It was introduced to the Democratic Republic of Congo as a famine-reserve crop in the 16th century, a move that marked the beginning of its widespread cultivation in the region (Okigbo, 1980). Initially grown for home consumption, cassava gradually became a commercial crop, providing families with an essential food source during difficult periods, including droughts and locust invasions (Hillocks, 2002). Today, Africa produces approximately half of the world's cassava, with countries like Nigeria, the Congo, and Tanzania leading production (IFAD & FAO, 2000). The crop's adaptability to a range of environments and its drought tolerance make it crucial for food security, particularly in regions with unreliable rainfall and poor soil quality (Colding & Pinstrup-Anderson, 2000).

Beyond its role in food security, cassava also has substantial economic value through its market applications. In Africa, Asia, and Latin America, cassava is not only consumed as food but is also processed into various industrial products, including gari, fufu, flour, and tapioca (Mensah et al., 2022). These products support both rural economies and urban food industries (Gockowski et al., 2013). Moreover, cassava is a key component in industries such as biofuels, starch production, and animal feed, thus enhancing its global market relevance (FAO, 2019). The expanding market for cassava-based products reflects its growing importance in both the food and industrial sectors, offering diverse economic opportunities.

Cassava's export potential is another significant aspect of its economic impact. While Africa remains the largest producer of cassava, the continent faces challenges in exporting processed products due to insufficient processing infrastructure. Countries such as Thailand, Vietnam, and Indonesia have capitalized on the global demand for cassava products, including chips, flour, and pellets, primarily targeting markets in Europe and Asia (Gockowski et al., 2013). However, Nigeria is

gradually improving its processing capacity, and cassava is emerging as a key export commodity for both food and industrial uses (Ghana Statistical Service, 2021). As demand for biofuels and starch increases globally, the export market for cassava continues to grow, with the crop contributing to international trade and economic development.

Cassava also plays a crucial role in employment and rural development. The cassava value chain provides livelihoods for millions of farmers, processors, and marketers, directly contributing to the local economy (Gyasi et al., 2021). Its adaptability to poor soils and resilience against climate variability make it particularly valuable in regions facing environmental stress, providing a reliable source of food and income (World Health Organization, 2007). By supporting smallholder farming systems and rural communities, cassava contributes to poverty alleviation and broader economic development, particularly in developing countries.

2.1 Socio-Economic Challenges in Africa and Cassava's Role

Africa's socio-economic challenges, such as civil strife, poverty, and unstable political regimes, have made food security a critical issue. Around three-quarters of Africa's poor population rely on agriculture for their livelihood, making the role of crops like cassava in food security all the more important (Donnelly et al., 2005). Africa's population is expected to double by 2020, and the urban population is growing rapidly, placing additional pressure on food production systems (World Bank, 1999).

Maize has traditionally been Africa's most important food crop, but it is highly vulnerable to the region's unpredictable rainfall. In contrast, cassava is a more resilient crop, thriving in drought conditions and degraded soils, making it an important alternative to maize in many regions (Blackie, 1990; Byerlee & Eicher, 1997). Cassava's adaptability has helped it play a famine-prevention role in Eastern and Southern Africa, where recurrent drought has made maize cultivation difficult (Hillocks, 2002).

2.2 Cassava's Economic Potential and Utilization in Ghana

Cassava is a staple food in Ghana, where its importance has grown steadily due to its adaptability and ease of cultivation. In Ghana, cassava has become a key substitute for other starchy crops like yam and plantain in the preparation of traditional foods such as *fufu*, a common meal in the country's forest zones (FAO, 2012). The labor-intensive nature of yam cultivation, along with cassava's ability to grow on marginal lands, has made it a more affordable and widely available alternative (Guira, 2017).

One of the main products derived from cassava in Ghana is *gari*, a fermented, roasted cassava product that is widely consumed across West Africa (Nweke et al., 2004). Recently, a soybean blended and micronutrient fortified version of *gari* has been developed by the Ghana Atomic Energy Commission (GAEC), containing added protein and iron to enhance its nutritional value. This fortified *gari*, known as *proGARI*, aims to address malnutrition and improve food security in Ghana. However, the key challenge remains in understanding how the public perceives this fortified product and whether they are willing to pay for it.

2.3 Willingness to Pay (WTP)

Willingness to Pay (WTP) measures the maximum amount consumers are willing to spend on a product or service, providing insights into preferences, demand, and policy-making. It is commonly assessed using methods such as contingent valuation (CV), choice experiments (CE), and experimental auctions. Consumers often exhibit a higher WTP for organic and sustainably produced food due to perceived health benefits and environmental sustainability. For example, Loureiro and Hine (2002) found that U.S. consumers were willing to pay 10–30% more for organic apples and lettuce. Similarly, Bonti-Ankomah and Yiridoe (2006) highlighted that Canadian consumers were willing to pay a premium for organic vegetables, with younger and health-conscious consumers driving demand. Labels like "Fair Trade" and "Rainforest Alliance" further influence WTP positively, as shown by Onyango et al. (2007), who found that eco-labels significantly increased WTP for coffee in the U.S. market. There is significant WTP for fortified and nutritional products, especially in low-income countries addressing deficiencies like anemia or iodine. In India, Chowdhury et al. (2011) observed high WTP for iron-fortified salt following awareness campaigns. In Tanzania, De Groote et al. (2011) reported substantial WTP for biofortified maize enriched with vitamin A, especially among mothers with young children. In high-income regions, consumers demonstrate higher WTP for functional foods enriched with

probiotics, omega-3, or antioxidants, provided they trust the health claims. Verbeke (2005) emphasized that European consumers are willing to pay more for functional foods, particularly those with cardiovascular benefits. Food safety and quality assurance also drive higher WTP. Certifications such as HACCP, ISO, and organic labels significantly enhance consumer confidence and willingness to spend. For example, Onozaka et al. (2010) highlighted that Japanese consumers were willing to pay a premium for vegetables certified as safe from pesticide residues. Similarly, Dickinson and Bailey (2002) reported that U.K. consumers paid significantly more for beef with traceability and pathogen-free guarantees. A study by Alfnes and Rickertsen (2003) also found that Norwegian consumers valued food safety labels on fish products. Methodological approaches to measuring WTP vary. CV is frequently used for public goods like nutritional programs and food safety interventions, as illustrated by Whittington (1998), who explored WTP for clean water in developing countries. CE is popular for multi-attribute goods like organic and fortified foods. Lusk and Schroeder (2004) used CE to estimate WTP for beef quality attributes such as tenderness and marbling. Experimental auctions provide robust WTP estimates by directly observing bidding behavior, as shown by Huffman et al. (2003) in their study of genetically modified food preferences.

Several factors influence WTP, including income, education, health awareness, cultural preferences, and trust in certifications. Research by Batte et al. (2007) confirmed that higher education levels and health consciousness are strongly linked to increased WTP for organic products. However, gaps remain, particularly in developing regions where nutritional deficiencies are more prevalent. Incorporating behavioral insights, such as framing effects and social norms, as suggested by Ariely et al. (2006), and conducting segmentation studies can enhance the understanding of WTP decisions across diverse consumer groups.

2.4 Objectives of the Study

The primary objective of this study is to assess consumers' perceptions of *proGARI* and to evaluate their willingness to pay for it. Understanding consumer behavior toward *proGARI* will provide insights into its market potential and inform strategies for promoting its consumption. Specifically, the study seeks to:

1. Ascertain consumer awareness and perceptions of the nutritional benefits of *proGARI*.
2. Evaluate the factors influencing consumer willingness to pay for the fortified product.
3. Explore the socio-economic characteristics of consumers that impact their purchasing decisions for *proGARI*.

Through this research, the study aims to contribute to the broader conversation on food security, nutrition, and market development for fortified foods in Ghana and beyond.

3. METHODOLOGY

This section outlines the research design, data collection methods, and analytical techniques employed to assess consumers' perceptions and willingness to pay (WTP) for *proGARI*. A mix of quantitative and econometric methods were applied to ensure a robust analysis, capturing consumer behavior and consumption patterns.

3.1 Data Collection

To gain insights into consumer preferences and WTP for *proGARI*, structured questionnaires were distributed in Sunyani (Bono Region) and Accra (Greater Accra Region). These regions were purposefully chosen to represent both rural and urban settings, ensuring the diversity of socio-economic backgrounds among the respondents. The choice of these regional capitals was strategic, as they feature varying levels of consumer awareness, income distribution, and food consumption habits (Gyimah-Brempong, 1987).

Data collection employed a combination of simple random selection and the snowball sampling approach. Simple random selection ensured that each participant in the study population had an equal chance of being included, thus minimizing selection bias (Etwire et al., 2013). The snowball technique was used to increase the sample size, particularly in areas where respondents were hard to reach, as it relies on referrals from initial respondents to recruit further participants (Goodman, 1961; Heckathorn, 2011). This method proved useful for accessing diverse consumer segments, particularly in densely populated areas of Accra and the peri-urban communities of Sunyani.

The survey collected a range of variables, including respondents' demographic characteristics (such as age and household size), gari consumption patterns (including frequency and type of gari consumed), and weekly purchasing behavior. Gathering this data enabled the study to explore how socio-economic factors influence purchasing decisions and consumption behavior related to *proGARI* (Awunyo-Vitor, 2012). For instance, information on household size and consumption patterns is critical in understanding the household demand for food products, which plays a vital role in assessing the potential market for *proGARI* (Akoto et al, 2020).

3.2 Willingness to Pay (WTP) Analysis

To evaluate consumers' willingness to pay (WTP) for *proGARI*, the study applied econometric models that are suitable for dealing with consumer behavior and monetary decisions. Specifically, a **double-hurdle model** was employed, consisting of a **probit model** and a **tobit model**. These models are particularly well-suited to examining situations where consumers make two decisions: first, whether or not they are willing to pay for a product, and second, how much they are willing to pay (Cragg, 1971; Wooldridge, 2010).

3.3 Probit Model

The probit model was used to analyze the binary decision of whether a consumer is willing to pay for *proGARI*. This model is ideal for understanding the factors that influence a yes/no decision. Independent variables such as age, household size, income level, and educational background were included in the model to explore their impact on consumers' willingness to pay. The general probit model takes the form:

P(Y=1) = represents the probability that a consumer is willing to pay (WTP)

X denotes a vector of independent variables (such as age, income, and household size) which might influence a consumer's WTP.

β represents the vector of coefficients associated with each independent variable in X. Each coefficient in β indicates the strength and direction of the effect that the corresponding variable in X has on WTP.

Φ(X′β) is the cumulative distribution function (CDF) of the standard normal distribution. The probit model uses Φ the normal CDF, to link the linear combination $X^i\beta$ to the probability P(Y=1), which keeps the output within the range [0,1]. The probit model, as outlined by Wooldridge (2010), provides a way to examine how demographic factors influence WTP by observing the significance and magnitude of coefficients in β. This is useful for identifying which factors (age, income, etc.) have a statistically significant effect on a consumer's willingness to pay.

3.4 Tobit Model

After identifying whether consumers are willing to pay, the tobit model was employed to examine the extent of their WTP. The Tobit model is commonly used for situations where the dependent variable Y is censored. For instance, it applies when we observe Y only if it falls within a certain range (e.g., non-negative values), and unobserved values below or above this range are censored at a limit.

The general form of the Tobit model can be expressed as:

$Y_i^* = X_i'\beta + \epsilon_i$

where:

Y_i^* is the latent (unobserved) dependent variable, representing the true underlying value we want to model.

X_i is a vector of independent variables for the i-th observation.

β is a vector of coefficients associated with the variables in X.

ϵ_i represents the error term, which we assume to be normally distributed with mean zero and constant variance σ2.

3.4.1 Censoring rule

The observed dependent variable Yi relates to Yi∗ as follows:

$$Y = \begin{cases} Y^* \; if \; Y^* > 0 \\ 0 \; if \; Y^* \leq 0 \end{cases}$$

This means:

If $Y_i^* > 0$, we observe Y_i directly as $Y_i = Y_i^*$.

If $Y_i^* \leq 0$ Y_i is censored at 0, and we observe $Y_i = 0$.

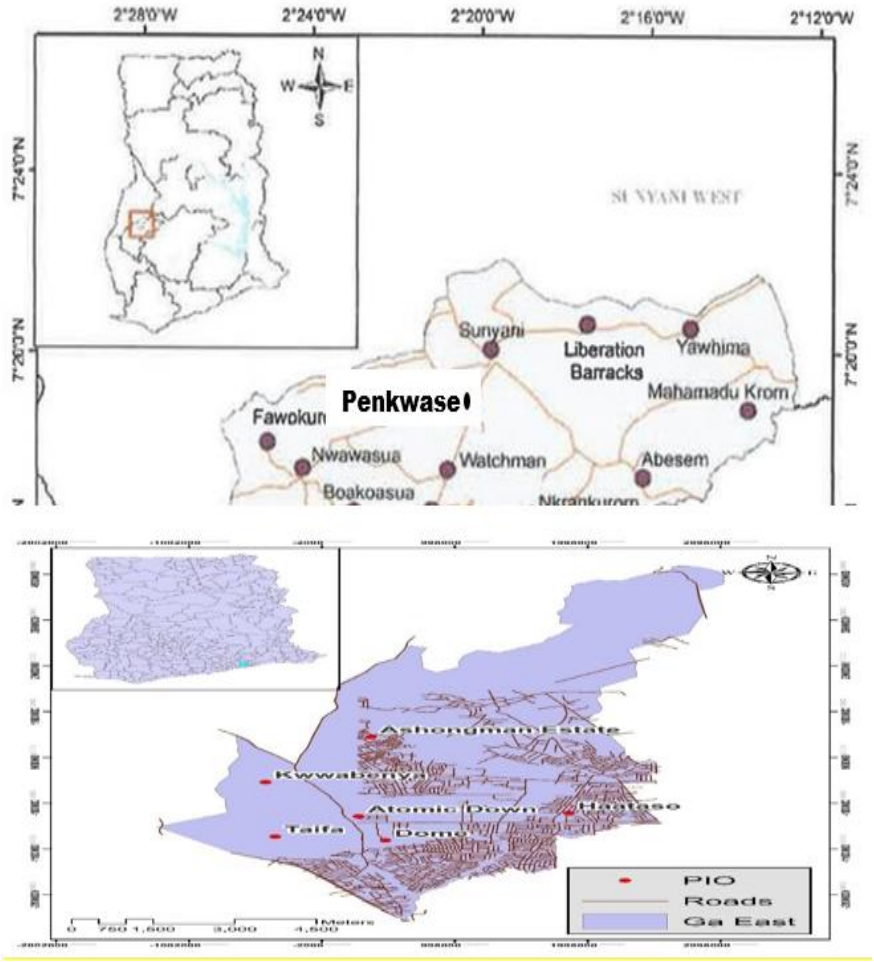

Fig. 1. A map showing the study communities

3.5 Estimation of the Tobit Model

To estimate β in a Tobit model, we use maximum likelihood estimation (MLE), which takes the censoring into account by modifying the likelihood function. The tobit model provides insights into the degree of consumer willingness to pay for *proGARI*, particularly important for pricing and market entry strategies (Maddala, 1983).

By combining the probit and tobit models into the double-hurdle framework, the study offers a comprehensive view of both the decision-making process and the extent of WTP. This approach ensures that both the likelihood of market entry and potential revenue from *proGARI* are accurately assessed.

4. RESULTS

4.1 Socioeconomic Characteristics

Socioeconomic characteristics play a critical role in consumer preferences and purchasing behavior. Understanding the community context, gender distribution, marital status, and other demographic factors help paint a clearer picture of the target market's preferences and their likelihood of adopting new products like *proGARI*. According to Asenso-Okyere et al. (1997), socioeconomic characteristics significantly influence consumption patterns and decision-making processes in both urban and rural areas. The data collected in Sunyani and Accra provides insights into these variables, and the following subsections elaborate on the key findings from the survey.

4.1.1 Community, gender, and marital status

The survey was conducted in two major cities in Ghana, Sunyani and Accra, with equal numbers of respondents from each location (179 respondents from Accra and 179 from Sunyani). Specific communities like Penkwasi contributed 16.5 % (60 respondents), while the rest came from areas like Haatso (25.4 %) and GAEC (17.4 %). Community-specific factors, such as local market structures and cultural norms, can influence consumption patterns (Fafchamps & Shilpi, 2003). Gender distribution and marital status were not explicitly mentioned but are important variables in similar studies, as they influence household spending and product choice (Hoddinott & Haddad, 1995).

4.1.2 Gari consumption and frequency of consumption

Gari, a popular staple in many Ghanaian households, was consumed by majority of the respondents, with 96.64% (345 respondents) stating that they consume gari. The frequency of consumption varied, with 72.17 % consuming gari once a week, 11.88 % consuming it twice a week, and 15.95 % consuming it more than twice a week. This pattern aligns with findings by Boateng et al. (2017), which show that staple foods like gari are consumed frequently in urban areas due to their affordability and versatility in meals.

4.1.3 Where do you buy your gari?

In line with common market trends, most respondents (71.40 %) purchased their gari from market centers, 12.14% from supermarkets, and 13.60 % from street vendors. Market centers are often the primary source of staple food products in Ghana, especially in low-income communities (Abbott, 2003). The smaller percentage buying from supermarkets reflects the gradual penetration of modern retail outlets, while street vendors remain a significant source due to convenience and price flexibility.

4.1.4 Factors considered when buying gari

The survey revealed that 41.50 % of respondents prioritized the neatness of the gari when making their purchasing decisions. This finding is supported by studies such as Omotayo et al. (2020), which indicate that product cleanliness and appearance are significant factors influencing food purchases in developing countries. Price, particle size, and environmental factors were also mentioned by a notable portion of respondents (33.57 %), indicating the multifaceted nature of consumer decision-making.

4.1.5 Awareness of different gari types

About 58.33 % of respondents were familiar with various types of gari, including CSIR gari, smooth, rough, dry, *proGARI*, and local white gari. Product differentiation in the gari market is minimal, but awareness of different varieties, such as white and yellow gari, suggests that consumers have a preference based on either regional origin or processing methods (Aidoo et al., 2009). The knowledge of specialty gari types like Angloga and Asante gari by 7.32 % of respondents suggests that regional identity plays a role in consumer choices.

4.1.6 Preferred gari type

Nearly half of the respondents (49.76 %) reported that they often purchase white gari, a popular choice in many households due to its versatility in meals. The preference for yellow gari by 8.30 % and other specialty types (Angloga, Asante, Ivorian) by 41.94 % indicates that certain consumers may seek out gari types based on texture, color, or perceived quality (Abdoulaye et al., 2015). This aligns with market segmentation theories that highlight how consumer preferences are shaped by product characteristics and cultural factors (Kotler & Keller, 2016).

4.1.7 Awareness of *proGARI*

The survey results indicate a considerable awareness gap regarding proGARI, with 91.04% of respondents unfamiliar with the new gari brand, and only 8.96% expressing familiarity. This low level of brand recognition underscores the challenges new products face when attempting to enter established markets, particularly those characterized by deep-seated consumer preferences and loyalty to traditional products. Gari, a staple food in West Africa, has long-standing cultural significance and is produced and consumed widely, making it challenging for alternative brands like proGARI to gain traction without significant brand awareness efforts According to Aaker (1996), brand awareness is a critical determinant in the adoption and success of new products. Higher awareness can foster a sense of familiarity and

trust among consumers, which is essential for encouraging trial and acceptance of new brands. In the case of proGARI, the low awareness level suggets that targeted marketing efforts are essential to establish the brand's identity and distinct value in the competitive gari market. Without an adequate awareness base, proGARI is at risk of remaining obscure to potential consumers who may otherwise benefit from its unique attributes, such as nutritional enhancements designed to offer health benefits over traditional gari.

4.1.8 Taste, color, and flavor of *proGARI*

Among those who sampled *proGARI*, 69.23 % reported that it had good taste, while 21.08 % were indifferent. In terms of color, 50.00 % made positive comments, while 35.14 % had negative perceptions. Flavor was viewed positively by 64.10 %, but 15.38% did not like it. Consumer preferences for sensory characteristics such as taste, color, and flavor are critical in food products (Cardello, 1994). The mixed reactions to *proGARI* highlight the importance of sensory appeal in gaining consumer acceptance for new food products.

4.1.9 Willingness to Pay (WTP)

The survey results indicate a promising level of interest among respondents in purchasing proGARI, with 86.04% expressing a willingness to pay (WTP) for the new product. Respondents reported a maximum WTP of GH¢50.00 and a minimum of GH¢2.00, with a mean WTP of GH¢17.5 ± GH¢12.1. This substantial variation in WTP underscores a wide range of consumer valuation, possibly influenced by factors such as income levels, household size, and perceived benefits of the product. Willingness to pay for new food products, as highlighted by Mitchell and Carson (1989), is typically shaped by perceptions of quality, pricing, and brand familiarity. In this context, the relatively high WTP observed suggests that many consumers may see potential value in proGARI, despite the low current level of brand awareness. This insight is encouraging for market penetration strategies, as it implies that consumers are likely to accept and invest in proGARI if they recognize tangible benefits such as enhanced nutritional value, unique flavors, or superior processing standards that distinguish it from traditional gari products.

4.2 Amount Spent in Ghanaian Cedis

Consumer spending behavior is often influenced by income levels, preferences, and product perceptions. According to Deaton and Muellbauer (1980), consumer demand varies with changes in price and income, and spending patterns often exhibit significant variability, especially in low- to middle-income settings. The observed mean spending of 5.02 Cedis, with a wide standard deviation of 8.47 Cedis, aligns with existing literature on the disparity in consumer expenditure in emerging economies (Deaton & Muellbauer, 1980). Moreover, studies by Abdulai and Huffman (2000) emphasize that variations in spending often reflect differences in income levels, household composition, and preferences, which may explain the observed range in your data.

4.2.1 Willingness to pay for a 10% benefit

Willingness to pay (WTP) is commonly used to evaluate consumer demand for product benefits. Hanemann (1991) posits that consumers' WTP is often determined by their perceived utility from the product. The average WTP of 9.82 Cedis for a 10 % benefit, with moderate variability (standard deviation of 4.39 Cedis), supports this theory, as consumers may assign varying values to incremental benefits based on their needs and economic circumstances (Hanemann, 1991). This finding is consistent with the work of Mitchell and Carson (1989), who found that consumer WTP for product improvements or benefits often varies across individuals due to factors like income, education, and personal preferences.

Table 1. Mean, minimum and maximum values of some socioeconomic variables

Variable	Obs	Mean	Std. Dev.	Min.	Max.
How much do you spend in Gh cedi	333	5.02	8.47	0	50
How much to pay for 10% benefit	345	9.82	4.39	2	50
How much to pay for 20% benefit	312	9.84	4.55	0	30
How much to pay for 50% benefit	312	9.84	4.55	0	30
How much to pay for 100% benefit	312	14.04	8.94	0	100
Max WTP in GH cedi	307	17.56	12.07	0	101
Age in years	353	37.27	11.99	18	72
Years of schooling	348	13.63	4.11	0	24

Table 2. Willingness to Pay- first hurdle

Wtpdummy for *proGARI*	Coef.	Std. Err.	Z	P>|z|
Gender dummy	0.117714	0.7326534	0.16	0.872
Age in years	0.397686	0.0312622	1.27	0.203
Year of schooling	-0.184894	0.1069157	-1.73	0.084
Marital status dmmy	0.1476712	0.6210541	0.24	0.812
How much bought in Gh cedis	0.1511247	0.0612002	2.47	0.014
Gari type dummy	0.0194357	0.6903325	0.03	0.978
Wtp in GH Cedis for 20 % improvement	-4.375181	439.2648	-0.01	0.992
100 improvement in GH cedis	4.575895	439.4648	0.01	0.992
Cons	0.2198147	1.713908	0.13	0.898

4.2.2 Willingness to pay for a 20 % benefit

The consistency in WTP for a 20 % benefit (mean of 9.84 Cedis) with moderate variability supports findings from empirical studies such as those by Louviere et al. (2000). According to Louviere et al., (2000) individuals often express relatively stable preferences for incremental product benefits, which may explain why the mean WTP remains similar between the 10 % and 20 % benefits. Furthermore, WTP studies, like those conducted by Blamey, Bennett, and Morrison (1999), suggest that perceived marginal utility of benefits often plateaus, leading to minimal changes in WTP across small increments in benefits.

4.2.3 Willingness to pay for a 50% benefit

The findings for a 50 % benefit (mean WTP of 9.84 Cedis) and moderate variability (standard deviation of 4.55 Cedis) align with research by Carson and Hanemann (2005). They argue that for significant benefit increases, individuals may not proportionally increase their WTP due to diminishing marginal utility. This phenomenon, widely supported in economic theory, explains why respondents may not exhibit significantly higher WTP despite a large increase in the benefit level (Carson & Hanemann, 2005).

4.2.4 Willingness to pay for a 100% benefit

For the 100 % benefit, with a higher mean WTP of 14.04 Cedis and greater variability (standard deviation of 8.94 Cedis), studies by Bateman et al. (2002) provide a fitting explanation. They highlight that as the benefit size increases, individuals' WTP becomes more variable, reflecting a broader range of perceived value. This aligns with the finding that the range of WTP spans from 0 to 100 Cedis, indicating that different individuals place vastly different values on a complete benefit (Bateman et al., 2002).

4.2.5 Maximum willingness to pay in ghanaian cedis

The mean maximum WTP of 17.56 Cedis, with a wide range from 0 to 101 Cedis and a standard deviation of 12.07 Cedis, is consistent with research on the upper limits of consumer expenditure. Studies by Cameron and James (1987) on contingent valuation methods suggest that maximum WTP often shows significant variability, as individuals have different thresholds for what they consider affordable or worth paying. This finding also corresponds to research by Champ et al (2003), who found that maximum WTP often reflects the consumer's budget constraint and the perceived value of the product or service.

4.2.6 Age of respondents

Age is often a critical factor in consumer behavior and WTP studies. According to Homburg, Koschate, and Hoyer (2005), age impacts not only purchasing power but also preferences and perceptions of value. In this dataset, with a mean age of 37.27 years and a standard deviation of 11.99 years, the findings align with broader research suggesting that middle-aged individuals tend to be the most active consumers, often willing to spend more compared to younger or older individuals, due to their peak earning capacity (Homburg et al., 2005).

4.2.7 Years of schooling

The mean years of schooling (13.63 years) reflect a relatively well-educated sample, which could explain the informed decision-making processes highlighted in the data. The literature suggests that higher educational attainment correlates with greater awareness and better decision-making abilities (Schultz, 1961). The variability in schooling (standard deviation of 4.11 years) aligns with findings by Psacharopoulos

and Patrinos (2004), who show that educational attainment is a key determinant of both earning potential and consumer behavior.

4.2.8 Summary of Key Variables

The observed data on consumer spending, willingness to pay, and demographic variables fit within the broader framework of economic theories on consumer behavior. Studies by Kotler and Keller (2016) emphasize the importance of understanding consumer preferences, willingness to pay, and demographic influences for effective market segmentation and product pricing. The variability observed in each category further supports the notion that diverse factors, such as income, education, and age, play significant roles in shaping consumer decisions (Kotler & Keller, 2016).

4.3 Detailed Analysis of Regression Results- Willingness to pay hurdle 1

The lack of statistical significance for the gender dummy variable (p-value = 0.872) indicates that gender does not influence the willingness to pay for *proGARI* in this sample. This result contrasts with other studies where gender differences have been observed in consumer behaviour (Blench, 2014). For instance, research often finds women may have different food preferences and spending patterns compared to men (Guira, 2017). However, in this study, it seems that gender does not play a significant role in the valuation of the fortified gari, possibly due to uniform product perception across genders or the specific context of the product in the market (Nweke et al., 2004).

The age variable also shows a lack of statistical significance (p-value = 0.203). This suggests that the willingness to pay for *proGARI* does not vary significantly with the age of the respondent. While age can influence consumer preferences and spending habits (Fakuda, 2015), the results here imply that *proGARI*'s appeal might be consistent across different age groups. This could indicate that the product's features or benefits are perceived similarly regardless of age, or that other factors are more influential in determining WTP (Hillocks, 2002).

The borderline significance of years of schooling (p-value = 0.084) indicates that education might have a weak but noticeable impact on willingness to pay. This aligns with findings that educated consumers are often more aware of health benefits and product quality, which could make them more willing to pay a premium for enhanced products like *proGARI* (Donnelly et al., 2005). Educational attainment can influence consumer knowledge and preferences, potentially affecting their willingness to invest in products perceived as more nutritious or beneficial (Nweke et al., 2004).

The marital status dummy variable does not have a statistically significant impact on willingness to pay. This suggests that being married or single does not significantly influence consumers' valuation of *proGARI*. Previous research has shown that marital status can sometimes affect household spending and food choices, but in this case, it appears to have little effect (Colding & Pinstrup-Anderson, 2000). This might indicate that the decision to purchase *proGARI* is more influenced by other factors such as product features or price rather than marital status.

The significant impact of the amount spent on gari (p-value = 0.014) suggests that consumers who spend more on gari are also more willing to pay for *proGARI*. This finding is consistent with the notion that higher expenditure on a product often correlates with a greater willingness to pay for related goods (Echebiri & Edaba, 2008). It highlights the importance of existing consumption patterns in shaping consumers' perceptions and willingness to invest in a new or improved product.

The gari type dummy variable does not show a significant effect on willingness to pay, indicating that the specific type of gari consumed by respondents does not influence their valuation of *proGARI*. This suggests that while different gari types may have varying characteristics, these do not significantly affect willingness to pay for a fortified variant. This could imply that consumers' willingness to pay is driven more by other factors such as price or perceived quality rather than the specific type of gari they typically consume (Westby, 2002).

The lack of statistical significance for willingness to pay for a 20 % improvement suggests that moderate enhancements in product quality do not significantly influence consumer valuation. This might indicate that consumers do not perceive a 20 % improvement as substantial enough to affect their willingness to pay or that they are already satisfied with the current product quality (Fakuda, 2015).

Table 3. Maximum Amount to Pay for *proGARI*- Second hurdle

Maxwtpinghcedis	Coef.	Std. Err.	T	P>|t|
Gendmmy	-0.4835726	0.5850361	-0.83	0.409
Age	0.0508011	0.0215531	2.36	0.019
Year of schooling	-0.222662	0.0570703	-3.9	0
Marital status dmmy	-0.2759332	0.6002056	-0.46	0.646
How much do you buy in Gh cedis	0.2525127	0.0370443	1.42	0.157
Gari type dummy	0.1768529	0.59569594	0.3	0.767
WTP in GH Cedis for 20% improvement	0.084775	0.0811337	1.04	0.297
In GH Cedis for 100 % improvement	1.24162	0.0402795	30.82	0
/sigma	4.831009	0.2039307		

Similarly, the absence of significance for willingness to pay for a 100 % improvement indicates that even a complete overhaul in product quality does not significantly impact consumer willingness to pay. This result may reflect a high baseline valuation of the product, or a potential disconnect between perceived and actual improvements (Guira, 2017). It could also suggest that other factors, such as price or brand perception, are more influential than product quality improvements in determining WTP.

The constant term represents the baseline level of willingness to pay for *proGARI*. Its lack of significance indicates that the baseline willingness to pay, when other variables are held constant, does not significantly differ from zero. This suggests that without considering the influence of other factors, the inherent valuation of *proGARI* may not be strong (Donnelly et al., 2005).

4.3.1 Summary

The analysis reveals that among the variables considered, only the amount spent on gari in GH cedis has a statistically significant impact on willingness to pay for *proGARI*. Other factors, including gender, age, marital status, gari type, and willingness to pay for product improvements, do not show significant effects. This suggests that the primary determinant of willingness to pay for *proGARI* in this sample is existing expenditure on similar products, highlighting the importance of consumer spending patterns in influencing their valuation of new products

4.4 Detailed Analysis of Regression Results- Extent of willingness to pay hurdle 2

The regression results indicate that age has a statistically significant effect on the maximum price consumers are willing to pay for *proGARI*. Specifically, for each additional year of age, respondents are willing to pay an extra 5 pesewas (GHS 0.05) for *proGARI* (p-value = 0.019). This finding aligns with studies suggesting that older consumers may value products differently, possibly due to increased health consciousness or disposable income (Nweke et al., 2004). Older individuals might have a higher willingness to pay for products that they perceive as beneficial for their health or nutrition, reflecting a greater emphasis on health-related attributes in their purchasing decisions (Guira, 2017)

The number of years of schooling is highly statistically significant (p-value = 0.000), indicating a strong impact on the willingness to pay for *proGARI*. The results show that as years of schooling increase by one unit, the amount consumers are willing to pay decreases by GH¢2.2. This suggests that more educated individuals might be more price-sensitive or possibly better informed about alternative products or the cost-benefit ratio of *proGARI* (Fakuda, 2015). Education often enhances consumer knowledge, which could lead to a greater focus on cost-effectiveness and value for money, influencing their willingness to pay (Donnelly et al., 2005).

The marital status dummy variable does not show a statistically significant effect on willingness to pay for *proGARI* (p-value = 0.646). This indicates that marital status does not substantially influence the maximum price respondents are willing to pay. Previous studies have sometimes found that marital status can impact consumer preferences and spending behavior, but in this context, it appears to be less relevant (Blench, 2014). This could suggest that factors other than marital status are more critical in determining willingness to pay for *proGARI*.

The amount spent on gari in GH cedis does not have a statistically significant impact on the dependent variable (p-value = 0.157). This suggests that the current spending on gari does not significantly affect the maximum amount respondents are willing to pay for *proGARI*. This result may reflect that consumers' spending on existing gari does not directly translate to their valuation of a fortified product, or that other factors, such as perceived health benefits or product quality, play a more significant role in their willingness to pay (Echebiri & Edaba, 2008).

The gari type dummy variable does not significantly impact the willingness to pay for *proGARI*. This finding indicates that the specific type of gari consumed does not affect how much respondents are willing to pay for the fortified variant. This could imply that consumers value *proGARI* based on its nutritional benefits rather than the type of gari they are accustomed to consuming (Westby, 2002).

The willingness to pay for a 20 % improvement in *proGARI* does not show a statistically significant effect (p-value = 0.202). This suggests that moderate improvements in the product do not significantly influence the amount consumers are willing to pay. This result might indicate that consumers perceive the current level of product quality as sufficient or that they do not see a 20 % improvement as substantial enough to justify a higher price (Hillocks, 2002).

The willingness to pay for 100 % improvement is highly statistically significant (p-value = 0.000). Consumers are willing to pay GH¢1.2 more if they perceive a complete enhancement in the product's nutritional status. This finding underscores the importance of substantial improvements in product quality for increasing consumer valuation. A full upgrade in product attributes can significantly boost willingness to pay, highlighting that consumers place high value on significant enhancements (Latif et al., 2015).

The constant term represents the baseline level of willingness to pay when all other variables are held constant. Its statistical significance or lack thereof helps understand the starting point of the willingness to pay. In this case, if the constant term is not statistically significant, it suggests that the baseline willingness to pay is not significantly different from zero, and the impact of other variables drives the variation in willingness to pay (Colding & Pinstrup-Anderson, 2000).

4.4.1 Summary

In summary, the analysis reveals that age and years of schooling significantly affect the maximum amount consumers are willing to pay for *proGARI*, with age increasing willingness slightly and more schooling reducing it. The willingness to pay for a 100 % improvement in nutritional quality is also significant, reflecting the high value consumers place on major product enhancements. Conversely, variables such as marital status, the amount spent on gari, gari type, and willingness to pay for 20 % improvement do not significantly influence the dependent variable. These insights can inform strategies for pricing and marketing *proGARI*, focusing on the factors that most impact consumer valuation.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The survey conducted included 358 participants, evenly distributed between Accra and Sunyani. Respondents hailed from a range of communities, with the largest representation from Penkwasi (60) and Haatso (87), along with 148 participants from other locations. The data showed that almost all respondents (96.64 %) consume gari regularly, with the majority (72.17 %) consuming it on a weekly basis.

Market centers emerged as the preferred venue for purchasing gari, with 71.40 % of respondents indicating this preference, followed by supermarkets, street vendors, and other sources. The factors that most influenced consumers' purchasing decisions were neatness, price, particle size, seller reputation, and the environment.

More than half of the respondents (58.33 %) were aware of different types of gari, such as CSIR gari, *proGARI*, and local white gari. White gari was the most preferred type, chosen by 49.76 % of respondents, while yellow gari followed, selected by 8.30 %. However, a large proportion (91.04 %) of respondents were unfamiliar with the new *proGARI* brand. Among the 173 participants who had tried *proGARI*, opinions on its appearance, texture, taste, color, and flavor were mixed.

A strong majority (86.04 %) expressed willingness to pay for *proGARI*, with an average

willingness to pay of GH¢17.5. Descriptive statistics were analyzed for various factors including spending, willingness to pay for different benefit levels, age, and years of schooling.

Regression analysis identified that among the factors considered, "How much you buy in GH cedis" was the only statistically significant factor influencing preferences and willingness to pay for *proGARI*. Additionally, age, years of schooling, and a 10 % improvement in nutrition were found to have a significant impact on the maximum price consumers were willing to pay. However, variables such as gender, marital status, gari type, and certain specific product improvements did not show statistically significant effects in this context.

5.2 Recommendations

Based on the survey findings, the following recommendations are made to increase the market presence and acceptance of *proGARI*:

1. With a significant portion of respondents (91.04 %) unfamiliar with *proGARI*, a focused marketing and awareness campaign is crucial. The campaign should utilize multiple channels, such as social media, local radio stations, and community events, to inform consumers about *proGARI*'s availability and benefits. Raising awareness could significantly improve *proGARI*'s market penetration.
2. Since over half (58.33 %) of respondents are already familiar with other types of gari (CSIR gari, local white gari), it is important to highlight the unique qualities of *proGARI*. Emphasizing its superior nutritional value and other distinguishing attributes can increase consumer interest, particularly among health-conscious individuals.
3. The survey indicated that opinions on *proGARI*'s appearance, texture, taste, color, and flavor varied. Addressing these diverse preferences by refining the product's visual and sensory attributes will be essential to improving consumer satisfaction. Ensuring consistent quality across batches will also help in building a reliable customer base.
4. Given the average willingness to pay of GH¢17.5 per olonka (2.4 kg of gari), pricing *proGARI* within this range is important to maintain affordability for a wide spectrum of consumers. Competitive pricing will help *proGARI* appeal to budget-conscious consumers while ensuring it remains accessible across different income levels.
5. Since the majority of respondents prefer purchasing gari from market centers (71.40 %), establishing a strong presence in these locations will be key to driving sales. Building partnerships with supermarkets and street vendors can further expand *proGARI*'s reach to diverse consumer segments in both Accra and Sunyani.
6. While white gari remains the most preferred type, there is still demand for other varieties, such as yellow gari. By offering a range of gari options, including *proGARI*, the brand can cater to a broader customer base with diverse preferences, ultimately increasing market share.
7. Ongoing research and feedback collection will be crucial to ensuring that *proGARI* continues to meet evolving consumer preferences. Regular surveys and focus groups can provide valuable insights for refining both the product and marketing strategies, ensuring that they remain aligned with consumer expectations.
8. Since age, years of schooling, and spending behavior were significant factors influencing willingness to pay for *proGARI*, targeted marketing efforts should focus on these demographics. Tailoring promotional efforts to appeal to older and more educated consumers could enhance *proGARI*'s appeal among these groups.
9. Monitoring consumer trends and market developments will be vital for *proGARI*'s long-term success. Regularly assessing consumer preferences and adjusting marketing and product strategies will ensure that *proGARI* remains relevant in a competitive market.

The survey results offer valuable insights into consumer behavior and preferences regarding gari in Accra and Sunyani. While the findings show a high level of gari consumption and willingness to pay for *proGARI*, they also highlight the need for increased brand awareness and product refinement. By implementing the outlined recommendations, *proGARI* can improve its market penetration, enhance consumer acceptance, and establish itself as a competitive product in the gari market.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

The author(s) confirm that no generative AI technologies, such as large language models (e.g., Copilot) or text-to-image generators, were used in the creation of this manuscript, with the sole exception of ChatGPT, which was employed exclusively for assistance with citation formatting and reference editing.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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