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Full Length Research Paper

Participatory consumer evaluation of twelve sweetpotato varieties in Kenya

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Eleven improved sweetpotato varieties; "Kemb10, SPK004, Mugande, Namaswakhe, K117, Polista, Bungoma, Odinga, 292-H-12, Zapallo" and "Nyathi Odiewo (improved) ", were tested against four popular farmer varieties; "Nyathi Odiewo (local), Jayalo, Amina and Kuny kibuonjo" for consumer preference. The experiment was laid out in a randomized complete block design with 12 treatments replicated four times in mother and baby trial with farmers' involvement. The study was conducted in farmers' fields in four locations covering the major sweetpotato production Agro-Ecological Zones (AEZ) of southwest Kenya namely; Kabondo AEZ, Upper Midland$_2$ (UM_2), Ndhiwa, Low Midland$_2$ (LM_2), Rangwe, Low Midland$_1$ (LM_1) and Kendu, Low Midland$_3$ (LM_3). The trials were planted in May and September 2005 both long and short rains, respectively. Ten participating and ten non-participating farmers per location formed a panel and evaluated the mother trial for consumer preference. Focused group discussions were held to determine farmers' perception for evaluation. Data was collected on consumer preference: - yield, taste, aroma, ease to cook and texture. There were differences in yield with variety "Mug and" yielding highest followed by "K117 Nyathi Odiewo, Namaswakhe" and "Kemb10" respectively across locations. Farmers' preferred local varieties "Nyathi Odiewo" and "Kuny kibounjo" were comparable to the improved varieties. Variety "Zapallo" and the local varieties; "Jayalo" and "Amina" had lower yielding. "Odinga" was most preferred for consumption followed by "Nyathi Odiewo Kemb10, SPK004, Polista, 292-H-12" and the local checks. Farmers' involvement is crucial in evaluation of preferred sweetpotato varieties for consumption. However, varieties "K117" and "Mugande" have potential to increase farmers production.

Key words: Sweetpotato, participatory, ipomoea batatas, consumer, preference, varieties Kenya.

INTRODUCTION

Sweetpotato [*Ipomoea batatas* (L.) Lam] belongs to convolvulaceae family. Sweetpotato is the world's seventh major food crop after maize, wheat, rice, potato, barley and cassava (Gichuki et al., 2003). Sweetpotato is mainly grown for its edible roots which are high in dietary energy (Woolfe, 1992).

In Kenya, over 75% of production is concentrated in western, central and coastal areas of the country. Out of this, over 80% is grown in the Lake Victoria basin (Grũneberg et al., 2004).

In western Kenya, farmers grow landrace varieties that are preferred locally but lack consumption appeal for distant market. Sweetpotato is an important food security crop in this region. The remedy is to involve the farmers through introduction, evaluation and selection of new varieties with superior preference (Mcharo et al., 2001; Keith et al., 2004). A participatory farmer approach of Mother-Baby trial (Snapp, 1999) was used to test a range of improved sweetpotato varieties. For each "mother" trial, there were eleven corresponding "baby" trials within a distance of 5 km. The mother trials were researcher and farmer group managed to evaluate the varieties under optimal management conditions. The trials were located at the centre of the identified farming community. The baby trials were farmer managed where each contained a subset of four sweetpotato varieties out of twelve

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varieties in the mother trials. The four subset treatments (varieties) were randomly assigned to each farmer (Snapp, 2004).

In addition to yield, other qualitative parameters that were considered by consumers include the roots taste, texture, aroma of the storage roots. All these influence consumer preference of sweetpotato (Woolfe, 1992; Kapinga et al., 2000; Opare-Obisaw et al., 2000; Marti, 2003).

In this study, potential consumer preference sweetpotato varieties have been identified by scientists from Kenya Agricultural Research Institute (KARI) and International Potato Centre (CIP) for consumer preference and acceptability.

These varieties had dry matter content of at least 27% were preferred by consumers due to their maeliness. The identified varietis are rich in β-carotene and may improve the nutritional status of the consumers (Hagenimana et al., 1999; Opare-Obisaw et al., 2000). Surplus production of these varieties will likely increase farmers' income and improve their livelihoods.

It has been found that consumers determine the adoption and acceptance of sweetpotato varieties therefore their preferences, fears and aspirations have to be taken into consideration before new varieties are released (Christopher et al., 1995; Martin and Rodriguez-Sosa, 1985).

Consumers preferred sweetpotato roots, with high dry matter content greater than 27%, mealy-fleshed and starchy (Omosa, 1997; Collins et al., 1998; Opare-Obisaw et al., 2000; Hagenimana et al., 2001; Keith et al., 2004).

MATERIALS AND METHODS

Four sets of experiments were undertaken in four agro-ecological zones (AEZs) for two seasons in 2005, the Long Rains (LR) and Short Rains (SR) in three locations; Kabondo Upper Midland$_2$ (UM_2), Ndhiwa Low Midland$_2$ (LM_2) and Rangwe Low Midland$_1$ (LM_1). In the fourth location for one season during the Long Rains at Kendu Low Midland$_3$ (LM_3) that has a single cropping season (Andima et al., 2003; FAO/UNESCO, 1990; Jaetzold and Schmidt, 1982). In western Kenya Long Rains (LR) is the major rainfall season and usually starts in February and spreads to July while Short Rains (SR) is the minor rainfall season starts in August to October yearly.

Rainfall received during the crop growth

During the LR season crop growth period, Ndhiwa location received a total of 896.5 mms, Kabondo, 634.1 and Kendu, 476.2 mm. In the SR season, Ndhiwa received a total of 782.0mm and Kabondo, 316.5mm. Rangwe rainfall data was not available.

Experimental approach

A participatory Mother Baby approach involving four farmers groups; Kabondo Farmer Field School (Nyapalo), Ndhiwa Farmer Men's group (Ndonyo), Kendu Self Help group (Hocapo) and Community Health and Rangwe Agricultural workers group (Lwaho). Mother-baby trial approach (Snapp, 1999) was used to test a range of improved sweetpotato varieties for consumer preference. For each "mother" trial, there were eleven corresponding "baby" trials within a distance of 5 km. The mother trials were researcher and farmer group managed to evaluate the varieties under optimal management conditions. The trials were located at the centre of the identified farming community. The baby trials were farmer managed where each contained a subset of four sweetpotato varieties out of twelve varieties in the mother trials. The four subset treatments (varieties) were randomly assigned to each farmer (Snapp, 2004). Each group elected eleven participating farmers who planted the baby trials. There were no replications at individual farm. The baby trials were to make the participating farmers understand the sweetpotao varieties better before requesting them to select for preference in the mother trials at harvesting.

Experimental design

The mother trial of twelve varieties was set in a randomised complete block design (RCBD) replicated four times in each location. Each variety was planted in a 3.3 x 4.0 m^2 plot. Sweetpotato vines were spaced 1.0 m between ridges and 0.3 m within the row. The gross plot had four rows each with twelve plants resulting in 48 plants per plot. This was managed by the researcher who collected the data and analysed statistically. The baby trials were set in a completely randomized design with four treatments (varieties); three improved varieties and one local check variety, without replication. Spacing for baby trials was the same as mother trials. This was managed by the farmers while data was collected by researcher and analysed statistically (Data not reported). The plot sizes were 6.0 x 5.0 m^2. The net plot harvested for root yield for both the mother and baby trials consisted of the two rows of each variety comprising of twenty plants (2 x 2.27) m^2 and was done 150 days after planting (CIP, 1999).

Data collected

Data collected during the experiment by the researcher at 90 days from planting (at vigorous vegetative stage) included number of plants planted, drought tolerance (those varieties which could not show any symptom of water stress after missing rains for one month), and early maturity (those varieties that form harvestable roots in 90 days) in the mother trials in all the four locations (data not reported).

At harvesting (150 days from planting) collected data on yield. During harvesting a sample weighing 200 gm per plot of root roots were picked at random cut into small cubes of 1 cm^3, oven dried at 80^0C for 24 h and dry matter content per variety determined as percentage of root dry weight to fresh weight (data not reported). Standard data collection procedures were followed according to the International Potato Centre (CIP, 1999).

Consumers' selection by the farmers

During the crop growth period in each season (three and five months) after planting at twenty farmers ten participating and ten non-participating (Table 1), per location evaluated the mother trial. Efforts were made to ensure the involvement of all gender (Table 1). Focused group discussions were held to determine farmers' perception for evaluating storage roots for consumer preference. The farmers set their own criteria (consumer preference, taste, aroma, market preference and overall acceptance) for evaluation. During the evaluation process, farmers evaluated two replications of all the twelve sweetpotato varieties per location. Each variety was scored according to the farmers' set criteria using a five point

Table 1. Socio-Characteristics of farmers who evaluated sweetpotato varieties mother trials at different locations during 2005 cropping seasons.

Location/socio-characteristics	Season					
	Long rains			Short rains		
	Ndhiwa	Kabondo	Rangwe	Kendu	Ndhiwa	Kabondo
Age in years						
1-25	5	5	0	13	5	12
26-50	60	60	81.8	50	60	60
51-75	35	30	18.2	31.8	35	28
76 and over	0	5	0	16.6	0	0
Educational Level						
Below primary	15	0	72.7	4.5	15	0
Primary	30	10	22.7	45.5	30	12
Secondary	55	80	4.5	36.4	55	68
Tertiary	0	10	0	13.6	0	12
Gender Composition						
Female	70	50	55	70	70	45
Male	30	50	45	30	30	55
Total Number of farmers	20	20	20	20	20	20

scale (5 = very good, 4 = good, 3 = satisfactory, 2 = poor and 1 = very poor). A mean score 3.0 and above was rated as acceptable while below 2.5 was rated as unacceptable.

After harvesting a coded sample of roots the twelve varieties were sealed in a clear polythene bag so as to retain its characteristics then cooked. The twelve varieties were each displayed on a plate after cooking without its name identification in to avoid any biasness. The cooked roots were cut into small pieces and taste by the farmers using a cocoa beverage as this was accepted in the locations where the experiment were conducted there were some (farmers) who are strong Seventh Day Adventist Church believers who could not accept other beverages such as coffee or tea for oganoleptic tests. Farmers rinsed their mouths after tasting each variety before tasting the next variety to reduce the lingering taste of the last tasted variety. All the twelve were all tasted. A five point scale (5 = very good, 4 = good, 3 = satisfactory, 2 = poor and 1 = very poor) was used. Each farmers involved in the taste filled in a score form independently. Lastly each the twenty farmers ranked the twelve for overall acceptability the best being ranked 1 and the least was ranked 12 (CIP, 1999).

Socio-characteristics of farmers who evaluation the twelve sweetpotato varieties

A total of twenty farmers (Table 1) per location were chosen by the themselves to represent them on the evaluation day at harvesting who formed the taste pannel members. The twenty farmers used a score forms for scoring the twelve sweetpotato varieties for analysis. They comprised of different age aductional level and gender (Table 1). The total number of farmers who were present on that day were more than 50 per location per season.

Data analysis

Consumer preference data was analysed using the Statisical Analysis for Scientists (SAS) statisical package version 8. General Linear Model (GLM) for the analysis of variance (ANOVA) and mean separation using LSD ($p \leq 0.05$) was applied to determine whether there were significant differences among the varieties (Gomez and Gomez, 1984; Virk and Witcombe, 2004).

RESULTS

Fresh root yields

Data for root yield was collected by the researcher. There were significant ($P \leq 0.05$) differences in fresh root yield among the varieties (Table 2). The variety “K117” had the highest fresh root yields at Ndhiwa of 27.8 tons ha^{-1} whilst the local check variety, “Jayalo” had the lowest yields of 3.0 tons ha^{-1} at Kendu during the long rains season. In the LR season Ndhiwa location had the highest mean fresh root yield of 20.6 tons ha^{-1} while Kendu had the lowest at 9.8 tons ha^{-1}.

In the LR season at Ndhiwa varieties “K117, Mugande, Improved Nyathi Odiewo and Spk004”, had root yields between 20.6 - 27.8 tons ha^{-1} while the local check variety “Kuny kibounjo” was comparable with them with a mean of 25.3 tons ha^{-1}. In the SR season varieties “K117, Mugande, Improved Nyathi Odiewo, Kemb10 and Odinga” had root yields between 10.2-15.7 tons ha^{-1} as compared with the local check “Kuny kibuonjo” with a mean of 13.2 tons ha^{-1}. The variety “Namaswakhe” had the lowest yield of 4.8 tons ha^{-1}.

In the long rains season at Kabondo the varieties “292-H-12 and Namaswakhe” were significantltly different from the varieties “K117, Nyathi Odiewo and Polista”. The varieties “292-H-12, Bungoma, Kemb10, Odinga, Mugan-de, and Namaswakhe”, had root yields between 17.1-21.4 tons ha^{-1} and the local check variety “Nyathi Odie-wo” was comparable with them with root yields of 18.7 tons ha^{-1}. In the SR season varieties “Zapallo, Namaswakhe, Improved Nyathi Odiewo, Mugande, Spk004”, had root yields

Table 2. Mean fresh root yields of twelve sweetpotato varieties mother trials at different locations during 2005 cropping seasons.

Fresh root yields tons ha^{-1}	Season					
	Long rains			Short rains		
Location / Variety	Ndhiw	Kabondo	Rangwe	Kendu	Ndhiwa	Kabondo
Mugande	26.4 ab	17.1 ab	16.1 a	9.3abc	15.7 a	14.0 ab
K117	27.8 a	11.2 b	14.3ab	14.9 a	15.1 a	10.9 bc
Improved Nyathi Odiewo	24.2 abc	13.4b	14.3ab	11.6 ab	14.2 abc	14.2 abc
Namaswakhe	20.3 abc	21.4 a	11.8 bc	11.0 ab	4.8 d	14.8 ab
Kemb10	19.2 bc	17.6 ab	11.5 bc	11.3 ab	10.7 bc	12.0 abc
Odinga	20.3 abc	17.6 ab	10.4 cd	11.6 ab	10.2 bc	9.6 bc
Local check ˇ	25.3 ab	18.7 ab	7.1 ef	3.0 c	13.2 ab	12.1 abc
Bungoma	19.2 bc	18.7 ab	12.9 abc	9.1 abc	7.3 cd	11.2 bc
Spk004	20.6 abc	15.6 ab	11.2 c	6.4 bc	8.4 cd	13.9 abc
Polista	20.0 abc	12.6 b	12.1 bc	11.2 ab	8.3 cd	11.0 bc
292-H-12	16.7 c	21.4 a	8.2 de	7.9 bc	6.8 cd	8.5 c
Zapallo	6.6 d	16.2 ab	5.2 f	11.0 ab	5.5d	17.8a
Mean	20.6	16.8	11.2	9.8	10.2	12.5
Lsd (0.05)	7.9	7.9	2.9	6.8	4.3	6.1
CV	26.8	23.6	18.3	18.3	29.7	14.2

Means followed by the same letter(s) in the same column are not significantly different as separated by Lsd p=0.05
ˇLocal check (s) varieties: Ndhiwa- "Kuny kibuonjo"; Kabondo- "Nyathi Odiewo"; Rangwe- "Amina"; Kendu- "Jayalo"

between 13.9 - 17.8 tons ha^{-1} as compared with the local check variety "Nyathi Odiewo" with a mean of 12.1 tons ha^{-1}. The variety Zapallo had the highest root yield while the lowest yield was the variety "292-H-12".

In the long rains seasons at Rangwe varieties "Mugande, K117, Improved Nyathi Odiewo, Namaswakhe, Kemb10, Bungoma, Spk004", had root yields between 11.2-16.1 tons ha^{-1} while the local check variety "Amina" had a lower mean of 7.1 tons ha^{-1}. The lowest was variety "Zapallo" with root yields of 5.2 tons ha^{-1}.

In LR season at Kendu varieties "K117, Improved Nyathi Odiewo, Namaswakhe, Kemb10, Odinga, Zapallo and Polista" had root yields between 11.0 - 14.9 tons ha^{-1} as compared with the local check "Jayalo" with root yields of 3.0 tons ha^{-1} and was the lowest The variety "K117" had the highest root yield of 14 tons ha^{-1}.The yield variation may be due to genetic potential of different varieties, climatic differences, such as amout of raifall recived by the crop during the growth period (Mcharo et al., 2001).

In short rains season, no data for Kendu was taken because it is a single season zone and Rangwe had crop failure due to drought.

Preference based on taste of cooked roots as scored by farmers

There were significant ($P \leq 0.05$) differences on taste preference of cooked roots among the varieties (Table 3). At harvest of mother trial in the LR season, the variety "Odinga" was the most preferred for taste at Kabondo and Kendu with a mean of 4.5 whilst the least preferred variety was "Jayalo" at Kendu with a score of 1.6. In SR variety "Odinga" had the highest mean score of 4.6 at Kabondo and Ndhiwa. The least preferred was "K117" with a mean of 2.9 at Kabondo.

At Ndhiwa during the LR, the varieties; "Odinga, Kemb 10, Spk004, Improved Nyathi Odiewo, 292-H-12, Bungoma" and the local check variety "Kuny kibuonjo" were preferred for taste. In SR season varieties; "Odinga, Spk004, 292-H-12, Improved Nyathi Odiewo; Bungoma" and the local check variety "Kuny kibuonjo" were selected. The varieties "Odinga, Kemb10, Spk004, Polista, Zapallo" and the local check variety "Nyathi Odiewo" were selected for taste in LR season at Kabondo. In the SR season at Kabondo the varieties, "Odinga, Improved Nyathi Odiewo, Kemb10 Polista, Spk 004, Namaswakhe, Bungoma" and the local check variety "Nyathi Odiewo" were selected. In the LR season at Rangwe varieties; "Odinga, Kemb10, Spk004, Polista, Im-proved Nyathi Odiewo, Mugande", and the local check variety "Amina" were preferred for taste. At Kendu the varieties "Odinga, Kemb10, Polista, 292-H-12, Mugande, and Zapallo" were selected while the local check variety "Jayalo" was not preferred in the LR season.

In short rains season, no data for Kendu was taken because it is a single season zone and Rangwe had crop failure due to drought.

Preference based on the roots ease to cook as scored by farmers

There were significant ($P \leq 0.05$) differences on the roots

Table 3. Mean score by farmers of twelve sweetpotato varieties on cooked root taste at harvesting mother trials at different locations during 2005 cropping seasons.

Mean taste score ˇˇ	Season					
	Long rains			Short rains		
Location / Variety	Ndhiwa	Kabondo	Rangwe	Kendu	Ndhiwa	Kabondo
Odinga	4.2a	4.5a	4.2ab	4.2a	4.6 a	4.6 a
Kemb10	4.0abc	3.7cd	3.7bcd	4.1ab	4.0 abcd	3.6 bcd
Spk004	4.2a	3.9abc	4.0abc	2.6d	4.5 a	3.7 bc
Polista	3.0e	4.3ab	4.4a	4.1ab	3.0 f	3.7 bc
Local check ˇ	4.1ab	3.9abc	4.0abc	1.6e	4.1 abc	4.0 ab
292-H-12	4.1ab	3.1def	2.8ef	4.1ab	4.1 abc	3.1 cdef
Mugande	3.4cde	3.0ef	3.7bcd	4.5a	3.5 cdef	3.0 ef
Improved Nyathi Odiewo	3.6abcde	3.2def	3.7bcd	3.1cd	4.3 ab	3.6 bcd
Bungoma	3.7abcd	2.8f	3.4cde	2.6d	3.7 bcde	3.6 bcd
Namaswakhe	3.4bcde	3.3cdef	3.1de	2.4d	3.4 def	3.3 cdef
Zapallo	3.2de	3.6cde	2.4f	3.5bc	3.2 ef	3.1 cdef
K117	3.0e	1.9g	2.4f	2.4d	3.0 f	2.9 f
Mean	3.5	3.4	3.5	3.3	3.6	3.5
Lsd (0.05)	0.6	0.6	0.7	0.6	0.6	0.6
CV	31.8	30.6	32.7	32.8	29.6	27.9

Means followed by the same letter(s) in the same column are not significantly different as separated by Lsd p=0.05
ˇLocal check (s) varieties: Ndhiwa- "Kuny kibuonjo"; Kabondo- "Nyathi Odiewo"; Rangwe- "Amina"; Kendu- "Jayalo"
ˇˇScored by 20 farmers per location per season: scale (5 = very good, 4 = good, 3 = satisfactory, 2 = poor and 1 = very poor)

ease to cook among the varieties (Table 4). In the LR at harvest of the mother trials variety "Odinga" had highest score as the most preferred for ease to cooking at Ndhiwa with a mean score of 4.5 while the lowest was "Jayalo" at Kendu with a score of 1.5. The variety "Odinga" had the highest mean score of 4.7 at Ndhiwa whilst variety Kemb10 had the lowest with a mean score of 3.0 at Kabondo in the SR season. At Ndhiwa the varieties; "Odinga, Improved Nyathi Odiewo, Bungoma, Zapallo, Spk004, 292-H-12" and the local check variety "Kuny kibuonjo" were preferred for ease of cook in the LR season. In the SR season varieties; "Odinga, Improved Nyathi Odiewo, Bungoma, Zapallo, Mugande, K117, Spk004, 292-H-12", were selected while the local check variety "Kuny kibuonjo" was rated very low. At Kabondo varieties "Odinga, Improved Nyathi Odiewo; Polista, Zapallo, Spk004, K117" and the local check variety "Nyathi Odiewo" were preferred for ease to cook in the LR season. The varieties, "Odinga, Improved Nyathi Odiewo; Kemb10, Polista, Zapallo" and the local check variety "Nyathi Odiewo" were selected in the SR season.

In the LR season at Rangwe varieties; "Odinga, Improved Nyathi Odiewo, Bungoma, Polista, Kemb10, Mugande, Spk004" and the local check variety "Amina" were selected.

In the LR season at Kendu; varieties "Odinga, Bungoma, Polista, Zapallo, Kemb10, Mugande, K117, 292-H-12 and Zapallo" selected while the local check variety "Jayalo" was rated very low with a mean score of 1.5.

In short rains season, no data for Kendu was taken because it is a single season zone and Rangwe had crop failure due to drought.

Based on preference on the aroma of cooked roots as scored by farmers

Sweet potato has different aromatic smell that varies with the variety. There were significant ($P \leq 0.05$) differences in preference on the aroma of cooked roots among the varieties (Table 5). In the LR the variety "Odinga" significantly scored the highest as the most preferred for aroma at Kendu with a mean of 4.3 while the least preferred for aroma was local check variety "Jayalo" at Kendu with a mean score of 1.7. In the SR season the variety "Odinga" significantly scored the highest as the most preferred for aroma at Kendu with a mean of 4.5 while the least preferred was variety the K117 with a mean score of 2.8 at Kabondo. Overall, variety "Odinga" led across the locations with a mean score of 4.0 and the less preferredvariety for aroma was "K117" with a mean score of 2.4.

In the LR season at Ndhiwa varieties; "Odinga, Kemb 10, Improved Nyathi Odiewo, Spk004, Namaswakhe, Bungoma, 292-H-12" and the local check variety "Kuny kibuonjo" were preferred based on their aroma. In the SR season varieties; "Odinga, Improved Nyathi Odiewo, Kemb10, Spk004, Bungoma, Namaswakhe" and the local

Table 4. Mean farmers score for ease cooking the roots at harvesting mother trials at different locations during 2005 cropping seasons.

Mean ease of cook score˘˘	Season					
	Long rains			Short rains		
LOCATION / VARIETY	Ndhiwa	Kabondo	Rangwe	Kendu	Ndhiwa	Kabondo
Odinga	4.0ab	3.5abc	3.6ab	4.5a	4.7 a	4.4 a
Improved Nyathi Odiewo	4.5a	3.6ab	3.6ab	3.5c	4.7 a	3.8 bc
Bungoma	4.0ab	3.2bcd	3.8ab	3.9bc	4.5 ab	3.6 c
Polista	3.5bc	3.9a	3.7ab	4.4ab	3.6 cd	3.8 bc
Zapallo	3.9abc	3.7ab	2.7cd	4.4ab	4.0 bc	4.2 ab
Kemb10	3.7bc	2.9cd	3.9a	4.4ab	3.7 cd	3.0 d
Mugande	3.7bc	2.8d	3.6ab	4.4ab	3.8 bc	3.3 cd
K117	3.7bc	3.8ab	2.7d	3.8bc	3.8 cd	3.3 cd
Spk004	4.0ab	3.8ab	3.8ab	2.4d	4.0 bc	3.5 cd
292-H-12	3.9abc	3.2bcd	2.3d	4.1ab	3.8 bc	3.6 c
Local check ˇ	3.7bc	3.7ab	3.4ab	1.5e	3.7 cd	3.8 abc
Namaswakhe	3.3c	3.1bcd	3.3bc	2.5d	3.3 d	3.6 c
Mean	3.8	3.4	3.4	3.6	3.8	3.7
Lsd (0.05)	0.6	0.6	0.6	0.6	0.6	0.5
CV	26.4	31.4	29.3	26.4	25.6	25.7

Means followed by the same letter(s) in the same column are not significantly different as separated by Lsd p=0.05
ˇLocal check (s) varieties: Ndhiwa- “Kuny kibuonjo”; Kabondo- “Nyathi Odiewo”; Rangwe- “Amina”; Kendu- “Jayalo”
˘˘Scored by 20 farmers per location per season: scale (5 = very good, 4 = good, 3 = satisfactory, 2 = poor and 1 = very poor)

Table 5. Mean farmers score on aroma preference of cooked roots at harvest of mother trials at different locations during 2005 cropping seaseons.

Mean aroma scores score˘˘	Season					
	Long Rains			Short Rains		
Location / Variety	Ndhiwa	Kabondo	Rangwe	Kendu	Ndhiwa	Kabondo
Odinga	4.0ab	3.8ab	3.8abc	4.3a	4.0 ab	4.5 a
Kemb10	4.0ab	3.7bc	3.2cd	3.8abcd	4.0 ab	3.0 d
Spk004	4.1a	3.7bc	3.6abc	3.4bcde	4.0 a	3.2 bcd
Improved Nyathi Odiewo	3.8abc	2.8de	3.8abc	3.3cdef	4.4 a	3.2 acd
Polista	2.9de	4.3a	3.9ab	4.2a	2.9 de	3.2 cd
Local checkˇ	3.9ab	3.9ab	4.0a	1.7g	3.9 ab	3.8 b
Namaswakhe	4.0ab	3.1cd	3.2cd	3.2def	4.0 ab	3.1 cd
Bungoma	3.6abc	2.9d	3.5abcd	2.8ef	3.6 bc	3.5 bc
Mugande	3.1cde	3.0d	3.8abc	3.8abcd	3.1 cd	3.3 bcd
292-H-12	3.3bcd	3.1cd	2.9de	4.0ab	3.4 bcd	2.8 de
Zapallo	2.9de	3.0d	2.0f	3.3cdef	2.9 de	3.3 bcd
K117	2.5e	2.2e	2.4ef	2.7f	2.5 e	2.4 e
Mean	3.4	3.3	3.3	3.4	3.4	3.3
Lsd(0.05)	0.6	0.6	0.6	0.6	0.6	0.5
Cv	32.1	30	32.5	29.9	31.2	27.7

Means followed by the same letter(s) in the same column are not significantly different as separated by Lsd p=0.05
ˇLocal check (s) varieties: Ndhiwa- “Kuny kibuonjo”; Kabondo- “Nyathi Odiewo”; Rangwe- “Amina”; Kendu- “Jayalo”
˘˘ Scored by 20 farmers per location per season: scale (5 = very good, 4 = good, 3 = satisfactory, 2 = poor and 1 = very poor)

Table 6. Mean farmers score on cooked roots texture preference at harvest mother trials at different locations during 2005 cropping seaseons.

Mean texture score˘˘	Season					
	Long rains			Short rains		
Location / Variety	Ndhiwa	Kabondo	Rangwe	Kendu	Ndhiwa	Kabondo
Odinga	4.4a	4.3c	3.2cd	4.5a	4.4 a	4.6 a
Spk004	4.4a	3.8abc	3.9ab	2.8d	4.4 a	3.6 b
292-H-12	4.2a	3.4cd	3.4bcd	4.1ab	4.1 ab	3.2 b
Kemb10	4.0ab	3.7abc	3.3bcd	4.4a	4.0 ab	3.1 b
Improved Nyathi Odiewo	4.0ab	3.0de	4.0a	3.7bc	4.4 a	3.1 b
Polista	3.3cd	4.0ab	3.9ab	4.3ab	3.3 cd	3.7 b
Bungoma	4.0ab	3.4bcd	3.3bcd	3.7bc	4.0 ab	3.1 b
Zapallo	3.5bcd	3.7abc	3.1cd	4.1ab	3.5 bcd	3.4 b
Mugande	3.5bcd	2.9de	3.2cd	4.1ab	3.5 bcd	3.4 b
Local check˘	3.8abc	4.2a	3.7abc	1.5e	3.8 abc	3.6 b
K117	3.3cd	2.5e	3.0d	3.3cd	3.3 cd	3.2 b
Namaswakhe	3.1d	3.0de	3.5abcd	3.2cd	3.1 d	3.2 b
Mean	3.7	3.5	3.5	3.6	3.7	3.4
Lsd(0.05)	0.6	0.5	0.6	0.5	0.6	0.6
Cv	27.4	27.7	28.6	25.3	26.8	30.0

Means followed by the same letter(s) in the same column are not significantly different as separated by Lsd p = 0.05

˘Local check (s) varieties: Ndhiwa- "Kuny kibuonjo"; Kabondo- "Nyathi Odiewo"; Rangwe- "Amina"; Kendu- "Jayalo"

˘˘Scored by 20 farmers per location per season: scale (5 = very good, 4 = good, 3 = satisfactory, 2 = poor and 1 = very poor).

check variety Kuny kibuonjo were preferred.

"Nyathi Odiewo" was preferred based on aroma. In the Short Rains season varieties, "Odinga, Improved Nyathi Odiewo; Mugande, Zapallo Bungoma" and the local check variety "Nyathi Odiewo" were preferred. At Rangwe in the LR season the varieties; "Odinga, Improved Nyathi Odiewo, Spk004, Bungoma, Polista, Mugande" and the local check variety Amina were preferred. In the LR season at Kendu varieties ""Odinga, Kemb10, Polista, Spk004, 292-H-12 and Zapallo" were preferred while the local check variety Jayalo was least preferred.

In short rains season, no data for Kendu was taken because it is a single season zone and Rangwe had crop failure due to drought.

Preference based on cooked root texture as scored by farmers

There were significant ($P \leq 0.05$) differences on preference of cooked root texture among the varieties (Table 6). Variety "Odinga" was significantly scored the highest as the most preferred for texture in Kabondo with a mean of 4.6 while the less preferred texture was local variety Jayalo in Kendu with a mean score of 1.5. Overall "Odinga" led across the locations with a mean score of 4.2 and the less preferred for texture were K117 and Namaswakkhe with a mean score of 3.1.

In the LR season at Ndhiwa, varieties; "Odinga, Kemb 10, Improved Nyathi Odiewo, Spk004, Namaswakhe, Bungoma, 292-H-12" and the local check variety "Kuny kibuonjo" were preferred based on their texture. In the SR season, varieties; "Odinga, Improved Nyathi Odiewo, Kemb10, Spk004, Bungoma" and the local check variety "Kuny kibuonjo" were preferred. At Kabondo in the LR season the varieties; "Spk004, Kemb10, Namaswakhe, Polista" and the local check variety "Nyathi Odiewo" were preferred on the basis of texture. In the same location in the SR season varieties, "Odinga, Improved Nyathi Odiewo; Mugande, Zapallo, Bungoma" and the local check variety "Nyathi Odiewo" were preferred based on their texture. In the LR season at Rangwe, varieties; "Odinga, Improved Nyathi Odiewo, Spk004, Bungoma, Polista, Mugande" and the local check variety "Amina" were preferred for texture. In the LR season at Kendu varieties "Odinga, Kemb10, Polista, Spk004, 292-H-12 and Zapallo" were preferred while the local check variety "Jayalo" was not preferred.

In short rains season, no data for Kendu was taken because it is a single season zone and Rangwe had crop

Table 7. Mean farmers rank on cooked overall roots acceptability at harvest of mother trials at different locations during 2005 cropping seasons.

Mean root overall acceptability rank ˇˇ	Season					
	Long rains			Short rains		
LOCATION / VARIETY	Ndhiwa	Kabondo	Rangwe	Kendu	Ndhiwa	Kabondo
Odinga	4.3de*	3.8c	6.6cd	1.6g	1.7 a	1.4 d
Kemb10	4.7de	5.9abc	6.9c	5.7def	2.8 e	7.7 ab
Spk004	3.5e	6.9ab	6.3cd	8.0bc	2.3 e	6.0 bc
Improved Nyathi Odiewo	6.3abd	6.3ab	3.7f	6.3cdef	6.3 bcd	6.5 bc
Polista	8.2a	6.0ab	3.9f	5.0ef	8.2 a	6.2 bc
292-H-12	5.3cde	7.1ab	8.9ab	4.7f	5.5 d	7.0 bc
Zapallo	5.0cde	5.3bc	10.4a	6.6bcde	5.7 acd	5.9 bc
Bungoma	6.6abc	6.4ab	6.2cd	8.0bc	6.5 abcd	6.0 bc
Mugande	7.6ab	7.3ab	6.0cde	4.5f	7.4 abc	7.1 bc
Local check ˇ	5.8cd	6.3ab	4.4ef	11.1a	5.8 cd	6.5 bc
Namaswakhe	7.8a	5.7abc	4.8cdef	7.6bc	7.8 ab	6.6 bc
K117	7.5ab	7.5a	7.6bc	7.2bcd	7.5 abc	9.4 a
Mean	6.4	6.2	6.3	6.4	6.2	6.3
Lsd (0.05)	1.9	2.1	1.8	1.7	1.8	1.9
CV	31	26.1	27.7	33.1	28.7	29.6

Means followed by the same letter(s) in the same column are not significantly different as separated by Lsd p = 0.05
ˇLocal check (s) varieties: Ndhiwa- “Kuny kibuonjo”; Kabondo- “Nyathi Odiewo”; Rangwe- “Amina”; Kendu- “Jayalo”
ˇˇRanked by 20 farmers per location per season: scale 1 - 12 (1 very highly accepted, - 12 very poorly accepted).

failure due to drought.

DISCUSSION

Preference for overall acceptability as ranked by farmers

Overall the farmers ranked the twelve varieties giving the best as rank number 1 while the least preferred was ranked 12. There were significant (P = 0.05) differences on overall acceptability among the varieties (Table 7). Variety, “Odinga” most accepted ranked as with a mean of 1.6 in the LR season at Kendu and in the same location variety Jayalo was the least accepted ranked number 11.1. In SR season “Odinga” was significantly accepted, ranked number 1.4 at Kabondo whilst variety K117 was significantly least accepted, ranked 9.4 at Kabondo location. The two varieties were significantly different from each other In the LR season, at Ndhiwa varieties; “Odinga, Kemb10, Spk004, Improved Nyathi Odiewo, 292-H-12, Zapallo” and the local check variety “Kuny kibuonjo” were overally accepted. In the Short Rains season, varieties; “Odinga Kemb10, Spk004, 292-H-12, Zapallo” and the local check variety “Kuny kibuonjo” were accepted.

In Long Rains season at Kabondo varieties; “Odinga, Kemb10, Zapallo, Namaswakhe and Polista” were accepted while the local check variety “Nyathi Odiewo” was not accepted. In the SR season varieties, “Odinga, Spk004, Polista, Zapallo and Bungoma” were accepted while the local check variety “Nyathi Odiewo” was not accepted.

At Rangwe in the Long Rains season, varieties; “Spk004, Improved Nyathi Odiewo, Polista, Bungoma, Mugande, Namaswakhe” and the local check variety “Amina” were accepted.

At Kendu, in the Long Rains season, varieties “Odinga, Kemb10, Improved Nyathi Odiewo, Polista, Spk004, 292-H-12 and Mugande” were accepted while the local check variety “Jayalo” was least acceptable due to its poor yields, taste and was also highly affected by viruses. Selection for market, preference for colour of root skin taste and aroma also vary with the locality. Martin and Rodriguez-Sosa (1985) on their work in Puerto-Rico on preference for colour, sweetness and mouth feel of sweetpotato reported that significance differences occur from one location to the other as some score one criteria high, the other very low they attributed this to individual differences, cultural affiliations and even sex differences amongst the groups. This might have been attributed to individual differences on taste and preferences, cultural affiliations, even sex differences amongst the groups, geographical locations. Similarly this study concurs with Hagenimana et al. (2001) who reported that some varieties differed in preferences than others of orange fleshed sweetpotato in western Kenya. Similarly Keith et al. (2004) reported that in rural communities in Africa are thought to be cautious about accepting foods substantially different in colour and taste from those they are

used to in Tanzania. There were significant differences in colour, aroma, taste texture and yields. This could have led to differences in overall acceptability. The variety "K117" was ranked very high for consumption at Kendu and very low at Kabondo. This might have been attributed to the variety "K117" having high yields potential. Kendu, being a dry area with deficit in sweetpotato production, so any high yield variety could be accepted as opposed to Kabondo location which is a high potential zone and has a surplus producer consumption and commercial market. "Zapallo" was ranked highly for ease to cook of other varieties. Overally, variety "Odinga" was most preferred variety across locations likely due to its taste, market, colour of skin and flesh while the least was K117 which is white skinned and less market preference

Farmers used various criteria for selecting sweetpotato for consumption; taste, ease to cook, aroma, and root texture. The study showed that there were significant differences amongst the varieties across locations. There were also variations per location. Farmers clearly selected variety "Odinga" as most preferred, varieties; "Kemb 10, Spk004, Polista" and local check varieties "Nyathi Odiewo and Kuny kibuonjo" were equally preferred for consumption, based on roots taste, ease of cook, aroma and texture. However, the varieties "K117, Zapallo, Namaswakhe and Bungoma" were less preferred because of poor taste, low dry matter and watery. Consitently six improved varieties "Odinga, Kemb10, Improved Nyathi Odiewo, Spk004, Polista Kuny kibuonjo and 292-H-12", were selected for consumption based on their preference for, taste, ease to cook, aroma and texture of the roots. The varieties "K117 and Mugande" led on yiled.this suggests that the newly introduced varieties could be adopted by producers for consumer demand.

In short rains season, no data for Kendu was taken because it is a single season zone and Rangwe had crop failure due to drought.

Conclusions

Six improved varieties "Odinga, Kemb10, Improved Nyathi Odiewo, Spk004, Polista Kuny kibuonjo and 292-H-12",were selected for consumption based on their preference for, taste, ease to cook, aroma, and texture of the roots. However the varieties "K117, Zapallo, Namaswakhe and Bungoma" were less preferred because of roots poor taste, low dry matter and watery. Based on yields the farmers preferred, "Mugande, K117, Improved Nyathi Odiewo, Namaswakhe, Kemb10 and Odinga". A breeding program to incorporate the good consumer preference traits might increase preference to consumers.

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REFERENCES

Andima D, Kwach J, Magenya O, Tana P, Oloo J (2003). Participatory rural appraisal of the farming systems of south west Kenya 2002. In Assessment of genetic diversity, farmer participatory breeding and sustainable conservation of East Africa sweetpotato germplasm (Grant no. 02-476). Annual report 1st April 2002-31st March 2003 KARI Lousiana State University, Austrian Research Centre, Seibersdorf, CIP, Lake Zone Agricultural Research and Development Institute, KARI, NARL, Nairobi, Kenya.

Christopher W, Gregory J, Best SR, Wiersema S (1995). Adding values to root and root crops. A manual on product development. Centre International de Agriculture Tropical (CIAT). Publication N. 247. Apartado Aereo 6713, Cali, Cololumbia. p. 166

CIP (International Potato Centre) (1999). Sweetpotato facts production, utilization, consumption, feed use. Apartado Lima, Peru.

Collins W, Carey EE, Mok G, Thompson P, Zhang DP (1998). Utilization of sweetpotato genetic resources to develop insect resistance. In Global plant genetic resources for insect resistant crops. Clement SL and Queensberry SS (eds) CRC, press Boca, Raton Florida USA. pp. 193-200.

FAO/UNESCO (1990). FAO/UNESCO Soil classification Map of the World Legend. Department of soil science and Agronomy, Lithuania University of Agriculture. Kaunas, Lithuania.

Gichuki ST, Berenyi M, Zhang D, Hermanan M, Schmidit J, Glusst J, Burge K (2003). Genetic diversity in sweetpotato in relationship to geographical sources. Genet. Crop Evol. 50: 429-437.

Gomez KA, Gomez AA (1984). Statisical procedure for agricultural research, A Wiley-Interscience Publication. 2 nd Ed. John Wiley and Sons. New York.

Grüneberg JW, Abidin E, Ndolo P, Pareira CA, Hermanan M (2004). Variance component estimations and allocations of resources for breeding sweetpotato under East African conditions. Plant Breed. 123: 311-316.

Hagenimana V, Carey EE, Gichuki ST, Oyunga MA, Imunga JK (1999). Carotenoid contents in fresh dried and processed sweetpotato products. Ecol. Food. Nutr. 37: 455-473.

Hagenimana V, Low J, Anyango M, Kurz K, Gichuki ST, Kabira J (2001). Enhancing vitamin A intake in young children in western Kenya: Orange-fleshed sweetpotato and women farmers can serve as key entry points. Food Nutr. Bull. 22: 376-387.

Jaetzold R, Schmidt H (1982). Farm management handbook of Kenya Volume II. Natural conditions and farm management information. Parva West Kenya. Ministry of Agriculture and GTZ, Nairobi. Kenya. p. 397.

Kapinga R, Rugutu C, Carey T, Rees D, Chirima B, Amuor R, Ruiza E (2000).Tanzania sweetpotato varieties and their associate acceptable qualities by end users. In African potato association conference proceeding. 5: 527-530.

Keith T, Rwiza E, Nyango A, Amuor R, Ngendello KR, Jolliffe DF (2004). The use of sensory evolution and consumer preference for the selection of sweetpotato cultivars in East Africa. J. Sci. Food Agric. 84(8): 791-799.

Marti RH (2003). Estimation of sample size in skin and flesh colour measurements of dry flesh sweet potato (*Ipomoea batata* (L) Lam) Sci. Hortic. 98: 331-336.

Martin FW, Rodriguez-Sosa EJ (1985). Preference for colour, sweetness and mouth feels of sweetpotato in Puerto-Rico. Journal of the University of Puerto-Rico. 69: 99-106.

Mcharo M, Carey EE, Gichuki ST (2001). Performance of selected sweetpotato varieties in Kenya. Afr. Crop Sci. 9: 49-59.

Omosa M (1997). Current and potential demand for fresh and processed sweetpotato products in Nairobi and Kisumu, Kenya. Social Science Department Working Paper No.1997.1. Post harvest management, marketing, program. International Potato Centre, Lima,

Peru. p. 88.
Opare-Obisaw C, Danquah AO, Doku EV, Boakye BB, Ansah-Kissiedu D (2000). Consumer evaluation of five new sweetpotato (*Ipomoea batatas*) varieties. Consumer Studies Home economics. 24: 61-65.
Snapp SS (1999). Mother and baby trials: A novel trial design being tried out in Malawi.Target Newsletter of the southern Africa Soil Fertility Network Vol. 17: p. 8.
Snapp SS (2004). Mother and baby trials: Participatory approaches to improving farmer research technologies. Lilongwe, Malawi: Michigan State University and International Crops Research Institute for Semi-Arid Tropiccs.
Virk DS, Witcombe JR (2004). An introduction to data management and analysis for participatory varietal selection trials. Centre for Arid Studies, University of Wales, Bangor, Gwynedd, UK.
Woolfe AJ (1992). Sweetpotato: an untapped food resource. University of Cambridge, New York U.S.A.