A Survey on Production Practices and Utilization of Vine Spinach (*Basella sp.*) In Western Kenya

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Abstract

Vine spinach is a traditional vegetable that is highly nutritious and a source of income in Kenya. It is semi domesticated and its potential to provide much needed nutrients at the household level is therefore curtailed. Its production is also constrained by varied agronomic practices, lack of quality seed for propagation, seed dormancy as well as its mucilaginous nature when cooked. A survey was conducted to obtain indigenous information on production and consumption of vine spinach. Purposive sampling was used select 77 farmers in Kakamega and Kisii counties for interviews using a pretested structured questionnaire. Data obtained was analyzed using descriptive statistics (percentages and means) from SPSS statistical package. It was found that majority of the farmers grew green leafed vine spinach (Basella alba), used vines to establish the plants, sourced the vines from their own farms, used organic but not inorganic fertilizers, used fences as a means of trelising the plants, did not observe any pests and diseases and harvested leaf once per week. Plant spacing and cooking methods varied considerably. Information obtained forms a basis for standardizing agronomic practices, provision of quality and nutritive ways preparing vine spinach for consumption.

Key words: Basella sp., seed quality; thermal leaf processing; post harvest leaf processing

INTRODUCTION

Basella (*alba* L. and *rubra* L.) known locally in Kenya as '*nderema*' and in other countries as vine or Ceylon spinach, is an evergreen creeping plant with heart shaped leaves commonly used as a vegetable. There are 2 types of *Basella sp*. found in Kenya. These are *Basella alba* L. which has green vines and white flowers and *Basella rubra* L that has purple vines and pink flowers (Malishobora, 2018). Both have shiny green leaves (See plate a and b).

Traditional vegetables (vine spinach included) are an appropriate strategy to improve nutrition and livelihoods in the rural communities of western Kenya. Vine spinach is a source of nutrients which include vitamins, minerals, proteins as well as phytochemicals. These nutrients include vitamin A, B and C, proteins, iron, calcium, magnesium, phosphorus, potassium and antioxidants betacarotene and lutein (Abukutsa

2010).

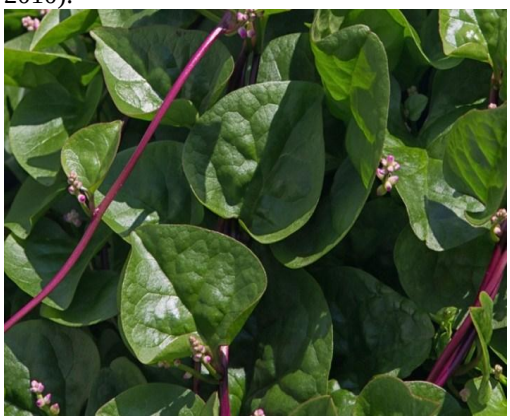

Plate a) ***Basella rubra***

Plate b) ***Basella alba***

It has medicinal properties derived from phytochemicals which have the ability to fight cancer, and cardiovascular diseases and has been used to treat headache, inflammation and ulcers (Kumar et al, 2013). Other uses include weight loss, improving digestion and eyesight, control of blood pressure, fighting infections and promoting bone health (Malishobora, 2018). Vine spinach is also a source of income for some rural households (Walingo et al, 2001; Mwaura, 2016). It can also be used as animal fodder and can increase milk yield (Slowfood, 2018).

African leafy vegetables (vine spinach included) are easy to cultivate, have a short growth period, produce seed under tropical conditions, respond well to organic manure and can tolerate both abiotic and biotic stresses compared to exotic vegetables (Grubben and Denton, 2004). They have a wide range of genetic diversity and valuable traits such as tolerance to low soil fertility, drought tolerance, and resistance to some pests and diseases that breeders can use to improve crops (Abbass, 2000). However, these vegetables have been undergoing genetic erosion and loss of indigenous knowledge concerning them. This is due to less than optimum cultivation and utilization (Rubaihayo, *et al*, 2002). There is an urgent need for intervention to avoid loss of these crops.

In comparison to other indigenous leafy vegetables in Kenya, vine spinach is rare, semi domesticated and therefore underutilized (Abukutsa 2007a; Onyango, 2013). Production at the farm level is constrained by variation in agronomic, harvest and post harvest practices used by farmers (Abukutsa, 2007b). Vine spinach is mostly propagated using stem cuttings with attendant disadvantages that poor traits of the mother plant directly being transferred to offspring. There is a need to come up with cost effective ways of producing quality seed at the farm level. Lack of information on the effect of thermal and post harvest processing methods on chemical composition and acceptability also affects utilization of these vegetables. There is need to increase production and utilization, for optimum benefits in income and nutrition by addressing these constraints.

MATERIALS AND METHODS

The study was conducted on September, 2017 in Kisii and Kakamega counties of Western Kenya. The choice of study sites was on the basis that African Leafy Vegetables (of which vine spinach is one) are extensively cultivated and consumed in these two counties. Seventy-seven respondents (38 in Kisii and 39 in Kakamega) were

purposively selected on the basis of their growing vine spinach. They were interviewed using a semi structured questionnaire. The questionnaire had been developed and pilot tested using 10 respondents in Uasin Gishu County. Data collected included traditional vegetables grown, most preferred traditional vegetable, type of vine spinach grown, how it is grown, reasons for growing it, the proportion of income from vine spinach if any, traditional uses of plant, the source of vine spinach seed, traditional methods of seed preservation, methods of cooking vine spinach leaves, methods of leaf preservation and problems encountered. Descriptive statistics (percentages and means) were used to analyze farmers' responses.

RESULTS AND DISCUSSION

Socioeconomic data of the respondents

Socio economic factors are important as what people know, do, need and opportunities vary with gender, age, culture, class, ethnicity, income and education hence the need to investigate these factors in the survey (Saad, 2000). People from various ages (above 18 years) were interviewed in this study. On average, 64% of the respondents were women (Table 1). This is similar to other findings where it was found that women had 3 to 4 vegetable plots while men had none (Walingo *et al*., 2001). Women, it has been noted, manage gardens with the highest level of genetic diversity especially traditional species and morphotypes which ALVs fall under (Cherfas, 2000; Price, 2003). Over half of the respondents had secondary school education. This implies that extension education activities directed to most of these farmers can easily be understood. In both counties quite a number of the respondents (average for the two districts was 43% in Kisii and 33% in Kakamega) had large families (six to ten members). Since vine spinach is highly nutritious it can help meet the nutritional needs of these families. Most of the respondents (75%) had grown vine spinach for more than 5 years (Table 1). This implies that since many of the farmers are producing at subsistence level these farmers can trained to produce vine spinach commercially.

Table 1 Socioeconomic Data of the Respondents in the survey

Socio economic indicators	Percentages of respondents Kisii	Kakamega	Mean
Age			
20 – 29 years	11	5	8
30 -39 years	41	24	32
40 -49 years	16	11	14
50 -59 years	11	35	23
Above 60 years	22	24	23
Gender			
Female	33	95	64
Male	67	5	36
Educational Level			
No schooling	0	6.2	3
Primary level	27	38	30
Secondary level	50	56	52
College level	23.3	0	15
Family Size			
One to five	57	48	52
Six to ten	43	33	38
More than 10	0	19	10
Duration of vine spinach Farming (Years)			
Less than 5 years	29	21	24
5-10 years	23	21	23
11-5 years	11	28	20
Over 15 years	37	31	34

Vegetable Consumed

Apart from vine spinach the respondents also consumed other traditional vegetables as shown in Fig. 1. Most farmers in western Kenya consume a number of ALVs in their households (Abukutsa, 2007a). Cowpea and slender leaf were more popular in Kakamega than in Kisii while amaranths and pumpkin leaves were more popular in Kisii than in Kakamega. These differences are due to different cultural backgrounds of the two counties ((Abukutsa, 2007a).

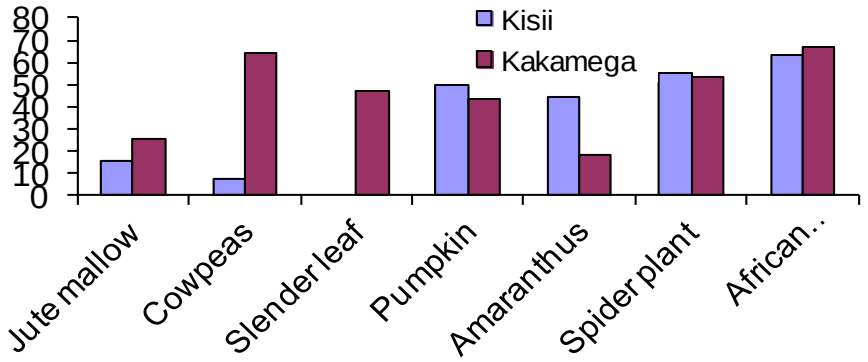

Figure 1: Traditional Vegetables consumed in Kisii and Kakamega Counties

Vegetable Preferences

Over half of the farmers in Kisii and 46% in Kakamega liked African nightshade compared to other African Leafy Vegetables (Fig. 2). Vine spinach was preferred by a few farmers. Both *Basella alba* and *rubra* were consumed. The reasons given for both vegetables were nutritional and medicinal benefits as well as good taste.

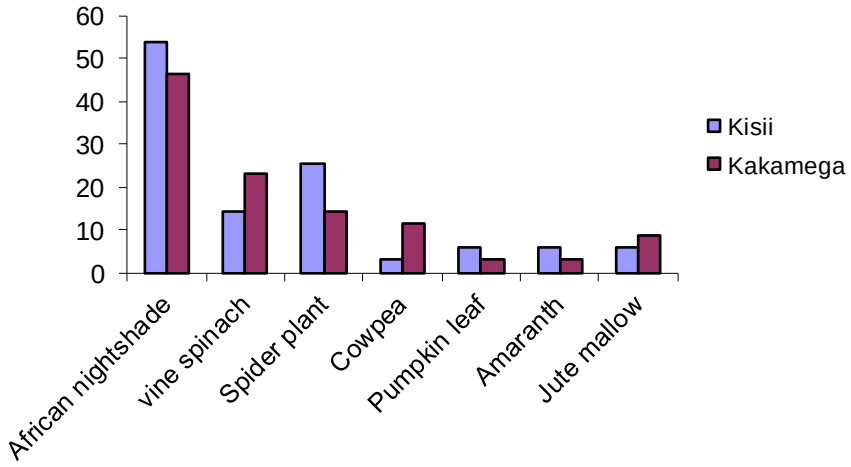

Figure 2: Farmers preferences of various vegetables in Kisii and Kakamega, Counties

Traditional uses of Vine spinach

Over half of the respondents indicated that vine spinach was mainly given to pregnant and lactating mothers (Fig. 3). This is because vine spinach has been shown to boost milk production in new mothers (Malishobora, 2018). Some respondents also indicated

that it is given to children during the weaning period since it is soft and mucilaginous when cooked.

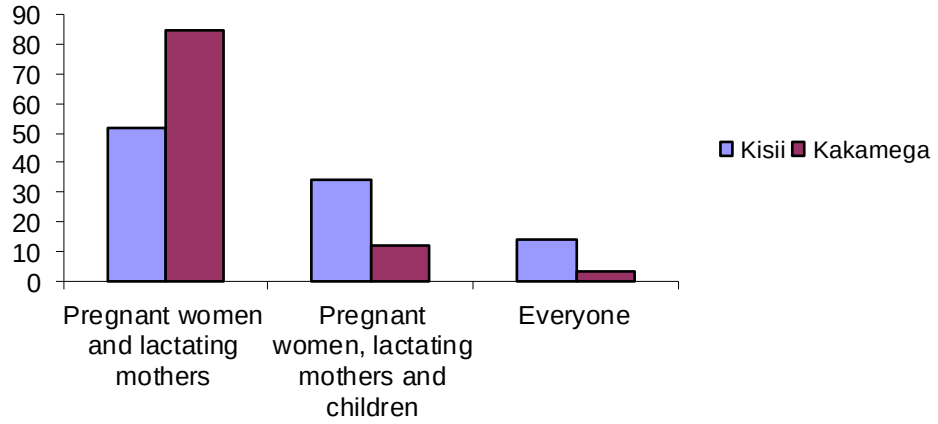

Figure 3: Traditional uses of vine spinach in Kisii and Kakamega Counties

Agronomic practices

All the farmers grew the green leafed vine spinach. Even though the farmers indicated that they grew green leafed vine spinach (*Basella alba* L.) morphological characterization of vine spinach grown in the two counties showed some morphotypes have green leaves with red margins, stems, petioles and pink flowers (*Basella rubra* L) while others had green leaves, stems and white flowers (*Basella alba* L) (Unpublished report on vine spinach morphotypes, 2018).

All farmers used vines to establish their crop. This is due to the fact that morphotypes found in the 2 counties do not produce any seeds (unpublished report on vine spinach morphotypes, 2018). Disadvantages of using vines is that poor traits of the mother plant e.g., diseases are directly transferred to offspring. As demand for vine spinach increases due to increased knowledge on its health and nutritional benefits among the Kenyan population there is a need to introduce seed producing morphotypes in the 2 counties (Abukutsa, 2007 b). The source of the vines for most of the farmers (81%) was their own farm. However, a few of them sourced the vines from neighbors, river banks and forest. This is similar to other findings and is evidence that vine spinach is still semi domesticated (Abukutsa, 2007a).

Most of the farmers (83%) ploughed their farms once before planting the crop (Table 2). Spacing from one plant to another varied from 0.5m to 3 m. This great variation in spacing emphasizes the need to standardize agronomic practices in order to maximize production. Most of the farmers (82% in Kisii and 67% in Kakamega) used the spacing of 1-2 meters between the plants. Majority of the farmers (94%) did not use inorganic fertilizers for vine spinach production. This could be due to the fact that the crop is majorly grown for subsistence. The few farmers who used inorganic fertilizers used DAP (Diammonium Phosphate) either at planting or top dressing. They also used FYM manures in addition to DAP. These farmers produced large quantities of vine spinach leaves for sale. Many farmers (46%) used organic manures. Type of manure used was farm yard manure obtained from cows or poultry. The quantities of FYM used varied form 100 g to 5 kg per plant. The manure was either applied during planting or as topdressing after weeding. The use of organic fertilizer is due to fact that ALVs respond well to manures (Schippers, 2002).

Table 2 Percentage of farmers using various agronomic and harvest practices in the production of vine spinach in Kisii and Kakamega Counties of Western Kenya

Field	Percentage of farmers		
Practices	**Kisii**	**Kakamega**	**Mean**
Type of vine Spinach grown			
Green leafed	100	100	100
Purple leafed	0	0	0
Type of planting material			
Vines	100	100	100
Seeds	0	0	0
Source of planting materials			
Own Farm	76	87	82
Neighbour	13	4	8
Own farm and river bank	0	5	3
Neighbour and river banks	0	5	3
Karlo Kisii	3	0	1
Forest	0	1	1
No. of times ploughing is done			
Once	78	88	83
Twice	22	12	17
Inorganic fertilizers			
Used fertilizers	9	3	6
Did not use fertilizers	91	97	94
Organic fertilizers			
Used manure	53	39	46
Did not use manure	47	62	54
Method of weeding			
Earthing up	59	82	71
Uprooting	35	15	25
Mulching	0	3	2
Earthing up/ Uprooting/ Mulching	6	0	3
Method of trellising			
Fence	69	59	65
Support (timber)	9	22	16
Fence and support (timber)	5	33	19
Banana plants	7	28	1
Pests			
No pests observed	69.4	66.7	68
Pests observed	30.6	33.3	32
Diseases			
No diseases observed	86	85	85
Diseases observed	14	15	15
Leaf harvest			
Once a week	100	97	98
Twice a week	0	3	2

Weeding was done by earthing up with a hoe by a majority of the farmers. Others uprooted the weeds or used mulching to suppress weed growth. For most of the

farmers (65%) trellising was achieved by planting the vine spinach next to the fences. However, there were few farmers who build support using timber while others planted the vine spinach in the banana plantation so that the banana plants could provide support. Most of the farmers did observe any pests on their crop (Table 2). Pests observed by few farmers include aphids, spider mites, caterpillars and nematodes. Most of the farmers did not observe any diseases. Those who did observed fungal diseases e.g. Rust. The low incidence of pests and diseases is related the ability of ALVs to withstand biotic stresses (Grubben and Denton, 2004). Almost all the farmers harvested the leaves for consumption or sale once a week (Table 2). This may be an indication of the agronomic limitations of existing varieties i.e., they do not produce enough herbage to be harvested more than once a week. None of the farmers harvested any seeds from the vine spinach. This is in line with the findings that morphotypes grown in the 2 counties produce flowers which abort without forming seeds. There is need to introduce varieties that produce seed to take production of vine spinach to the next level (Unpublished report on vine spinach morphotypes, 2018).

Commercialization of vine spinach

In Kisii 51.4% of the respondents did not sell any of their vine spinach vegetables but instead consumed them in the home. For those who sold vine spinach the income obtained ranged from Kshs 19 to Kshs 962 per week with the mean income being Kshs 132.5 per week. The range of income obtained shows knowledge gaps exit in production and marketing of vine spinach in Kisii. In Kakamega, 81.1% did not obtain any income from vine spinach but consumed it at the household level. The income of those who sold their vine spinach vegetable ranged from Kshs 25 to 500 per week with the mean being Kshs 27.7 per week. To improve commercialization, educational forums emphasizing on benefits of consuming vine spinach can be organised. This will improve on the demand of vine spinach creating a market.

Nutrition Aspects

About half of the respondents (56%) in both counties boiled and fried vine spinach leaves for consumption (Table 3). Frying can be done using oil, onions, tomatoes and spices. Duration of boiling for over half of the respondents (64%) in both counties was 15 to 30 minutes. Some boiled the leaves for as little as 2 minutes while other boiled for 45 minutes. Boiling has been shown to reduce phytates in vine spinach by 5% - 15% (Sandberg, 1991). Phytate is known to block availability of iron and and zinc. Boiling therefore increases bioavailability of iron and zinc. Boiling also enhances bioavailability of vitamins and caretonoids (Gibson, et al, 2010). The additives used during this cooking were salt, milk, ash (made from dried bean stalks or maize cobs) and milk. This has also been reported by other authors (Abukutsa, 2010 and Habwe, 2009). Majority of the respondents (66.7%) in Kakamega add salt only while about 41% in Kisii added salt, bean ash and milk during cooking. Most of the respondents liked the sliminess of the cooked leaves (Table 3). However, they (59%) still sought to reduce the sliminess by mixing the vine spinach leaves with other vegetables such as cowpea and pumpkin. Combining vegetables affects nutrient content due to nutrient interactions. For example some mixtures reduce or increase iron content (Habwe, 2009). Others placed the freshly harvested leaves in the sun for some hours or did not added little water when boiling. This is because vine spinach has high moisture (Slowfood, 2018). Majority of the respondents indicated that everyone consumes vine spinach in the home (Table 3). Most of the respondents did not store the leaves but cooked immediately after harvesting. This is because vine spinach deteriorates fast due to high moisture and mucilage content. Of those who stored 60% stored on an open shelf while others put the leaves in a container or banana leaves and left them outside the house overnight. Ninety percent of the respondents indicated that they did not have

any challenges when cooking vine spinach. The few that had challenges indicated that the leaves became tough to cook and also developed a bitter taste when too mature.

Table 3 Thermal and post harvest processing methods for vine spinach leaves in Kisii and Kakamega Counties of Western Kenya

	Percentage of farmers		
	Kisii	Kakamega	Mean
Methods of cooking vine spinach			
Boil	2.8	28.2	16
Fry	50	5.1	26.7
Boil and Fry	47.2	64.1	56
Mix with pumpkin then Boil and fry	0	2.6	1.3
Additives during cooking			
None	0	2.6	1.3
Salt	66.7	23.1	44
Bean ash	0	23.1	12
Milk	2.8	0	1.3
Salt and milk	27.8	2.6	14.7
Salt and Bean ash	0	41	21.3
Salt, bean ash and milk	0	7.7	5.3
Like the sliminess			
Yes	72.2	79.5	76
No	27.8	20.5	24
Reduce Sliminess			
Yes	64.5	54.8	59.3
No	35.7	45.2	40.7
Members of the household who consume on vine spinach			
Everybody	86.1	86.8	86.5
Parents	11.1	5.3	6
Children	2.8	2.6	2.7
Everyone except husband	0	5.3	2.7
Storage of vine spinach			
Cook immediately	80.6	92.3	86.7
Keep for one day	2.8	5.1	4.0
Cook immediately/ Keep for one day	5.6	0	2.7
Wilt then cook	11.4	2.6	6.7

CONCLUSION

From the survey conducted in this study it was concluded that agronomic practices varied from one farmer to another. The extent of commercialization of vine spinach is still low. Women are the main farmers of vine spinach. Cooking methods also varied which can impact the bioavailability of the nutrients from the vine spinach leaves.

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