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Participatory Farmer Evaluation of Selected African Indigenous Vegetables for Enhanced Food and Nutrition Security in Western Kenya

Francis Wayua[1]*, Christine Ndinya[1], Noel Makete[1], Martins Odendo[1], Eunice Onyango[1], Maurice Mudeheri[1], Elias Thuranira[1], Ludovicus Okitoi[1], Samuel Akolo[2], and Suleiman Kweyu[3]

[1]Kenya Agricultural and Livestock Research Organization, Non-ruminant Research Institute, P. O. Box 169-50100, Kakamega, Kenya
[2]Anglican Development Services – Western Region, P.O. Box 2830-50100, Kakamega.
[3]Agrokenya, P. O. Box 99-50100, Kakamega.

***Corresponding author:** fwayua@yahoo.co.uk, francis.wayua@gmail.com

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ABSTRACT

Production and consumption of African indigenous vegetables is low in western Kenya, yet these vegetables could provide needed micronutrients to the local population if production and consumption could be increased. The vegetables are also important for economic benefit as they take shorter duration to mature and can be sold to earn household income. This study was conducted in Busia, Kakamega and Vihiga counties of western Kenya with the objective to participatory evaluate selected indigenous vegetables with small-holder farmers. Six types of indigegous vegetables including grain amaranth (*Amaranthus* spp.), leafy amaranth, spider plant (*Cleome gynandra*), nightshade (*Solanum nigrum*), slender leaf (*Crotolaria spp.*) and cow pea (*Vigna unguiculata*) were participatory evaluated by 11 farmer groups comprising of 95 farmers (males=31, females=64). Traits evaluated included plant stand at harvest, pest and disease tolerance, time to maturity, leaf size, market demand and sensory evaluation of cooked vegetables. Spiderplant and nightshade were the most preferred vegetables across the three counties in terms of market demand. Sensory evaluation of cooked vegetables demonstrated variant preference but grain and leafy amaranth, spiderplant and nightshade were the most preferred. This study shows that African Indigenous Vegetables are popular but not readily available or highly consumed. Future studies can concentrate on awareness creation on the benefits of the vegetables, considering site-specific farmer preferences. This should be coupled with capacity building for farmers on appropriate postharvest handling and processing methods to enhance the contribution of the vegetables to food security for the target population.

INTRODUCTION

Increased consumption of African Indigenous Vegetables (AIV) is encouraged because of their health benefits and high level of nutrients related to prevention of chronic diseases. Promotional efforts of AIVs have been constrained by negative perception, poor quality seeds, inaccessibility to high yielding varieties, inadequate knowledge on Good Agricultural Practices (GAP) and high postharvest losses—estimated at 10-50% (Gogo *et al*., 2018). Adoption of agricultural technologies can be enhanced if farmers are involved in the development process. Participatory varietal selection (PVS) is a simple way for researchers to learn which varieties perform well on-station and on-farm, and to obtain feedback from end-users in the early stages of technology development. These approaches have been successfully used to identify preferred varieties of AIVs by farmers in a short time and accelerating their dissemination in Kiambu (Muthoni *et al*, 2010) and Kilifi

counties of Kenya (Ndiso *et al*., 2016a). However, data on PVS of AIVs in western Kenya is scarce.

Kenya Agricultural and Livestock Research Organization (KALRO) and stakeholders developed various AIV cultivars that have potential for improving nutrition and income of smallholder farmers. These cultivars require testing and evaluation in on-farm trials. These AIVs include grain amaranth (AH-TL), leafy amaranth (EX-ZIM), spiderplant (PS), African nightshade (BG-16), slender leaf (local landrace) and cow pea (local landrace). The objective of this study was to evaluate these varieties under farmers' management practices in different AIV growing areas of western Kenya. The target population were youth, women, people living with disability and HIV/AIDs. It was envisioned that the target population will select preferred varieties for growing and consumption which could lead to improved nutrition status and food security for local populations. The findings contribute to the Government of Kenya's Big 4 Agenda on improving food and nutrition security (KSG, 2018).

MATERIALS AND METHODS

Study area. The study was conducted in Busia, Kakamega and Vihiga counties of Western Kenya. These sites represent major AIV growing agro-ecological zones in western Kenya. Site identification was done by Implementing Partners (IPs)—Anglican Development Services, Western Region (ADS-W) in Vihiga and Busia, and Agrokenya in Kakamega. The sites were confirmed by KALRO before land was prepared. Criteria used to select farmers were: farmers had to belong to one of the following groups—youth, women, people living with physical disability and/or HIV/AIDs; and, demonstration plot land had to be owned by the group, who had a willingness to provide labour for crop management, and willingness to receive other farmer visitors to learn Good Agricultural Practices on AIVs from the demonstration plots.

Experimental Design. There were five demonstration plots per county, for a total of 15. The study employed a randomised complete block design. Each farmer was considered a replicate. The AIVs planted per demonstration plot were grain amaranth (AH-TL), leafy amaranth (EX-ZIM), spiderplant (PS), African nightshade (BG-16), slender leaf (local landrace) and cow pea (local landrace). For grain amaranth, the major product is usually the grains, however for this study, what was consumed were the leaves. The leaves were harvested before grain production in the crops growth cycle. Poultry manure was applied to the demonstration plot at a rate of 10 ton.ha^{-1}. The manure was worked into the soil. The control plot AIVs were planted without poultry manure (results not presented). Farmers were trained on GAPs on AIV production. Participatory farmer evaluation, however, involved 11 demonstration plots (Table 1).

Data Collection. Farmers evaluated raw vegetables in the field and cooked vegetables.

Evaluation of raw vegetables in the field. The evaluation approach was explained to the farmers before evaluation. Individual farmers were guided around the experimental field for evaluation on a plot by plot basis. Farmers evaluated the plots using the following criteria: plant stand at harvest, pest and disease tolerance, time to maturity, leaf size, and market demand. Market demand was determined by farmers' own feeling - i.e. by asking farmers to indicate the demand of the particular vegetable. Farmers scored each criterion on a 5-point hedonic scale: 1=very poor; 2=poor; 3=fair; 4=good; 5=excellent.

Sensory evaluation of cooked vegetables. Sensory evaluation was conducted as a farm experiment at study sites. Each vegetable variety was harvested and cooked by farmers using their normal cooking methods (basically steaming) using firewood. The vegetables were then served in coded plates and individual farmers evaluated the vegetables for colour, appearance, taste, aroma, tenderness and overall acceptability. These criteria were scored on a 5-point hedonic scale: 1=very poor; 2=poor; 3=fair; 4=good; 5=excellent, depending on the intensity of sensation.

Panelists included farmers (group members). The panelists were briefly trained on the sensory attributes to be used for evaluating the cooked AIVs, i.e. colour, appearance, taste, aroma, tenderness and overall acceptability. As the participants had limited previous experience of testing food products, the rating test was

simplified with respect to consumer preference, i.e. a 5-point hedonic scale was used. The instructions were given orally in the local language and also translated into Kiswahili in the sensory evaluation form. Colour and appearance were rated using sight. Aroma was rated using the sense of smell, whereas taste and tenderness were evaluated orally. Overall acceptability was the sum total of these parameters. To ensure independent ratings, the panelists were separated from each other to avoid group bias. Panelists tasted all the AIV type samples, one at a time followed by rinsing their mouths with water between the tasting to prevent carryover effects of tasting one sample to the next sample.

Data analysis. Data were analyzed using one-way analysis of variance, mean separation was done using the Least Significant Difference (LSD) derived from the Tukey HSD test. Chi-square test was used to test the effect of gender, education, and occupation on sensory characteristics. All analyses were done in Genstat Edition ver. 15.0 (Genstat, 2012), at 5% significance level.

RESULTS

Socioeconomic characteristics of the respondents. Women constitute over 75% of the respondents in Busia and Vihiga counties and 52.9% in Kakamega. About 33 to 50% of the farmers had secondary level of education (Table 2).

Evaluation of vegetables in the field. Significant differences ($p \leq 0.05$) were observed among the AIVs in the three counties in all the parameters studied, with cowpea having the highest plant stand at harvest and nightshade the least (Table 3). Spider plant and nightshade had the highest market demand, whereas grain and leafy amaranth had the least. Slender leaf had the highest tolerance to pests and disease, and nightshade the least (Table 3). The main pests observed at harvest were aphids.

*Sensory evaluation of cooked vegetables***.** There were no significant differences ($p > 0.05$) in colour, appearance, taste and aroma of the cooked AIVs across the three counties (Table 4). However, significant differences ($p \leq 0.05$) were observed in tenderness. Grain and leafy amaranth had the highest tenderness score (4.8) whereas cowpea had the least (3.6).

Effect of socioeconomic variables on sensory attributes. There was no significant relationship ($p > 0.05$) between socioeconomic variables (gender and main occupation) and sensory attributes of the cooked AIVs in the three counties. Education, however, affected overall acceptability of the AIVs in Vihiga County ($p = 0.029$) and taste in Busia County ($p = 0.062$).

Market demand. Regarding market demand, the most preferred AIVs across the three counties were spiderplant and nightshade (Table 5).

DISCUSSION

Socioeconomic characteristics of the respondents. Majority of the respondents were women. In western Kenya, cultivation and processing of AIVs is the domain of women. However, the project targeted youth, women, people living with disability and HIV/AIDs, and this may have contributed to the almost equal distribution of women and men in Busia and Vihiga. About a third of the respondents in all the counties had secondary level education. The ability to read and write would enable the respondents to better utilize effectively and efficiently whatever resources existed in their area, including the AIVs.

Evaluation of vegetables in the field. Cowpea is usually a drought tolerant crop and can survive with little moisture, and this agrees with previous findings (Ndiso *et al*., 2016a). Previous studies also found that nightshade is usually negatively affected by water stress (Muthomi and Musyimi, 2009). This means slender leaf was tolerant against most of the pests in the study area.

The high demand for spider plant and night shade was expected as these vegetables always have high demand in western Kenya, which corroborates the findings of previous studies in the region (Gido *et al*., 2017a). However, grain and leafy amaranth were a new introduced variety with completely distinct morphological features different from the traditional varieties grown by farmers. Most farmers were, therefore, not aware of these vegetables and this contributed to the low rating of market demand.

*Sensory evaluation of cooked vegetables***.** The high rating of leafy amaranth corroborate the findings of Muthoni et al. (2010) in which amaranth was rated highly during sensory evaluation compared

to other AIVs.

Effect of socioeconomic variables on sensory attributes. The result on gender differed with the findings of Gido *et al*. (2017b) which found that women are more informed about healthier diets and are found to consume more vegetables than men. Findings of the present study show that both gender in the study sites equally appreciated the health and nutritional benefits of AIVs and hence there was no gender-disaggregated difference in preference for the vegetables. This finding has important implications in initiatives aimed at promoting the production and consumption of AIVs in the study areas. Educated people are presumed to be more aware of the nutritional and health benefits of AIVs and hence this increases consumption. This finding corroborates earlier studies (Gido *et al*., 2017b) which revealed that education positively influenced consumption of AIVs in Kenya.

Market demand. The preference for spider plant and nightshade across the counties (Table 6) was expected as these AIVs always have high demand in western Kenya.

Regarding sensory evaluation, the most preferred cooked AIVs in each county were: grain amaranth and nightshade in Vihiga, slender leaf and spider plant in Busia, and leafy amaranth and nightshade in Kakamega (Table 6). Similar variations in sensory evaluation of cooked AIVs were reported in Kiambu County, Kenya (Muthoni *et al*., 2010).

CONCLUSION

Participatory farmer evaluation of selected AIVs was successfully conducted in western Kenya. The results of this study indicated that the most preferred AIVs in terms of market demand across the three counties were spiderplant and nightshade. Sensory evaluation of cooked AIVs demonstrated variant preference but grain and leafy amaranth, spiderplant and night shade were most prominent.

Future studies should concentrate on awareness creation on the benefits of the vegetables, considering site-specific farmer preferences. Farmers should be taught on appropriate postharvest handling and processing methods to enhance the contribution of the AIVs to food and nutrition security of the target population.

Table 1. Groups and farmers involved in participatory evaluation of indigenous vegetables in Busia, Kakamega and Vihiga counties of western Kenya

County	Sub-county	Farmers group	Number of farmers		
			Males	Females	Total
Busia (n=33)	Nambale (Nambale Ward)	Philippians 4:13	0	4	4
		Mlimani Kalikhunyola	2	17	19
		Sango Welila Self-help group	5	5	10
Kakamega (n=38)	Mumias East (Lushea Lubinu Ward)	Elwasambi Women Group	6	7	13
		Emalingana Self-help group	5	5	10
		Lubinu local vegetable group	4	7	11
		Lushea Self Help Group	4	0	4
Vihiga (n=24)	Sabatia (Chavakali Ward)	Nzigwiri Nondele Association for the Disabled	3	6	9
		Wanondi Youth Bunge	2	0	2
		Community Light Women Group	0	7	7
		Chavakali Action Group	0	6	6
Total			**31**	**64**	**95**

Table 2. Socioeconomic characteristics of the study respondents in western Kenya

Characteristics	Category	Busia (n=33)	Kakamega (n=38)	Vihiga (n=24)
Age (years)	Mean±SE*	43.5±0.8	41.1±1.1	52.6±1.1
Gender (%)	Male	19.4	47.1	23.5
	Female	80.6	52.9	76.5
Education level (%)	None	16.7	2.9	9.1
	Primary	46.7	38.2	51.5
	Secondary	33.3	50.0	33.3
	Post-secondary	3.3	8.8	6.1
Main occupation (%)	Farmer	87.1	73.5	64.7
	Business	6.5	14.7	23.5
	Moulding pots	-**	-	5.9
	Carpenter	-	-	5.9
	Teacher	3.2	-	-
	Disk Jockey	3.2	-	-
	Photographer	-	2.9	-
	Student	-	2.9	-
	Village elder	-	2.9	-
	Mason	-	2.9	-
Participation in previous AIV/NRF project (%)	Yes	25.8	55.9	47.1
	No	72.2	44.1	52.9

*SE=Standard error **means no data

Table 3. Performance of indigenous vegetable varieties in Busia, Kakamega and Vihiga counties in western Kenya

Vegetable type	Plant stand at harvest	Pest and disease tolerance	Time to maturity (days)	Leaf size	Market demand
Grain amaranth	3.6b	3.6b	33.9ab	3.6ab	3.6c
Leafy amaranth	3.7b	3.4bc	33.1ab	3.6b	3.6c
Spiderplant	3.8b	3.6bc	31.0b	3.7ab	4.6a
Nightshade	3.5b	3.3c	36.9a	3.8ab	4.6a
Slender leaf	4.1a	4.0a	34.8ab	3.7ab	4.1b
Cow pea	4.4a	3.5bc	32.7b	4.0a	3.8c
Grand Mean	3.9	3.6	33.7	3.7	4.0
LSD ($p \leq 0.05$)	0.2	0.2	2.7	0.3	0.2
CV %	27.1	27.8	36.8	32.4	24.0

Note: Means with the same letter in a column are not significantly different at 5% level LSD derived from the Tukey HSD mean separation test; Data are based on a 5-point hedonic scale (1=very poor, 2=poor, 3=fair, 4=good, 5=excellent), apart from time to maturity which is reported in days.

Table 4. Hedonic ratings for sensory attributes of cooked AIV vegetable types Busia, Kakamega and Vihiga counties in western Kenya

Vegetable type	Mean hedonic ratings for sensory attributes					
	Colour	Appearance	Taste	Aroma	Tenderness	Overall acceptability
Grain amaranth	4.4a	4.2a	4.4a	4.0a	4.8c	4.4ab
Leafy amaranth	4.5a	4.5a	4.5a	4.3a	4.8c	4.5b
Spiderplant	4.3a	4.3a	3.9a	4.3a	4.0ab	4.3ab
Nightshade	4.4a	4.1a	4.2a	4.3a	4.4bc	4.4ab
Slender leaf	4.6a	4.5a	4.5a	4.5a	4.6bc	4.3ab
Cow pea	4.3a	3.9a	3.7a	3.9a	3.6a	3.6a

Note: Means with the same letter in a column are not significantly different at 5% level using Tukey HSD mean separation test; Data are based on a 5-point hedonic scale (1=very poor, 2=poor, 3=fair, 4=good, 5=excellent)

Table 5. Ranking of indigenous vegetables and the most popular variety in Busia, Kakamega and Vihiga counties by market demand

Vegetable type	County		
	Vihiga (n=24)*	Busia (n=33)	Kakamega (n=38)
Grain amaranth	3.8a	3.1a	3.5a
Leafy amaranth	4.4ab	3.6ab	3.3a
Spiderplant	4.8b	4.7e	4.2bc
Nightshade	4.8b	4.6de	4.5c
Slender leaf	4.3ab	4.2cd	4.0b
Cow pea	4.1ab	4.0bc	3.5a
Grand Mean	4.4	4.0	3.2
LSD (≤0.05)	0.5	0.3	0.3
CV %	21.7	23.5	24.8

*n=number of panelists; Means with the same letter in a column are not significantly different at 5% level using Tukey mean separation test; Data are based on a 5-point hedonic scale (1=very poor, 2=poor, 3=fair, 4=good, 5=excellent)

Table 6. Ranking of indigenous vegetables and the most popular variety in Busia, Kakamega and Vihiga counties based on sensory evaluation of cooked samples

Vegetable type	County		
	Vihiga (n=24)*	Busia (n=33)	Kakamega (n=38)
Grain amaranth	5.0a	4.1ab	3.7c
Leafy amaranth	4.7ab	4.2ab	4.7a
Spiderplant	4.5b	4.3a	3.0d
Nightshade	4.7ab	4.2ab	4.2ab
Slender leaf	4.5b	4.5a	3.8bc
Cow pea	4.4b	3.8b	2.9d
Grand Mean	4.6	4.3	3.7
LSD (≤0.05)	0.3	0.3	0.3
CV %	13.7	22.4	25.1

*n=number of panelists; Means with the same letter in a column are not significantly different at 5% level using Tukey HSD mean separation test; Data are based on a 5-point hedonic scale (1=very poor, 2=poor, 3=fair, 4=good, 5=excellent)

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REFERENCES

Genstat. 2012. GenStat Edition ver. 15.0 for Windows. Lawes Agricultural Trust, Rothamstead Experimental Station, UK.

Gido, E.O., Ayuya, O., Owuor, G., and Bokelmann, W. 2017a. Consumer acceptance of leafy African indigenous vegetables: Comparison between rural and urban dwellers. International Journal of Vegetable Science. 23(4): 346-361.

Gido, E.O., Ayuya, O., Owuor, G., and Bokelmann, W. 2017b. Consumption intensity of leafy African indigenous vegetables: Towards enhancing nutritional security in rural and urban dwellers in Kenya. Agricultural and Food Economics. 5(14): 1-16.

Gogo, E., Opiyo, A., Ulrichs, C., and Huyskens-Keil, S. 2018. Loss of African indigenous leafy vegetables along the supply chain. International Journal of Vegetable Science. 24(4): 361-382.

KSG. 2018. Kenya School of Government. Unpacking the Big Four Agenda. Weekly Bulletin, Vol. 7. Issue 20. 2nd to 8th June 2018, Nairobi, Kenya.

Muthoni, J., Nyamongo, D., and Silingi, M. 2010. Participatory characterisation and evaluation of some African leafy vegetables in Lari, Kiambu West District, Central Kenya. Journal of Horticulture and Forestry. 2(2): 12-16.

Muthomi, J. and Musyimi, D. 2009. Growth responses of African nightshades seedlings to water deficit. ARPN Journal of Agricultural and Biological Science. 4(5): 24-31.

Ndiso, J., Chemining'wa, G., Olubayo, F., and Saha, H. 2016a. Participatory selection of cow pea varieties in Kilifi County, Kenya. International Journal of Plant and Soil Science. 9(2): 1-10.