

A Food-Based Intervention to Meet SDG 2; Consumer Education Influence on Willingness to Purchase a Nutritionally Improved Staple Food in Ibadan-Nigeria

Leticia Amoakoah Twum¹  | Fidelis C. K. Ocloo^{1,2}  | Isaac K. Asare¹  | Bernard Tawiah Odai^{1,2}  | Joshua Neiderman³ | Sofela Sofolabi³ | Andrew Agyei-Holmes⁴  | Bernard Darfour^{1,2,*} 

¹Biotechnology and Nuclear Agriculture Research Institute (BNARI), Ghana Atomic Energy Commission, P.O. Box LG 80 Legon Accra, Ghana

²Graduate School of Nuclear and Allied Sciences, University of Ghana, Legon, Ghana

³World Initiative for Soy in Human Health- American Soybean Association, 12647 Olive Boulevard, St. Louis Missouri, USA

⁴Institute of Statistical, Social and Economic Research, University of Ghana

*Corresponding Author E-mail: yawdar4@yahoo.com

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Abstract

Background: The UN Sustainable Development Goal (SDG) 2 seeks to reduce all forms of hunger by 2030. The feasibility of this goal relies on factors such as food availability, consumer nutrition awareness, and purchasing power. Through innovative food technologies, new food products have been developed to meet household nutritional needs. However, household socioeconomic characteristics, food product awareness, and perception are critical to food choices. Consumer socioeconomic characteristics influence healthy eating and willingness to purchase foods. But, which socioeconomic characteristics and level of product data influence consumer willingness to pay for a product or are there other contributing factors? This project was part of a successful food product development research where an existing food product was nutritionally improved. A consumer acceptance and willingness to pay survey was undertaken in Nigeria to make a policy recommendation. This study determined the influence of product data on the willingness of consumers in Nigeria to pay for a nutritionally improved cassava product.

Materials and methods: Snowballing and convenient sampling methods were used to obtain participants' willingness to pay for *proGARI* (micronutrient fortified and soybean blended *gari*). One thousand five hundred (1500) people from four local governments in Ibadan-Nigeria participated in the study. Regression analyses were performed to establish a predictive relationship between participants' socioeconomic characteristics and their willingness to pay for *proGARI*.

Results: The results indicated that consumer education was essential. However, the price of *proGARI* was significant in determining participants' willingness to pay for the product. *proGARI* could help meet SDG 2, nonetheless, particular importance should be placed on the price and consumer education.

Conclusion: The participants highly accepted *proGARI* and were willing to purchase at higher prices.

Keywords: SDG 2, *proGARI*, Consumer education, Soybean, Micronutrient-fortification.

Introduction

The health and cost-effectiveness of food-based nutritional interventions in households cannot be over-emphasized. Complementary food processing and consumption are healthy and cost-effective nutritional interventions [1,2], providing an excellent avenue to reducing malnutrition challenges among target groups. Malnutrition, especially undernutrition, protein-energy, and micronutrient deficiency remain a major health challenge among low-income households in Africa [3]. This according to Cole [4], Gödecke *et al.* [5], and Jiang *et al.* [6] could be curtailed by interventions such as bio-fortification supplementation, and food enrichment/fortification. Some biofortification supplementation and food enrichment/fortification sources can be obtained from other research findings [7-9]. Diet diversity is also effective in reducing micronutrient deficiency [10]. However, the cost implication is enormous for the average household [11]. Composite flour in porridge, pastries, and bread making has been a cheaper means of improving the nutritional quality of many low-income households' diets [10-12]. The main challenge with food composition could be changes in sensory attributes and opportunity cost of the developed product which may be unacceptable to processors or consumers. Sensory attributes play a significant role in food product development and consumer acceptance [13-15]. However, consumer responses to changes in sensory attributes are influenced by socioeconomic characteristics and cultural background [16-18]. Differences in sex, age, education, and employment status play vital roles in product acceptance. Folkvord *et al.* [19] and Polleau and Biermann [20] also reported that sensory may be a determinant in food product choice. Nonetheless, consumer nutritional needs and product knowledge,

greatly influence food product purchasing decisions and choosing one product over another. Health-conscious consumers will consider nutrition more in their food choices than those who are price-conscious. Such consumers may sometimes harbour skepticism towards nutritional claims, attributing it to the prevalence of fraudulent practices. Whilst, claims substantiated by regulatory authorities authenticate these claims and give consumers a sense of confidence in the validity of such assertions [21,22]. Consumer education provides consumers with the right data about a product. This can greatly influence their willingness to accept/pay for that product [23]. Thus, a consumer equipped with the right product data may accept and appreciate the value of a product's price. *Gari* is a widely consumed carbohydrate and fibre-rich West African staple food made from cassava. *proGARI* (generic name) is a market-driven food fortification developed product geared at nutritionally improving *gari* with micronutrients (premix) and soybean flour (protein). Maintaining its eating and sensory attributes as conventional *gari* [24] was paramount. This aimed at mitigating against malnutrition. *proGARI* has the potential to be used as a sustainable population nutrient intake. As recommended by the joint WHO/FAO expert consultants [25], such food products have a positive effect on the environment and contribute to food security. This also enables a healthy life for a wider population. It can be an excellent food-based intervention aimed at addressing malnutrition in *gari*-consuming countries. Research by Amoakoah Twum *et al.* [24] reported that the iron in iron-fortified soybean *gari* blend can be bioavailable. The innovation can help solve food security issues in *gari*-consuming communities. However, acceptance of *proGARI* is particularly important since consumers can easily

reject it if *proGARI* has altered sensory functionalities or a high price index as compared to conventional *gari*. Some consumers, however, are likely to accept a product if it can provide the nutrition and functionality they perceive as good. Thus, consumer decisions are sometimes dependent on benefits not necessarily price [26]. The current study was part of a food product development project to improve cassava food products for a target group of which *proGARI* was the outcome. To commercialize or recommend *proGARI* in food-based policies, it was necessary to determine consumer acceptance and willingness to pay in Nigeria. This study followed the one conducted in Ghana [27]. This study, therefore, determined the influence of product information on participants' willingness to pay for *proGARI* in four local government levels in Ibadan, Nigeria.

Materials and Methods

Source of Materials

Cassava roots (IITA 419 variety) were purchased from a local cassava farmer in Ibadan, Oyo state- Nigeria. Commercial food-grade defatted soybean flour (0.5% fat content, hexane extracted) was obtained from Alltech Nutrient Limited, Ikeja, Lagos-Nigeria. Commercial food-grade premix micronutrients were supplied by the Royal DSM, South Africa.

Mixture Model

The mixture model was according to the model described by Amoakoah Twum *et al.* [24] and product guidelines by the Royal DSM. The composition ratio was 15% defatted soybean to 85% cassava mash on a dry matter basis.

Preparation of Progari

Processing of *proGARI* was done at the Cassava Processing Unit of the International Institute of Tropical Agriculture (IITA), Ibadan-Nigeria. The cassava roots were sorted, cleaned, peeled, washed, milled into cassava mash, and dewatered while spontaneously fermenting for 72 h [24]. The two fermented samples were separately blended and fortified with defatted soybean flour and micronutrients (premix). The mixture was roasted into *proGARI*, and allowed to cool, after which it was sieved and packaged into plastic (PET) containers.

Participants' Acceptance and Willingness to Pay Survey

Questionnaire Administration Instrument

A semi-structured questionnaire containing a mixture of open-ended and closed-ended questions was administered to participants. The questionnaire covered participants' knowledge of *gari* processing and perception of *gari* improvement. The nutritional composition of *gari* and their willingness to pay for nutritionally improved *gari* were similarly investigated. There were 18 items and the first five items required participants' demographic data. Thus, sex, age, years of schooling, marital status, and employment status. The next five questions centred on participants' general perception of *gari* processing, variations, and types. This was to validate the participants' knowledge of *gari* and the consumption pattern. Questions on the different methods of *gari* processing (fermentation and roasting), and how they affect the cooking and sensory attributes of the final product were asked as well as the appearance, taste, flavour, aftertaste, and usage in meal preparation. The next three questions also centred on ways of improving *gari* with regard to processing, marketing, and nutrition.

Participants were asked to prioritize *gari* processing, marketing (packaging and price), and nutrition as a way of improving *gari* processing. This was also to ascertain participants' concerns about *gari* as a household staple food. The last six questions were about the marketing, health benefits, acceptance, and willingness to pay for *proGARI*. Before marketing questions were asked, participants were shown a 2 kg packaged *proGARI* and were informed about the project scope and objective. An ethical clearance letter for this study was obtained from the Ministry of Health, Nigeria (Department of Planning, Research and Statistics Division Oyo State- Nigeria). For health concerns, the ethical clearance letter was shown to all participants. Then, each participant was given 10 grams of *proGARI* in a clear cup to observe for its physical and sensory attributes before the willingness to pay questions were asked. To avoid limiting the participants, they were allowed to provide amounts that they perceived as appropriate to all willingness to pay questions. The current rate of conventional *gari* was used as a reference.

Questionnaire Administration Procedure

The pretesting of the questionnaire was done at the IITA research site (Ibadan) with about one hundred people (staff and non-staff). The IITA staff pretested for questionnaire readability, cultural and language content suitability, and local terminology used in the *gari* assessment. Further modifications were made based on the feedback obtained from the pretest. Snowballing and convenient sampling techniques [28-30] with few modifications were employed when administering the questionnaire to consumers of *gari* (participants). The contingent valuation method was used. To minimize biases in participants' responses, the survey included

participants from diverse backgrounds and localities. Likewise, six (6) individuals were trained (to avoid introducing biases) to administer the questionnaire in person to ensure standardized data collection. In addition, all the responses from the 1800 respondents were screened to 1500 before the analyses were done. Moreover, the administrators of the questionnaire strictly adhered to the inclusion and exclusion criteria. Nigeria is well known for the production and consumption of *gari* as a staple food irrespective of socioeconomic background. Every household consumes *gari*. Though *proGARI* was developed in Ghana, the consumer acceptance and willingness to pay study was undertaken in Nigeria since their response would give a credible validation of the improved *gari*. To cover a wide range of different categories of consumers, questionnaires were administered in schools, open marketplaces, communities (among households), and offices. Written permission was sought from schools and offices to allow for the survey. Verbal permission was sought from heads of households and people in the open markets. In each of the categories the obtained ethical clearance was shown to the participants and the purpose of the research was explained in detail.

The inclusion criteria applied for recruiting participants were as follows: 1) The participant has no allergies to any ingredient in the *proGARI*. 2) They were willing and available to participate in the study. 3) Participants would have to sign a consent form for participation. Consent was obtained from parents and guidance of participants below 18 years of age.

Each participant was asked a series of questions before being served with approximately 10 g of *proGARI* in transparent plastic cups. This was to assess the sensory attributes and indicate their perception. Participants were later asked about the extent to which they

would pay/buy for the *proGARI*. The monetary value participants were willing to pay was asked at five levels. Participants were shown 2 kg of a well-packaged *proGARI* without any information given and were asked to value it. Participants were then given three levels of progressive information levels (20, 50, and 100%) about *proGARI*. They were asked, “With that level of information how much were they willing to pay for 2 kg packaged *proGARI*”.

At 20% information level participants were told the following. With the sensory attributes they have perceived, *proGARI* can be used for all *gari* dishes, has no sand, and comes in very fine particle sizes.

In addition, *proGARI* has a good water-holding capability and swells better than conventional *gari*. At 50% information level, participants were informed of the following. With all the properties given at the 20% information level, *proGARI* would be registered with the relevant Nigerian authorities and sold in a well-labelled package to consumers. At 100% information, participants were given additional information about *proGARI*. All the nutritional benefits of *proGARI* were given at 100% information level. Conventional *gari* needs to be complemented with protein sources from other foods.

Table 1 The nutritional data of *proGARI*

Nutritional data of <i>proGARI</i>		
Macronutrient	Quantity	Unit
Moisture	2.40	g/100g
Ash	2.84	g/100g
Total fat	1.20	g/100g
Protein	8.06	g/100g
Crude fiber	3.47	g/100g
Total carbohydrate	82.03	g/100g
Energy	371.16	Kcal/100g
Micronutrients		
Copper	4.59	mg/Kg
Selenium	0.05	mg/Kg
Calcium	2487	mg/Kg
Magnesium	1169	mg/Kg
Iron	235	mg/Kg
Zinc	22.30	mg/Kg
Iodine	0.50	mg/100g
Vitamin A	87.70	µg/100g
Vitamin B9 (Total folate)	158	µg/100g
Vitamin K	1.42	µg/100g
Vitamin D3	3.08	µg/100g
Vitamin B12	1.06	µg/100g
Folic Acid	104	µg/100g
Vitamin B	0.98	mg/100g
Vitamin B1	0.53	mg/100g
Vitamin B2	0.34	mg/100g
Vitamin C	15.20	mg/100g
Vitamin E	5.37	mg/100g
Vitamin B3 (Niacine)	10.20	mg/100g

Furthermore, *proGARI* can be consumed without necessarily considering other foods as a complement to meet nutritional needs. *ProGARI* used defatted soybean to improve the protein content and fortified with micronutrients. [Table 1](#) indicates the nutritional data of *proGARI*.

Convenience sampling was used mostly among students and sedentary workers. The schools were informed about the survey. The school administrators organized students for questionnaire administration. The same was done with sedentary workers. Snowballing sampling was mostly used among participants in households and marketplaces. The participants referred or recommended the research team to other potential participants. The semi-structured questionnaire was administered to 1500 participants in four (4) local government locations. The locations were Iddo, Akinyele, Ibadan North, and Ibadan South-West all in Ibadan-Nigeria. Participants were not compensated for the survey participation. However, some participants requested some *proGARI* to prepare their favourite *gari* dishes.

Data Analyses

Participants' willingness to pay for *proGARI* was analysed using SPSS version 20. The cross-tabulation considered participants' socioeconomic characteristics (age, sex, and educational levels). Regression analyses (on the amount that participants were willing to pay) were then performed for the four categorised local governments and the entire local government (together). This was done in relation to participants' socioeconomic characteristics at the different levels of *proGARI* data. The data were analysed using the Ordinary Least Squares (OLS) regression. This was to determine the influence of participants'

socioeconomic status on their willingness to pay for *proGARI*. The dependent variable was the willingness to pay while the independent variable was the participants' socioeconomic characteristics. The variables were analysed based on individual local government participants and the total of all the participants. The regression model used:

$$\text{Consumer willingness to pay for } proGARI = \beta \text{ constant} + \beta_{sex} + \beta_{age} + \beta_{years \text{ of schooling}} + \beta_{marital \text{ status}} + \beta_{employment}$$

The male and female sexes were represented with 0 and 1, respectively. The participants interviewed were all 11 years and above. Years of schooling were between 0- and 22-years including participants with no formal education. The participants with no formal education were scored 0, and those with Ph.D. were scored 22. Marital status was categorised as single (1) and married (1). Employment was categorised as unemployed (0) and employed (1). The survey was carried out from September to October 2021. One (1) mudu of *gari* measured 1.1 kg in quantity and had an average price of 400 Naira which was about \$1.

Results

The participants' responses to acceptance and willingness to pay for *proGARI* are presented in Tables 2 to 8. These responses were obtained after the participants had observed the physical characteristics and perceived the sensory attributes of *proGARI*. The summary of the demographic characteristics of all participants is provided in [Table 2](#).

Participants' Perception of Progar

Participants' responses to the willingness to pay for *proGARI* are presented in [Tables 3](#) and [4](#). Participants'

response of “Yes” was considered as acceptance of *proGARI*. A response of “No” meant participants had rejected *proGARI*'s physical characteristics and sensory attributes. Considering the male participants, 93.7% said “Yes” and 6.3% said “No” they would not purchase *proGARI*. In the case of female participants, 93.5% were willing to purchase while 6.5% were unwilling to pay/buy. The categories in age showed that 10-19 years represented 32.5%, 20-29 years represented 22.0%, 30-59 years

represented 43.6%, and >60 represented 3.2% of the total participants (Table 3). In each of the age categories (Table 3), there was a higher percentage response for participants' willingness to pay/buy than those who were unwilling to purchase *proGARI*. In the age category between 10 and 19 years, 93.6% were willing to purchase as compared to 6.4% who indicated they would not purchase *proGARI*. Again, age categories between 20 and 29, and 30 and 59 years also had 94.8% and 92.4%, respectively.

Table 2 The demographic characteristics of all participants

Variable	Participant	Means	Std. Dev.	Min	Max
Sex	1,500	0.70	0.46	0	1
Age	1,500	29.63	13.31	2	80
age ²	1,500	1054.89	960.97	4	6400
Years of schooling	1,500	12.25	3.53	0	22
Marital status	1,500	0.58	0.49	0	1
Employment status	1,500	0.66	0.48	0	1

Table 3 Participants' acceptance and willingness to pay for *proGARI*

Participants' acceptance and willingness to pay for <i>proGARI</i>					
Variable			Yes	No	Total
Sex	Male	Participant	418	28	446
		% Male	93.7	6.3	100
	Female	Participant	985	69	1054
		% Female	93.5	6.5	100
Age (years)	10-19	Participant	456	31	487
		% 10-19	93.6	6.4	100
	20-29	Participant	291	16	307
		% 20-29	94.8	5.2	100
	30-59	Participant	608	50	658
		% 30-59	92.4	7.6	100
	≥60	Participant	48	0	48
		% ≥60	100	0	100
	0-9	Participant	263	28	291
		% 0-9	90.4	9.6	100
Educational (years)	10-15	Participant	855	47	902
		% 10-15	94.3	5.2	100
	16-22	Participant	285	22	307
		% 16-22	92.8	7.2	100
Total	Participant	1403	93	1500	
	% within CWP	93.5	6.5	100	

Table 4 How much (in Naira) are participants willing to pay?

Variables	How much are you willing to pay for 1 mudu of packaged <i>gari</i> (<i>proGARI</i>)				
	All local government	Akinyele	Ibadan North	Iddo	Southwest
Sex	19.39* (9.41)	17.66 (25.65)	8.54 (19.97)	14.85 (14.70)	31.85 (21.59)
Age	2.64 (2.07)	6.26 (6.10)	5.04 (4.27)	4.38 (3.61)	-2.47 (3.57)
Age ²	-0.05 (0.03)	-0.10 (0.08)	-0.09 (0.05)	-0.05 (0.04)	0.01 (0.04)
Years of schooling	2.44 (1.25)	0.49 (2.69)	0.42 (2.43)	0.34 (2.56)	5.70** (2.65)
Married	-15.47 (13.05)	-54.97 (35.45)	3.77 (32.03)	-21.63 (23.53)	-19.73 (19.65)
Employment	51.64** (15.99)	88.95* (43.43)	42.12 (34.43)	23.92 (27.36)	86.48** (28.98)
Constant	183.56** (37.72)	58.83 (107.80)	122.66 (71.47)	293.23** (68.25)	341.63** (77.20)
Observations	1,403	297	345	382	372
R-squared	0.23	0.32	0.35	0.13	0.20

Standard errors in parentheses ** $p < 0.01$, * $p < 0.05$.

This indicated participants' willingness to pay/buy as compared to 5.2% (20-29 years) and 7.6% (30-59 years) who were unwilling to pay/buy *proGARI*. At age ≥ 60 years, all participants indicated that they were willing to pay/buy *ProGARI*. The total percentage of participants who accepted and were willing to pay for *proGARI* was 93.5%. Hence, a higher acceptance for *proGARI*.

When participants were asked how much they were willing to pay for packaged *gari* (without data), there were some significant responses (Table 4). Concerning all local governments together, only sex ($p < 0.05$) significantly responded to their willingness to pay for *proGARI*. All participants (male and female) were willing to pay 19.39 \pm 9.41 Naira more for *proGARI*. Females preferred paying more for packaged *gari* than male participants. The willingness to pay for packaged *gari* such as *proGARI* was influenced by how long a participant has stayed in school (educational level).

Participants with higher educational levels were willing to pay 2.44 \pm 1.25 Naira more for *proGARI*. Employment also influenced participants' willingness to pay for packaged *gari* (*proGARI*). Participants were willing to pay 51.64 \pm 15.99 Naira more for 1 mudu of *proGARI* (Table 4). At the individual local government levels, only the participants in Southwest local government were willing to pay a significant ($p < 0.05$) amount of 5.70 \pm 2.65 Naira more. Thus, for packaged *gari* (*proGARI*), years of schooling were considered (Table 4). Regarding employment status, employed participants from Akinyele and Southwest were also willing to pay 88.95 \pm 43.43 ($p < 0.05$) and 86.48 \pm 28.98 ($p < 0.01$) Niara more for 1 mudu of packaged *gari* (*proGARI*), respectively. Though most of the mean values were positive they did not significantly influence participants' willingness to pay for *proGARI*. Therefore, the packaging of *gari* alone would not significantly influence how much

participants are willing to pay for *proGARI*.

Participants' Willingness to Pay/Buy Based on Different Levels of Benefit/Data

Participants were given progressive levels of benefits/data on purchasing and consumption of *proGARI* (Tables 5-7). These levels were categorized as 20 (physicochemical characteristics), 50 (food safety and certification of *proGARI*), and 100 (nutritional) percent (%) benefit/data. Participants were then asked to put a price or monetary value on *proGARI* based on the percentage benefit/data.

Participants' Willingness to Pay for ProGARI at 20% Level of Data

Participants' willingness to pay for 1 mudu of *proGARI* at 20% data is presented in Table 5. The table contains the four individual local governments and the total

number of participants from the various local governments. When 20% of data about *proGARI* was given the analysed data of the total participants showed that participants were willing to pay a significant ($p < 0.01$) amount of 35.20 ± 10.78 Naira more (Table 5). At the individual local government level, participants from Iddo and Southwest showed a significant response ($p < 0.05$). An increasing amount of 46.41 ± 19.41 and 54.92 ± 24.95 Naira was obtained, respectively. Increasing age showed a negative participants' willingness to pay for *proGARI* at 20% of data. Except for participants from Iddo local government which was 11.20 ± 4.77 Naira (significant at $p < 0.05$). However, Southwest showed a negative response (-7.90 ± 4.13) (Table 5). Mean values for age showed a negative response. The age square showed that at a point in the participants' age, as little as 20% of data about *proGARI* can positively influence the participant's willingness to pay (Table 5).

Table 5 Participants' willingness to pay at 20% level of data

Variable	The maximum amount to be paid for 1 mudu of <i>proGARI</i>					
	All government	local	Akinyele	Ibadan North	Iddo	Southwest
Sex	35.20** (10.78)		9.21 (26.71)	17.87 (20.16)	46.41* (19.41)	54.92* (24.95)
Age	-3.32 (2.42)		-7.56 (6.35)	-7.59 (4.69)	11.20* (4.77)	-7.90 (4.13)
Age ²	0.03 (0.03)		0.09 (0.08)	0.07 (0.06)	-0.13* (0.06)	0.08 (0.05)
Years of schooling	7.00** (1.44)		5.64* (2.81)	7.10** (2.45)	3.41 (3.38)	6.74* (3.07)
Married	-19.50 (14.93)		-5.42 (36.91)	24.48 (32.27)	-27.80 (31.08)	-54.72* (22.71)
Employment	50.45** (18.59)		103.56* (45.22)	35.79 (36.61)	8.17 (36.13)	68.94* (33.49)
Constant	265.25** (43.71)		197.52 (112.25)	186.54* (75.96)	291.25** (90.13)	427.54** (89.22)
Observations	1,402		297	344	382	372
R-squared	0.20		0.29	0.34	0.18	0.17

Standard errors in parentheses. ** $p < 0.01$, * $p < 0.05$.

However, it was significantly ($p < 0.05$) negative at Iddo local government (-0.13 ± 0.06). Years spent in schooling had a total significant effect ($p < 0.05$) on how much participants were willing to pay for *proGARI* at 20% data. A total of all the local governments showed that participants were willing to pay a significant ($p < 0.01$) amount of 7.00 ± 1.44 Naira more for 1 mudu of *proGARI*.

In the individual local governments, participants from Akinyele, Ibadan North, and Southwest were willing to pay a significant amount of 5.64 ± 2.81 , 7.10 ± 2.45 , and 6.74 ± 3.07 Naira extra for 1 mudu *proGARI*, respectively (Table 5). Educational levels positively influenced the premium put on *proGARI* at the 20% level of information. Marital status had a negative and insignificant effect on participants' willingness to pay for *proGARI* at 20% data. Though negative mean values were obtained for Southwest local government participants, there was a significant ($p < 0.05$) effect on their

willingness to pay for *proGARI*. The employment status of participants positively influenced their willingness to pay for *proGARI*. For the employed, participants were willing to pay more for *proGARI* (Table 5). At the 20% level of information, the mean value of all the local government workers showed that participants were willing to pay a significant amount of an extra 50.45 ± 18.59 Naira for 1 mudu of *proGARI*. Participants in Akinyele and Southwest were willing to pay a significant ($p < 0.05$) amount of 103.56 ± 46.61 and 68.94 ± 33.49 Naira more for 1 mudu of *proGARI*, respectively. Sex, years of schooling, and employment were the main determinants for participants' willingness to pay for *proGARI* at a 20% data level for the total participants. At the individual local government level, years of schooling, and employment were the determinants in Akinyele. Likewise, at the individual local government level, years of schooling were the determinant factor in Ibadan North.

Table 6 Participants' willingness to pay for *proGARI* at 50% level of data

Variable	The maximum amount to be paid for 1 mudu of <i>proGARI</i>				
	All local government	Akinyele	Ibadan North	Iddo	Southwest
Sex	54.25** (12.48)	1.34 (25.84)	27.45 (20.44)	47.67* (19.87)	54.24 (38.32)
Age	-7.65** (2.80)	-1.48 (6.14)	-3.84 (4.76)	7.08 (4.89)	-18.14** (6.34)
Age ²	0.07* (0.03)	0.02 (0.08)	0.02 (0.06)	-0.09 (0.06)	0.17* (0.07)
Years of schooling	6.25** (1.66)	4.60 (2.71)	4.26 (2.49)	3.62 (3.45)	4.84 (4.71)
Married	36.51* (17.30)	-26.94 (35.71)	11.54 (32.72)	-14.12 (31.81)	67.36 (34.88)
Employment	-3.82 (21.53)	108.34* (43.76)	24.37 (37.13)	-16.40 (36.97)	-27.97 (51.44)
Constant	387.60** (50.64)	159.79 (108.61)	196.54* (77.03)	376.21** (92.24)	724.19** (137.04)
Observations	1,402	297	344	382	372
R-squared	0.17	0.31	0.36	0.14	0.16

Standard errors in parentheses. ** $p < 0.01$, * $p < 0.05$.

Similarly, sex and age were the determinants in Iddo, while sex, years of schooling, and employment were the determinants in Southwest.

Participants' Willingness to Pay for proGARI at 50% Level of Data

The total and individual local government participants' responses to their willingness to pay for 1 mudu of *proGARI* at 50% data level are presented in Table 6. When 50% data about *proGARI* was given the mean values obtained showed that all sexes of all four local governments were willing to pay a significant extra amount of 54.25±12.48 Naira for *proGARI* (Table 6). All the other local governments showed a positive mean value. However, it was only participants from Iddo who were willing to pay a significant extra amount of 47.67±19.87 Naira for *proGARI* at a 50% level of information. Age negatively affected the maximum amount participants were willing to pay for *proGARI* at all local governments except in Iddo (7.08±4.89 Naira). When the means for age were squared, all means were positive except for Iddo local government. The means of Southwest (0.17±0.07 Naira) and the total of all local governments (0.07±0.03 Naira) were significant ($p < 0.05$) (Table 6). Hence, at a point, the increment in the age of participants has a linear relation with participants' willingness to pay for *proGARI* at a 50% level of information. The number of years spent in school affected participants' willingness to pay for *proGARI*. The data of the total participants showed their willingness to pay a significant ($p < 0.01$) extra amount of 6.25±1.66 Naira for *proGARI*. Participants from Akinyele and Ibadan North were willing to pay an extra 4.60±2.71 and 4.26±2.49 Naira, respectively, for *proGARI* (Table 6). Data on marital status showed

that the sum of all participants indicated the willingness to pay a significant ($p < 0.05$) extra amount of 36.52±17.30 Naira for *proGARI*. Participant employment status showed that only participants from Akinyele (108.34±43.73) and Ibadan North (24.37±37.13) were willing to pay extra for *proGARI*. However, only participants from Akinyele showed significant ($p < 0.05$) responses. Analysing all the responses at the 50% level of data, sex, years of schooling, and marital status mainly influenced participants' willingness to pay for *proGARI*. However, at the individual local government levels, years of schooling and employment mainly influenced participants' willingness to pay. Especially at Akinyele and Ibadan North, but at Iddo it was sex, and at Southwest local governments it was age.

Participants' Willingness to Pay for proGARI at 100% Level of Data

The participant's willingness to pay for 1 mudu *proGARI* at 100% data level is shown in Table 7. At 100% level of information, the total of all participants' characteristics (sex, age, age², years of schooling, marital status, and employment) showed participants' willingness to significantly pay extra for *proGARI*. The mean values were 77.29±17.81 ($p < 0.01$) for sex, and -10.68±4.00 ($p < 0.01$) for age, 6.90±2.37 ($p < 0.01$) for years in school, and 108.81±24.68 ($p < 0.01$) for marital status and -71.59±3.72 ($p < 0.05$) for employment status (Table 7).

At Akinyele local government it was only the employment status (104.22±50.27) of participants that significantly ($p < 0.05$) affected the willingness to pay extra for *proGARI* (Table 7).

Table 7 Participants' willingness to pay for *proGARI* at 100% level of data

Variable	The maximum amount to be paid for 1 mudu of <i>proGARI</i>				
	All local government	Akinyele	Ibadan North	Iddo	Southwest
Sex	77.29** (17.81)	-7.85 (29.69)	61.57* (28.64)	50.15* (23.19)	18.42 (63.17)
Age	-10.68** (4.00)	7.62 (7.06)	-2.98 (6.66)	8.51 (5.70)	-27.82** (10.46)
Age ²	0.09 (0.048)	-0.10 (0.087)	0.00 (0.082)	-0.10 (0.067)	0.26* (0.122)
Years of schooling	6.90** (2.37)	4.74 (3.12)	4.41 (3.48)	1.79 (4.03)	7.95 (7.76)
Married	108.81** (24.68)	-17.76 (41.02)	-0.48 (45.84)	-63.92 (37.12)	261.08** (57.51)
Employment	-71.59* (30.72)	104.22* (50.27)	-1.61 (52.02)	11.50 (43.15)	-203.62* (84.82)
Constant	480.11** (72.24)	76.27 (124.77)	262.42* (107.91)	359.98** (107.64)	869.40** (225.94)
Observations	1,402	297	344	382	372
R-squared	0.12	0.25	0.21	0.11	0.18

Standard errors in parentheses. ** $p < 0.01$, * $p < 0.05$.

Sex (characteristic) of the participants in Ibadan North (61.57 ± 28.64) and Iddo (50.15 ± 23.19) was significant ($p < 0.05$) concerning willingness to pay extra for *proGARI*. The age of participants in Southwest local government was significant (-27.83 ± 10.46 , $p < 0.01$). The age² of participants in Southwest local government was significant (0.26 ± 0.12 , $p < 0.05$). The marital status of participants in Southwest local government was significant (261.08 ± 57.51 , $p < 0.01$). Likewise, the employment status of participants in Southwest local government was significant (-203.63 ± 84.2 , $p < 0.05$) (Table 7). The maximum amount participants were willing to pay for *proGARI* after all data about *proGARI* were provided.

Table 8 indicates the maximum amount participants are willing to pay for 1 mudu of *proGARI*. The total number of participants showed that the sex of participants significantly ($p < 0.01$) influenced the amount participants were

willing to pay. Thus, they were willing to pay an extra 64.55 ± 19.76 Naira for *proGARI*. For individual local government, it was only participants in Ibadan North that showed the willingness to pay a significant ($p < 0.05$) extra amount of 95.35 ± 44.67 Naira for *proGARI*. The age of the total number of participants from all four local governments was not positive regarding willingness to pay extra (-14.18 ± 4.44 Naira). Participants in Southwest local government showed a significant ($p < 0.01$) willingness to pay an extra amount of -36.21 ± 10.22 Naira for *proGARI*. However, squaring the age gave a positive and significant ($p < 0.05$) amount of 0.13 ± 0.05 Naira for the total of all four local governments. The number of years spent in school influenced the maximum amount that participants were willing to pay for *proGARI*.

The total of all four local governments showed that participants were willing to pay a significant extra amount of 5.33 ± 2.26 Naira for *proGARI*.

Table 8 The maximum amount that participants were willing to pay for *proGARI*

Variable	The maximum amount to be paid for 1 mudu of <i>proGARI</i>				
	All local government	Akinyele	Ibadan North	Iddo	Southwest
Sex	64.55** (19.76)	-21.41 (30.79)	95.35* (44.67)	0.64 (26.04)	60.05 (61.72)
Age	-14.18** (4.44)	9.85 (7.32)	-3.71 (10.40)	3.48 (6.40)	-36.31** (10.22)
Age ²	0.13* (0.05)	-0.12 (0.09)	0.01 (0.13)	-0.06 (0.08)	0.35** (0.12)
Years of schooling	5.33* (2.63)	5.81 (3.23)	3.41 (5.43)	0.04 (4.53)	5.09 (7.58)
Married	83.12** (27.37)	-40.94 (42.55)	-28.84 (71.52)	-44.44 (41.68)	203.84** (56.23)
Employment	-45.30 (34.06)	130.74* (52.14)	-29.84 (81.15)	-17.00 (48.45)	-75.04 (82.88)
Constant	585.29** (80.11)	260.06 (129.41)	330.35 (168.35)	490.58** (120.87)	1,080.44** (220.79)
Observations	1,400	297	344	382	370
R-squared	0.10	0.27	0.10	0.08	0.19

Standard errors in parentheses. ** $p < 0.01$, * $p < 0.05$.

Marital status further influenced the maximum amount that participants were willing to pay for *proGARI*. The marital status of the total participants showed their willingness to pay a significant ($p < 0.01$) higher extra amount of 83.12 ± 27.27 Naira for *proGARI*. Participants in Southwest local government also showed the willingness to pay a significant ($p < 0.01$) higher extra amount of 203.84 ± 56.23 Naira for *proGARI*. Concerning the employment status (all forms of income generation) only the participants from Akinyele local government showed the willingness to pay a significant ($p < 0.05$) higher extra amount of 130.74 ± 52.14 Naira for *proGARI*. Sex, age, years of schooling, and marital status mainly influenced participants' willingness to pay for *proGARI* for all the total responses. However, willingness to pay extra for *proGARI* at the individual local government levels at Akinyele was influenced by years of schooling, and status of employment. At Ibadan North, it was only sex that influenced willingness to pay extra for *proGARI* at the individual

local government levels. Only marital status influenced willingness to pay extra for *proGARI* at the individual local government levels at Southwest.

Discussion

The results from Tables 3 and 4 indicate that packaging and sensory attributes alone did not influence participants willingness to pay more for *proGARI*. There was a general improvement in the packaging of *gari* products for the market. Packaged *gari* is very common in Nigeria since it is a requirement for obtaining food certification. Hence, packaging alone was not likely to influence participants' willingness to pay. The majority of participants accepted and responded "Yes" to buying *proGARI*. It was an indication that without data *proGARI* was perceived as either a conventional *gari* or *gari* with premium qualities and hence, participants' acceptance and willingness to pay extra. Although *proGARI* was accepted, participants' ability to make informed decisions was also necessary.

The responses of participants changed with progressive information. Thus, when participants were given data about *proGARI* based on the physicochemical characteristic (20%); processing, packaging, and food safety/certification (50%); and nutritional benefit (100%) (Tables 5-8).

The total data from all four local governments showed that socioeconomic factors influenced participants' responses. Females would pay more for *proGARI* at all levels of provided data. Females are predominately the caregivers in most households in Africa. Traditionally, females are responsible for the household meal selection, preparation, and serving. Thus, the nutritional well-being of the household relies on the females. It was observed that at each level of data provided females would significantly pay more for *proGARI*. This suggests that many females knowing *proGARI* is an improved product of conventional *gari* are likely to buy. They know that this nutritionally improved *gari* would help the well-being of their households. Among all four local governments, it is only females from Iddo local government whose responses were significant for all three levels of data. Participants' increment in age negatively affected the participant's willingness to pay for *proGARI*. From the data, it could be deduced that as participants age their interest in *gari* diminishes compared with other foods. Though *proGARI* has nutritional benefits, participants in the higher age group did not respond favourably to the willingness to pay extra for it. *Gari* is said to be less nutritious, hence, middle-aged people who have healthy lifestyle challenges would consume less of it. In Ghana, *gari* is widely eaten by adolescents in secondary schools because of its shelf stability and ready-to-eat characteristics. As people leave schools they turn to diversify their food choices. This could be the reason that age

did not respond positively to the willingness to pay extra for *proGARI*. However, when age was squared it gave a positive mean value. This means that at a point in the participant's age, nutrition is an essential determinant in food choices and may prompt participants' willingness to pay extra for *proGARI*. Nonetheless, targeted marketing strategies can influence consumer behaviour since *gari* is a widely consumed staple in Nigeria. Also, given the added nutritional benefits of *proGARI*, it is anticipated that consumers may be willing to pay higher prices compared to the unfortified *gari*. For the safety and nutritional quality information on *proGARI*, there was a significant mean value for age² in the total mean of all four local governments and Southwest. This implies that participants were willing to pay extra for the safety and nutritional qualities of *proGARI*. There was a significantly positive mean value for physicochemical quality information about *proGARI* by the Iddo local government. It is possible that, in considering age the participants from Iddo were willing to pay extra for *proGARI*'s based on physicochemical characteristics and not necessarily the safety and nutrition. The number of years spent in school determines the participant's educational level. Participants with 19 years of schooling had received at least a bachelor's degree. Participants who had completed many years of schooling expressed a higher willingness to pay for *proGARI*. At all three levels of data, the year of schooling showed a significant willingness of participants willingness to pay more for *proGARI*. Participants were willing to pay extra for the physicochemical characteristics, safety, and nutritional improvement of *proGARI*. Nutritional information about *proGARI* did not influence willingness to pay more for *proGARI*. However, the physicochemical and safety of the product influenced

participants' willingness to pay for *proGARI* at Akinyele, Ibadan North, and Southwest. The years spent in school did not influence the decision of participants from the Iddo local government. This may be because participants from Iddo might not have received longer years of schooling. Marital status influenced participants' willingness to pay extra for *proGARI*. The total participants from all local governments, and Southwest showed their willingness to pay more for *proGARI* because of the safety and nutrition. Married people are more conscious of the safety and nutrition of food for household consumption than single people. The influence of employment status on *proGARI* was not so impactful. Employment status did not influence participants' willingness to pay for *proGARI*. However, in Akinyele every level of data about *proGARI* influenced the participant's willingness to pay more for *proGARI*. Akinyele was likely populated by the working class. In other words, their employment and income status did not influence their perception of *gari*. Some socioeconomic characteristics of participants might have influenced their decision to purchase *proGARI*. Likewise, participants' education or product data might have impacted their willingness to pay for the improved *gari*. All the local governments used in the study are per-urban settlements. Each local government has a mixture of all levels of socioeconomic diversity. Akinyele according to Oladeji *et al.* [31] is the largest in terms of landmarks. Low socioeconomic status is observed in most households in Ibadan [32] and this influences purchasing power which indirectly influences household food choices. Oderinde *et al.* [33] reported that 81% of food insecurity is attributed to limited financial resources, inadequate access to productive assets, and lack of social safety networks among the poorest people. The present study observed no

particular pattern in the extra amount that participants from the different local governments were willing to purchase *proGARI*. However, participants from Southwest and Iddo showed a significant willingness to pay more for *proGARI* at all levels of data. Demartini *et al.* [34] and Onwezen *et al.* [35] reported that when consumers are familiar with a product, they turn out to be indifferent and may not be willing to pay more for the product. Therefore, product data is mostly the sure way to increase consumers' willingness to pay [36] although *proGARI* was developed to have the same cooking and eating qualities as conventional *gari*. Because of the similarities to conventional *gari* in sensory attributes, participants were not willing to pay extra for it. According to Nitzko [37], plant by-product for human nutrition generally receives low acceptance. In contrast, Onwezen *et al.* [35] reported that plant-based products are more acceptable than animal-based products, basically due to health concerns. Since plant by-products generally do not contribute significantly to the sensory attributes of final products, the participants might have not perceived changes that would require favourable responses. Therefore, products with improved nutrients from plant by-products should have consumer education. Consumer education on product safety, nutrition, and product use greatly influences consumer acceptance of a product [38-41]. Consumer education according to Chen *et al.* [38] builds consumer trust in a product. It is based on this trust that consumers would build their loyalty for a product and increase the value put on the product. The aesthetics of the product, its packaging, and certification from authorized authorities assure consumers of the safety of the product. According to Chen *et al.* [38], the participants were willing to pay more for products with EU certification/approval than those with

China or Hong Kong certification. The study attributed this to consumers' trust in the EU system of food safety. Thus, the consumers had confidence in EU certification since the product might have gone through vigorous food safety protocols. In the present study, the participants' willingness to pay extra for *proGARI* at the 20% level of information was significant. However, the willingness to pay extra for *proGARI* increased at the 50% level of information provided. Yang *et al.* [41] reported that the type of data can affect both the psychology and behaviour to purchase a product. Generic information may not be impactful. According to Piracci *et al.* [42], elaborate data about a product would allow the consumer to understand and greatly appreciate the product. Positive data can influence how consumers would accept the price value of a product [43]. Pricing is very important in consumer purchase but how much value a consumer puts on a product depends on the level of data available to the consumers. Though food safety may be a priority for most consumers, prices are very influential in product choices [44,45]. All the right data can be given but if the price is not economical the consumer may reject the product. From the results of the present study, it was observed that willingness to pay extra for *proGARI* changed as the degree of provided data increased (from 20 to 100%). Nevertheless, the maximum extra amount that participants were willing to pay for *proGARI* was around 85 Naira. But at 100% availability of information, participants were willing to pay an extra 150 Naira. This means that pricing is a major factor in purchasing *proGARI*. When a consumer psychologically believes that a product meets his/her needs the perception and behaviour toward the product changes. Appreciation for the product increases and would be willing to pay more for the product. Lee *et al.* [46] reported that

consumers' awareness of a product's utilization and importance increases their perception and are likely to respond positively to the product. *Gari* is widely consumed in Nigeria and its utilisation cuts across gender, age, social status, and education. The *proGARI* ability to meet nutritional needs; well packaged, safe, and certified; without affecting cooking and eating qualities provides premium value. Hence, participants would be willing to spend more money to purchase. Dynamism in participants' socioeconomic characteristics influences their willingness to pay for a product. Research has shown that females are more likely to choose nutritious food than males [47, 48, 49]. Females tend to understand product data and can make informed decisions to meet their household nutritional needs. Chen *et al.* [50] reported that females have more preference for healthier foods than males. In this present study, females were willing to pay more for *proGARI* than males. In Africa, women are seen as household caregivers and are responsible for providing nutritious food for the household. Females' willingness to pay more for *proGARI* meant the product could meet the household's nutritional needs. Andaregie *et al.* [51] indicated that socioeconomic characteristics like years of schooling, employment status, income, and number of children in a household influence their food/nutritional choices. Households focus on nutritional food choices based on age diversity. Therefore, married people with children are more likely to buy nutritious foods than single people. The present study showed that participants who were married or "had married before" paid more for *proGARI* than the single participants. Likewise, ageing at a point positively affected participants' willingness to pay extra for *proGARI*. Household nutritional needs are met through the diversity of food items in their meal. Adams *et al.* [52] reported that this can be expensive, especially for low-

income households. Therefore, there is a need for subsidizing *proGARI* to help improve household food security. Food products such as *proGARI* have the potential to economically meet household food security in *gari-consuming* communities. Improving on traditional food or products that consumers are familiar with is very essential [53,54], especially for product acceptance. Consumers would tend to accept such products based on their previous knowledge of the product. However, the improvement should not significantly alter the sensory attributes. According to Boccia *et al.* [55] and Raimondo *et al.* [56], prices, information, and socioeconomic factors influence consumers' willingness to pay for a product. But the sensory attributes should be the major determinant for producers to consider in food product development. The present study participants were shown the packaged product and allowed to taste and analyse the texture before administering the questionnaire. The responses were based on participants' experience of the real *proGARI* as it would be presented in the markets. Hence participants' willingness to pay for *proGARI* was a real-life scenario of their responses to the product in the market settings.

Conclusion

proGARI was well accepted by the participants who were also willing to pay more for it. The product data influenced participants' acceptance and perception of *proGARI* in all four local governments. The willingness of participants to pay for *proGARI* increased when full data and nutritional benefits of consuming *proGARI* were provided. Participants' sex and years of schooling were very significant in influencing participants' willingness to pay for *proGARI*. *proGARI* has the potential to be used as a food-based program to

address malnutrition and contribute to meeting Sustainable Development Goal 2 (reduce hunger of all forms). However, participants' education and the price of *proGARI* are key factors in determining the willingness to pay. Nonetheless, educating participants on the benefits of *proGARI* can enhance market acceptability. Alternatively, the government can subsidize the price of *proGARI* to enhance its consumption. Public-private partnerships can also help reduce the price and promote *proGARI* consumption.

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Competing Interest

The authors declare that they have no known competing financial interest(s) or personal relationship that could have appeared to influence the work reported in this study.

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Orcid

Leticia Amoakoah Twum

<https://orcid.org/0000-0002-9770-6709>

Fidelis C. K. Ocloo

<https://orcid.org/0000-0002-8926-4875>

Isaac Kwabena Asare

<https://orcid.org/0000-0002-2689-0043>

Bernard Tawiah Odai

<https://orcid.org/0000-0001-8602-8976>

Andrew Agyei-Holmes

<https://orcid.org/0000-0003-0812-7631>

Bernard Darfour

<https://orcid.org/0000-0003-3321-0242>

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