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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Proximate and Mineral Compositions of *Dioscorea rotundata* (White Yam) and *Colocasia esculenta* (White Cocoyam)

I.J. Alinnor and C.O. Akalezi
Department of Pure and Industrial Chemistry,
Federal University of Technology, P.M.B. 1526, Owerri, Imo State, Nigeria

Abstract: *Dioscorea rotundata* (white yam) and *Colocasia esculenta* (white cocoyam) were analyzed for their proximate and mineral compositions. The result showed that *Dioscorea rotundata* has a moisture content 54.50%, ash content 1.4%, crude fat content 2.70%, crude protein content 0.087%, crude fibre content 0.70%, carbohydrate content 40.61%, available energy 731.75 kJ; while *Colocasia esculenta* has moisture content 38.50%, ash content 1.60%, crude fat content 1.05%, crude protein content 0.066% crude fibre content 1.0%, carbohydrate content 57.78%, available energy 1022.27 kJ. The mineral content of the analyzed samples showed that *Dioscorea rotundata* and *Colocasia esculenta* were rich in iron of values 81.85 mg/100 g and 59.07 mg/100 g respectively. The copper content of the samples were 10.06 mg/100 g and 6.72 mg/100 g for *Dioscorea rotundata* and *Colocasia esculenta* respectively.

Key words: *Dioscorea rotundata*, *Colocasia esculenta*, proximate analysis, mineral compositions

INTRODUCTION

Dioscorea rotundata (white yam) is grown in West Africa especially Nigeria. It is about 1.6 m in height and weighs about 2-5 kg depending on size. The tuber has a rough skin usually dark to light brown in colour. This rough skin can be peeled with minimal degree of difficulty. The yam become edible only if it is well washed and properly cooked. These steps are necessary in order to reduce the anti-nutritional components of yam before consumption (Dumnnt and Vernier, 1997). Planting of yam tuber starts from march and harvesting is between September and October and late harvesting is between November and December for those not living in coastal region (FAO, 1990). The Igbos of Eastern Nigeria call white yam Jiaga, the Yorubas of Western Nigeria call it Isu ewura and Hausas of Northern Nigeria call it Doya. Yam is not only a preferred high energy food, but a king crop tied up with the socio-cultural life of the people in West Africa especially Nigeria.

Colocasia esculenta (white cocoyam) is a tropical root crop grown in Nigeria. It is planted between the month of March and April. It is harvested between August and September. The Igbos of Eastern Nigeria call it Ede Ocha, while the Yorubas of Western Nigeria call it Isu kobo and the Hausas of Northern Nigeria call it Gwasa or Makani.

White yam and white cocoyam are tropical tubers that store edible material in subterranean roots, corms or tubers. They consist of starch which is the only quantitative important digestible polysaccharides being regarded nutritionally superior to low molecular weight carbohydrate or sugar (Malcolm, 1990). Starch is an

important ingredient in food and non-food industries such as paper, plastic, adhesive, textile and pharmaceutical industries. Tubers processing is aimed at obtaining products that are stable in terms of longevity, nutrition and palatability (Oladebeye *et al.*, 2008a). The aim of present study is to compare the proximate and mineral compositions of *Dioscorea rotundata* and *Colocasia esculenta* since some tribes in Nigeria do not eat cocoyam due to cultural and superstitious believe that it is a taboo for somebody to eat cocoyam.

MATERIALS AND METHODS

Sample collection and preparation: Fresh samples of *Dioscorea rotundata* (white yam) and *Colocasia esculenta* (white cocoyam) were obtained from Nkwo Amafor market in Ohaji Local Government Area of Imo State, Nigeria. Both samples were thoroughly washed, peeled, air dried and ground with manual blender. The powdered samples of *Dioscorea rotundata* and *Colocasia esculenta* were finally sieved through 250 µm mesh and stored in plastic container until use.

Proximate analysis: The moisture, ash and crude fibre contents of samples of *Dioscorea rotundata* and *Colocasia esculenta* were determined using Standard Chemical Methods described by Association of Official Analytical Chemistry (AOAC, 1990) by drying 2g each of the sample at 105°C for 24 h for moisture content determination. The ash content was determined by incineration of 2 g of each sample in a muffle furnace at 500°C for 2 h. Soxhlet extraction technique using

petroleum ether (40-50°C) was used to evaluate the fat contents of the samples (Pearson *et al.*, 1981). Kjeldahl method was used to determine the crude protein contents of the samples as described by (AOAC, 1990). The contents of carbohydrate of the samples were estimated by difference (% carbohydrate = 100% - sum of percentage of moisture, ash, fat, crude fibre and crude protein contents).

Mineral analysis: Mineral composition of the samples were determined according to methods recommended by Association of Official Analytical Chemists (AOAC, 1990). 1g each of the sample of *Dioscorea rotundata* and *Colocasia esculenta* was digested using 12 cm³ of mixture of HNO₃, H₂SO₄ and HClO₄ (9:2:1 v/v) (Sahrawat *et al.*, 2002). Copper, iron, zinc, sodium, potassium, calcium and magnesium were analyzed by Atomic Absorption Spectrophotometer (Pye-Unicam 969, Cambridge, UK). Phosphorus contents of the samples were determined using Flame photometer.

RESULTS AND DISCUSSION

The results of the proximate composition of flour samples of *Dioscorea rotundata* and *Colocasia esculenta* were depicted in Table 1. *Dioscorea rotundata* and *Colocasia esculenta* have moisture content 54.50% and 38.50% respectively. Generally the moisture content of the two samples were high, indicating that the samples are prone to microbial attack in the course of storage. The moisture content of the two samples however indicates that the samples could not be stored favourably for a long period of time because they will deteriorate. It has been reported (Oladebeye *et al.*, 2008a) that sweet potato and red cocoyam have moisture content 8.72% and 9.02% respectively. The result of the analysis shows that flours of white yam and white cocoyam have ash content 1.40% and 1.60% respectively. Ash is a measure of total mineral content in the samples. The result indicates that the samples could be a source of mineral elements having nutritional importance.

Table 1 shows the fat content 2.70% and 1.05% in flours of white yam and white cocoyam respectively. That fat supplies most of the energy required by man (Osborne and Voogt, 1978) suggests that *Dioscorea rotundata* is a better source of calories than *Colocasia esculenta*. Fat serve as energy store in the body. It can be broken down in the body to release glycerol and free fatty acids. The glycerol can be converted to glucose by the liver and used as a source of energy. It has been reported (Oladebeye *et al.*, 2008b) that flours of rice, millet and wheat have fat content 0.75%, 0.79% and 3.03% respectively. The result indicates that fat content of white yam and white cocoyam were higher than rice and millet except wheat flour. It has been reported that 1 g of fat provide 37 kcal of energy (Gaman and Sherrington,

Table 1: Proximate composition of *Dioscorea rotundata* and *Colocasia esculenta* samples (% dry weight)^a

Parameters	<i>Dioscorea rotundata</i> (White yam)	<i>Colocasia esculenta</i> (White cocoyam)
Moisture contents	54.50±0.03	38.50±0.04
Ash contents	1.40±0.02	1.60±0.01
Crude fat contents	2.70±0.02	1.05±0.01
Crude protein contents	0.087±0.03	0.066±0.04
Crude fibre contents	0.70±0.01	1.00±0.01
Available carbohydrate	40.61±0.02	57.78± 0.02
Available energy (kJ) ^b	731.75±0.14	1022.27±0.14

^aValues are mean±standard deviation of triplicate determinations.

^bCalculated Metabolisable energy (kJ/100 g sample):(Protein x 17 + fat x 37 + carbohydrate x 17)

1990). The crude protein content of *Dioscorea rotundata* and *Colocasia esculenta* were low of values 0.087% and 0.066% respectively. Whereas crude protein content of 1.41% and 1.63% have been reported (Oladebeye *et al.*, 2008a) in red cocoyam and sweet potato respectively. The result of the analysis indicates that crude protein content of the two samples were very low. Therefore, *Dioscorea rotundata* and *Colocasia esculenta* are not good sources of protein.

The crude fibre content of flour samples of *Dioscorea rotundata* and *Colocasia esculenta* were 0.70% and 1.00% respectively. The result indicates that white cocoyam has higher fibre content than white yam. Report (Oladebeye *et al.*, 2008a) have shown that fibre content of red cocoyam and sweet potato were 0.50% and 0.75% respectively. Fibre has useful role in providing roughage that aids digestin (Eva, 1983). Dietary fibre reduces the risks of cardiovascular diseases. Report have shown that increase in fibre consumption might have contributed to the reduction in the incidence of certain diseases such as diabetes, coronary heart disease, colon cancer and various digestive disorder (Augustin *et al.*, 1978). Fibre consumption also soften stools and lowers plasma cholesterol level in the body (Norman and Joseph, 1995). The carbohydrate contents of white yam and white cocoyam were 40.61% and 57.78% respectively. It has been reported that carbohydrate content of red cocoyam and sweet potato were 86.69% and 86.90% respectively. The result of the analysis shows that carbohydrate content of white yam and white cocoyam were low when compared to values reported for red cocoyam and sweet potato. Carbohydrate supplies energy to cells such as brain, muscles and blood. It contribute to fat metabolism and spare proteins as an energy source and act as mild natural laxative for human beings and generally add to the bulk of the diet (Gordon, 2000; Gaman and Sherrington, 1996). The calculated metabolizable energy values show high value of 1022.27 kJ for *Colocasia esculenta* and 731.75 kJ for *Dioscorea rotundata*. The high energy value of *Colocasia esculenta* may be attributed to high carbohydrate content.

Table 2: Mineral composition of *Dioscorea rotundata* and *Colocasia esculenta* samples (mg/100 g)^a

Minerals	<i>Dioscorea rotundata</i> (White yam)	<i>Colocasia esculenta</i> (White cocoyam)
Sodium	185.15±0.05	270.83±0.04
Potassium	209.13±0.03	345.32±0.02
Calcium	132.02±0.04	87.14±0.02
Magnesium	45.90±0.02	28.02±0.03
Iron	81.85±0.01	59.07±0.03
Copper	10.06±0.05	6.72±0.04
Zinc	5.46±0.02	1.30±0.03
Phosphorus	54.00±0.04	36.00±0.02
Na/k	0.89	0.78
Ca/P	2.44	2.42
Ca/Mg	2.88	3.11

^aValues are mean±standard deviation of triplicate determinations

Minerals are important component of diet because of their physiological and metabolic function in the body. The result presented in Table 2 shows that *Dioscorea rotundata* and *Colocasia esculenta* have sodium content 185.15 mg/100 g and 270.83 mg/100 g respectively. Sodium is an important mineral that assist in the regulation of body fluid and in the maintenance of electric potential in the body tissue. The World Health Organization (WHO) recommended intake of sodium per day is 500 mg for adult and 400 mg for children (WHO, 1973). The result indicates that sodium content of *Dioscorea rotundata* and *Colocasia esculenta* were below WHO recommended standard. This study shows that white yam and white cocoyam have potassium content 209.13 mg/100 g and 345.32 mg/100 g respectively. Potassium is important in the regulation of heart beat, neurotransmission and water balance of the body. The WHO recommended intake of potassium per day is 2000 mg for adult and 1600 mg for children. This study revealed that potassium content of white yam and white cocoyam were below WHO standard.

Calcium is an important mineral required for bone formation and neurological function of the body. *Dioscorea rotundata* and *Colocasia esculenta* have calcium content 132.02 mg/100 g and 87.14 mg/100 g respectively. The recommended daily intake of calcium by WHO is 800 mg for both adult and children. This study indicates that white yam and white cocoyam were below WHO standard. *Dioscorea rotundata* and *Colocasia esculenta* have magnesium content 45.90 mg/100 g and 28.02 mg/100 g respectively. Magnesium plays essential role in calcium metabolism in bones and also involve in prevention of circulatory diseases. It helps in regulating blood pressure and insulin releases (Onyiriuka *et al.*, 1997; Umar *et al.*, 2005). Recommended Dietary Allowance (RDA) for magnesium in adult is 350 mg/day, while children is 170 mg/day. The result revealed that the values obtained from white yam and white cocoyam were far below the recommended values. Therefore white yam and white cocoyam cannot be regarded as a rich source of magnesium.

Table 2 shows iron content 81.85 mg/100 g and 59.07 mg/100g for *Dioscorea rotundata* and *Colocasia esculenta* respectively. The recommended dietary allowance for iron in adult and children is 10 mg/day, while female adult is 15 mg/day. This study indicates that both white yam and white cocoyam were rich in iron and far above the recommended standard. Iron is required for blood formation and it is important for normal functioning of the central nervous system (Adeyeye and Fagbohon, 2005). It also facilitates the oxidation of carbohydrate, protein and fats. The copper content of *Dioscorea rotundata* were higher than that of *Colocasia esculenta* of values 10.06 mg/100 g and 6.72 mg/100 g respectively. The values of the two samples were higher than the recommendation dietary allowance of 3 mg/day for adult and 2 mg/day for children. Copper is required in the body for enzyme production and biological electron transport.

The result of this study shows that *Dioscorea rotundata* and *Colocasia esculenta* have zinc content 5.46 mg/100 g and 1.30 mg/100 g respectively. The WHO recommended standard for zinc in adult and children are 15 mg/day and 10 mg/day respectively. The values of the two samples studied were below WHO standard. Zinc is an essential micronutrient associated with number of enzymes, especially those associated with synthesis of ribonucleic acid (Guil-guerrero *et al.*, 1998). Zinc deficiency limits the rate of recovery for protein energy in malnourished children (Hambridge, 1986). The phosphorus content of white yam and white cocoyam were 54.00 mg/100 g and 36.00 mg/100 g respectively. The RDA for phosphorus in adult and children is 800 mg/day. The values of phosphorus in both samples were far below recommended standard.

The ratio of sodium to potassium in the body is of great concern for prevention of high blood pressure. Na/k ratio less than one is recommended. The ratio of Na/k were less than one in *Dioscorea rotundata* and *Colocasia esculenta*, therefore the two samples would not promote high blood pressure. The result of the analysis indicates that Ca/P ratio were similar in *Dioscorea rotundata* and *Colocasia esculenta* of values 2.44 and 2.42 respectively. If the Ca/P ratio is low (low calcium, high phosphorus intake), more than the normal amount of the calcium may be lost in the urine. Food is considered "good" if Ca/P ratio is above one and "poor" if the ratio is less than 0.5, while Ca/P ratio above two helps to increase the absorption of calcium in the small intestine. This study indicates that both white yam and white cocoyam are good source of calcium and phosphorus. The Ca/Mg ratio in *Dioscorea rotundata* and *Colocasia esculenta* were high of values 2.88 and 3.11 respectively, above the recommended value of 1.00 (NRC, 1989).

Conclusion: The result of the analysis shows that *Dioscorea rotundata* and *Colocasia esculenta* were rich in carbohydrate. This study revealed that *Colocasia esculenta* has higher available energy more than *Dioscorea rotundata*. The result revealed that the two samples were rich in iron when compare to RDA for both adult and children. Also *Dioscorea rotundata* and *Colocasia esculenta* were rich in copper when compared to WHO standard. The Ca/P ratio indicates that both *Dioscorea rotundata* and *Colocasia esculenta* are good food sources.

From the result of the analysis it is recommended that people should eat white cocoyam as staple food like white yam, especially those tribes in Nigeria who do not eat cocoyam because of superstitious believe that it is a taboo for somebody to eat cocoyam.

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