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Proximate, Vitamins and Elemental Analysis of seeds of *Telfairia occidentalis* and *Anacardium occidentale* Nuts

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Abstract

Seeds of Telfairia *occidentalis* (fluted pumpkin) and *Anacardium occidentale* (cashew nuts) were analyzed for their proximate composition, elements and vitamins. The fluted pumpkin fruits and cashew nuts were purchased randomly from dealers in Uyo local Government area of Akwa Ibom State, Nigeria. The samples were stored in black polythene bags and conveyed to the laboratory for analysis. All analytical methods were adopted from those recommended by Association of Official Analytical Chemist Proximate compositions in mg/100g were; moisture content (36.18 ± 2.65, 27.48 ± 0.96), crude protein (28.88 ± 2.14, 24.00 ± 0.81), ash content (5.20 ± 0.27, 3.60 ± 0.61), crude fibre (3.45 ± 0.47, 2.40 ± 0.41), total carbohydrate (4.06 ± 0.50, 27.85 ± 0.36), lipid (58.41 ± 0.49, 42.15 ± 0.23) and energy(kcal/100g) (657.45, 583.75 ± 0.23) respectively. Mean concentrations (mg/100g) of magnesium, iron, calcium, zinc, sodium, potassium, manganese and phosphorus (Pumpkin seed, cashew nuts) were (11.94 ± 0.08, 12.15 ± 0.13), (0.33 ± 0.05, 0.36 ± 0.04), (135.40 ± 1.06, 149.25 ± 0.64), (1.75 ± 0.03, 3.36 ± 0.04), (1.48 ± 0.01, 1.43 ± 0.02), (57.30 ± 0.29, 47.78 ± 0.62), (<0.002, 0.59 ± 0.61) and (73.50 ± 2.37, 58.90 ± 0.22) respectively. The vitamins A and C composition (mg/100gDM) of fluted pumpkin seeds and cashew nuts were, vitamin A; (1.86, 6.76), vitamin C;(2.12, 156.78). Based on this findings, the consumption of these seed is advocated in this work.

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Introduction

A balanced diet must contain the entire nutrient in the right amount (De Ridder *et al*., 2017) but no single food or food materials contain all the nutrients require for a balance diet. This implies that all attempts to meet human dietary profile, requires a medium of thought on the type of food, food materials or its combination that should be consumed in order to meet the body dietary requirement.

Food nutrients include lipids, proteins, carbohydrates, minerals, vitamins and water (Eddy and Udoh, 2005). Sources of nutrients are generally grouped into plant and animal sources.

Cereals are one of the most widely consumed grains in the world. In Nigeria, especially in the northern part of the country, cereals are the major sources of carbohydrates and proteins in the diet of the people (Ismaila *et al*., 2010). The cereals cultivated are sorghum, maize, millet and wheat.

Fluted pumpkin belongs to the family cucurbitaceae and is widely cultivated as garden and farm vegetable is native of West Africa and grows in humid tropical climate in a high well-drained soil. It behaves like a perennial plant and can grow for more than two years if there is moisture in the soil (Dada and Abiodun, 2014). It can grow like a creeping plant on the ground or a climbing plant if supported with sticks. The leaves of fluted pumpkin is an important food vegetable for many people especially in the mid-western and eastern parts of Nigeria (Okonwu *et al*., 2018) and it is a perennial vine with stem that can be as long as 10metres. Amoa *et al*. (2018), stated that the leaves and edible shoots of fluted pumpkin together contain 85% moisture, while the dry portion contains 11% crude protein and 25% carbohydrate.

Seeds of fluted pumpkin contain 21% brownish-yellow oil (Abu *et al*., 2014). The leaves contain 37% protein, 5.96% total N, 0.62% P, 0.40% Ca, 0.50% Mg, 4.0% K and 180ppm Mn. According to Akwaowo *et al*. (2000), fluted pumpkin seeds contain 53% oil and the crop could potentially become another source of vegetable oil in the world market. Goler and Ibrahim (2017) observed that fluted pumpkin seeds are good source of major minerals required for human

nutrition and that the seed contained 29% oil and 30% protein. According to Ebere and Ogaraku (2017), fluted pumpkin seeds contain 40% oil and 31% protein; the protein markedly deficient in the sulphur-containing amino acids such as methionine and cysteine.

Amoa, *et al*. (2018) reported that fluted pumpkin seeds contain 53% fat, 22% protein, 3% fibre, 15% carbohydrate and 2% ash. The other major and micronutrients in pumpkin seeds have also been reported by Ashagidigbi *et al*. (2018).

The present study is aimed at complementing researches done on these seeds and to examine in details the nutritional potentials of these seeds based on their chemical composition

Materials and methods

The fluted pumpkin fruits and cashew nuts were purchased randomly from dealers in Uyo local Government area of Akwa Ibom State, Nigeria. The samples were stored in black polythene bags and conveyed to the laboratory for analysis.

Sample preparation and treatment: The samples were treated according to AOAC (1993) method. The seed samples were cut open and the edible portion of the seed were removed and dried in an oven at a temperature of about 40°C for 24hours.

The dried samples were crushed into powder form with the aid of a manual grinder. Each set of ground samples were stored in labeled air-tight plastic containers and kept in desiccators. The samples meant for moisture determination were used directly without the above treatment, although the outer coats of the seeds were removed.

Extraction of oil: This was done by using Soxhlet extraction method as reported by James (1984). The samples were placed in a Soxhlet extractor and the extractions were done continuously using petroleum ether. The extracted oil was recovered by evaporation, cooled and preserved for further analysis.

Proximate analyses of sample: Proximate composition of fluted pumpkin seeds and cashew nut was carried out according to specifications by the Association of Official Analytical Chemists. The procedures are as follows:

Determination of moisture content: The seed samples were used for moisture content determination immediately after the removing them from the fruits. In the determination of moisture content of the seeds, the method reported by the A.O.A.C (1993) was adopted. 5g of each sample was weighed and dried in an oven at a temperature of 105°C until a constant weight of sample was observed. The weight loss, i.e. the difference between the initial weight of the seeds and the final weight after continuous drying was recorded as the moisture content of the seed

The percentage moisture content of the seed was calculated from the formula;

$$\%\text{Moisture} = \frac{\text{Loss in weight of the sample} \times 100}{\text{Initial weight of the sample}}$$

Determination of crude protein: In the determination of the crude protein content of the seed, Kjeldahl method of nitrogen determination was used (AOAC, 1993). 0.5g of the grounded sample was digested in the kjeldahl flask with concentrated tetraoxosulphate (VI) acid and heated gently. 25ml of the digest was heated with 40% NaOH in a micro kjeldahl flask and the liberated ammonia was distilled into boric acid. The filtrate was titrated with 0.1N HCl to phenolphthalein end point. The percentage protein of the sample was calculated by multiplying the nitrogen content of the sample by 6.25. Nitrogen factor; 100/16 = 6.25

Determination of ash content: In order to determine the ash content of the sample, the method recommended by AOAC (1993) was adopted. The samples were first oven dried to remove all moisture present and were separately transferred to a muffle furnace. The temperature of the furnace was set to 250°C after which it was re-set to 550°C in order to ash the sample. The ash content of the samples was calculated as the percentage of the dried mass.

$$\text{Percentage ash} = \frac{\text{Weight of ash} \times 100}{\text{Weight of oven dried sample}}$$

Determination of crude fibre content: In the determination of the crude fibre content of the sample, the method recommended by the AOAC (1993) was adopted. 2g of the sample was successively digested with 50ml of 1.25% H_2SO_4 and filtered through a buckner funnel. The residue was washed with distilled water and digested with 1.25% NaOH, 95% methanol and dried at 100°C. The weight of the oven-dried residue was noted. The residue was ignited at 550°C and the weight of the ash was noted. The percentage crude fibre was calculated from the sample by using the formula,

$$\text{Percentage fibre} = \frac{\text{Weight of sample after ignition} \times 100}{\text{Weight of sample before ignition}}$$

Determination of the lipid content: In the determination of the lipid content of the sample, the A.O.A.C (1993) recommended method was used. The crude fat was extracted from 4g of each sample using Soxhlet extractor with low boiling point (40 – 60°C)

petroleum ether. The weight of the lipid after evaporating off the solvent represented the weight of the lipid.

$$\%\text{Lipid} = \frac{\text{Weight of extract X 100}}{\text{Weight of dry sample}}$$

Determination of carbohydrate content: The carbohydrate content of the sample was estimated by the method of difference as recommended by A.O.A.C. (1993). Therefore, percentage carbohydrate was obtained from the formula,

%Carbohydrate = Weight of dry matter (100%) – (% protein + %ash + %lipid +%fibre)

Estimation of caloric value

The caloric value of the sample was estimated by multiplying the protein content, carbohydrate content and fat content of the sample by 4, 4 and 9 respectively (James, 1984) and taking the sum of the products expressed in kilocalories per 100g.

Determination of minerals composition: The method adopted for this determination was the A.O.A.C (1993) recommended method and the procedures included, preparation of the ash solution of the sample, preparation of stock solution of the element and the determination of the concentration of the element through the calibration curve.

Ashing of samples and preparation of ash solutions

2g of each sample were ashed in a furnace. To the ash sample, 5ml of concentrated HCl was added and boiled for five minutes on a hot plate under a fume cupboard. The sample was diluted with water, re-boiled and further diluted to 100ml.

Standard solution of Mg was prepared by dissolving 1g of Mg metal in 20ml 1: 1 HNO_3 and diluting it to 1L with deionized water.

Standard solution of Ca was prepared by suspending 2.5g of calcium carbonate, $CaCO_3$, dried for 1hour at 180°C in deionized water. The sample was dissolve by adding of dilute HCl. This was diluted to 1L with deionized water.

Standard solution of iron was prepared by dissolving 1.0g of iron wire in 10ml re-distilled HNO_3 and diluting it to 1L with deionized water.

Standard solution of manganese was prepared by dissolving 1.0g of manganese metal in 10ml re-distilled HNO_3 and diluting it to 1L with deionized water.

Standard solution of zinc was prepared by dissolving 1.0g of zinc metal in re-distilled HNO_3 and diluting it to 1L with deionized water.

Standard solutions of sodium and potassium were prepared by dissolving 1.907g of KCl (dried at 110°C) and 2.542g of NaCl in deionized water respectively. KCl solution was diluted to 1L while NaCl solution was acidified with 10ml redistilled HNO_3 and diluted to 1L.

Estimation of Mg, Ca, Zn, Mn and Fe by AAS:The concentration of Mg, Ca, Zn, Mn and Fe were determined by using atomic absorption spectrophotometer. Prior to the determination, the hallow cathode lamp of the corresponding element were in turn placed in the AAS and the ash solution was aspirated into the flame of the AAS. The absorbance reading for the respective element was recorded and the concentration of the element was determined by extrapolating the data from the respective calibration curve.

Estimation of Na and K by Flame Emission Spectrophotometry: The sodium and potassium content of the sample was determined by using flame emission spectrophotometer. Aliquots of the digested samples were sucked into the flame and the emission intensity of sodium and potassium was recorded at 587nm and 766nm respectively. The concentration of sodium and potassium were determined through the calibration curve prepared for the respective metals.

Estimation of phosphorus: The phosphorus content of the sample was determined by colorimetric method as described by James (1984) using hydroquinone as the reducing agent. In this method 1.0ml of hydroquinone was added to 0.5ml of the mineral digest. The mixture was agitated and allowed to stand for 30 minutes. The blue colour that developed was quantitated colorimetrically at 660nm against a reagent blank.

Determination of vitamin composition of the samples: To determine the vitamin A content of the sample, 20g of antimony trichloride was dissolved in 100ml of chloroform, warmed and cooled in ice water until excess of the reagent was separated. The solution was used for the analysis.

1mg of standard vitamin A was dissolved in 100ml of chloroform to obtain a solution containing 10mg/ml of vitamin A. 2, 3, 4 and 5mg/ml of standards were also prepared. 1g of each sample was taken and soaked in 100ml of chloroform, 10ml of the solution were each treated with antimony trichloride to develop blue colour.

The vitamin A was determined at 620nm against chloroform/antimony trichloride blank.

$$\text{Vitamin A (mg/l)} = \frac{\text{Absorbance of test X concentration of standard}}{\text{Absorbance of standard x weight of sample}}$$

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Determination of vitamin C: 2g of the dried sample was weighed and mixed with 20ml of 5% trichloro acetic acid. A little activated charcoal was added to facilitate the rapid oxidation of vitamin C (as dehydro ascorbic acid) and filtered. 1ml of 2,4-dinitro-phenyl hydrazine was added to the filtrate and mixed. The test tubes were incubated for 3 hours at 37°C and placed in an ice bath. 5ml of 85% H_2SO_4 was added to the test solution, mixed and allowed to stand for 30minutes. The absorbance of each test sample was determine against the corresponding blank at 540nm

Vitamin C (mg/l) =

$$\frac{\text{Absorbance of test X concentration of standard}}{\text{Absorbance of standard X weight of sample}}$$

Results and Discussion

The results of the proximate composition, mineral element composition, vitamin content, toxicant content, physicochemical characteristics and amino acid profiles of fluted pumpkin seed oil and cashew nut oil are presented in tables 1 to 5

Table 1: Proximate composition of pumpkin and cashew nuts. (%)

Proximate composition	Fluted pumpkin seed	Cashew nut
Moisture content (wet weight)	36.18 ± 2.65	27.48 ± 0.96
Crude Protein content	28.88 ± 2.14	24.00 ± 0.81
Ash content	5.20 ± 0.27	3.60 ± 0.61
Crude fibre	3.45 ± 0.47	2.40 ± 0.41
Total carbohydrate	4.06 ± 0.50	27.85 ± 0.36
Lipid	58.41 ± 0.49	42.15 ± 0.23
Energy (Kcal/100g)	657.45	583.75 ± 0.23

Mean of three determinations ± Standard Deviation

Proximate compositions of the seeds of fluted pumpkin seed and cashew nut revealed statistical difference ($P \geq 0.5$) in their content of moisture, protein, ash, crude fibre, carbohydrate and lipid indicating that the proximate composition of the two seeds are not the same. However, the moisture content of fluted pumpkin seeds (36.18 %) was slightly higher than the moisture content of cashew nuts (27.48%) Similarly, fluted pumpkin seeds had higher content of protein, ash, crude fibre and lipid than cashew nut while cashew nut had a higher carbohydrate content than fluted pumpkin seed.

Moisture content of most seeds depends on many factors and can vary significantly according to harvest period, storage condition, environmental temperature humidity and the presence for adsorbed or occluded moisture (Frazier and Westhoff, 1978). The use of moisture content of seeds as an index for its nutritional value should therefore be treated with reserve. However, the values obtained for the moisture content of the seeds are relatively comparable to values reported in literature for the moisture content of some plant seeds. The moisture content of fluted pumpkin seed (36.18%) is comparable to the value (33.37%) earlier reported for fluted pumpkin seed by (Akwaowo *et al*., 2000). Fetuga and Oyenuga (1974) reported the moisture content of cashew nut (5.5%), this is not comparable to the moisture content (27.48%) obtained for cashew nut in this work. The difference may be attributed to geographical source of the sample and the season of sampling. Also according to Frazier and Westhoff (1978), the inherent moisture content of any food affects the shelf life and perishability of food materials. The slight difference between the moisture content of the seeds indicates that cashew nut can be preserved for a longer time than fluted pumpkin seeds. The crude protein content of fluted pumpkin seed (28.88%) is slightly higher than the crude protein content of cashew (24.00%). The crude protein content of the two seeds are not significantly different from each other and are comparable to the values of 28.10%, 29.60% and 28.80% reported by Giami and Bekebain (1992) for raw, geminated and fermented fluted pumpkin seeds and to the value of 21.20% reported by Fetuga *et al*. (1974) for cashew nuts. However, these values are lower than the values reported by Achinewhu (1998) for fermented (4 7.85%) and unfermented (47.57%) fluted pumpkin seeds. The difference might have been caused by the analytical techniques or the species of fluted pumpkin seed used for the respective study. The values are also comparable to the range of values 22-28% reported by Oyenuga (1968) for some edible seed. In recent times, much emphasis on nutrition has been placed on protein and protein energy (FAO, 1996), because protein is the food nutrient needed by the body for growth, provision of energy for other biological roles. (Eneobong, 2001). Proteins are also needed in the transportation of gas, organ component and water and in metabolic regulation (Eddy and Udoh, 2005). For a Nigerian reference man and woman, the estimated protein requirement is given as 65g per day. The energy value

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of most foods can be estimated from their content of protein, fat and carbohydrate by multiplying the constituents by a factor of 9, 4 and 4 respectively. This implies that the physiological fuel value of fluted pumpkin seeds and cashew nut are 115.52 KCal and 98 KCal respectively. It can be deduced from the above that the seeds of fluted pumpkin and cashew nut are good sources of protein when compared with other edible seeds.

The ash content of fluted pumpkin seeds (5.20%) was higher than the ash content of cashew nut (3.60%) and there was a significant difference ($P<0.05$) between the ash content of the two seeds. Fetuga *et al*. (1974) reported the ash content cashew nut to be 3.30% while FAO (1968) reported the ash content of cashew nut to be 2.4% respectively. This value compares favourably with the value (3.60%) obtained in this study. Also Sallau *et al*. (2004) reported ash content of fluted pumpkin seed to be 4.78%, this is also comparable to the value obtained for fluted pumpkin seed in this study. The values obtained for the ash content of fluted pumpkin seed and cashew nuts are higher than the range of values (1.2% - 2.86%) obtained for some seeds (Oyenuga, 1968).

There was no significant difference ($P \geq 0.05$) between the crude fibre content of fluted pumpkin seed (3.45%) and cashew nut (2.40%), implying that the crude fibre content of both seeds are comparable. The crude fibre content of fluted pumpkin seed is higher than the crude fibre value (1.80%) earlier reported by Akwaowo *et al*. (2000) for fluted pumpkin seed. Longe *et* al. (1983) reported that fluted pumpkin seed contains 3.0% crude fibre. These variations could be due to both varietal and environmental differences. Crude fibre influences the digestion of food by providing the necessary roughage (Davidson *et al*.1975). The values of crude fibre content of fluted pumpkin seed and cashew nut were within the range of values (1.40 -13.66%) reported by Oyenuga (1968), Eka (1980) and Giami and Bekebain (1992) for fluted pumpkin and some edible seeds. The low content of dietary fibre in these seeds may be due to high lipid, protein, carbohydrate and ash content of these seeds. Eddy and Udo (2005) have stated that dietary fibres are the portions of plant food that cannot be digested by human alimentary enzymes and that dietary fibre helps to soften bulky stools and play a major role in protection against colon and rectal cancer. These seeds are therefore excellent sources of nutrition for growing children because they do not need excessive intake of dietary fibre (Eneobong, 2001)).

The lipid content of fluted pumpkin seed (58.41%) was higher than the lipid content of cashew nut (42.15%). Longe *et al*. (1983) and Akwaowo *et al.* (2000) have documented that fluted pumpkin seeds contain 53.0% and 56.24% lipid respectively. The high lipid content of fluted pumpkin seed in this work (58.41%) closely agrees with those reported by these earlier workers. Achinewhu (1968) documented the lipid content of cashew nut as 48.0% while Fetuga *et* al. (1974) reported the lipid content of cashew nut as 48.1%. These values are slightly higher than the value obtained in this study (42.15%), the difference may be due to species related factors or seasonal differences. The values obtained for the lipid context of both seeds are comparable to the range of values (42.10 -70.0%) reported for some oil bearing seeds (Jameison, 1953). The high protein and lipid contents of these seeds have confirmed earlier reports that these seeds are potentially very good sources of protein and lipids (Akwaowo *et al*., 2000, Sallau *et al.*, 2004). The physiological fuel value that can be obtained from consumption of 1g lipid is 9 KCal implying that the consumption of 100g of cashew nut will liberate 42.15x 9= 379.35 KCal while 100g of fluted pumpkin seed will liberate 58.41x 9 = 525. 69 KCal of energy. The recommended daily intake of lipid is 80 -100g and out of this value, plant lipids containing unsaturated fatty acids should not be less than 20-25g per day (Stoed, 1989). Therefore, both seeds are excellent sources of lipids.

The carbohydrate content of fluted pumpkin seeds (4.06%) was lower than the carbohydrate content of cashew nuts (27.85%). There was a significant difference between the carbohydrate content of the two seeds ($P < 0.05$). The value for the carbohydrate content of fluted pumpkin seed obtained in this study is much lower than 16.10% reported by Akwaowo *et al.* (2000) and 23.70% reported by Sallau *et al* (2004) for fluted pumpkin seeds respectively. The difference might be due to geographical location and stage of maturity of the seeds (Eneobong, 2001). The value for carbohydrate content of fluted pumpkin seeds fall within the range of values 3.50 – 14.10% reported for some oil bearing seeds (Eneobong, 2001) while the carbohydrate content of cashew nuts is higher than that of the seeds and is comparable to the value reported for cashew nut 27.80% (Fetuga *et al*., 1974). The nutritional role of carbohydrate has been extensively studied and reviewed (Oke, 1965; Ihekoronye and Ngoddy, 1985; Lee, 1983). It therefore follows that the energy which can be liberated by the combustion of 100g of cashew nut (27.85 x 4=111.40 KCal) will be greater than the energy liberated by combustion 100g of fluted pumpkin seed (4.06 x 4 = 16.24 Kcal), this may reduce the value of fluted pumpkin seed as a source of carbohydrate since carbohydrate is required for proper metabolism of fats. Therefore, foodstuff rich in carbohydrate should be consumed along with fluted pumpkin seed to avert ketosis.

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The caloric value for fluted pumpkin seed (657.45 Kcal/100g) was higher than the value obtained for cashew nut (583. 75 Kcal100g) probably due to the high lipid content of fluted pumpkin seed. The caloric value of most foods can be estimate by multiplying its content of carbohydrate protein and lipid by factors of 4.4 and 9 respectively (James, 1984 and Lee, 1984). Sallau *et al.* (2004) also reported that the contribution to the total caloric value by any food materials by each of protein, lipid and carbohydrate depends on the quantity of each of these nutrients present in the analytic material. The caloric values of the seeds are high, therefore when the seeds are consumed in high enough quantities, they can meet the recommended daily caloric allowance for an adult (FAO/WHO, 1972).

Table 2: Mineral element composition of fluted pumpkin seeds and cashew nuts (mg/100g)

Elements	Fluted pumpkin seeds	Cashew nuts
Magnesium	11.94 ± 0.08	12.15 ± 0.13
Iron	0.33 ± 0.05	0.36 ± 0.04
Calcium	135.40± 1.06	149.25 ± 0.64
Zinc	1.75 ± 0.03	3.36 ± 0.04
Sodium	1.48 ± 0.01	1.43 ± 0.02
Potassium	57.30 ± 0.29	47.78 ± 0.62
Manganese	<0.002	0.59 ± 0.61
Phosphorus	73.50 ± 2.37	58.90 ± 0.22

* Mean of three determinations ± Standard Deviation

The magnesium content of fluted pumpkin seed (11.94mg /100g) was comparable with magnesium content of cashew nut (12.15mg /100g). The magnesium content of fluted pumpkin was higher than the value reported for fluted pumpkin seed by Akwaowo *et.al*., 2000. The concentrations of magnesium in the two seed samples were lower than the range of values (183.50 - 530 mg/100g) reported for some edible seeds. (Oke, 1965; Fetuga *et al.*, 1974). The nutritional roles of magnesium have been associated with conduction of nerve impulse, retention of calcium in teeth and adjustment of the body to cold environment (Onimawo and Egbekun, 1998). Magnesium is also needed for the normal functioning of the nervous system and plays part in bone formation.

The concentration of Iron in fluted pumpkin seed (0.33mg /100g) was comparable to the concentration of iron in cashew nut (0.36mg /100g). The values are low when compared with the range of values reported for some seeds (38.0-89.60 mg /100g) by Oyenuga and Fetuga (1975) and are also lower than the value reported for fluted pumpkin seed (9.82mg/100g) by Akwaowo *et al.* (2000). Iron is an essential element required by the body for numerous biochemical processes such as formation of haemoglobin, myoglobin and haemenzymes such as cytochromes and for the release of energy, (Lee, 1984). The dietary allowance for iron is 10mg for a 70kg man (NRC 1989), therefore the two seed samples are not very good sources of iron and should be consumed with Iron-rich foodstuff.

The calcium content of fluted pumpkin seeds (135.40mg) was lower than the calcium levels in cashew nut (149.25mg), however there was no significant difference between the calcium content of both seeds (P>0.05). The values are higher when compared with the value (80.90mg/100g) reported for fluted pumpkin seed by Akwaowo *et al*.,2000) and with the range of values (FAO, 1968). But are relatively within the range (180-816mg /100g) reported for some edible seeds (Oyenuga, 1968) the calcium values of these seeds indicate that the seeds are good sources of calcium. The recommended daily allowances for calcium ranges from 500-1,200mg (FAO/WHO, 1976). The availability of calcium to consumers may be affected by many anti nutritional factors such as oxalic acid and phytic acid, which form insoluble salts with calcium (Eddy *et al*., 2004). Calcium functions in the formation of skeleton, regulation of muscle contraction, nerve instability and activation of some enzymes.

The concentration of zinc in cashew nuts (3.36mg/100g) was higher than the concentration of zinc in fluted pumpkin seeds (1.75mg/100g). The values are comparable to results obtained by Akwaowo *et al*. (2000) for fluted pumpkin seeds (2.40mg/100g) and are also comparable to the range of values (0.4-6.40mg/100g) reported for some seeds (Olaofe *et al*., 1987; Dashack and Fali, 1993). The recommended daily zinc intake for infants is 3-5mg and 10-13mg for adults (NRC, 1974) while FAO (1980) recommended 22mg for a moderately active adult. Zinc functions as component of metallic enzymes and in metabolism of nucleic acids.

The levels of sodium (1.48mg/100g) in fluted pumpkin seed and cashew nuts (1.43mg/100g) showed no significant difference (P>0.05) These values are comparable to values reported for some edible seeds (1.52 -1.96mg /100g) by Food Basket Foundation (1995) and lower than values (140.0-145.mg/100g) reported for some edible seeds (Oyenuga and Fetuga, 1975). The nutritional roles of sodium have been

overemphasized. Studies have shown that these roles include the maintenance of electrolyte balance in the body, the regulation of pH osmotic pressure and water balance, the transmission of nerve impulse, the transportation of glucose and amino acids in the body systems. The recommended daily intake of sodium is given as 3 - 5g (NRC, 1974). The dietary allowance for sodium is 110 – 330 mg/100g for adults (NRC, 1989), therefore these seeds are not good sources of sodium.

The concentration of potassium in fluted pumpkin seeds (57.30mg/100g) was higher than the concentration of potassium in cashew nuts (47.78mg /100g). The values are lower when compared with the range of values (540-670mg/ 100g) reported for some oil bearing edible seeds (Oke, 1965). The nutritional role of potassium is similar to sodium. Potassium is useful in regulation of osmotic pressure and acid – base balance, activation of intracellular enzymes such as pyruvate phosphokinase and regulation of nerve and muscle instability. The seed samples are not very good with respect to potassium.

The levels of manganese in fluted pumpkin seeds (< .002mg) was insignificant and lower than the level in cashew nuts (0.61mg) and the manganese levels in the two seed samples are comparable. The values are comparable to the negligible values reported by Fetuga *et al*. 1974) and Oyenuga (1968) for some oil bearing seeds. Oke (1968) also reported negligible levels of manganese in oil producing and edible seeds.

The phosphorus level in fluted pumpkin seed (73.50mg) was higher than the level in cashew nut (58.90mg) respectively. These values are low when compared with values reported for some oil-bearing seeds (FAO, 1968). The dietary allowance for phosphorus is 800mg per day for an adult and 240 - 400mg/100g for infants and children (Eneobong, 2001). Phosphorus functions in the formation of bones and teeth, as constituent of high energy compounds, nucleo-proteins, phospholipids, enzyme systems and buffer salts. Both fluted pumpkin seeds and cashew nuts are therefore, low in phosphorus content and should be consumed with other seeds rich in phosphorus.

Table 3: Vitamin composition of fluted pumpkin seeds and cashew nuts (mg/100g)

Vitamins	Fluted pumpkin seeds	Cashew nuts
Vitamin A	1.86 ± 0.11	6.76 ± 0.16
Vitamin C	2.12 ± 0.85	156.78 ± 0.17

* Mean of three determinations ± Standard Deviation

The vitamin A level in fluted pumpkin seeds (1.86 mg/100g) was lower than the vitamin A level in cashew nuts (6.76mg/100g). Ihekoronye and Ngoddy (1985) have reported that the vitamin A levels in some vegetables and seeds range from 40 – 11000mg/100g. Umoh, (1998) stated that vitamin A is present in the form of carotenes in foods. According to Ogundahunsi (2004), the nutritional role of vitamin A to include adoption to dim light, promotion of growth, prevention of keratinaton of the skin and eye, promotion of resistance to bacterial infection and necessary in the normal development of bone and teeth. It plays an important role in dark adaptation where it is required for the formation of retinal pigment, rhodopsin. In terms of international units, the daily intake of 500 iu in pregnant and lactating mothers and 75,000 iu in growing children is recommended, (NRC, 1974). The low levels of vitamin A in these seeds may have resulted from loses during drying and processing since loss of vitamin A and carotene may occur at very high temperatures and vitamin A is also labile to light. Vitamin A may also be oxidized on exposure to oxidizing agents and rancidity may also occur. The seeds are not very rich sources of Vitamin A.

The levels of vitamin C in cashew nut (156.78mg) was higher than the level in fluted pumpkin seeds (2.12mg/100g), however there was a significant difference between the vitamin C content of both seed samples ($P < 0.5$).

The vitamin C levels in cashew nuts is comparable with the range of values (10 – 250mg) reported for some seeds and vegetables by Ihekoronye and Ngoddy (1985) implying that cashew nut is an excellent source of vitamin C. According to Ndubisi (2004), vitamin C is needed for the formation of collagen, formation of calcium in bones and teeth, increased elasticity and strength of capillaries and in the formation red blood cells (erythrocytes). Vitamin C is essential for the conversion of folic acid to tetrahydro folic acid hence given in the treatment of haemorrhage resulting from scurvy; also vitamin C has been used in treatment of common cold. The recommended daily requirement of vitamin C for infants and children is 30 – 40mg, 60mg, in pregnancy and 80mg in lactation (NRC, 1974). Cashew nut should therefore be consumed as a source of vitamin C.

Conclusion

The results obtained from the studies have indicated that both fluted pumpkin seed and cashew nut are regarded as valuable oil-bearing seeds due to their high crude fat content. The proximate composition shows that fluted pumpkin seeds and cashew nuts are also rich in crude protein, lipid, and ash and high in

caloric values. The elemental composition of both seeds shows that the seeds are rich in magnesium, calcium, potassium, and phosphorus but low in manganese, sodium, iron, and zinc. When eaten in sufficient quantities, the seeds can supply the recommended daily requirements of these elements and could serve as good sources of energy.
These seeds are rich in oil contents and are so classified as oil bearing seeds. The oil obtained from these seeds may serve several nutritional and industrial purposes.

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