Proximate and mineral composition of cocoyam (Colocasia esculenta L. and Xanthosoma sagittifolium L.) grown along the Lake Victoria Basin in Tanzania and Uganda

7 authors, including:

Herbert Talwana
Makerere University

Richard Mongi
Sokoine University of Agriculture (SUA)

Abdulsudi Issa-Zacharia
Sokoine University of Agriculture (SUA)

African Journal of Food Science Vol. 5(4) pp. 248 - 254, April 2011
Available online http://www.academicjournals.org/ajfs
ISSN 1996-0794 ©2011 Academic Journals

Full Length Research Paper

Proximate and mineral composition of cocoyam (*Colocasia esculenta* L. and *Xanthosoma sagittifolium* L.) grown along the Lake Victoria Basin in Tanzania and Uganda

Ndabikunze B. K. [1]*, Talwana H. A. L. [2], Mongi R. J. [1], Issa-Zacharia A.[1], Serem A. K.[3], Palapala V.[4] and Nandi J. O. M.[5]

[1]Department of Food Science and Technology, Sokoine University of Agriculture, P. O. Box 3006, Morogoro, Tanzania.
[2]Department of Crop Science, Makerere University, P. O. Box 7062 Kampala, Uganda.
[3]Department of Agricultural Resources Econonomics and Marketing, Moi University, Box 1125-0100, Eldoret, Kenya.
[4]Department of Biological Sciences, Masinde Muliro University of Science and Technology, P. O. Box 190-50100, Kakamega. Kenya.
[5]Department of Social Sciences, Masinde Muliro University of Science and Technology, P. O. Box190-50100 Kakamega, Kenya.

Accepted 11 March, 2011

The proximate and mineral compositions of cocoyam (*Colossian esculenta* L. and *Xanthosoma sagittifolium* L.) grown along Lake Victoria Basin in Tanzania and Uganda were analyzed. *C. esculenta and X. sagittifolium* samples were significantly ($p < 0.05$) different in terms of their proximate composition and mineral contents regardless of their country of origin. Proximate analyses included ash, crude protein, and crude fibre. Proximate composition of cocoyam results demonstrated that X*. sagittifolium* variety is nutritionally superior to that of *C. esculenta.* Minor nutrients measured were calcium, magnesium, copper, iron, sodium, zinc, manganese, and potassium. The results from these analyses demonstrate that the proximate composition of cocoyam produced in Uganda is substantially different from that produced in Kenya, regardless of the variety. Information obtained from this study can be used to develop cocoyam based food products with enhanced nutrition and potential to promote commercial scale production and utilization of cocoyam in East African countries.

Key words: *Colocasia esculenta*, *Xanthosoma sagittifolium*, proximate composition, mineral content, Lake Victoria Basin.

INTRODUCTION

Colocasia esculenta and *Xanthosoma sagittifolium* (cocoyam) are herbaceous perennial plants belonging to the Araceae family and constitute one of the six most important roots and tuber crops world-wide (Jennings, 1987). About 1.4 million ha worldwide have been recorded to be cultivated with aroids yielding 8.3 million tonnes per year (FAO, 1998). China, Ghana, Nigeria, Burundi, Cóte d'Ivoire, Japan, Madagascar, Papua New Guinea, Philippines and Thailand are cocoyam producers in the world (FAO, 1998). In most African countries, cocoyam is mainly cultivated by small-scale farmers (Onwueme and Charles, 1994). Like many plants of the Araceae family, cocoyam grows from the fleshy corm (tuber) that can be boiled, baked or mashed into a meal and used as staple food or snack. The corms supply easily digestible starch and are known to contain substantial amounts of protein, vitamin C, thiamine, riboflavin, niacin and significant amounts of dietary fiber (Niba, 2003). Leaves of taro (*Colocasia*) are cooked and eaten as vegetable. They contain β-carotene, iron and folic acid, which protects against anemia (FAO, 1990; Sukamoto, 2003), and are important source of proteins and vitamins. The main nutrient supplied by cocoyam, as

*Corresponding author. E-mail: bndabikunze.acdm@yahoo.com. Tel: +255 754 397700. Fax: +255 232 604402.

with other roots and tubers, is dietary energy provided by the carbohydrates (Jirarat et al., 2006). Cocoyam flour can be used for the preparation of soups, biscuits, bread, beverages, and puddings. However, in spite of its importance as a staple food in many countries, cocoyam has received very little research attention to enhance its production and utilization potentials (Goenaga and Heperly, 1990; Watanabe, 2002). Research and development of root and tuber crops in general, and cocoyam in particular, have been neglected because only 10% of the world populations, mainly leaving in the developing tropical countries, use root and tuber crops as staple foods. Despite their nutritional composition, the potential for the development of value added cocoyam products have not been investigated (Palapala et al., 2005). Opportunities to promote and support the use of cocoyam can make a major contribution to the food security of countries in the cocoyam growing regions. It is for this reason the current study was aimed at investigating the proximate and mineral composition of two cocoyam varieties (*X. sagittifolium and C. esculenta*) grown along Lake Victoria basin in Tanzania and Uganda and to explore the possibility of promoting their utilization within the partner countries.

MATERIALS AND METHODS

Materials

Fresh samples of *C. esculenta* and *X. sagittifolium* varieties (20 samples each) were randomly obtained from selected areas of Kagera, Tanzania and Kampala, Uganda. Reagents and chemicals for chemical analysis (proximate and mineral contents) were obtained from Sigma-Aldrich chemical suppliers, Nairobi, Kenya and are of analytical grade.

Preparation of cocoyam samples

Fresh cocoyam samples were collected randomly from farmers along the Lake Victoria basin in Kagera region, Tanzania. These samples were peeled prior to drying in a conventional oven at 105°C for 24 h at Maruku research station (Tanzania) followed by transportation to Jomo Kenyatta University of Agriculture and Technology for analysis. Cocoyam samples from Uganda were collected along Kampala region followed by peeling and drying in a conventional oven at 105°C for 24 h at Makerere University (Uganda) prior to transportation to Sokoine University of Agriculture (Tanzania) for further analysis. The weight loss of fresh cocoyam samples after drying is calculated as moisture content. The samples were milled, labeled and stored in airtight containers in the freezer at -14°C prior to analysis at Sokoine University of Agriculture.

Research design

A 2 × 2 experimental design was used in the study and the principal factors were cocoyam varieties (*C. esculenta* and *X. sagittifolium)* and, countries of origin (Tanzania and Uganda). The samples were then analyzed for proximate composition (moisture, protein, fat, ash, fiber and carbohydrate) and mineral contents (phosphorous, copper, iron, zinc, manganese, calcium, magnesium, potassium and sodium). The effects of the principal factors on these parameters and their interactions were determined.

Proximate analyses

Proximate composition (moisture, ash, crude fat, crude protein, and crude fiber) of samples were analyzed in triplicate using Association of Official Analytical Chemists (AOAC) approved methods (2000). Moisture content of the dried samples was determined by weighing 5 g of the sample and drying in an oven at 105°C to constant weight. The loss in weight of the sample was calculated as moisture content. Ash content was determined by incineration of 5 g of the freeze-dried sample in a muffle furnace at 525°C and the weight of ash was calculated by difference from the sample taken and calculated on dry weight bases. Crude protein was determined by Kjeldahl method. The crude fibre was determined by fibretec system. Crude fat was quantified from dried samples by soxhlet extraction method using n-hexane as solvent and percentage fat calculated on dry weight bases (Subbulakshim and Chitra, 1996). Carbohydrate was estimated by difference (AOAC, 1990).

Mineral analyses

The mineral contents of dried cocoyam samples were determined at Food science laboratory of the Jomo Kenyatta University Agriculture and Technology (Kenya) using the standard AOAC (1990) method. Ash was dissolved in 20 ml of 1 N HCl and heated for 5 min at 80 to 90°C. The solute was then transferred quantitatively to a 100 ml volumetric flask and made to level with distilled water. Ca, Mg, Cu, Fe, Na, and K were determined using atomic absorption flame emission spectrophotometer (AA-6200 Shimadzu Corp, Kyoto Japan) with air acetylene flame at 722 nm. Each sample was analyzed in triplicate. Quantification was accomplished by comparison with standard curve drawn using standard solution of known concentration at 0.5, 1.00, 1.5, and 2.5 ppm. The phosphorous was determined by flame photometric method (AOAC, 2000). Each sample was analyzed in duplicate.

Statistical data analyses

All statistical analyses were performed using SPSS 16.0 (SPSS software for Windows, release 16.0, SPSS, Inc., USA). Differences in treatments at $p < 0.05$ were considered significant. The effect of cocoyam variety and country of origin on the proximate composition and mineral contents of cocoyam was evaluated according to the following general linear model without interaction term, as the interaction for all tested variables was not significant:

$$Yij = \mu + Di + Cj + \xi ij$$

where;

Yij = the individual observation; μ = the overall mean; Di = the effect of cocoyam variety; Cj = the effect of country of origin; ξij = the residual error.

RESULTS AND DISCUSSION

Proximate composition

Table 1 shows the comparison of average proximate composition of the investigated cocoyam varieties regardless of their country of origin. All proximate composition results are presented in dry weight basis. The results

Table 1. A comparison of proximate composition of cocoyam (*X. sagittifolllium* and *C. esculenta*) with respect to their variety (a pooled analysis).

Proximate composition	Wet land cocoyam (*X. sagittifolium*)	Dry land cocoyam (*C. esculenta*)	SEM[1]	Significance
Moisture content (%)	68.41	68.7	0.084	0.068
Ash (g/100 g DM)	3.51	2.69	0.142	*
Crude protein (g/100 g DM)	4.75	3.8	0.14	***
Crude fibre (g/100 g DM)	1.96	1.34	0.052	***
Ether extract (fat) (g/100 g DM)	0.43	0.44	0.009	*
Carbohydrate (g/100 g DM)	20.95	23.03	0.207	***

[1]SEM is the standard error of mean. Data presented are univariate estimated means with n = 40 for each variety. Level of significance are ***p < 0.001, **p < 0.01, *p < 0.05 and mean values with p > 0.05 are not significantly different and their respective p-values are shown.

Table 2. A comparison of proximate composition (g/100 g DM) of cocoyam (*X. sagittifolllium and C. esculenta*) with each country analyzed separately (un-pooled).

Country	Variety	Moisture	Crude protein	Ether extract (fat)	Ash	Crude fibre	Carbohydrate
	X. sagittifolium	68.39±0.01	4.66±0.25	0.40±0.01	3.10±0.13	1.6105±0.11	21.83±1.68
Tanzania	*C. esculenta*	68.36±0.01	3.89±0.05	0.37±0.01	1.82±0.04	1.1570±0.01	24.43±0.34
	Significance	0.084	**	*	***	***	***
	X. sagittifolium	68.42±0.515	4.84±0.269	0.47±0.012	3.91±0.324	2.31±0.093	20.058±1.55
Uganda	*C. esculenta*	69.045±0.93	3.70±0.15	0.51±0.01	3.56±0.19	1.53±0.05	21.645±1.60
	Significance	0.062	***	***	0.061	**	***

Data presented are univariate estimated means with n = 20 for each variety. Level of significance are ***p < 0.001, **p < 0.01, *p < 0.05 and mean values with p > 0.05 are not significantly different and their respective p-values are shown.

show that *X. sagittifolium* had significantly higher ($p<0.05$) ash (3.51 g/100g), crude protein (4.75 g/100 g) and crude fibre (1.96) than ash (2.69 g/100 g), crude protein (3.80 g/100 g) and crude fibre (1.34 g/100g) contents of *C. esculenta*. However, *C. esculenta* variety showed significantly ($p < 0.05$) higher carbohydrate content than *X. sagittifolium.* Interestingly, moisture content of *C. esculenta* variety (68.7%) and *X. sagittifolium* (68.4%) did not differ. Both varieties showed only low amount of fat expressed as ether extract (about 0.44 g/100 g) that was not statistically different ($p > 0.05$). These results demonstrate that *X. sagittifolium* (upland variety) is nutritionally superior to *C. esculenta* (wetland variety) regardless of country of origin. Additionally, simple Students' test analysis was carried out to assess proximate composition differences between *X. sagittifolium* and *C. esculenta* within each country (Table 2). Results revealed that *X. sagittifolium* had significantly ($p < 0.05$) higher ash, crude protein and crude fibre than values obtained with *C. esculenta.*

The analysis of variance results on the effect of country of origin and the comparison of proximate composition from the two countries regardless of their variety are presented on Table 3. Cocoyam samples from Uganda showed an overall significantly ($p < 0.05$) higher value of ash, crude fibre and fat contents as compared to those of Tanzanian origin. The ash, crude fibre and fat contents were 3.74, 1.92 and 0.49 g/100 g, respectively, for cocoyam of Ugandan origin while Tanzania samples contained ash (2.41 g/100 g), crude fibre (1.38 g/100 g) and fat (0.34 mg/l). However, cocoyam samples of Tanzanian origin

Table 3. A comparison of proximate composition (g/100 g DM) of cocoyam (*X. sagittifolllium and C. esculenta*) with respect to country of origin (a pooled analysis).

	Tanzania	Uganda	SEM[1]	Significance
Moisture content (%)	68.38	68.73	0.084	0.052
Ash (g/100 g DM)	2.46	3.74	0.142	***
Crude Protein (g/100 g DM)	4.28	4.27	0.14	0.503
Crude fibre (g/100 g DM)	1.38	1.92	0.052	***
Ether extract (g/100 g DM)	0.39	0.49	0.009	***
Carbohydrate (g/100 g DM)	23.18	20.85	0.207	***

[1]SEM is the standard error of mean. Data presented are univariate estimated means with n = 40 for each country. Level of significance are ***p < 0.001, **p < 0.01, *p < 0.05 and mean values with p > 0.05 are not significantly different and their respective p-values are shown.

Table 4. A comparison of proximate composition (g/100g DM) of cocoyam (*X. sagittifolllium and C. esculenta)* of Tanzanian and Ugandan origin with each variety analyzed separately (un-pooled).

Variety	Country	Moisture	Crude protein	Ether extract(fat)	Ash	Crude fibre	Carbohydrate
X. sagittifolllium	Tanzania	68.39±0.01	4.66±0.25	0.40±0.01	3.10±0.13	1.6105±.11	21.83±1.68
	Uganda	68.42±0.52	4.84±0.27	0.47±0.01	3.91±0.32	2.31±0.09	20.058±1.55
	Significance	0.085	0.075	**	***	***	*
C. esculenta	Tanzania	68.39±0.01	3.89±0.05	0.37±0. 01	1.82±0.037	1.1570±.005	24.43±0.34
	Uganda	69.045±0.93	3.70±0.15	0.51±0.01	3.56±.194	1.53±0.045	21.645±1.60
	Significance	0.052	0.061	***	***	***	***

Data presented are univariate estimated means with n = 20 for each country. Level of significance are ***p < 0.001, **p < 0.01, *p < 0.05 and mean values with p > 0.05 are not significantly different and their respective p-values are shown.

carbohydrate content (23.2 g/100g) as compared to those of Ugandan origin (20.9 g/100g). No significant differences were observed in moisture and protein contents of the same cocoyam variety grown in the two countries. These results show that cocoyam of Ugandan origin had superior proximate composition quality as compared to those of Tanzanian origin, a factor that need to be considered during formulation cocoyam based products. To investigate whether the nutritional composition of Tanzanian cocoyam is different from Ugandan cocoyam, proximate composition of these cocoyams was compared (Table 4). The results presented in Table 4 demonstrates that cocoyam of Ugandan origin is superior in proximate composition than that of Tanzanian origin.

The mean crude protein, total fat, ash, and crude fibre obtained in this study is comparable with those reported by Sefa-Dedeh and Agyir-Sackey (2002) in which the mean values of the proximate composition of *X. sagittifolllium and C. esculenta* evaluated were; crude protein, 2.98 to 5.50 g/100 g; total fat, 0.28 to 0.97 g/100 g; ash, 1.56 to 2.98 g/100 g; starch, 12.2 to 36.0 g/100 g; and crude fibre, 1.11 to 3.00 g/100 g. Similar compositions were observed between the two varieties by Onwueme (1999) who reported *X. sagittifolium* to be nutritionally superior to *C. esculenta* in terms of energy, fat and proteins. The source of these variations can be attributed to genetic variation, season of harvest and the agronomic factors of the sampled varieties as it was observed by Onwueme (1978). In Kagera region (Tanzania) where the samples were taken, cocoyam is grown in marginal land with poor soil fertility, while in Kampala, cocoyam is grown as a

Table 5. A comparison of mineral contents (mg/100 g DM) of cocoyam (*X. sagittifolllium and C. esculenta)* with respect to their variety (a pooled analysis).

Mineral content	Wet land cocoyam (*X. sagittifolllium)*	Dry land Cocoyam (*C. esculenta)*	SEM[1]	Significance
Potassium (mg/100 g DM)	908.25	715.39	30.01	**
Phosphorus (mg/100 g DM)	207.50	134.30	7.17	**
Copper (mg/100 g DM)	0.63	0.19	0.03	*
Iron (mg/100 g DM)	4.54	3.48	0.98	**
Zinc (mg/100 g DM)	2.72	4.32	0.23	*
Manganese (mg/100 g DM)	1.95	3.68	0.22	***
Calcium (mg/100 g DM)	110.17	68.67	10.04	***
Magnesium (mg/100 g DM)	90.62	83.76	2.35	***
Sodium (mg/100 g DM)	23.98	13.18	2.25	***

[1]SEM is the standard error of mean. Data presented are univariate estimated means with n = 40 for each variety. Level of significance are ***: $p < 0.001$, **: $p < 0.01$, *: $p < 0.05$ and mean values with $p > 0.05$ are not significantly different and their respective p-values are shown.

commercial crop in prime land and sometimes fertilizer is used to improve yield (Talwana et al., 2009). The high level of carbohydrate observed in both varieties of cocoyam from both countries also agrees with the finding reported by FAO (1990) that, the main nutrient supplied by cocoyam, as with other roots and tubers, is dietary energy provided by the carbohydrates. This can be utilized in preparation of various food products of medicinal value such as carbohydrate-based foods for the prevention of allergic diseases (Rehm and Espig, 1991) and fibre-based foods for activation of intestinal bifidobacteria for good digestion and vitamin synthesis (Sotozono, 1989). It has also been reported that cocoyam starch granules are so small (ranging from 3 to 20 µm) rendering it very easily digestible thus making cocoyam suitable for potential baby foods and composite bread production (Onwueme, 1978; King and Meadows, 2007). However, low levels of protein in cocoyam limits its utilization in preparation of protein rich foods. This can be improved by combining cocoyam with other high-protein sources.

Mineral contents

The comparison of average mineral contents levels between *X. sagittifolllium and C. esculenta* regardless of country of origin, are presented in Table 5. Potassium was the most abundant mineral with 908.3 and 715.4 mg/100 g present in *X. sagittifolllium and C. esculenta*, respectively. *X. sagittifolllium and C. esculenta* contained 207.5 and 134.3 mg/100 g of phosphorus, respectively. Calcium was the third most abundant mineral in both varieties of cocoyam amounting to 110.2 and 68.7 mg/100g for *X. sagittifolllium and C. esculenta*, respectively. Copper was the only mineral that had the least value (< 1 mg/100 g) in both varieties. With exception to zinc and manganese, *X. sagittifolllium* variety contained significantly higher ($p < 0.05$) amount of other minerals than *C. esculenta*, indicating that upland cocoyam is far better than wetland cocoyam in terms of mineral content. The comparison of these varieties for each country separately (Table 6), further indicated that indeed, *X. sagittifolllium* is superior to *C. esculenta* in terms of mineral composition. Based on individual country analysis (Table 6), the cocoyam of *C. esculenta* variety was found to be rich in magnesium and showed significantly ($p < 0.05$) higher magnesium content than *X. sagittifolllium* from Tanzania and Uganda. This could be attributed to the fact that this variety is cultivated in swampy areas where there is outlet of industrial waste. The influence of country of origin on the mineral composition of cocoyam was further assessed and the comparison of cocoyam mineral contents between Tanzania and Uganda regardless of the cocoyam variety is presented on Tables 7 and 8. Generally, cocoyam of Ugandan origin contained significantly higher mineral content ($p < 0.05$) than those of Tanzanian origin. The content (mg/100 g) of iron, manganese, calcium, magnesium, potassium and sodium were significantly higher in cocoyam of Ugandan origin as compared to those of Tanzanian origin. Cocoyam from both countries did not differ significantly in terms of copper, phosphorus and zinc content. The mean iron, calcium, magnesium, potassium and sodium content obtained in this study were in line with the results of Sefa-Dedeh and Agyir-

Table 6. A comparison of mineral composition (mg/100 g DM) of cocoyam (*X. sagittifolllium and C. esculenta*) with each country analyzed separately (un-pooled).

Country	Variety	Ca	Cu	Fe	Mg	Mn	P	K	Na	Zn
Tanzania	*X. sagittifolium*	76.66±11.70	0.43±0.44	3.28±0.19	69.53±4.90	0.783±0.05	277.76±9.02	760.21±29.0	8.39±0.22	1.35±0.13
	C. esculenta	57.89±0.57	0.20±0.01	3.24±0.09	86.362±1.39	0.54±0.01	114.32±0.37	381.80±3.49	6.87±0.15	5.63±0.04
	Significance	*	***	0.865	**	***	***	***	***	***
Uganda	*X. sagittifolium*	265.68±25.42	0.83±0.06	21.81±2.65	11.71±2.17	3.12±0.43	187.15±17.87	1065.29±66.87	39.56±6.28	4.08±0.55
	C. esculenta	79.44±4.62	0.19±0.04	11.72±0.79	81.16±3.92	6.82±0.43	154.27±3.28	1048.98±0.43	19.49±0.89	3.01±0.34
	Significance	***	***	***	***	***	0.865	0.927	**	***

Data presented are univariate estimated means with n = 20 for each variety. Level of significance are ***p < 0.001, **p < 0.01, *p < 0.05 and mean values with p > 0.05 are not significantly different and their respective p-values are shown.

Table 7. A comparison of mineral content (mg/100 g DM) of cocoyam (*X. sagittifolllium and C. esculenta*) with respect to country of origin (a pooled analysis).

Mineral content	Tanzania	Uganda	SEM[1]	Significance
Potassium (mg/100 g DM)	571.00	1052.63	30.01	***
Phosphorus (mg/100 g DM)	171.00	170.70	7.17	0.540
Copper (mg/100 g DM)	0.31	0.51	0.03	0.893
Iron (mg/100 g DM)	3.26	5.49	0.98	***
Zinc (mg/100 g DM)	3.49	3.55	0.23	0.520
Manganese (mg/100 g DM)	0.66	4.97	0.22	***
Calcium (mg/100 g DM)	67.27	109.56	10.04	***
Magnesium (mg/100 g DM)	77.95	96.43	2.35	***
Sodium (mg/100 g DM)	7.63	29.52	2.25	**

[1]SEM is the standard error of mean. Data presented are univariate estimated means with n = 40 for each country. Level of significance are ***: p < 0.001, **: p < 0.01, *: p < 0.05 and mean values with p > 0.05 are not significantly different and their respective p-values are shown.

Table 8. A comparison of mineral (mg/100g DM) of cocoyam (*X. sagittifolllium and C. esculenta)* of Tanzanian and Ugandan origin with each variety analyzed separately (un-pooled).

Variety	Country	Ca	Cu	Fe	Mg	Mn	P	K	Na	Zn
X. sagittifolium	Tanzania	76.66±11.70	0.43±0.45	3.28±0.19	69.53±4.90	0.783±0.05	277.76±9.015	760.21±29.00	8.39±0.22	1.35±0.13
	Uganda	265.68±25.42	0.83±0.06	21.81±2.65	11.71±2.17	3.12±0.45	187±17.87	1065.29±66.87	39.56±6.28	4.08±0.55
	Significance	***	**	***	**	***	***	***	***	***
C. esculenta	Tanzania	57.89±0.57	0.20±0.01	3.24±0.09±0.09	86.362±1.39	0.54±0.01	114.32±0.37	381.80±3.49	6.87±0.15	5.63±0.04
	Uganda	79.44±4.62	0.19±0.04	11.72±0.79	81.16±3.92	6.82±0.43	154.27±3.28	1048.98±0.43	19.49±0.89	3.01±0.34
	Significance	***	0.650	***	**	***	***	***	***	***

Data presented are univariate estimated means with n = 20 for each country. Level of significance are ***: p < 0.001, **: p < 0.01, *: p < 0.05 and mean values with p > 0.05 are not significantly different and their respective p-values are shown.

(2002). However, as compared to the results of current study, Njoku and Ohia (2007) reported lower values of zinc (2.49 to 310 mg/100 g), Phosphorous (44.39 to 72.2 mg/100 g) and higher values of copper (0.52 to 1.04 mg/100 g). Nutritional composition of roots and tubers varies from place to place depending on the climate, the soil, the crop variety and other factors (FAO, 1990). Consumption of micronutrient rich foods such as cocoyam is important for building a strong immune system that help the body to utilize protein, carbohydrates and other nutrients. The adult daily requirements for these nutrient are: Ca, 700 mg; Fe, 13 to 16 mg; Mg, 13 mg; K, 1 to 2 mg; and Na, 6 g (Longman, 2006). Considering the mineral nutrient levels in the cocoyam varieties studied, it suggests that a daily diet of cocoyam has been found to be of high nutritive value whereby 100 g cocoyam flour contained greater quantities of Mg and K than the daily requirements (Ndimantang et al., 2006). The value obtained for Ca, Fe and Na in this study are less than the daily requirement but could be augmented by either increasing the quantity of cocoyam consumption or complementing it with other food sources that are rich in these minerals. Therefore, results obtained in this study agree with previously reported studies (Njoku and Ohia, 2007; Enomfon and Umoh, 2004; FAO, 1990) which suggest that cocoyam can be a good source of dietary potassium.

CONCLUSION

The results from current study reveal that cocoyam is nutritionally rich in carbohydrates and minerals such as potassium and phosphorous. However, its composition varies according to the variety and country of origin. The *X. sagittifolium* variety was nutritionally superior to *C. esculenta* both in terms of proximate composition and mineral content. Findings of current study are significant and have potential to offer tangible contribution towards food shortage alleviation by promoting the production and consumption of cocoyam in Sub-Sahara Africa.

ACKNOWLEDGEMENTS

This research was conducted as a regional research project with grant support from the Swedish International Development Cooperation Agency (SIDA) through the Lake Victoria Research Initiative (VicRes) of the Inter-University Council of East Africa (IUCEA).

REFERENCES

AOAC (2000). Official Methods of Analysis*,* 15th Ed., Association of Official Analytical chemists, Washington, D. C.

AOAC (1990). Official Methods of Analysis*,* 15th Ed., Association of Official Analytical chemists, Washington, D. C.

Enomfon JA, Umoh IB (2004). Effects of heat and tetracycline treatment on the food quality and acridity factors in cocoyam (*Xanthosoma Sagittifolium*). Pak. J. Nutr., 3: 570-575.

FAO (1998). Production Year Book for 1997. Food and Agriculture Organization of the United nations, Rome, Italy.

FAO (1990). Roots, tubers, plantain and bananas in human Nutrition. Effect of processing on nutritive values. Food and Agriculture Organization of the United Nations, Rome, Italy.

Goenaga R, Hepperly P (1990). Flowering, pollen and seed viability and artificial hybridization of taniers (*Xanthosoma* spp.). J. Agri. Univer. Puerto Rico. 74 (3): 253-260.

Jennings DL (1987). Starch crops In: *CRC* Handbook of Plant Science in Agriculture. Volume II. (Edited by Christie, B. R). CRC Press, Inc. Boca Raton, Florida, USA. pp. 137-143.

Jirarat T, Sukruedee A, Pasawadee P (2006). Chemical and Physical Properties of flour extracted from Taro *Colocasia esculenta* (L) Schott grown in different regions of Thailand. Sci. Asia. 32: 279-284.

King M, Meadow L (2007). Malanga. Florida Food Fare, Family & Consumer Sciences University of Florida / IFAS, Sarasota County Extension, USA.

Longman (2006). In: www.longman.co.uk (ttsecsi/resource/database/datanutri.htm/

Ndimantang B, Asinobi CO, Obiaku N (2006). The effect of different processing methods on some anti-nutritional factors contents of Ede Uhie (*Xanthosoma Sagattifolium*) and Ede Ocah (*Colocasia esculenta*). Int. J. Agric. Dev., 7: 7-14.

Niba LL (2003). Processing effects on susceptibility of starch to digestion in some dietary starch sources. Int. J. Food Sci. Nutr., 54: 97-109.

Njoku PC, Ohia CC (2007). Spectrophometric Estimation Studies of Mineral Nutrient in Three Cocoyam Cultivars. Pakistan J. Nutr., 6: 616-619.

Onwueme IC (1999). Taro cultivation in Asia and Pacific. Food and Agriculture Organization of the United Nations Regional Office for Asia and the pacific Bangkok, Thailand.

Onwueme IC, Charles WB (1994). Cultivation of cocoyam. In: Tropical root and tuber crops. Production, perspectives and future prospects. FAO Plant Production and Protection Paper 126, Rome. pp. 139-161.

Onwueme IC (1978). *Colocasia* and *Xanthosoma* (Cocoyams). In: The tropical tuber crops: yams, cassava, sweet potato, and cocoyam. Eds. J. Wiley and Sons Ltd. New York, pp. 589-606.

Palapala V, Talwana H, Nandi JOM, Sereme AK, Ndabikunze BK (2005). Evaluation of prospects and constraints to sustainable cocoyam (*Colocasia esculenta*) production in Lake Victoria crescent. A Project report.

Rehm S, Epsig G (1991). The cultivated plants of the tropics and subtropics. Priese, Gmbh, Berlin, German.

Sefa-Dedeh S, Agyir-Sackey EK (2002). Chemical composition and the effect of processing on oxalate content of cocoyam *Xanthosoma sagittifolium* and *Colocasia esculenta* cormels. J. Food Chem., 85: 479-487.

Sotozono M (1989). Ice cream sherbet containing taro as main raw material. Japan Patent No 03098539A.

Subbulakshim G, Chitra L (1996). Method for determining nutrients in foods. A critical apraisal. J. Food Sci. Technol., 33: 267-284.

Sukamoto LA (2003). Development of early maturing and leaf blight resistant cocoyam *(Colocasia esculenta (*L.*)* Schott*)* with improved taste. Proceedings of a final research coordination meeting organized by the joint FAO/IAEA division of nuclear techniques in food and agriculture and held in Pretoria, South Africa, pp.19–23

Talwana HAL, Serem AK, Ndabikunze BK, Nandi JOM, Tumuhimbise R, Kaweesi T, Chumo EC, Palapala V (2009). Production status and prospects of Cocoyam (*Colocasia esculenta Schott.)* for improving food and income security in East Africa. J. Root Crops., 35: 98 – 107.

Watanabe KZ (2002). Challenges in biotechnology for abiotic stress tolerance on root and tubers. JIRCAS Working Reports. pp. 75-83.