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Evaluation of Yellow-Rooted Cassava Varieties for Differences in ß-Carotene and Gross Energy

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Abstract: Carotenoids are precursors of vitamin A and this vitamin is required for body growth, building of immunity against diseases and for clear eye-sight. Plants could be a cheap source of Vitamin A when carotenoid-rich varieties are selected. Cassava varieties cultivated in Nigeria have low carotene content, but in recent times new yellow rooted lines supposed to have high carotene were introduced for evaluation. Two popular varieties, TME – 1 and TMS 30572 as checks and twenty-two yellow rooted lines were evaluated for gross energy and ß -carotene content in the Institute of Agricultural Research and Training, Ibadan, Nigeria. The results showed that the ß-carotene from checks were < 2.0 mg/g while their gross energy was about 3.0 kcal/g. Among the twenty-two yellow-rooted tubers, only 7 lines have ß -carotene contents that ranged from 2.0 to 4.0 mg/g. The seven lines are TMS 01/1442,TMS 01/1610, TMS 01/1224, TMS 01/1331, TMS 01/1235, TMS01/1368 and TMS01/1649. Three of the lines TMS 01/1442,TMS 01/1610 can sufficiently meet the Vitamin A daily requirements in adults with their ß -carotene contents ranging from 3.22 -4.03mg/g and gross energy from 3.05 - 4.13 kcal/g. The flour from these lines can be used as composites of wheat flour in bakery, poultry feed in animal nutrition and weaning foods in industries especially in Vitamin A deficient areas in Nigeria.

Key words: Cassava, ß –carotene, gross energy.

INTRODUCTION

Cassava roots are quantitatively the third most important food in the tropics, after rice and maize. It is an important source of calories because it provides 60% of the daily calorific needs of the populations in tropical Africa and Central America[7]. It is estimated that it sustains more than 800 million people[4]. Cassava has also been instrumental in alleviating the food crises in many war-turn and drought ravaged parts of Africa[6].

Vitamin A deficiency ranges from night blindness to xerophthalmia and keratomalacia, leading to total blindness[8]. Deficiency also leads to susceptibility to infection and congenital defects in animals. The principal Vitamin A source is from animal origin, which has elevated cost to most population in poor countries[2]. The pro-vitamin A carotenoids are cheaper sources of vitamin A since they are found abundantly in plants[8].

Carotenoids are a group of over 600 naturally occurring plant pigments. Structurally, Vitamin A (retinol) is essentially one-half of the ß -carotene molecule. Consequently, ß -carotene is the most potent pro-vitamin A and it is also the most widespread[9].

Differences in carotenoids among cultivars/varieties of same crop are well documented[5]. Selecting cassava varieties with high ß -carotene content may contribute significantly to resolving the problem of vitamin A deficiency in poor countries[2]. The average requirement of ß-carotene recommended by WHO for adults is 2.4mg to 3.5mg[8].

The aim of this work was to assess the variation in ß-carotene and gross energy contents of cassava lines. This will influence the selection of new cassava for various utilization purposes especially those required for high quality to upgrade food value.

MATERIALS AND METHODS

Twenty-two yellow rooted and two white rooted cassava lines (Table 1) collected from IITA,Ibadan were planted in October, 2004 and harvested in September, 2005 from Institute of.Agricultural Research and Training experimental Station at Ikenne, Ogun state, Nigeria.

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Table 1: Effect of Variety on ß -Carotene and Gross Energy Values of Cassava Roots.

Sample	ß -Carotene (mg/g)	Gross Energy (Kcal/g)
TME-1	0.250^{p}	2.867^{j}
TMS 01/1662	0.790^{h}	4.481^{b}
TMS 98/2132	0.465^{m}	3.224^{h}
TMS 01/1235	2.290^{e}	3.229^{h}
TMS 01/1371	0.295^{o}	3.943^{d}
TMS 90/01554	0.120^{q}	3.227^{h}
TMS 01/1277	0.5801	3.415^{f}
TMS 95/0379	0.440^{m}	3.414^{f}
TMS 01/1368	2.220^{f}	3.052^{i}
TMS 01/1663	0.5401	3.954^{d}
TMS 94/0330	0.055^{r}	3.057i
TMS 01/1331	2.530^{d}	3.416^{f}
TMS 01/1412	0.725^{i}	3.239^{g}
TMS 01/1273	0.230_{p}	3.590^{e}
TMS 94/0006	0.070^{r}	3.956^{d}
TMS 01/1649	2.275^{e}	3.591^{e}
TMS 01/1336	0.410^{n}	3.052^{i}
TMS 30572	1.825^{g}	3.055^{i}
TMS 01/1413	0.615^{k}	3.231^{g}
TMS 91/02324	0.820^{h}	2.872^{j}
TMS 01/1646	0.635^{j}	4.667^{a}
TMS 01/1442	3.225^{c}	3.056^{i}
TMS 01/1610	4.035^{a}	4.133^{c}
TMS 01/1224	3.715^{b}	3.234^{g}

Means with same superscripts are not significant at p<o.o5

Cassava roots from each variety were washed with clean water, peeled and cut into flakes. The flakes were dried at 50°C and milled into cassava flour.

The *B*-carotene content of the tubers was determined by AOAC method (1997). 2g of samples were hydrolysed with 25mls of 5% alcoholic KOH and extracted thrice with 50mls petroleum ether (B.pt. 40-60°C). The petroleum ether fraction was evaporated to dryness and residue taken up in 10ml chloroform. The absorbance was measured, using spectrophotometer at wavelength of 440 nm. The concentrations of ß- carotenoids in test samples were read from the standard curve.

The gross energy was determined against thermo-chemical-grade benzoic acid, using a Gallenkamp ballistic bomb calorimeter (Cam Metric Ltd, Cambridge, England). Analysis of variance (ANOVA) was used to determine the differences within the cassava lines and Duncan multiple range test was used to determine the differences within the varieties at 95% confidence level ($p<0.05$).

RESULTS AND DISCUSSIONS

ß -carotene contents differ significantly among (Table 1) the cassava lines. The highest values were found in TMS 01/1610, TMS 01/1224 and TMS 01/1442 and it ranged from 3.22 mg/g to 4.04 mg/g. These can meet the optimum ß carotene required of adults[8]. Other varieties with high potential that can meet the minimum ß -carotene requirement for an adult include TMS 01/1331, TMS 01/1649, TMS 01/TMS 01/1368 and TMS 01/1235 with ß -carotene contents ranging from 2.22 – 2.53 mg/g.

The ß -carotene content of checks was low, 0.25mg/g in TME-1 and 1.38 mg/g in TMS 30572. This suggests that, the food quality of the two popular varieties is low and there is need to introduce lines that have high food nutrient value. The gross energy of the checks ranged between 2.86 and 3.05 kcal/g while it ranged from 3 – 4.0 kcal/g in the seven lines identified to have high ß -carotene content.

The gross energy from these varieties was highest in TMS 01/1610 with 4.13 kcal/g while TMS 01/1442 and TMS 01/1224 have gross energy of 3.05 and 3.23 Kcal/g respectively. Results indicate that TMS 01/1610 is the best variety in terms of high ß carotene and gross energy when compared to other varieties evaluated.

Due to the genetic diversity in ß-carotene contents in the lines evaluated there is the possibility of enhancing the ß-carotene concentration of existing popular varieties that are low in this pro-vitamin. Caterers and bakers use cassava flour at various levels of inclusion in their products[3]. With the recent 10% inclusion of cassava flour in bread and other wheat flour products in Nigeria, the use of carotene-rich cassava will be add to bread and other confectionary products. It will improve the vitamin in the baked products, reduce the cost of production by eliminating the cost of inorganic vitamins and also reduce the incidences of skin disease (Pellagra) and eye diseases in consumers.

Conclusion: 1. ß -carotene and gross energy contents differ between above cassava varieties.

Seven of these varieties were very impressive in terms of their ß -carotene contents.

This diversity can be utilized by breeders to develop B-carotene rich cassava varieties and upgrade existing varieties. Furthermore, the food nutrient quality of cassava based food products will be enhanced by the popularization of the B-carotene rich varieties.

These B-carotene rich cassava varieties can also be used to supplement yellow maize in poultry feed.

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