Quality and Yield Assessment of sweetpotato (*Ipomea batatas* L.) Advanced Lines in Kano, Nigeria

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Abstract----An experiment was conducted to evaluate root yield potentials and nutritional composition of some improved sweetpotato lines obatained from National Root Crops Research Institute [NRCRI], Umudike, Nigeria. The lines were evaluated for root yield, Vitamins A and C, crude protien, carbohydrate and crude fibre. The root yields ranged from 2.5 t ha^{-1} for Laurdes to 28.5 t ha^{-1} for Danchina. Melinda had the highest vitamin A [49.73µmol/l] while T121 had the lowest [7.34µmol/l]. The vitamin C content ranged from 3.85 mg/dl for Gloria to 9.23 mg/dl for T121. The carbohydrate levels ranged from 41.71% for Mothers delight to 52.22% for T121. King J sweetpotato line recorded the highest crude protien content of 6.50%, while Sumai had the lowest [4.33%]. The study demonstrated wide variability of root yield and nutrional composition of improved sweetpotato lines. The significance of consuming nutritionaly rich sweetpotato lines on promoting health were highlighted.

Key words: *Nutritional quality, root yield, sweetpotato lines, Vitamins*

1 INTRODUCTION

Sweetpotato [*Ipomea batatas* L] is one of the most important staple crop in sub-Saharan Africa and is quickly becoming an important supplementary staple in many parts of the world ''[1]''. It is a member of convolulaceae family and grow well in tropical, subtropical and temperate areas ''[2]''. Both the leaves and, more commonly, the tuberous roots are eaten [3)'' ''[4]''. Sweetpotato was ranked the seventh most important food crop worldwide with an annual production of 106 million tonnes from 6.6 million ha in the world ''[5], ''[6];'). It ranks as the fifth most important food crop on a fresh-weight basis in developing countries after rice, wheat, maize and cassava. Among the world's root crops, it is second only to white potato (*Solanum tuberosum*) in importance while in Africa, it is the third most important root crop after cassava (*Manihot esculenta*) and yam (*Dioscorea spp*) ''[7]''. Nigeria is the second largest producer of sweetpotato in the world in terms of quantity, after China '' [8]''. In 2010, Nigeria produced 2.5% of the world's production of sweetpotato and ranked the tenth highest producer of the crop '' [9]''.

Sweetpotato is one of the most important staple food crop with significant role for food security and also a commercial crop in many sub-Saharan African countries ''[10]''. The most commonly cultivated sweetpotato varieties in Nigeria are white and yellow/orange-fleshed. Sweetpotato has high nutritive value, outranking most carbohydrate in vitamin, mineral, protein and energy content ''[11]''. The amount of carbohydrate, vitamins, minerals, protein and fibre varies with variety ''[12]''. Orange-flehed sweetpotato variety was reported to contain higher amount of vitmin A which is required for vision, cellular differentiation and morphogenesis and thus has an important role on many physiologal process on growth, reproductive and the immune réponse ''[13].. The carotenoid content of sweetpotato have multplicity of protective efficience on cancer, aging, immunomodulation, ischemic heart diseases, stroke, photoprotection, cataracts and mascular degeneration '' [14]''. Beta-caroten rich sweetpotato emerged as one of the most promicing plant source of vitamin A and stand to be cheaper, complementary and sustainable sources of vitamin A to the rural and urban families '' [13]''. Similarly, ''[2]'' has reported that vitamin deficiency cause over 600,000 deaths per year mostly of young children or pregnant women. Identifying and cultivating sweet-potato varieties that are higher in yielding and nutrient contents will go along way in saving human life globally. Farmers are interested in cultivating sweetpotato varieties that will satisfy their nutritional requirements. Unfortunately not much has been reported on yielding potentials and nutrive value of sweetpotato in the study area.

To establish the acceptability of a new lines, evaluation of their yield potentials and nutrient composition is required. Finding higher yielding and nutrient rich sweetpotato is of promount importance to rural and urban dwells of sub-Saharan Africa. About 11.681 million metric tonnes are needed to satisfy the needs of over 208 million people most at risk for poverty and vitamin A deficiency ''[2]''. To this demand, higher yielding and nutritionally rich sweetpotatoes are needed

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hence the justification of this research. This study was therefore aimed at evaluating the root yield potentials and nutritional composition of some improved sweetpotato lines.

2 MATERIALS AND METHOD

The experiment was conducted in farmers' fields during 2016 rainy season at Kibiya [11^{0}32'N 8^{0}40"E], Bagwai [12^{0}09'28"N 8^{0}08'09"E], Garko [11^{0}39'N 8^{0}54'E], Madobi [11^{0}46'38"N 8^{0}17'18"E] and Rimingado [11^{0}57'54"N 8^{0}15'0"E] all in Kano state, in Sudan Savanna of Nigeria. The treatments consisted of 10 improved sweetpotato Lines [A0305, Centennial, Delvia, Gloria, King J, Lourdes, Melinda, Mothers delight, Sumaia, and T121] and a local check [Dachina]. These were obtained from National Root Crops Research Institute [NRCRI], Umudike, Nigreia. The treatments were arranged in a Randomized Complete Block Design with three replications. The lands were manually cleared off stumps, harrowed to fine tilth and then ridges 75 cm apart and marked into plots. Gross plot consisted of 4 ridges spaced at 0.75m a part and 3m long [9m^2]. The 2 inner rows served as net plot [4.5 m^2]. Vines cuttings of 30 cm length with 3-4 buds were planted at intra- row spacing of 30 cm. At 4 weeks after planting NPK [15.15.15] fertilizer was applied at the rate 400 kg ha^{-1}. Two manual hoe weeding were carried out to control weeds at 4 and 8 weeks after planting. Insect pests were controlled by spraying with Optimal 20 SP and Cypermetrin at the rates of 250 g ha-^{1} and 1.0 L a.i ha^{-1} respectively. Harvesting was carried out at maturity when 90% of the plant leaves in a plot turned yellow and by cracking of the soil. The mature roots were dug up manually with hoe.

The roots from the net plot were deduced using weighing balance [Camry model:Sp, capacity 20 kg] and extrapolated to t ha^{-1}. Root samples were taken from each plot in each of the replicate for nutritional quality assessment. This was conducted at laboratory of the Department of Biochemistry, Bayero University, Kano using standard laboratory procedures. Vitamin A was determined from the prepared sample by spectrophometric method ''[15]''. Vitamin C, carbohydrates and fibre were also determine by using procedure of Association of the Official Analytical Chemist ''[15]''. The protein content was determined by Kjeldahl method of Association of the Official Analytical Chemist ''[15]''. Data generated were subjected to analysis of variance using Genstat 17th edition statistical software. Significantly different means were separated using Student New-man Keuls (SNK) at 5% level of probability.

3 RESULTS

The result of total yield t ha^{-1} is presented in figure 1. Sweetpotato lines differed significantly [$p \leq 0.05$] in root yield. This showed that Local check, Danchina produced the highest root yield which was also at par with King J. Lourdes was found to have the lowest root yield which was at par with all the other lines.

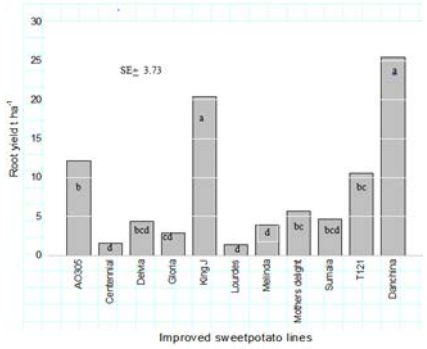

Figure 1: Root yield of improved sweetpotato lines during 2016 rainy season in some selected areas of Kano, Nigeria.

The results of nutritional composition of the improved sweetpotato lines were presented in Table 1. This showed significant differences [P<0.05] among all the variables examined. Melinda had the highest vitamin A [49.73µmol^{-1}], which was followed by Danchina [36.93µmol^{-1}]. The lowest vitamin A content was obtained from T121 [7.34 µmol^{-1}]. The mean vitamin C levels of the lines ranged from 3.85- 9.23 mg/d^{-1}. The highest vitamin C level was obtained from T121 [9.23 mg/d^{-1}] which was followed by Centennial and Delvia with 8.46 mg/d^{-1} each, while Gloria had the lowest [3.85 mg/d^{-1}]. The mean values for the carbohydrate showed significant differences [P<0.05] among the improved sweetpotato lines tested. The levels ranged from 41.71% for Mothers delight to 52.22% for T121. The sweetpotato lines also showed wide variations on their protein content. King J recorded the highest protein content of 6.50% which was significantly different from all other lines tested. The lowest crude protein content was observed from Sumaia with mean protein content of 4.33%. Similarly, the improved lines differed significantly on crude fibre content. The mean crude fibre levels range from 4.01% for Mothers delight to 6.88% for Centennial.

Table 1: Nutritional composition of improved sweetpotato lines

Sweetpotato lines	VIT A µmol/l	VITC mg/dl	CHO %	CP%	CF%
AO305	7.28k	6.15c	43.84j	5.13f	5.37d
Centennial	30.14c	8.46b	45.04i	5.33e	6.88a
Delvia	26.36e	8.46b	45.59h	4.86h	4.76f
Gloria	27.54d	3.85f	48.26c	4.73i	4.56h
King J	15.36h	5.38d	46.66f	6.50 a	5.21e
Lourdes	16.09g	4.62^{e}	48.12d	5.40d	5.62c
Melinda	49.73a	4.62e	47.63e	4.16k	4.57h
Mothers delight	8.40i	6.15c	43.71k	5.83b	4.01i
Sumaia	23.92f	5.38d	51.56b	4.33j	6.35b
T121	7.34j	9.23a	52.22a	5.70c	4.6g
Danchina	36.39b	6.15c	46.28g	4.89g	5.39d
LSD	0.018	0.018	0.016	0.017	0.017

Means followed with the same letter in the same column are not significant at 5% level of significant
VIT=Vitamin, CHO=Carbohydrate, CP= Crude protein and CF=Crude fibre

4 DISCUSSION

The local variety Danchina and King J produced significantly higher root yield, which could be attributed to highest average root weight observed in these lines. These lines were noted to have larger and more number of leaves that enabled them to initiate bigger root and started bulking earlier than the other varieties. This is supported by the work of ''[16]'' who noted large leaf area as the contributory factor to root yield. However some lines such as Centennial, Delvia, Lourdes and Sumaia despite earlier large leaf area establishment yet produced low root yield. This could be attributed to varietal effect in translocation rate of photosynthates to the sink [root] among the lines tested. ''Bhagsari and Ashley [17] reported that sink strength differed among sweetpotato genotypes and this disparity suggested differences in the rate of photosynthate translocation to storage roots which caused differences in root yield''. They further reported that Centennial had slow rate of translocation of assimilates to its storage roots.

The variability in vitmin A levels among the improved lines makes possible the selection of vitamin A rich sweetpotato. This was particularly evident in Melinda, Danchina and to a lesser extent Gloria and Delvia in which high levels of vitmin A were found. Cultivar is one of the most important factor affecting carotene concentration of sweetpotato ''[13]''. The vitamin A levels obtained in this study indicated that these lines could be considered as vitamin A rich sweetpotato lines. They could therefore be introduced in areas with high prevalence of nutritionally related disease. This will go a long way in reducing high loss of life reported by ''[2]''. Beta-carotene rich sweetpotato have been use to allevi ate vitamin A deficiencies among children, pregnant and lactating mothers in many sub-Saharan African countries ''[18], [19], [20]''.

Wider variations were observed in vitamin C content of the improved sweetpotato lines. T121, Centennial and Delvia can be considered as a rich source of vitamin C. The vitamin C contents of these lines were generally higher than mean ranging of 17.3 to 34.5 mg x 100^{-1} g fwt as reported by ''[13]''. These lines with higher vitamin C can therefore be selected and used in preventing scurvy and maximize health by reducing the risk of cancer and atherosclerosis as reported by ''[21]''

The results revealed that some sweetpotato lines had higher crude protein contents than those reported in *Discorea alata* ''[22]'' and also higher than what ''[23]'' reported in cassava. This indicates that Kin J with higher crude protein of 6.50% should be considered as protein rich sweetpotato. The value was generally higher than what was reported by ''[12]'' in sweetpotato variety TIS87/0087 [5.47%]. Consumption of King J could help in reducing the incidence and severity of kwashiorkor among children. This showed the superiority of improved lines over other varieties. The nutritional quality of sweetpotato protein is good with protein efficiency ratio equal to that of casein ''[24]''.

The carbohydrate content observed among the improved sweetpotato lines were generally lower than the values reported from yam ''[22]''. This indicates that the lines tested have lower calories than those obtained from yam. However, ''[3]'' reported that the calories obtained from sweetpotato has the highest useful energy production rate among the major tropical crop and can provide more calories on a given unit of land per unit of time. Significant genetic variations within sweetpotato genes pool for carbohydrate have been reported ''[13]''. The crude fibre of the improved lines was also higher than those reported on yam ''[22]'' and some sweetpotatoes varieties ''[25], [12]''. Increase in consumption of Centinial and Sumaia with higher fibre content, may be associated with lower serum cholesterol, lower risk of coronary heart diseases, reduced blood pressure, enhanced weight control, better glycemic control, reduced risk of certain forms of cancer and improved gastrointestinal functions ''[13]''.

5 CONCLUSION

The improved sweetpotato lines tested could be categorized into high [King J, AO305 and T121] medium [Mothers delight, Sumaia and Delvia] and low yielders (Gloria, Centennial and Lourdes). Cultivation of King J, AO305 and T121 in the study area

may help farmers to attend a level of food security and increase their income. Nutritionally, all the lines performed above the average standard nutritive value of sweetpotato reported by various organisations. The scientists who developed these lines deserved recommendation and plant breeders may wish to select lines with certain nutritional characteristics. Based on aforementioned, Melinda and King J could be selected for intensive cultivation in Nigeria for increased Vitamin A and crude Protein intake. The cultivation of these lines will provide feasible means of reaching under nourished population in remote rural areas their by alleviating vitamin A deficiency and kwashiorkor among children in the affected communities.

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