

# Barriers and Facilitators of African Indigenous Vegetable Preparation and Consumption: A Qualitative Exploration

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## Abstract

Undernutrition continues to be a major concern in sub-Saharan Africa (SSA). One potential solution to undernutrition is to increase the consumption of nutrient-dense African Indigenous Vegetables (AIVs). The objectives of this study were to: (i) document current methods used for preparation and consumption; (ii) identify barriers to and facilitators for AIV consumption; and (iii) identify a package of interventions to increase the consumption of AIVs. This study used qualitative data from semi-structured focus group discussions (n=14; 7 male and 7 female) to achieve these objectives. Most households reported that they prepared AIVs, using the traditional method of boiling and then pan cooking the vegetables with oil, tomato, and onion but there were large discrepancies between reported cooking times. Many of the reported barriers and facilitators were contradictory to one another implying that the barriers to preparation and consumption of AIVs are situational and could be modified through interventions. Key barriers were availability and affordability of AIVs during the dry season, poor taste and monotonous diets, and perceived negative health outcomes. Key facilitators included availability and affordability particularly when produced at home, ease of preparation, and beneficial health attributes. Within this community group, nightshade (*Solanum spp.*), cowpea leaves (*Vigna unguiculata*), and spider plant (*Cleome gynandra*) were the most preferred AIVs. From these findings, interventions to promote preparation and consumption of AIVs should include improved own production to improve affordability of AIVs, improved cooking methods and recipes, and awareness creation on the beneficial health attributes of AIVs.

**Keywords:** Affordability, African nightshade, AIVs, amaranth, availability, consumption, cooking, culinary, spider plant

## INTRODUCTION

The prevalence of undernutrition continues to remain relatively high in sub-Saharan Africa (SSA). Undernutrition, measured by stunting, increased by 30% between 1990 and 2013 (Guibou, 2017). Simultaneously areas throughout SSA are experiencing a nutrition transition (Kimani-Murage et al., 2015; Ajayi et al., 2016), where urbanization, economic growth, and modernization are shifting dietary and activity patterns increasing the prevalence of overnutrition, while not increasing micronutrient intake (Raschke-Cheema and Cheema, 2008; Popkin et al., 2012)

African Indigenous Vegetables (AIVs) such as African nightshade (*Solanum scabrum*), spider plant (*Cleome gynandra*), amaranth (*Amaranthus spp.*), and cowpea leaves (*Vigna unguiculata*) are culturally accepted, nutrient dense, leafy greens, that may offer a partial solution to malnutrition in SSA by meeting this nutrition gap without introducing excess calories (Weller et al., 2015; Hoffman et al., 2017). While an improved AIV value-chain may support increased demand for AIVs (Gillespie and Bold, 2017; Maestre et al., 2017), there are drivers within the food environment that may create additional barriers to and facilitators for preparation and consumption of AIVs. The food environment consists of two domains. The *external food*

*environment* includes exogenous dimensions such as food availability, prices, vendor and product properties, and marketing and regulation within a given context. The *personal food environment* includes endogenous dimensions such as accessibility, affordability, convenience and desirability at the individual level (Turner et al., 2017). Research suggests that, in order to change household food preferences to adopt regular consumption of AIVs that maximize their nutritional profile, they need to be available, affordable (Muhanji et al., 2011), desirable, and palatable (Hartmann et al., 2013); however, an understanding of current methods and barriers to and facilitators for preparation and consumption of AIVs are needed to develop context specific interventions.

Increased consumption of AIVs (Kamga et al., 2013; Neugart et al., 2017) and thoughtful preparation techniques that maximize nutrition (Yang and Tsou, 2006; Mepba et al., 2007) and taste can lead to improved micronutrient intake and therefore improved micronutrient status (Ochieng et al., 2018). Through a qualitative exploration, the objectives of this study were to document current methods used for preparation and consumption; identify barriers and facilitators of AIV preparation and consumption; and identify a package of interventions to increase the consumption of AIVs.

## MATERIALS AND METHODS

As part of a larger study examining the production and consumption of AIVs in Kenya, we focused on the barriers of and facilitators of preparation and consumption of AIVs in western Kenya. The protocol for this sub-study received ethical approval from Rutgers University, the State University of New Jersey and Academic Model for Providing Access to Healthcare (AMPATH) in Kenya. All study participants provided informed oral consent to participate in the study.

### Study population and sample selection

In 2017, 145 individuals (n=78 female and n=67 male) participated in 14 focus group discussions (FGD) in four counties in western Kenya: Bungoma, Busia, Kisumu, and Nandi. The FGDs were separated by sex (n=7 male and n=7 female FGDs). FGDs size ranged from 8 to 17 participants. The total number of males and females in each FGD can be found in Table 1. Participants were randomly selected using farmer group contact lists. The respondents were from communities that had prior exposure to AIVs through USAID-funded Horticulture Innovation training programs. The respondents were from households that had a man or woman (age 18-65 years) and owned a small farm or garden (defined as <1 hectare (ha)). In addition, respondents were selected based on ease of access and proximity to other homes participating in the FGD. Horticultural farmers or commercial farmers cultivating and managing land more than 3 ha were excluded from the study. For each of the selected respondents, the spouses were also invited to participate in the FGDs.

Table 1: Focus Group Discussions: dates, locations, and participant numbers

Focus Group	Date	County	Female	Male
1&2	5/29/2017	Nandi	9	10
3&4	5/30/2017	Kisumu	11	9
5&6	5/31/2017	Busia	17	9
7&8	6/01/2017		12	11
9&10	6/05/2017	Bungoma	11	12
11&12	6/06/2017		9	8
13&14	6/15/2017	Busia	9	8

Total			78	67
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### Data collection

A semi-structured interview was developed by Rutgers University, the State University of New Jersey (USA) in collaboration with KALRO in English and then translated into the local languages was used to collect data. The FGDs had six themes that included staple foods, familiarity of AIVs, importance (or lack of) of consuming AIVs, favorite recipes for cooking AIVs, and barriers and facilitators of consuming AIVs. On average, interviews took 90 minutes to complete and were conducted in the local language. Each FGDs was led by two project team members, one acting as the FGD facilitator and the other as a notetaker. Interviews were not audio recorded due to the limitation of language; however, extensive notes were taken by trained enumerators.

### Analysis

Thematic analysis of FGDs was conducted using NVivo (Version 12). Data analysis followed qualitative thematic exploration (Williams et al., 2019) where the data was open-coded and organized based current methods, and barriers to and facilitators of preparation and consumption of AIVs within the context of the external (availability) and personal (affordability, convenience, desirability, and health) food environments. FGDs provided common AIV recipes. These responses were aggregated, and the full range of responses were recorded. During the FGDs, respondents were asked to list the most important AIVs. This free list data was then measured using Smith's Saliency Index (Smith's S) with the Flares program (Free list analysis under R environment using Shiny) (Wencelius et al., 2017). Smith's S measures the frequency of each response and ranges from 0 to 1. A higher Smith's S is a result of a high response frequency and therefore considered to have a higher average importance. Data were input to Flares as free lists with AIVs listed in order of importance declared by each FGD. Smith Index was then transposed into Excel and conditional formatting was used to apply a color scale where dark green represents a higher Smith index score. Freelisting techniques are used to elicit commonalities and differences in cultural domains.

## RESULTS

Results are organized into current practices and perceived barriers and facilitators of the preparation and consumption of AIVs within the external and personal food environment.

### Preparation and Consumption

#### Current Methods

Preferred foods: FGDs identified the common foods consumed within their household. Ugali, a mixture of cassava, sorghum, millet, and/or maize, was reported to be the most common food consumed among participants: "*Ugali from maize flour – Most common*" (Focus Group 1, Women). Respondents noted that beans, sweet potatoes, githeri (a mixture of beans and corn), porridge, fish, bananas, potatoes and AIVs as other common foods. One FGD noted the most common consumed AIVs: "Spider plant, kales, slender leaf, nightshade, cowpea leaves, and African kale" (Focus Group 1, Women). The Night shade had the highest Smith's S (0.70) for women, while spider plant had the highest Smith's S (0.65) for men, implying that night shade was the most preferred by women, while spider plant was most preferred by men. Pumpkin leaves and jute mallow were not considered important by women and men, respectively (Table 2). FGDs noted that nightshade, spider plant, and cowpea are the most preferred AIVs.

Table 2: Smith's Saliency Index for Preferred AIVs for Women and Men

Preferred AIV	Women	Men	Pooled Data
	Smith's Index	Smith's Index	Smith's Index
Nightshade	0.70	0.54	0.61
Spider plant	0.47	0.65	0.57

<b>Cowpea</b>	0.53	0.50	0.52
<b>Slenderleaf</b>	0.05	0.31	0.19
<b>Amaranth</b>	0.13	0.25	0.20
<b>Jute mallow</b>	0.15	0.00	0.07
<b>Pumpkin leaves</b>	0.00	0.13	0.07
<b>African kale</b>	0.07	0.04	0.05

Recipes: FGD provided common cooking methods and added ingredients for AIVs (Table 3). It was noted that all of the AIVs were cooked alone. However, in common practice, these same AIVs are usually mixed together and ingredients such as salt, milk, and groundnuts are added to the dishes. In addition, it was commonly noted that wood ash was added to the cooking water to soften the vegetables; however, too much wood ash can result in the dish being unappetizing: *“It becomes difficult to eat the AIVs if too much ash water is used during cooking”* (Focus Group 12, Men). There was a range of cooking times reported between FGDs. Some FGDs noted that the cooking time is extended when mixing different AIVs together so that the flavors blend.

Table 3: Commonly added ingredients and cooking methods for AIVs

<b>Vegetable</b>	<b>Added Ingredients</b>	<b>Methods of Cooking</b>
Spider plant (Saga)	Salt, fermented milk (Mala) or fresh milk, sesame seeds, and cooking oil	1. Boil for 30-50 minutes then fry with oil or eat without frying 2. Boil for 1-2 hours then fry with oil or eat without frying
Nightshade (Managu)	Salts, milk, onions, tomatoes, groundnuts, sesame seeds, and cooking oil	1. Boil for 1-5 minutes then fry with oil 2. Boil for 30-50 minutes then fry or eat without frying 3. Boil for 1-2 hours then fry or eat without frying 4. Ferment for up to 3 days and add sour milk
Pumpkin leaves (Muboora)	Milk	1. Boil for 10-25 minutes with wood ash
Crotalaria (Mitoo)	Salt and milk	1. Boil for 15-20 minutes with wood ash liquid then fry with oil or eat without frying
Amaranth (Terere/muchicha)	Salt, onions, tomatoes, milk, and cooking oil	1. Boil for 15-30 minutes then fry with oil or eat without frying 2. Boil for 1 hour then fry with oil or eat without frying 3. Fried alone for 5 minutes in cooking oil 4. If mixed with other AIVs boil for 1 hour then fry in oil *Some noted boiling with wood ash
Cowpea leaves (Kunde)	Salt, milk, groundnuts, sesames, and cooking oil	1. Boil with wood ash liquid for 10-30 minutes to soften then fry in oil for 15-45 minutes or eat without frying 2. If mixed with other AIVs, fry for 15-30 minutes after boiling

\*Names in () represent a common name in east Kenya

Consumption frequency: Respondents noted that they did not set goals for consumption frequencies: *“No, we don’t set goals for serving new vegetables for the family because it depends on what is available in the farm or the market and the women are the ones who plan family meals”* (Focus Group 12, Men).

### **External Food Environment**

#### *Availability*

Barriers: Respondents noted that seasonality impacts availability of AIVs: *“Shortage of AIVs during drought”* (Focus Group 6, Men). This can prevent acquiring the necessary ingredients to prepare desired meals for household consumption: *“Not all vegetables are available in each season this makes it difficult to get the required varieties for mixing”* (Focus Group 11, Women). In addition to limited availability in the marketplace, respondents noted that this may be attributed to low production of vegetables on the farm: *“Most of the land has maize and little land is left for AIVs”* (Focus Group 1, Women).

Facilitators: On the contrary, FGDs reported market availability as a facilitator for consuming AIVs: *"They are found easily in the market compared to other foods"* (Focus Group 11, Women).

### **Personal Food Environment**

#### *Affordability*

Barriers: FGD respondents noted that affordability is a major barrier to consuming AIVs, particularly during the dry season when they are sold at a premium: *"When not in season especially during the dry season, most AIVs are sold expensively"* (Focus Group 8, Men). This also influences the variety of AIVs that are purchased for household consumption: *"Financial ability is sometimes a limitation to changing the type of vegetables to be eaten"* (Focus Group 13, Women).

Facilitators: Many FGDs mentioned that AIVs are inexpensive to acquire and plant, particularly if they are wild harvested: *"Vegetables from the wild, volunteers or vegetable gardens help reduce amount of money spent on food"* (Focus Group 4, Men).

#### *Convenience*

Barriers: FGDs noted several barriers with regard to the convenience of preparing AIVs. It was noted that preparing AIVs, from harvest to table is labor-intensive: *"Some women pick less vegetables from the farm to avoid the long preparation time required before cooking (plucking the leaves, washing several times to remove soil)"* (Focus Group 14, Men). It was further noted that AIVs take a long time to cook: *"The local vegetables take long to cook which discourages some people because they don't have much time to wait"* (Focus Group 13, Women). Respondents noted that, when they have the economic resources, they prefer to purchase exotic vegetables or "expensive" food: *"Many people prefer global vegetables because they are easy to prepare"* (Focus Group 12, Men).

Facilitators: There are several aspects with respect to preparation that facilitate the consumption of AIVs. Some respondents noted that AIVs are easy prepare and further noted that they often do not require additional ingredients such as oil or meat: *"Can be cooked very easily with simple ingredients"* (Focus Group 7, Women). Furthermore, AIVs can easily compliment other foods to create a complete meal: *"Vegetables is a ready food that can consumed with other food like meal to form a complete meal for the family"* (Focus Group 11, Women).

#### *Desirability*

Barriers: Survey respondents provided a range of challenges related to the consumption of AIVs. Respondents that some AIVs have a bitter taste, which reduces consumption particularly for children: *"Some vegetables are bitter which makes some youths and children dislike them"* (Focus Group 13, Women). Furthermore, it was noted that a lack of variety results in boring and monotonous meals: *"Cooking one type of vegetable several times make the family member loose interest hence consumption reduces"* (Focus Group 13, Women). Poor culinary skills were noted as another major challenge: *"Poor cooking skills make most of family members refuse to eat vegetables"* (Focus Group 11, Women). AIVs carry a social stigma, which affects household consumption: *"Believe that vegetable is for the poor people"* (Focus Group 10, Men).

Facilitators: Respondents noted that AIVs are naturally appetizing and taste good. Additionally, respondents noted that eating AIVs may increase appetite for eating ugali and can be made even tastier with complimentary ingredients such as milk.

#### *Health*

Barriers: Many respondents noted that consumption of AIVs can cause or exacerbate health conditions, particularly in the gut and digestion system. Stomach upset, ulcers, and diarrhea were reported as common health impacts of eating AIVs: *"Some people have ulcers hence preventing them from using some AIV"* (Focus Group 9, Women). In addition, it was noted that some AIVs can

cause allergic reactions: *“Allergies, some people when they eat some vegetables they get rushes”* (Focus Group 13, Women). Some respondents noted ‘oldwives tales’ regarding a few of the AIVs, notably that crotalaria negatively impacts the liver and that spider plant can cause death: *“Rumor has it that some spider plant (saga) seeds were brought from Uganda and people who ate the spider plant died so many people stopped planting the spider plant”* (Focus Group 12, Men). It was noted that some do not know the health benefits of AIVs: *“Lack of knowledge on the importance of AIVs”* (Focus Group 10, Men).

Facilitators: FGDs noted a wide variety of health components of AIVs that facilitate their consumption. Generally, respondents noted that AIVs are nutritious, rich in vitamins, and considered to have medicinal properties: *“It’s a source of health food”* (Focus Group 7, Women). It was noted that consuming them may slow the effects of aging: *“Improve on health hence help in retarding aging effect”* (Focus Group 9, Women). Some respondents were able to identify ways that AIVs impact one’s general wellness, such as adding strength and energy (through blood), promoting a strong immune system, and preventing/reducing diseases such as cancer and infections: *“The vegetables add blood and strength in the body”* (Focus Group 9, Women). Respondents also noted other general wellness attributes such as AIVs are low in calories, increase appetite for water, and are safe to eat because they are planted without chemicals. Specifically, respondents were able to make note of ways that AIVs directly benefit the body such as reducing blood pressure, improving digestion, eyesight, intelligence, and memory, and settling the stomach. In addition, they noted that AIVs improve skin and reduce skin diseases: *“Curing diseases like skin rushes”* (Focus Group 13, Women). Some respondents noted that consumption of AIVs is important for pregnant and lactating mothers.

## **DISCUSSION**

Undernutrition continues to be a concern in SSA (Guibou, 2017). AIVs, which are nutrient rich culturally appropriate foods, may offer a partial solution to undernutrition (Abukutsa-Onyango, 2010, Weller et al. 2015, Simon et al., 2020). The FGDs analysis presented several opportunities with the personal and external food environment to promote the preparation and consumption of AIVs that build upon the pre-existing methods and facilitators. These opportunities are particularly highlighted in instances when the barriers and facilitators were contradictory to one another implying that the barriers to preparation and consumption of AIVs are situational and could be modified through interventions. A package of interventions designed to promote the preparation and consumption of AIVs should include improved availability to affordable AIVs, improved cooking methods and recipes, and promotion of the beneficial health attributes of AIVs.

### *Improved Availability and Affordability of AIVs Through Household Production*

It was reported that during the dry season, both availability and affordability were negatively affected, however, when in season, respondents reported that AIVs were available and affordable. This seasonal fluctuation causes decreased household consumption of AIVs prohibiting families from making and/or meeting consumption goals. It is recommended that individuals consume 400 g of fresh fruits and vegetables daily (WHO, 2003). To meet this goal, fresh dark, leafy greens must be available and affordable year-round. One way to ensure year-round availability and affordability is home production and the introduction of affordable water collection systems and water management during the dry season. This is particularly approachable for subsistence farmers (Musotsi et al., 2009), such as those who participated in the study. Participants noted that it is common for households to produce AIVs; however, it was reported that households are not growing enough to meet household consumption demands. Promoting the production of AIVs through provision of improved seeds and good agronomic practices. This will improve production for household consumption of a variety of AIVs at the household level and sale of surplus. In addition, households could be trained to preserve AIVs when they are in plenty and how to prepare preserved AIVs. This would allow for year-round access during seasons when AIVs are not readily available in the home garden plot.

### *Improved Cooking Methods and Recipes*

In addition to access, individual and household demand can impact consumption. The FGDs noted that common barriers households face when encouraging their families to eat dark leafy greens is monotony and poor taste. A majority of households reported that they prepare AIVs, using the traditional methods of boiling and then pan cooking the vegetables with oil, tomato, and onion but often there was a discrepancy between reported cooking times. A part from culinary monotony, the lengthy cooking time causes the vegetable to lose nutritional value (Kamga et al., 2013; Gogo et al., 2017). Improved culinary habits can minimize monotony, improve taste, and promote more frequent consumption of AIVs with higher nutrition relative to traditional cooking methods. There is some evidence to suggest that culinary interventions can have positive outcomes, such as weight loss, altering food attitude and preferences, and increasing nutrition literacy (Lautenschlager and Smith, 2007; Flynn et al., 2013). However, the direct link between intervention components and outcomes is not clear and further research is needed to assess intervention impact (Reicks et al., 2014).

### *Promotion of the Beneficial Health Attributes of AIVs*

In addition to providing high concentrations of essential nutrients such as iron, protein, calcium, and magnesium (Abukutsa-Onyango et al., 2010; Byrnes et al., 2017), AIVs also contain secondary plant metabolites such as carotenoids, glucosinolates and phenolic compounds that contribute to human health (Fadl Almoulah et al., 2017; Neugart et al., 2017). Each AIV contains a unique profile of vitamins, minerals, and plant metabolites therefore, the consumption of a variety of these indigenous African leafy vegetables may contribute to different benefits such as antioxidant activity, increase pro-vitamin A and anticarcinogenic compounds (Neugart et al., 2017). Although AIVs are considered highly nutritious, FGDs reported that the consumption of AIVs may cause or exacerbate pre-existing health conditions. While more research is required to understand the link between consuming AIVs and negative digestive and skin related health outcomes, some of these assumptions may be due to the AIVs' bitter flavor. Many of the health benefits attributed to AIVs are due to their bioactive compounds, some of which may impart a bitter, astringent, acrid flavor and impact perception of AIVs (Drewnowski and Gomez-Carneros, 2000). While some of these AIVs are indeed known to contain anti-nutritive factors including glycoalkaloids, phytic acid, and oxalic acid, the concentration and type of anti-nutritive factors is complex. Genetics and the environment have a strong impact on the levels and/or content of such compounds (Rouphael et al., 2012). In general, these AIVs are healthy and highly nutritious. It is important that nutritious intervention focus on the health benefits of AIVs to dispel misinformation. Any concerns relating to the possible content of anti-nutritive compounds should be clearly examined as described using nightshade as an example (Yuan et al. 2017).

### **Conclusion**

An increase in the consumption of AIVs could improve micronutrient deficiencies within at-risk populations in Kenya. It was reported that AIVs are prepared, using the traditional method of boiling and then pan cooking the vegetables with oil, tomato, and onion but there were large discrepancies between reported cooking times. Availability and affordability of AIVs during the dry season, poor taste and monotonous diets, and perceived negative health outcomes were reported as key barriers, while availability and affordability particularly when produced at home, ease of preparation, and beneficial health attributes were reported as facilitators. Interventions within the personal and external food environments should focus on the availability and affordability, desirability, palatability, and health benefits of AIVs. Furthermore, this promotion may improve social outcomes by fostering a sense of cultural pride and belonging in turn reshaping the negative social stigma associated with these nutritionally dense vegetables.

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