

Assessment of consumers' preference for orange-fleshed sweet potato puree *chapati*: a case of rural and urban consumers in Kenya

Antonate Akinyi Owuor,^{a*} David Jakinda Otieno,^a Julius Juma Okello,^b Willis Oluoch-Kosura^a and Dominique Dufour^{c,d*}

Abstract

BACKGROUND: Orange-fleshed sweet potato (OFSP) is bio-fortified with vitamin A precursors through breeding and is thus ideal for combating vitamin A deficiency (VAD). One of the potential mechanisms to promote the consumption of OFSP is to enhance its availability through processing into products with a longer shelf life and more desirable to consumers. However, very few farmers and agro-processors practice value addition due to market uncertainties; there is little information on market availability for OFSP products. This study examined consumers' preference for OFSP puree *chapati* in rural and urban areas of Kenya, using the contingent valuation method. Data was collected from a random sample of 411 sweet potato consumers and a double-bounded logit model was applied to analyze consumers' willingness to pay (WTP) for OFSP puree *chapati*.

RESULTS: Consumers were willing to pay a price of Kenya shillings (KES) 19 (USD 0.14) and 35 (USD 0.26) for OFSP puree *chapati* in Homa Bay and Nairobi counties, respectively. The presence of children under 5 years in a household, consumers' awareness of OFSP products and benefits of consuming OFSP, and level of education had a positive and significant influence on WTP for OFSP puree *chapati* in both regions.

CONCLUSION: The study demonstrated that consumers exhibited a positive preference for OFSP puree *chapati*. In order to increase the consumption of OFSP and its value-added products, it is important to promote consumer awareness of OFSP puree *chapati* and other such nutritious products through cooking demonstrations and other nudging approaches using attractive illustrations and social media platforms that engage mothers and care-givers of children under 5 years old as well as the youth. © 2023 The Authors. *Journal of The Science of Food and Agriculture* published by John Wiley & Sons Ltd on behalf of Society of Chemical Industry.

Keywords: consumer preference; contingent valuation; Orange-fleshed sweet potato; value addition

INTRODUCTION

Micronutrient malnutrition (including vitamin A deficiency – VAD) has become a major public health problem in developing countries. Between 2015 and 2018, the number of undernourished people globally increased from approximately 615 million to 633 million, with sub-Saharan Africa (SSA) accounting for one-third of this vulnerable group.¹ In Kenya, the prevalence of VAD among pre-school children is 9.4%.² Occurrence of VAD affects newborns' physical and mental development, causes night blindness, and can lead to death.³ For example, according to the Kenya National Bureau of Statistics,⁴ 18% of children under 5 years old in Kenya are stunted or too thin for their age (sign of chronic under-nutrition), while 5% are wasted or too thin for their height (sign of acute undernutrition); VAD is a key contributor to both stunting and wasting. As a response mechanism, the consumption of bio-fortified foods is therefore being promoted especially in African countries as a low-cost strategy for combating micronutrient deficiency.⁴ Orange-fleshed sweet potato (OFSP) is one of the food-based approaches used to complement other efforts in

combating VAD, especially in SSA. The government of Kenya, in partnership with research and development organizations including the International Potato Center (CIP), has been promoting the consumption of OFSP by supporting post-harvest value addition. Value addition through processing is a potential strategy to increase consumption of OFSP among urban consumers on one

* Correspondence to: AA Owuor, Department of Agricultural Economics, University of Nairobi, PO Box 29053-00625, Nairobi, Kenya. E-mail: antonateowuor65@gmail.com; or D Dufour, CIRAD, UMR Qualisud, Montpellier, France. E-mail: dominique.dufour@cirad.fr

a Department of Agricultural Economics, University of Nairobi, Nairobi, Kenya

b International Potato Centre (CIP), Kampala, Uganda

c CIRAD, UMR Qualisud, Montpellier, France

d Qualisud, Université de Montpellier, CIRAD, Montpellier SupAgro, Université d'Avignon, Université de La Réunion, Montpellier, France

hand, and to reduce postharvest losses for farmers in the main producing rural area besides providing more sustainable income generating opportunities to many women and youth involved in the sweet potato value chain activities on the other hand.

Despite concerted donor efforts in promoting production, processing and consumption of OFSP, the consumption level is still low in Kenya. The low consumption of OFSP compared to white-fleshed sweet potato is happening against the background of high levels of VAD, anemia and increased need for vitamin A supplementation in the East African region than elsewhere in the world, perhaps due to limited awareness on the nutritional benefits of OFSP.⁵ Successful promotion of OFSP products is heavily dependent on consumer awareness, which is expected to trigger growth in demand. The current study explores consumer preferences for OFSP puree *chapati* as a potential pathway to promote OFSP demand and consumption. *Chapati* is widely consumed wheat-based baked product in Kenya. There has been growing interest in the substitution of OFSP flour with OFSP puree as an intermediate product in the baking industry. Incorporation of OFSP puree in the baking process can considerably lower the costs because OFSP is grown locally and entails less processing compared to flour. In addition, it reduces the amount of money spent on wheat flour. The puree yields healthier products since its preparation involves more nutrient-conserving methods such as steaming/boiling than smashing the OFSP, which retain β -carotene content at about 90%, with enhanced color and desired microbial properties that preserve the quality of baked products.^{6,7} According to Malavi et al.,⁸ incorporating OFSP puree into baked products like bread improves their texture, making them easier to chew and digest. Moreover, studies in the SSA region have shown that it is economically feasible to use OFSP puree as a substitute for wheat flour compared to OFSP flour.⁹ For instance, in terms of durability, bread containing OFSP puree lasts 6 days before spoilage compared to conventional bread, which expires on the fourth day due to high water activity in the non-puree bread.⁸ Further, incorporation of OFSP puree reduces expenditure on wheat flour and other additives such as artificial coloring with yellow egg, fat and sugar in the baked product.⁵ A study on consumer acceptability in Ghana reported that 30% of pureed OFSP added to wheat flour for baking bread is a suitable substitute for wheat flour.¹⁰ Most of the research on OFSP puree has focused on its use as a substitute for wheat flour in bread preparation at the industrial level.^{8,11–17} However, limited empirical attention has been paid to the use of OFSP puree in the preparation of *chapati*. The current study fills this knowledge gap by addressing the following objectives:

- (1) Estimating consumer willingness-to-pay (WTP) for OFSP puree *chapati* in rural and urban areas of Kenya.
- (2) Assessing socio-demographic characteristics that influence consumers' WTP for OFSP puree *chapati*.

METHODOLOGY

Theoretical framework

Considering the hypothetical nature of the OFSP puree *chapati*, the study used contingent valuation method (CVM)¹⁸ in eliciting WTP instead of conventional economic valuation approaches that are suitable for goods and services whose transactions are already directly observable in the existing markets. CVM was preferred over other stated preference methods such as choice

experiment due to the interest in and feasibility of measuring the economic value of OFSP puree *chapati* as a composite product presented as a one scenario rather than being disaggregated into individual attributes.¹⁹ The price-bidding technique of CVM, allowing OFSP consumers to choose from two bids (double-bounded questions), was applied to elicit their WTP estimates. The double-bounded elicitation approach engages respondents in two rounds of bidding. If the response to the first bid is positive the second bid is set at a higher level, but if the answer is negative the second bid is lowered further. The follow-up bid is therefore contingent on the first bid. The bidding process is stopped after the second bid.

The analysis of CVM data on consumers' WTP for OFSP puree *chapati* was based on the random utility theory,²⁰ which posits that rational consumers would only be willing to pay for any product such as the OFSP puree *chapati* if they deemed to maximize their expected utility or satisfaction. According to this theory, utility is unobservable to the researcher but can be inferred from choices made by an individual over a set of goods.¹⁸ The utility function is expressed as shown in Eqn (4):

$$U_{ij} = V_{ij} + e_{ij} \quad (1)$$

where U_{ij} represents the utility derived from good j by individual i , V_{ij} represents the deterministic component that can be measured, and e_{ij} is the random error term. The error component arises from randomness in the environment in which choices are made, as well as unobserved factors that influence individual behavior during a choice situation. The implication is that we cannot state with certainty the bundle of goods that an individual prefers. Consumers will be willing to pay for the OFSP puree composite *chapati* if the utility derived from its consumption is higher compared to other alternative products.

Sampling procedure

A multistage sampling technique was used to select consumers in markets and commercial centers, since there was no sample frame.²⁰ In the first stage, Homa Bay and Nairobi counties in Kenya were purposively selected for the study. Nairobi county was selected because it is the county with the highest population (about 23% of the 47 million people) in the country²¹ and it is the major designated urban consumer market for OFSP. Homa Bay was selected to represent rural consumers who reside in the leading sweet potato production zone in the country. Furthermore, the choice of Homa Bay was informed by the need to understand the extent to which various projects conducted by various development agencies in promoting production of OFSP for almost a decade prior to this study had contributed to commercialization and consumption of OFSP.¹¹ The second stage involved purposive selection of three sub-counties in Nairobi based on the high proportion of middle-class consumers, and in Homa Bay based on the volume of production. In the third stage, volume or intensity of trade and population density were used to select one main market from each of the selected sub-counties of Nairobi, while in Homa Bay the volume of production was used to select one main market from the selected sub-counties. In the final stage, a systematic random sampling method was applied to select consumers at the point of sale. Every third person who came to purchase sweet potato from a sweet potato seller in the market was

interviewed. Only a few consumers were skipped due to limited number sweet potato buyers per day.

Data collection

Data collection entailed a survey of a total of 411 sweet potato consumers (198 from Homa Bay and 213 from Nairobi). Focus group discussions provided information on consumers' preference for OFSP products, including OFSP *chapati* and consumption pattern. Face-to-face interviews with individual consumers were conducted using semi-structured questionnaires. This survey method was preferred since it allowed for further probing and clarification of the questions to the respondents.²⁰ The survey questionnaire comprised three sections seeking information on sweet potato purchase and consumption pattern, socio-demographic characteristics and CE questions on WTP for OFSP puree composite *chapati*.

The respondents were provided with a hypothetical scenario as a basis for eliciting the amount of money that they would be willing to pay for OFSP puree composite *chapatis*. The hypothetical scenario was framed as follows:

There are plans to use orange-fleshed sweet potato (OFSP) puree (steamed and mashed sweet potato) in the preparation of chapati. The OFSP is a special type of bio-fortified sweet potato which is high in beta carotene, a vitamin A precursor. It helps in the prevention of vitamin A deficiency-related health problems, improves digestion, and boosts the immune system. Suppose chapati containing OFSP is introduced in your normal shopping place today. Would you buy it at KES 15 (the average price of chapati in Homa Bay County) and at 30 (the average price of chapati in Nairobi County)?

The questionnaire structure provided a bidding procedure in which the initial prices of KES 15 (for Homa Bay) and Ksh 30 (for Nairobi) were based on the average prevailing prices of one piece of *chapati* in the study areas. If the answer to the first bid was 'Yes', the prices were increased to 20 and 40 for Homa Bay and Nairobi, respectively. If the answer to the first bid was 'No', the prices were

reduced to Kshs 10 and 20 for Homa Bay and Nairobi, respectively. The questioning process stopped after the second bid. The protest response was accounted for by first asking the respondent if he or she would be willing to pay for the OFSP puree *chapati* or not. The expected outcome from both bids included 'Yes, Yes'; 'Yes, No'; 'No, No' and 'No, Yes'.

Data analysis

The double-bounded logit model was applied in the estimation of consumers' WTP for OFSP puree composite *chapati*. Following Kenya Population and Housing Census Results,²¹ data generated by the double-bounded format can be modeled as shown in Eqn (2):

$$WTP_{ij} = u_i + \varepsilon_{ij} \quad (2)$$

where WTP_{ij} is the j th respondent's WTP, $i = 1, 2$ represents the first and second equation, and ε_{ij} is the error term, which captures unobservable factors that influence the decision-making process of an individual.

The j th contribution to the likelihood function is given as

$$L(u|B) = \Pr(u_1 + \varepsilon_{1j} \geq B_i, u_2 + \varepsilon_{2j} \geq B^u)^{yy} \times \Pr(u_1 + \varepsilon_{1j} < B_i, u_2 + \varepsilon_{2j} < B^l)^{nn} \times \Pr(u_1 + \varepsilon_{1j} \geq B_i, u_2 + \varepsilon_{2j} < B^d)^{yn} \times \Pr(u_1 + \varepsilon_{1j} < B_i, u_2 + \varepsilon_{2j} \geq B^u)^{ny} \quad (3)$$

where u_1 and u_2 are the means for the first and second responses. The setting $u_{ij} = X' \beta_i$ allows the means to be influenced by the characteristics of the consumer and the good. The empirical model for mean WTP estimated using double-bounded logit is as follows:

$$WTP = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \dots + \beta_n X_n + \varepsilon_j \quad (4)$$

The dependent variable in the double-bounded logit included the two bids and their responses. Coefficients of the model were

Table 1. Respondents' socio-demographic characteristics

Variable	Urban site– Nairobi (n = 213)	Rural site–Homa Bay (n = 198)	Pooled sample (n = 411)	Test of statistical differences in means (t-ratio)
Sex of respondent (% male)	31.0	36.0	33.0	−0.94
Sex of household head (% male)	80.0	76.0	78.0	0.99
Average age of respondents (years)	36.5 ^b	39.3 ^a	37.8	−2.22**
Average years of schooling for respondents	14.1 ^a	10.2 ^b	12.2	11.63***
Marital status of respondents (% married)	84.0	88.0	86.0	−0.11
Households with children under 5 years old (%)	91.0	95.0	93.0	0.93
Respondents' awareness of OFSP benefits (%)	76.5 ^a	65.1 ^b	71.0	2.55***
Nutritional training of respondents (%)	40.8	44.9	42.8	0.40
Average household's monthly income (KES)	32 698.0 ^a	14 837.0 ^b	24 093.0	13.67***
Average household size	4.0 ^b	5.0 ^a	4.0	−7.72***
Consumption of conventional <i>chapati</i> (%)	99.0	97.0	98.0	0.32
Awareness of sweet potato products (% of respondents)	84.0	87.0	86.0	−0.96

Note: Asterisks denote statistically significant differences in means between study sites at ***1% and **5%. Superscripts a, b denote the magnitude of difference in descending order.

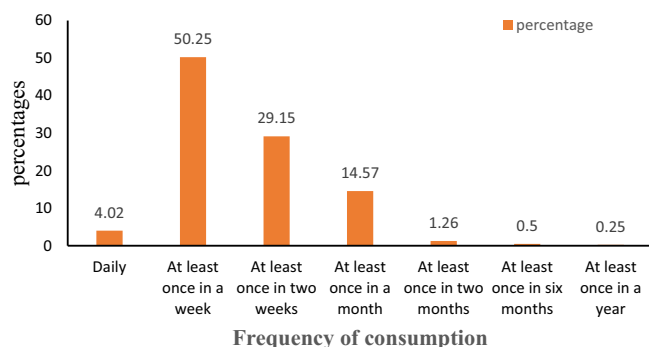


Figure 1. Frequency of consumption of *chapati*.

estimated through the maximum likelihood method. This involved two stages whereby, in the first stage, the dependent variable, which includes the two bids and their responses, were regressed to generate mean WTP, which represented the amount that consumers were willing to pay. In the second stage, independent variables were included to determine the factors that significantly influence a consumer's WTP.

RESULTS AND DISCUSSION

Socio-demographic profile of the respondents

Table 1 shows the socio-demographic profile of the respondents. From the pooled sample, two-thirds of the respondents were female. This is consistent with the general observations that, first, sweet potato is considered to be a 'woman's crop' in terms of relative time use in the production process. Second, most food purchases and cooking in Africa are done by women; hence the likely knowledgeable respondent on sweet potato matters in a typical household would be a female person. The average years of schooling were about 12 years and the respondents from the urban area – Nairobi County – had a higher level of education than their counterparts from the rural site – Homa Bay County.

The average household's monthly income for the pooled sample was KES 24 093. There was a significant difference in average income levels between the two counties, with Nairobi County recording a higher average income of about KES 32 697, which is higher than the national average monthly income of 20 123.²² The income disparity could be attributed to differences in main economic activities in the two counties. In Homa Bay County, about 74% of the labor force is employed in the relatively low-paying agricultural enterprises. Most of the households derive their incomes from fishing, crops and livestock farming activities. On the other hand, according to the Nairobi County Integrated Development Plan (CIDP 2018–2022), the highest percentage of employment is from the manufacturing industry, followed by trade and service industries.²³ Moreover, the average household size of four persons from the pooled sample is consistent with the average household size of 3.9 that was reported in the latest national population and housing census.¹⁹ The average age of the respondents was less than 40. Further, there was no significant difference in the level of awareness on OFSP products between the two regions.

The results also showed significant differences (65% and 76% of the consumers in Homa Bay and Nairobi counties, respectively) in the level of awareness of nutritional benefits that are derived from the consumption of OFSP. However, less than half of the consumers in both regions had received nutritional training. A total of 98% of the respondents consume *chapati*. This implies that the incorporation of OFSP puree in *chapati*, and promotion of OFSP puree in *chapati*, is a good opportunity to increase the consumption of OFSP at household levels.

Respondents' frequencies of consuming conventional *chapati*

As indicated in Fig. 1, half of the respondents consume *chapati* at least once a week and close to one-third consume it at least once in 2 weeks. This implies that if OFSP puree is incorporated into *chapati* there is a likelihood that the households will consume it

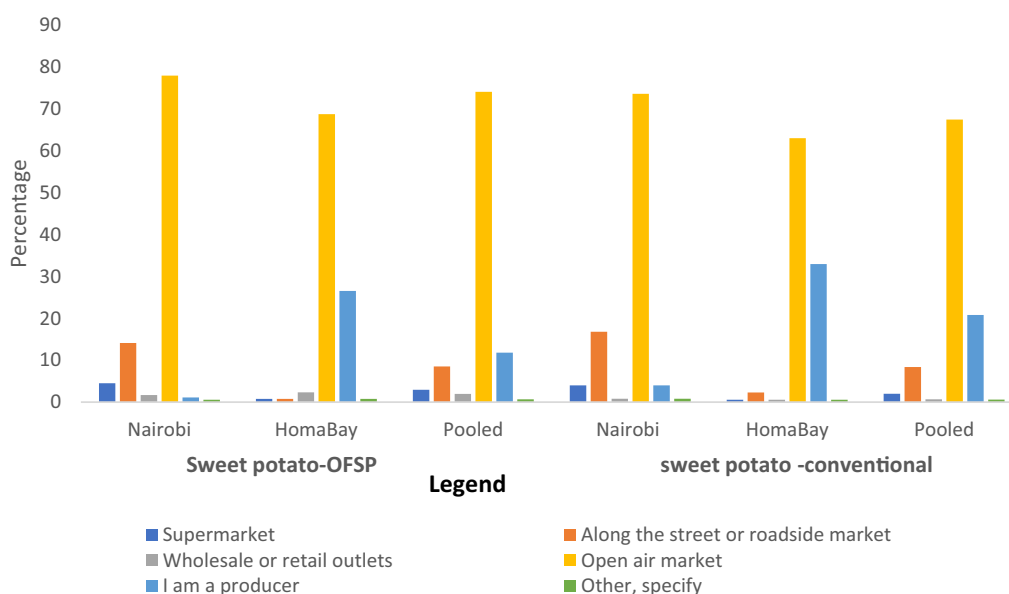


Figure 2. Main sweet potato purchase outlets.

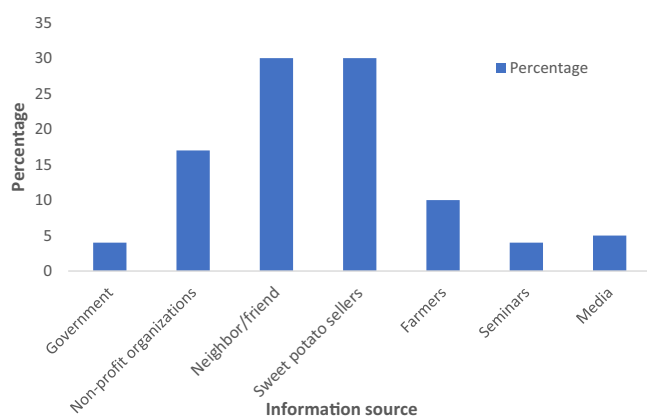


Figure 3. Sources of information on OFSP products.

Table 2. Mean willingness-to-pay (WTP) values for orange-fleshed sweet potato puree *chapati*

County	WTP	Current price	Standard error	Z	P > z
Nairobi	35.2	30	0.77	46.0	0.000
Homa Bay	19.2	15	0.75	25.5	0.000

on a weekly basis and therefore there is an opportunity to sustainably commercialize it.

Sweet potato purchase outlets and sources of information on OFSP

Figure 2 provides information on the places where consumers purchased their sweet potato. From the pooled sample, more than two-thirds of sweet potato consumers buy their sweet potato from open-air markets. In Homa Bay County, more than a third of the respondents produce their own conventional sweet potato, while about a quarter produce their own OFSP.

In Nairobi County, less than 5% of respondents produce their own sweet potato. Generally, most respondents prefer purchasing their sweet potato from open air-markets, followed by roadsides or on the streets. This could be explained by the relative proximity to

residential areas, fair prices, quantity and freshness of sweet potato sold in such outlets.

Figure 3 provides results on where consumers obtain information on OFSP products. The result showed that most of the respondents obtained information on OFSP products from their neighbors or friends, followed by sweet potato product sellers. More than 15% of the respondents obtained information from non-governmental institutions, including CIP. Only 10% of the consumers obtained information on OFSP from farmers.

Mean WTP values for OFSP puree *chapati*

Sweet potato consumers in Nairobi County were willing to pay an average price of KES 35 for OFSP puree *chapati*, which was higher than the average current market price of KES 30.

Similarly, sweet potato consumers in Homa Bay were willing to pay KES 19 for OFSP puree *chapati*, which is above the average market price of KES 15 in the region. These results imply that consumers are likely to buy OFSP puree *chapati* at a higher price as compared to the conventional *chapati* if it was to be supplied in the market. This could be attributed to the perception that OFSP has high nutritional value, and hence its products have added value. The result is consistent with the findings by CIDP²³ that consumers were willing to pay more for cricket flour buns. Additionally, the result conforms with the observation by Malavi *et al.*⁸ that consumers were willing to pay more for OFSP bread than conventional bread. This is a good pointer to the potential for upscaling the commercialization of OFSP products in both rural and urban areas, with the likely effect of helping to reduce VAD levels (Table 2).

Factors influencing WTP for OFSP puree *chapati*

Table 3 shows the results of the double-bounded logit model on factors that influence consumers' WTP for OFSP puree *chapati*. The goodness-of-fit measure represented by the $P > \chi^2$ value of 0.000 for the estimated models in both Homa Bay and Nairobi counties confirms that indeed the double-bounded logit model fits the survey data well. The Wald test results showed that the explanatory variables had a value greater than zero, implying that they influence consumers' WTP. The initial bid, which was the current average market prices for *chapati*, had a positive significant influence on WTP for OFSP puree *chapati*. This implies that an increase in the initial bid would translate into the higher

Table 3. Maximum likelihood estimate of factors influencing willingness to pay for orange-fleshed sweet potato (OFSP) puree *chapati*

Variable	Nairobi		Homa Bay	
	Coefficient	SE	Coefficient	SE
Bid 1 (initial bid)	8.130***	0.003	10.31***	0.021
Awareness of OFSP benefits	5.950***	0.365	2.792**	0.351
Marital status	0.390	0.294	1.37	0.563
OFSP product awareness	5.288***	1.704	4.798**	0.177
Education in years	0.623***	0.231	0.299**	0.175
Nutrition training	1.909**	0.782	1.746	1.350
Average income	−0.001**	0.346	−0.050**	0.367
Presence of child under 5 years old	3.847***	0.362	6.388***	0.403
Average household size	−0.052	0.069	−0.741**	0.266

Nairobi: $P > \chi^2 = 0.000$; Wald $\chi^2 = 65.20$; log-likelihood = −235.55858; $n = 213$.

Homa Bay: $P > \chi^2 = 0.000$; Wald $\chi^2 = 29.57$; log-likelihood = −235.34636; $n = 198$.

Note: Asterisks denote statistical significance at *10%, **5% and ***1% levels.

probability of an increase in consumer WTP amount. The result means that there could be a starting point bias.²⁴ Consumers' awareness of the benefits of consuming OFSP, such as improved vision and boosting of the immune system, awareness of OFSP products and presence of an under-5-year-old child in the household, had positive and significant effects on WTP for OFSP puree *chapati*. Further, nutritional training had a positive and significant influence on WTP for OFSP puree *chapati* in the urban area, while household size had a negative significant effect on WTP for OFSP puree *chapati* in the rural area. These results are consistent with the finding of Muzhingi *et al.*,¹⁵ who reported a positive relationship between nutritional knowledge and consumers' WTP for OFSP juice. It was also reported by Boyle *et al.*²⁵ that the nutrition information in traditional wet markets significantly boosts consumers' purchasing intention. Consumers who were aware of existing OFSP products such as crisps, chips, bread and flour were likely to pay more for OFSP puree *chapati*. The result is consistent with the findings of Yang *et al.*,²⁶ who reported that an increase in consumer awareness has a positive influence on consumer interest in purchasing a product.

An increase in the level of education improved consumers' awareness of the value of consuming OFSP and its products, hence increasing WTP. This result is consistent with the findings of Nkoko, ²⁷ who reported that education level had a positive significant influence on consumers' WTP for OFSP bread, flour and biscuits. Consumers with a higher level of education are more likely to purchase OFSP puree *chapati*. Income had a significant negative influence on consumer WTP for OFSP puree *chapati* in both areas. This finding is similar to that of Mawia Joel, ²⁸ who reported a negative effect of income on consumer WTP for chicken meat derived from insect-based feeds. The negative effect of income on WTP for OFSP puree *chapati* could imply that wealthier consumers do not attach priority to the value addition in their *chapati* or OFSP since they can afford other alternative sources of vitamin A.

The higher positive effect of children under 5 years on WTP for OFSP puree *chapati* noted in Homa Bay than in Nairobi could be linked to vigorous promotion by various NGOs, including CIP, of OFSP consumption and utilization among children under 5 years, especially in the rural areas of the country. The negative effect of household size on WTP for OFSP puree *chapati* is contrary to the findings of Alemu *et al.*,²⁴ which showed that households with more members put much emphasis on healthy nutrition. However, this result is consistent with the findings of Mawia Joel²⁸ that large families were less likely to pay for chicken meat derived from insect-based feeds.

CONCLUSIONS

The study assessed consumers' WTP for OFSP puree *chapati*. The results showed that consumers were willing to pay a mean price of KES 19 and 35 for OFSP puree *chapati* in Homa Bay and Nairobi counties, respectively. This calls for a differentiated pricing approach for OFSP puree *chapati* that considers the variations in consumers' affordability in different localities.

Although over four-fifths of respondents were aware of sweet potato products, only about three-quarters were aware of the benefits of OFSP and less than one-half had received nutritional training. The implications here are the need for targeted awareness creation on a rural-urban nexus, as well as a shift from general nutrition information provision to more specific content delivery that focuses on developing and relaying information on

the nutritional value of OFSP products. This can be achieved through the organization of food demonstration shows and exhibitions in which simple recipes for preparation of OFSP puree *chapati* are provided, and ready-made OFSP *chapati* samples are presented to respondents so that they can taste the products and provide their feedback on the sensory aspects for further improvement. Other public awareness creation media platforms such as billboards and posters can also be used to showcase nutritional messages about the benefits of OFSP value-added products using attractive pictorial illustrations. The youth can also be engaged as champions of promoting OFSP value-added products through social media outlets. Finally, mothers and care-givers of the under-5-year-old children should be specifically targeted as a primary entry point for introducing and sustaining the consumption of OFSP puree *chapati* in households, hospitals and early child education centers through an integrated multi-stakeholder capacity building approach.

FURTHER RESEARCH

This study has provided useful insights from a hypothetical valuation of consumers' WTP for OFSP puree *chapati*. A more practical sensory experimental assessment of consumers' preferences for actual OFSP *chapati* may offer further learning points. Moreover, an extended analysis of the preferences of multiple stakeholders in the OFSP value chain beyond the consumers would enlighten the implementation process for scaling up the value addition and commercialization of OFSP products by showing the strengths, weaknesses and roles of different actors in the process.

ACKNOWLEDGEMENTS

This research was undertaken as part of the CGIAR Research Program on Roots, Tubers, and Bananas (RTB). Funding for this work was provided by RTB Cluster 4.4 and the African Economic Research Consortium (AERC) through the provision of a research grant to the first author, who was a student in the Collaborative Masters in Agricultural and Applied Economics (CMAAE) program. The authors are also grateful to grant opportunity INV-008567 (formerly OPP1178942): Breeding RTB Products for End User Preferences (RTBfoods), to the French Agricultural Research Centre for International Development (CIRAD), Montpellier, France, by the Bill & Melinda Gates Foundation (BMGF): <https://rtbfoods.cirad.fr>. Previous versions of this paper and the ideas in it benefited greatly from suggestions and comments by the editorial team. Editorial comments by Hernán Ceballos as well as final checking of the manuscript by Clair Hershey greatly improved its quality. The valuable suggestions and corrections by reviewers also contributed significantly towards improving the quality of this article.

CONFLICT OF INTEREST

The author declare no conflict of interest with respect to authorship and publication of this research article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, [Owuor A.A.], upon reasonable request.

REFERENCES

- 1 FAO, *The State of Food Security and Nutrition in the World 2021: Transforming Food Systems for Food Security, Improved Nutrition and*

- Affordable Healthy Diets for all*. FAO, Rome, Italy, p. 240 (2021) The State of Food Security and Nutrition in the World.
- 2 Oyie S, Safari N, Anyango J, Arimi C, Nyawa B, Kimeu M *et al.*, PanAfrican Medical Journal 2019. ISSN 1937-8688.
 - 3 World Health Organization, *Guideline: Sugars Intake for Adults and Children*. World Health Organization, Geneva (2015) [Internet]. [cited 2023 Apr 18].
 - 4 Kenya National Bureau of Statistics, *Kenya Demographic Health Survey 2022 Key Indicators Report*. Republic of Kenya, Nairobi, Kenya (2023).
 - 5 Low JW and Thiele G, Understanding innovation: the development and scaling of orange-fleshed sweetpotato in major African food systems. *Agr Syst* **179**:102770 (2020).
 - 6 Moyo M, Truong VD, Simunovic J, Pankuku J, Abong GO, Amagloh FK *et al.*, Orange-fleshed sweetpotato puree: a breakthrough product for the bakery sector in Africa, in *Root, Tuber and Banana Food System Innovations: Value Creation for Inclusive Outcomes*. Springer International Publishing, Cham, pp. 145–172 (2022).
 - 7 Ojwang S, Okello JJ, Otieno DJ, Mutua JM, Lindqvist-Kreuz H, Coaldrake P *et al.*, Targeting market segment needs with public-good crop breeding investments: a case study with potato and sweetpotato focused on poverty alleviation, nutrition and gender. *Front Plant Sci* **14**:1105079 (2023).
 - 8 Malavi D, Mbogo D, Moyo M, Mwaura L, Low J and Muzhingi T, Effect of orange-fleshed sweet potato purée and wheat flour blends on β -carotene, selected physicochemical and microbiological properties of bread. *Foods* **11**:1051 (2022).
 - 9 Muoki P and Agili S, Scaling up sweetpotato through agriculture and nutrition in Kenya. International Potato Center (CIP). 2 p. 2015 [cited 2023 Apr 18].
 - 10 Wanjau C, Bocher T, Abong' G, Low J, Mbogo D, Heck S *et al.*, Consumer knowledge and attitude towards orange-fleshed sweetpotato (OFSP) puree bread in Kenya. *Open Agri* **4**:616–622 (2019).
 - 11 Orange-fleshed sweet potato (*Ipomoea batatas*) composite bread as a significant source of dietary vitamin A-Awuni-2018-Food Science & Nutrition-Wiley Online Library [Internet]. [cited 2023 Apr 18].
 - 12 Bonsi EA, Zabawa R, Mortley D, Bonsi C, Acheremu K, Amagloh FC *et al.*, Nutrient composition and consumer acceptability of bread made with orange sweet potato puree. *Acta Hort* **1128**:7–14 (2016).
 - 13 Okello JJ, Shiundu FM, Mwende J, Lagerkvist CJ, Nyikal RA, Muoki P *et al.*, Quality and psychosocial factors influencing purchase of orange-fleshed sweetpotato bread. *Int J Food Sci Technol* **56**:1432–1446 (2021).
 - 14 Owade JO, Abong GO and Okoth MW, Production, utilization and nutritional benefits of orange fleshed sweetpotato (OFSP) puree bread: a review. *Curr Res Nutr Food Sci J* **6**:644–655 (2018).
 - 15 Muzhingi T, Owade JO, Abong GO, Okoth MW, Heck S, Low J *et al.*, Sensory attributes of composite breads from shelf storable orange-fleshed sweetpotato puree. *Open Agric* **3**:459–465 (2018).
 - 16 Ombaka JO, Physico-chemical characteristics, sensory profile and shelf stability of bread incorporating shelf-storable orange fleshed sweetpotato puree [Internet] [Thesis]. University of Nairobi; 2018 [cited 2023 Apr 18].
 - 17 Bocher T, Sindi K, Muzhingi T, Nshimiyimana JC, Nzamwita M and Low J, Investigating consumer preferences and willingness to pay for Orange-fleshed sweet potato (OFSP) juice in Rwanda. *Open Agric* **4**:227–236 (2019).
 - 18 Mitchell RC and Carson RT, The contingent valuation method, in *Valuing Natural Assets*. RFF Press, New York, p. 484 (2013).
 - 19 Merino-Castello A, Eliciting Consumers Preferences Using Stated Preference Discrete Choice Models: Contingent Ranking Versus Choice Experiment [Internet]. Rochester, NY; 2003 [cited 2023 Apr 18].
 - 20 Chauvet G, Coupling methods for multistage sampling (2015).
 - 21 Kenya Population and Housing Census Results-Kenya National Bureau of Statistics, 2019 [Internet]. [cited 2023 Apr 18].
 - 22 Bateman JJ and Mawby J, First impressions count: interviewer appearance and information effects in stated preference studies. *Ecol Econ* **49**:47–55 (2004).
 - 23 CIDP- County Integrated Development Plan 2018-2022 working Draft | Nairobi City County [Internet]. [cited 2023 Apr 18].
 - 24 Alemu MH, Olsen SB, Vedel SE, Kinyuru JN and Pambo KO, Can insects increase food security in developing countries? An analysis of Kenyan consumer preferences and demand for cricket flour buns. *Food Secur* **9**:471–484 (2017).
 - 25 Boyle KJ, Bishop RC and Welsh MP, Starting point bias in contingent valuation bidding games. *Land Econ* **61**:188–194 (1985).
 - 26 Yang SH, Suhandoko AA and Chen D, Impact of nutritional information on consumers' willingness to pay for meat products in traditional wet markets of Taiwan. *Foods* **9**:1086 (2020).
 - 27 Nkokelo U, *Consumer Acceptability and Willingness to Pay for Selected Processed Orange Fleshed Sweet Potato Products in Morogoro Municipality* [MS Thesis]. Sokoine University of Agriculture, Tanzania (2016).
 - 28 Mawia Joel H, *Consumer Willingness to Pay for Chicken Meat Derived from Chicken Fed on Insect-Based Feed in Kenya* [Msc. Thesis]. University of Nairobi, Kenya (2018).