Consumption pattern of biofortified vitamin A cassava products in Oyo state, South-West Nigeria

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This study investigated the consumption pattern of biofortified vitamin A cassava products in Oyo state, Nigeria using data collected from 120 households selected via multi-stage sampling. Findings from the study revealed that the households consume cassava products in the form of garri (85.8%), lafun (59.2%) and fufu (30.8%), while the consumption of non-biofortified vitamin A cassava products (62.5%) is higher than the consumption of biofortified vitamin A cassava products (37.5%). Results from the LA-AIDS analysis revealed that the significant factors influencing the demand for the three cassava products were the prices of biofortified vitamin A and non-biofortified vitamin A cassava products, age, gender, education of household head and household income. The expenditure elasticity for the biofortified garri, lafun and fufu indicated that they are normal and luxury foods. The own-price elasticity of the three majorly consumed biofortified cassava products indicated that their demand was price elastic, while the cross-price elasticity of the three biofortified products in relation to non-biofortified cassava products indicated that they were substitutes. It is recommended that policymakers implement strategies for stimulating the demand for biofortified cassava products, as this will not only improve food-nutrition security, but also create income-yielding opportunities.

Keywords: Biofortification, cassava products, demand, elasticity, vitamin A

There is an increasing concern about the prevailing impact of micronutrient deficiencies, which pose serious public health issues, particularly in the world's developing nations. These deficiencies are associated with the major consumption of staple foods deficient in vitamins and minerals required for optimum body function (Okwuonu et al. 2021). Given the importance of staple foods in the diets of these nations, biofortification becomes imperative for reducing the burden of micronutrient deficiencies. Previous studies in Nigeria have demonstrated that micronutrient deficiencies, notably vitamin A, zinc and iron deficiencies, are a common major health problem that demands immediate attention (Abubakar et al. 2017; Afolami et al. 2021; Harika et al. 2017). The present study focuses on the consumption of biofortified vitamin A staple foods, particularly cassava products in the country. Nigeria is the world's leading producer of cassava, and the crop is the second most popular staple food consumed in the country (FAO et al. 2019). Hence, cassava qualifies as a suitable food choice for delivering vitamin A through biofortification in the country. HarvestPlus, an international initiative aimed at enhancing the micronutrient components of major staple foods, prioritized the biofortification of cassava and maize with vitamin A in Nigeria (Asare-Marfo et al. 2013). In 2015, it was estimated that three-quarter of all harvested biofortified roots were planted as part of the project (Bouis and Saltzman 2017). Unfortunately, only 10% of the expected yield from biofortified vitamin A cassava roots were sold in the local markets (Ilona 2014), thus demonstrating that biofortified foods are only a modest percentage of total food consumption in Nigeria (Oteh et al. 2020). As a result of the low patronage and market presence, it is difficult to increase consumer demand and, as a result, supply for these products. Hence, this study aimed to examine the consumption pattern of biofortified vitamin A cassava products in South-West Nigeria. The consumption pattern can be used to forecast market demand

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potential for biofortified cassava, which can help to create new economic opportunities and strengthen local economies. The possibility of improving food-nutrition security is also part of the spillover effect.

Methodology

Study location

The study was conducted in Oyo state situated in the South-West Nigeria. The state lies between longitude 3° - 5° E and latitude 7° - 8° N. According to the National Population Commission (2006), the state had an estimated population of 5,580,894 people. The major occupation practiced by the people dwelling in the state is agriculture.

Sampling procedure

The study utilized primary data collected through a household survey in six communities of two Local Government Areas (LGA) within Oyo state. A total of 120 cassava product-consuming households were randomly selected through a three-stage sampling procedure and interviewed using a structured questionnaire. Two LGAs – Iseyin and Kajola, were randomly selected in the first stage, after which three communities were selected randomly from each LGA. In the final stage, 20 cassava product-consuming households were selected randomly within each of the selected communities.

Analytical Framework

Descriptive statistics was employed to profile the selected households according to their socioeconomic characteristics. The Linear Approximate Almost Ideal Demand System (LA-AIDS) model was employed to determine the consumption behavior of the selected households for biofortified cassava products by estimating the portion of household incomes allocated to the consumption of biofortified cassava products relative to total household expenditures (Deaton and Muellbauer 1980; Jumah et al. 2008; Akinbode 2015). Three forms of Marshallian uncompensated elasticity including expenditure elasticity, own-price elasticity, and cross-price elasticity were calculated using the LA-AIDS model to predict the nature of demand for biofortified cassava products (Agbola 2000; Alpay and Koc 2002)

Following the demand system developed by Deaton and Muellbauer (1980), the LA-AIDS model can be written as:

$$\omega_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} + \ln \rho_i + \beta_i \ln\left(\frac{X}{\rho}\right) + \lambda_{ij} z_j + \varepsilon_I$$

Where, ω_i represents the budget share of i^{th} food item

n is the number of cassava products

ρ_i represents the price of i^{th} food item

X represents the total expenditure on the food items in the system

ρ represents the price index

z_j represent the selected socioeconomic attributes of the households.

α_i, γ_{ij}, λ_{ij}, and β_i represent the parameters to be estimated

ε_i is the disturbance term

From the parameter estimates of the LA-AIDS model, the Marshallian uncompensated measures of expenditure, own-price, and cross-price elasticity (Alpay and Koc 2002) can be computed as:

$$\delta_i = 1 + \left(\frac{\beta_i}{\omega_i}\right)$$

$$\varepsilon_{ii} = -1 + \left(\frac{\gamma_{ii}}{\omega_i}\right) - \beta_i$$

$$\varepsilon_{ij} = \left(\frac{\gamma_{ii}}{\omega_i}\right) - \beta_i \left(\frac{\omega_j}{\omega_i}\right)$$

where δ_i, ε_{ii}, and ε_{ij} represent the Marshallian expenditure, own-price and cross-price elasticity respectively.

Results and discussion

Socioeconomic characteristics of respondents

Table 1 presents the socioeconomic characteristics of the sampled households. The majority (63.3%) of the household heads are male with an average of 42 years. This finding is similar to the Demographic and Health Survey (2003) report, that majority (83%) of Nigerian households are headed by men. The average size of the households is four with the majority (56.7%) of the households having less than five members. Cumulatively, 74.1% of the household heads have secondary and tertiary education as their highest level of education attained. The most common primary occupation (37.5%) of the households is farming. Previous studies have shown that agriculture is a primary source of food and livelihood, particularly for rural households in Nigeria (Adepoju and Obayelu 2013; Kenny 2019). The households earn an average monthly income of about ₦30,000; This indicates that the average household in the study location lives on a low income.

Table 1: Socioeconomic Characteristics of Respondents

	Frequency	Percent	Mean
Age of household head			
≤30	18	15.0	42
31 – 40	39	32.5	
41 – 50	41	34.2	
51 – 60	18	15.0	
>60	4	3.3	
Total	**120**	**100**	
Gender of household head			
Male	76	63.3	
Female	44	36.7	
Total	**120**	**100**	
Household size			
≤5	68	56.7	4
6 – 10	35	29.2	
>10	17	14.2	
Total	**120**	**100**	
Educational attainment			
No formal education	3	2.5	
Primary education	28	23.3	
Secondary education	55	45.8	
Tertiary education	44	28.3	
Total	**120**	**100**	
Primary occupation			
Farming	45	37.5	
Salaried employment	32	26.7	
Trading	22	18.3	
Artisans	19	15.8	
Pensioners	2	1.7	
Total	**120**	**100**	
Household monthly income (₦)			
<10000	3	2.5	30,042
10000 – 19999	21	17.5	
20000 – 29999	37	30.8	
30000 – 39999	42	35.0	
40000 – 49999	11	9.2	
≥50000	6	5.0	
Total	**120**	**100**	

Note: $1 = ₦360

Household consumption practices for cassava products

Table 2 shows the consumption practices of households for cassava products. The majority (60%) of the households indicated cassava to be their major source of carbohydrate. This finding supports FAO et al. (2019) that cassava is the second most-consumed staple food in Nigeria. The percentage of households consume cassava products in the form of flake (garri), flour (lafun) and fufu are 85.8, 59.2 and 30.8% respectively. The consumption of products from non-biofortified vitamin A cassava (62.5%) is higher than the consumption of biofortified vitamin A cassava products (37.5%).

Table 2: Household cassava products consumption practices

	Frequency	**Percent**
Cassava as major source of carbohydrate		
Yes	72	60.0
No	48	40.0
Forms of consumption		
Cassava flakes (garri)	103	85.8
Cassava flour (lafun)	71	59.2
Fufu	37	37.0
Type of cassava consumed		
Biofortified vitamin A	45	37.5
Non-biofortified vitaminA	75	62.5
Totals	**120**	**100**

Factors influencing the demand for biofortified vitamin A cassava products

Table 3 presents estimates for the LA-AIDS analysis for the factors determining the demand for biofortified vitamin A cassava products. The expenditure share of the biofortified vitamin A cassava products represents the dependent variables which are: the expenditure share on biofortified vitamin A garri, the expenditure share on biofortified vitamin A lafun, and the expenditure share on biofortified vitamin A fufu. The explanatory variables included the natural logarithm of the prices of various cassava products including biofortified vitamin A garri, biofortified vitamin A lafun, biofortified vitamin A fufu, non-biofortified vitamin A garri, non-biofortified vitamin A lafun, and non-biofortified vitamin A fufu. Some socioeconomic attributes of the household were also included as explanatory variables. The value of the coefficients of determination, R^2, varied from 0.5162 – 0.3664, indicating the variation in the expenditure share on biofortified vitamin A lafun, garri, and fufu. The result reveals that the significant factors influencing the demand (expenditure share) for bio-fortified cassava products include prices of biofortified vitamin A cassava products, prices of the non-biofortified vitamin A products, age of household head, gender of household head, education of household head and household income. The own price of each product negatively influences the expenditure share of the biofortified cassava products. Also, the prices of the non-biofortified cassava products positively affect the demand for the biofortified products. This may be because the products are substitutes, as a result, if the price of the non-biofortified cassava products relative to the price of the biofortified cassava products increases, the expenditure share on biofortified vitamin A cassava products among

the household may increase. The analysis also revealed that the income of households is positively associated with the expenditure share of households on the three biofortified cassava products. This suggests that as the income of households increases, the expenditure share of households on the biofortified cassava products may increase. Also the educational attainment of the household head positively influences the expenditure share of households on the three biofortified cassava products, indicating that the expenditure share of households on the biofortified products may be higher if the household head is educated or has beyond basic level of education. According to Onyeneke et al. (2020), education is essential for reception of ideas and accessibility of knowledge that will enhance adoption. As a result, educated household heads are more likely to possess knowledge of the nutritional benefit of the biofortified vitamin A cassava products which may motivate them to spend more to purchase the biofortified products than their uneducated counterparts. This result agrees with the findings of Kolapo and Abimbola (2020) that an increase in the educational attainment of household head increases the probability to pay for biofortified vitamin A garri.

Table 3: Estimates of the LA-AIDS analysis of demand for vitamin A biofortified cassava products

	E_BVAG	**E_BVAL**	**E_BVAF**
Constant	–2.302	5.057	1.411
LnPBG	–0.693**	0.326	0.074
LnPBL	–0.051	–0.175**	0.372
LnPBF	–0.164	–0.047	–0.231
LnPNG	0.429*	0.236	0.291
LnPNL	0.378	0.077***	0.175
LnPNF	0.094	0.113	0.153**
Age	–0.103***	0.064***	0.078**
Gender	0.062	0.228**	0.435*
Household size	–0.022	0.041	0.083
Education	0.277***	0.136**	0.184**
Income	0.185**	0.181***	0.122***
R^2	0.4218	0.5162	0.3664

Note: **, ** and *** indicates significance level at 10%, 5% and 1% respectively.* E_BVAG, E_BVAL, and E_BVAF represent the expenditure share on biofortified vitamin A garri, biofortified vitamin A lafun, and biofortified vitamin Afufu respectively. LnPBG, LnPBL, and LnPBF represent the natural logarithm of the prices of biofortified vitamin A garri, biofortified vitamin A lafun, and biofortified vitamin A fufu respectively. LnPNG, LnPNL, and LnPNF represent the natural logarithm of the prices of for non-biofortified vitamin A garri, non-biofortified vitamin A lafun, and non-biofortified vitamin A fufu respectively.

Elasticities for biofortified vitamin A cassava products

Table 4 shows the values for the Marshallian expenditure and own-price elasticity for biofortified vitamin A cassava products. The result shows that the expenditure elasticities for biofortified garri, lafun and fufu are positive and greater than one, indicating that they are normal and luxury foods. The own-price elasticity of the three majorly consumed biofortified cassava products is negative and exceeds one, thus indicating that their demand is price elastic.

Table 4: Marshallian expenditure and own-price elasticity for biofortified vitamin A cassava products

	Expenditure elasticity	Own-price elasticity
Biofortified vitamin A garri	1.42	–1.12
Biofortified vitamin A lafun	1.12	–2.21
Biofortified vitamin A fufu	1.05	–1.98

Source: Authors' estimate

Table 5 shows the Marshallian cross-price elasticity for biofortified vitamin A cassava products relative to the non-biofortified cassava products. The results show that the values of the elasticity are mostly positive indicating that they are substitute products. The few negative values indicate complementarity between the products. For instance, non-biofortified vitamin A garri is a substitute for biofortified vitamin A garri and fufu but a complement food product to biofortified vitamin A lafun. Similarly, non-biofortified vitamin A lafun and fufu are substitutes for biofortified vitamin A lafun and fufu but complement food products to biofortified vitamin A garri.

Table 5: Marshallian cross-price elasticity for biofortified and non-biofortified vitamin A cassava products

	Bioft vit.A garri	Bioft vit.A lafun	Bioft vit.A fufu
Non-biofortified vitamin A garri	1.28	–1.71	0.93
Non-biofortified vitamin A lafun	–0.88	1.35	1.21
Non-biofortified vitamin A fufu	–1.04	1.17	1.44

Source: Author's estimate

Conclusion

The study provides concrete indicators for designing policy frameworks to improve nutrition security and stimulate the economy. From the study findings, it can be concluded that the demand for biofortified vitamin A cassava products is low relative to the non-biofortified products. Moving forward, it is recommended that policymakers implement strategies for stimulating the demand for the biofortified cassava product, as this will not only improve food-nutrition security but also create income-yielding opportunities.

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