

Acceptability studies of orange-fleshed sweetpotato varieties in Uganda

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Abstract. Use of orange-fleshed sweetpotatoes (OFSP) as a food-based approach has been suggested as an alternative option to combat vitamin A deficiency (VAD) in Uganda. The OFSP have high β -carotene and are seen as a cheaper and complementary source of vitamin A for the rural poor families who are the most vulnerable to VAD in Uganda. The opportunity is that about 90% of the rural poor households in Uganda use sweetpotato as a staple or co-staple. However OFSP are not known to most of the communities. In this study, we used farmer managed trials as a way of screening and introducing OFSP varieties to communities in Uganda. The study has shown that Ejumula and SPK 004 are the most accepted OFSP varieties in Uganda. Good yields and appealing flesh colour were the reasons put forward for their acceptance by both adults and children.

Introduction

In Uganda about 28% of children and 60% women are reported to be vitamin A deficient (VAD) (UDHS, 2002). The deficiency exposes children to common illnesses, impairs their growth, development, vision as well as immune systems. In severe cases it results in blindness and death (Ruel, 2001), with between 15000 and 60000 death cases reported annually. In women, VAD increases the risk of death during pregnancy, results in low birth weight in children and may increase

chances of HIV/AIDS infection. In Uganda campaigns to combat VAD include among others administration of vitamin A capsules and vitamin A rich natural and fortified foods. Although these have a positive impact, their sustainability is poor especially for the rural poor. Food-based approaches are seen as a viable option for the rural poor. In Uganda, vitamin A rich crops that can be adopted by the rural populations include carrots, fruits and green vegetables. The potential is even bigger with the orange fleshed vitamin A rich sweetpotatoes. Unlike other crops, sweetpotatoes grow and are consumed almost across the country. About 90% of the rural poor households eat sweetpotato as a staple or co-staple, leading to a per capita consumption of 119 kgs. Unfortunately, the cultivation of OFSP has not been widely adopted. Studies were therefore conducted to introduce and evaluate the acceptability of the OFSP varieties among the rural poor communities in Uganda.

Materials and Methods

Seven sweetpotato varieties, namely Ejumula, SPK 004, Kala, Sowola 6, Sudan, 4-4, and Naspot 5 were evaluated between 2001 and 2003 in seven districts representing three major agro ecological zones (Tables 1 and 2). SPK 004 is an introduction from Kenya while the rest are local Ugandan varieties. The seven districts were Kabale, Ntungamo, Mpigi, Luwero, Busia and Soroti. Of the seven

Table 1: Morphological characteristics of orange-fleshed sweetpotato varieties tested in different agro-ecologies of Uganda.

Variety	Flesh colour	Skin colour	Maturity	DM category
Ejumula	Deep orange	Cream	4	High
SPK 004	Orange	Red	4	High
Kala	Light Orange	Cream	4	High
Sowola 6	Orange	Cream	5	High
Sudan	Orange	Cream	6-7	High
4-4	Light Orange	Cream	5	High
Naspot 5	Light Orange	Red	5	High

Table 2: Characteristics of different agro-ecologies of sweetpotato in Uganda.

Region	Locations	Rainfall (mm)	Topography	Vegetation
Central	Mpigi Luwero	1200 - 1500	Low land	Tropical rain forest
Eastern	Busia Soroti	500 - 1200	Low land	Dry savanna grassland
South Western	Ntungamo Kabale	1500 - 1750	Highlands	Montane grass land

varieties only Ejumula, SPK 004 and Kala were evaluated in all the sites. The evaluation was done with farmer research groups. Access to these groups was made through grass root organizations - AFRICARE in Kabale, VEDCO in Luwero, and SOCADIDO in Soroti. Individual volunteer farmers adopted a mother baby trial system where each group established a group trial and other trials. The trails were planted and managed by farmers. They also made observations throughout the trials' life cycle and also collected data. The plot sizes and methods of planting varied with locations. Five months after planting, the trials were harvested and evaluated for performance. Various attributes were assessed using a subjective score of 1-5, where 1 = very bad, 2 = bad, 3 = moderate, 4 = good and 5 = very good. Field performance attributes used for varietal assessment were foliage coverage, resistance to diseases and pests, drought tolerance, maturity period, root yield, shape and size of roots, root skin

appearance, root flesh appearance and general crop appreciation. Crop yield was also recorded. In addition, sample roots of each of the harvested varieties were peeled, cooked and served separately to children between 7 and 10 years and adult men and women. Cooked roots were assessed for appearance, taste, flavour, starchiness, fibrousnesses and general acceptability using a similar subjective scoring used in the field. Pair wise rankings of varieties were also done for both field performance and consumer acceptance (Chirimi *et al.*, 2000; Munga *et al.*, 2000, Wanjekeche *et al.*, 2000). Data analysis was carried out using the Statistical Package for Social Sciences (SPSS).

Results and Discussions

Yields of orange-fleshed sweetpotato varieties in Uganda. Sweetpotato storage root yields across sites are presented in Table 3. The yields varied with varieties and across

Table 3: Indicative yield* performance of OFSP varieties in different agro ecologies of Uganda between 2001 and 2003.

Location	Root yields (t/ha) of orange-fleshed sweetpotato varieties						
	Ejumula	SPK 004	Kala	Sowola 6	Sudan	4-4	Naspot 5
Luwero	5.2	3.9	5.0	-	-	-	-
Mpigi	10.0	7.3	10.6	4.4	-	7.1	2.5
Kabale	12.7	8.0	9.6	7.3	-	11.0	1.7
Busia	9.5	8.3	12.3	5.3	6.7	7.5	-
Soroti	8.9	8.0	8.7	5.2	6.7	1.2	-
Ntungamo	25.1	12.5	10.3	9.8	16.3	-	-
Mean	12.1	8.0	9.4	6.4	9.9	6.6	2.1

*Yields are averaged over years.

locations. Overall variety means across locations showed that Ejumula was the highest yielding variety (12.1 t/ha). Apart from Mpigi and Busia, Ejumula yielded higher than the other varieties in the rest of the locations. This suggests that it may be a yield stable variety. This was followed by Sudan, Kala, and SPK 004. Although Naspot 5 yield estimates are not across all study sites, it gave the least average yields (2.1 t/ha), confirming reports from farmers and field extension officers about the poor yields of this variety.

A comparison of on-farm and on-station yields for the 3 best yielding varieties (Table 4) reveals the great yielding potential of these varieties under improved agronomic practices. For example Ejumula can yielded up to 38 t/ha, which is well beyond the national average (Mubiru, 2000). The observed yield variation is probably due differences in the yielding potentials of the different varieties and

Table 4: On farm and on station yield performance comparison in Uganda.

Variety	Yield (t/ha) ranges	
	Farmers' fields	On-station
Ejumula	5-17	12-38
SPK 004	5-16	14-35
Kala	3-13	10-33

differences in the climatic conditions across the locations (Mubiru, 2000).

Field evaluations of OFSP varieties by farmers. Evaluation data for OFSP varieties is presented for 2 districts, Luweero and Soroti. In Luweero, farmers ranked Ejumula the best variety at field level (Table 5). Detailed data presented in the table seem to suggest that farmers liked Ejumula for its flesh root appearance, yield, as well as good root characteristics like shape and size. However, it is important to note farmers' dissatisfaction with Ejumula over its poor foliage coverage, disease and drought tolerance. Ejumula is known to be susceptible to virus infections (Mwanga *et al.*, 2004). This together with poor tolerance to drought affects the foliage cover of the variety, which in turn affects planting material availability at the on-set of the season. Good seed multiplication schemes that aim at maintaining clean planting material are recommended as a solution if Ejumula is to be widely adopted by farmers in Uganda. Field assessment results from Soroti (Table 6) were similar to Luweero results. Similarly, results obtained from the rest of the districts revealed a similar trend.

SPK 004 was ranked the second in Luweero despite its low scores on general variety appreciation than Kala and the local checks. This is probably due to better foliage coverage, pest and disease resistance and

Table 5: Farmers assessing* orange-fleshed sweetpotato varieties in Luwero district, Uganda 2001/2002.

Variety	Foliage cover	Disease resistance	Pest resistance	Drought tolerance	Early maturity	Root yields	Root shape	Root size	Skin appearance	Flesh appearance	General acceptance	Rank
Ejumula	2.5	2.7	3.2	2.7	3.8	3.8	3.9	3.7	3.7	4.1	4.2	1
SPK 004	3.6	3.9	4.0	3.7	3.3	2.9	3.1	2.9	3.5	3.5	3.5	2
Kala	3.1	3.5	3.7	3.3	3.5	3.6	3.6	3.3	3.4	3.2	3.8	3
Local checks	3.9	4.0	4.1	3.9	3.5	3.5	3.6	3.4	3.7	3.6	3.9	5
Mean	3.3	3.5	3.8	3.4	3.4	3.5	3.6	3.3	3.6	3.6	3.9	-
C V %	18.6	16.9	10.8	15.6	5.8	11.2	9.3	10.0	4.2	10.4	7.5	-

*Subjective ranking: 1 = very bad, 2 = bad, 3 = moderate, 4 = good, 5 = very good; N = 103.

Table 6: Field assessment* of orange-fleshed sweetpotato by farmers in Soroti district, Uganda 2002/2003.

Variety	Foliage cover	Disease resistance	Pest resistance	Drought tolerance	Early maturity	Root yields	Root shape	Root size	Skin appearance	Flesh appearance	General acceptance	Rank
Ejumula	3.6	3.8	3.6	4.0	4.2	4.4	4.3	4.3	4.3	4.5	4.5	1
SPK 004	4.3	4.9	4.0	4.1	3.7	3.8	3.8	4.1	3.8	3.9	4.0	2
Kala	3.3	3.7	4.0	3.9	4.1	4.1	4.1	3.9	4.1	4.1	4.1	3
Sowola 6	3.9	4.0	3.9	4.0	3.4	3.1	3.2	3.2	3.6	3.7	3.5	5
Sudan	3.8	3.9	3.7	4.0	3.6	3.7	3.2	3.3	3.6	3.7	3.9	4
4-4	3.6	3.9	4.2	3.3	2.3	2.0	2.1	2.1	2.0	2.7	2.2	6
Mean	3.8	4.0	3.9	3.9	3.6	3.5	3.5	3.5	3.6	3.8	3.7	-
C V %	9.0	10.9	5.6	7.5	19.2	24.6	22.9	23.0	22.6	15.8	21.7	-

* 1 = very bad, 2 = bad, 3 = moderate, 4 = good and 5 = very good; N = 112.

flesh root appearance. During assessments farmers asserted that SPK 004 had more and clean planting material and envisaged no planting material scarcity for the variety compared to Ejumula. Farmers in Soroti, like in Luwero were dissatisfied with Ejumula's foliage coverage, disease and pest resistance. However, unlike in Luwero farmers in Soroti found Ejumula tolerant to prolonged dry weather. This is probably due to the fact that the variety originates from this area and is probably adapted to the local conditions (Mwanga *et al.*, 2004). Similarly, SPK 004 was the second best preferred variety in Soroti. Apart from dissatisfaction with yields, farmers seem to like it for its good foliage coverage, root shape and size. The variety, 4-4 performed poorest and was the least preferred in Soroti for field performance. This was primarily because of its poor yields, which was associated with small and poor shaped roots. The variety was also late maturing.

Although the local varieties were generally the least preferred, they were scored above moderate for foliage coverage, pest and disease resistance as well as tolerance to prolonged dry spells. Local check varieties consisted of varieties that have over a period been grown by farmers and were already liked for a number of attributes including adaptability.

Consumer acceptability studies of orange-fleshed sweetpotato. Unlike for field assessment of the OFSP varieties where only adults were involved, both adults and children participated in consumer acceptability tests of the varieties. Results from two study sites, Luwero (Table 7) and Soroti (Table 8) are presented.

In Luwero, both adults and children generally preferred the cooked roots of Ejumula to the rest of the varieties. Whereas adults felt that Ejumula is good for all the

Table 7: Assessment* of cooked OFSP in Luwero district, Uganda, during 2001/2002.

Varieties	Consumer acceptability attributes assessed by farmers						Over all Rank
	Appearance	Taste	Flavor	Starchiness	Fibrousness	General acceptance	
Adults (N = 119)							
Ejumula	4.5	4.2	3.9	4.1	4.1	4.4	1
SPK 004	3.8	3.8	3.7	3.8	3.7	4.2	2
Kala	3.4	3.7	3.3	3.9	3.3	4.0	4
Local checks	3.1	3.5	3.4	3.8	3.5	3.9	3
Means	3.7	3.8	3.6	3.9	3.7	4.1	-
CV	16.4	7.7	7.6	3.6	9.2	5.4	-
Children (N = 105)							
Ejumula	5.0	4.8	4.7	4.8	4.2	4.8	1
SPK 004	4.2	4.2	4.0	4.6	3.3	4.2	2
Kala	4.0	3.9	3.7	4.7	3.4	3.9	3
Local checks	3.9	4.1	3.6	4.6	3.5	3.8	4
Means	4.3	4.3	4.0	4.7	3.6	4.2	-
CV	11.6	9.0	12.4	2.0	11.3	11.8	-

*1 = very bad, 2 = bad, 3 = moderate, 4 = good, 5 = very good.

Table 8: Post harvest assessment of orange-fleshed sweetpotato by adults and children in Soroti, Uganda 2002/2003.

Varieties	Consumer acceptability attributes assessed by farmers						Over all Rank
	Appearance	Taste	Flavor	Starchiness	Fibrousness	General acceptance	
Adults (N = 115)							
Ejumula	4.5	4.4	4.1	3.7	3.9	4.3	1
SPK 004	4.0	4.3	3.9	3.9	4.1	4.3	2
Kala	4.1	4.0	3.9	3.9	4.0	4.2	4
Sowola 6	3.8	3.9	3.6	3.6	4.0	3.8	5
Sudan	4.2	4.4	4.2	4.1	4.0	4.3	3
4-4	3.3	3.5	3.4	3.5	3.4	2.8	6
Means	4.0	4.1	3.9	3.8	3.9	4.0	-
CV %	10.2	8.6	7.7	5.9	6.4	15.1	-
Children (N = 49)							
Ejumula	4.5	4.1	3.9	4.0	4.3	4.3	1
SPK 004	3.8	3.9	4.0	4.0	4.2	3.7	4
Kala	4.1	4.1	4.4	4.4	4.3	3.9	2
Sowola 6	3.7	4.3	4.1	3.8	4.2	3.8	5
Sudan	3.8	4.1	3.9	3.9	4.1	4.0	3
4-4	3.4	3.1	2.9	2.9	3.3	2.9	6
Means	3.9	3.9	3.9	3.8	4.1	3.8	-
CV %	9.7	11.0	13.0	13.2	9.3	12.4	-

Subjective ranking: 1 = very bad, 2 = bad, 3 = moderate, 4 = good and 5 = very good.

attributes except flavour, children felt it was good in all attributes. Children were emphatic on the cooked root appearance, which they all felt was very good for them. The dissatisfaction expressed by adults on the flavour of Ejumula, is probably due to the squash-like-flavour characteristic of most OFSP varieties. For adults, SPK 004 cooked roots were the second most preferred variety, followed by Kala and lastly the local checks. In Soroti, Ejumula was the best variety for both adults and children. However, the two age groups differed on the second preferred variety. While adults chose SPK 004 as the second best variety, children preferred Kala.

Farmers’ observations on the overall acceptability of orange-fleshed sweetpotato.

This section presents sentimental comments

made by farmers at different times during the evaluation process of the OFSP varieties. In Soroti for example, a farmer observed, “It is very sweet and we do not even need sugar while taking our tea”. Sweetpotato is commonly used for breakfast in many Ugandan households. In Kabale, a male farmer referred to the appearance of the varieties as that of “egg yolk”. There is a general perception that eggs are a nutritious food among Ugandan communities and therefore this resemblance implies that OFSP are nutritious. In Mpigi, a farmer likened the appearance of cooked roots of OFSP as of cooked bananas. In Central Uganda people have a historical liking for bananas and therefore any association of the OFSP with bananas suggests acceptance among the people in this region. A lot more testimonies

have been heard from mothers. “My children enjoy eating orange types of sweetpotato” many mothers were heard commenting during the evaluations.

Conclusions

It is clearly evident from the findings of the study that OFSP varieties are acceptable to the rural based communities in Uganda. Ejumula and SPK 004 are the most accepted varieties in Uganda for both field and consumer performance. At field level they produced average good yields and were also liked for their starchiness by adults and appearance, largely by children. However, Ejumula the best variety suffers from viral infections and is affected by prolonged drought, resulting in scarcity of planting material at the on-set of rains. These studies have introduced more adapted, high yielding, disease resistant and equally acceptable OFSP varieties.

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