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Nutrient, Anti-nutrient and Phytochemical Composition of Garlic (*Allium sativum*), Alligator Pepper (*Aframomum melegueta*), Kola nut (*Cola nitida*) and Pepper fruit (*Dennettia tripetala*)

ONYENEKE, E.N

Department of Nutrition and Dietetics,
Faculty of Health Sciences,
Imo State University, Owerri, Nigeria
Contact;estyninika@gmail.com

ABSTRACT
The proximate composition, mineral, vitamin contents, anti-nutrients and phyto-chemicals screening of kola nut and three other local spices (alligator pepper, pepper fruit, and garlic) were carried out in order to obtain their nutritional and anti- nutritional benefits to mankind. The four samples were sorted out, processed and dried at 70°c before the phyto-chemical screening, and other analysis were carried out on them. A significant difference ($p<0.05$) was observed in the chemical composition of each material (both raw and dry milled) after drying process was carried out on them at 70°c. The highest value of crude protein was recorded in garlic (raw) at 8.95% while kola nut had the least protein at 1.56% (raw). The highest amount of crude fat (ether extract) was found in pepper fruit at 5.71% (dry milled). There was a difference in the composition of each sample when comparing the raw and dry milled, either an increase or a decrease in the composition of the sample was noticed.
Keywords; Nutrients, anti-nutrients, phytochemicals, dry milled.

INTRODUCTION
Plants are important in our everyday existence. They provide our food; produce the air we breathe, and serve as raw materials for many industrial products such as clothes, footwear's and so many others. Plants also provide raw materials for our buildings and in the manufacture of bio fuels, dyes, perfumes, pesticides and drugs. The use of plants in traditional medical practice has a long drawn history, and remains the mainstay of primary health care in most of the third world. Traditional medicines are used by about 60% of the world population; in both developing and developed countries where modern medicines are predominantly used (Mythilypriya *et al*.,2007).While an estimated 60-80% Africa's population depends solely on herbal remedies for its primary health care needs. In diversity, plants are thought to be between 25,000-400,000 species spread across all continents from the Antarctic to the Arctic. They thrive in all environments from the flooded plains to the deserts, and from those who live on the seas and oceans to others that thrive on fresh water and ponds. For classification and easy identification plants were divided into different taxonomical groups known as kingdoms; these are further streamlined into phylum, class, order, family, genus and species. The fruits include pepper fruit (*Dennettia tripetala*), garlic (*Allium sativum*), alligator pepper (*Aframomum melegueta*), and kola nut (*Cola nitida*). The result of this study will aid in appreciating the acclaimed medical and nutritional properties of this fruits and also and their age long usage by people.
Pepper fruit (*Dennettia tripetala*) is a tree of the rain forest and occasionally in the savannas; it grows to 18m high by 60cm girth, of limited distribution in Ivory Coast, South Nigeria and West Cameroons. The wood is white, soft and not durable and is susceptible to termites; bark is fibrous and strongly scented. The young leaves are chewed on account of their pungent spicy taste (Aiyelola and Bello, 2006; Ndukwu and Nwadibia, 2006; Oyemitan *et al*., 2006). The fruits, green at first then turning red, ripen in April and May, have a peppery spicy taste and are chewed for this property.

Dennettia tripetala fruit serve as mild stimulant to the consumer (Aiyelola and Bello,2006; Ndukwu and Nwadibia,2006; Oyemitan *et al*., 2006).The fruits and leaves are used as seasonings which are added to prepared foods such as meat, soup, sausages and even zobo drinks and in some local dishes and vegetables (Ejechi and Akpomedaye,2005*). D.tripetala* plant yields a good fuel wood (Abbiw, 1990 and Duguma *et al*., 1990)

Allium sativum, commonly known as garlic, is a species in the onion genus. Its close relatives include the onion, shallot, leek, chive, and rakkyo. With a history of human use of over 7,000 years, garlic is native to central Asia and has long been staple in the Mediterranean region, as well as a frequent seasoning in Asia, Africa and Europe. It was known to ancient Egyptians, and has been used for both culinary and medicinal purposes. *A.sativum* is a bulbous plant; it grows up to 1.2m (4ft) in height. It produces hermaphrodite flowers. Pollination occurs by bees and other insects. According to Zohany and Hopf (2001), 'A difficulty in the identification of its wild progenitor is the sterility of the cultivars', thought to be descended from the species *Allium longicupus*, which grows wild in central and south-western Asia. *Allium sativum* grows in the wild areas where it has become naturalized. Garlic is widely used around the world for its pungent flavour as a seasoning or condiment.

The kola nut is the fruit of the kola tree, a genus (cola) of trees that are native to the tropical rainforest of Africa.

The caffeine-containing fruit is used as a flavouring ingredient in beverages, and is the origin of the term cola (Arogba , 1999).According to Oshodi (2006), kola nut is a caffeine-containing fruit of evergreen trees of the genus 'cola', primarily, the species *Cola acuminata* and *Cola nitida*. *Cola acuminata* is a tree of about 20metres in height, and has long, ovoid leaves pointed at both the ends with a leathery texture.

The trees have yellow flowers with purple spots, and star shaped fruit. Inside the fruit, about a dozen round or square seeds can be found in a white seed shell. The nuts aroma is sweet and rose-like. The first taste is bitter but sweetens upon chewing. The nut can be boiled to extract the cola. This tree reaches 25metres in height and is propagated through seeds.

MATERIALS AND METHODS

Materials collection

Fresh fruits were obtained from a farm in Ofeiyi village, Isiala Mbano in Imo state. The proximate compositions of the samples were determined in triplicate and their average values recorded.

Preparation of powdered samples of fruits

Five hundred (500g) grams of fresh garlic, pepper fruit, alligator pepper and bitter kola were cleaned to remove foreign particles (such as stone e.t.c). The samples were then subjected to drying process using oven-drying at 70°c to obtain moisture ranges between 10-12%. The dried fruits were milled into powder using manual grinding machine (model crown). The powder was then further sieved using a 0.45µm sieve aperture. The fine particles obtained from each fruit was packaged using poly ethylene bag for further analysis.

Proximate composition determinations

According to the method described by Pearson (2000), the proximate composition which comprises crude protein, crude fibre, carbohydrate, fat, ash and moisture content were determined.

Crude protein contents of fruits

According to methods described by A.O.A.C (2000), a 2.0g of each sample were weighed and put in a 250ml kjeldahl digestion flask containing boiling chips. Copper sulphate and sodium sulphate (mixed together with a spatula) were added to raise the boiling temperature. Also 20ml concentrated tetraoxosulphate VI acid was added. The mixture were placed in a fume cupboard and heated until a clear solution was obtained. It was then cooled at room temperature and made up to 100ml in a volumetric flask containing 20ml of 2% boric acid solution and 2drops of methyl red indicator was put in the receiving flask under the condenser.35ml of 4% caustic soda solution was added to the distillation flask and the plug was quickly replaced. Distillation of the mixtures was carried out on the blank and the distillates collected were titrated against 0.04N of hydrochloric acid, hence the nitrogen and protein content determined.

% protein= % N+ 6.25
Note that %N = 0.196 X 100X 100
Where x is the titre value

Crude fibre contents of selected fruits

Methods described by A.O.A.C (2000) were used. Each sample was digested with tetraoxosulphate acid and caustic soda, prior to incinerating in a muffle furnace at 550°c for 5hrs. The loss in weight during incineration was equivalent to the amount of crude fibre.

% crude fibre = wtA – (wtB) × 100/ sample wt.
Where wtA = weight of sample after drying
WtB = weight of sample after ashing.

Moisture/Ash content of selected fruits

Weight difference method of A.O.A.C (2000) was used, 2g of each sample were weighed into an aluminium moisture can and placed in a hot-air electric oven, then dried at 105°c for 3hrs.The samples were cooled in a dessicator after which it was weighed and put back in the oven for further drying.

The process of drying, cooling and reweighing was repeatedly carried out until a constant weight was obtained.

% moisture content = w2 – w3/w2 – w1 × 100.
Where w1 = weight of empty can
W2 = weight of can _ sample before drying
W3 = weight of can + sample at constant weight.

After reweighing, the samples were incinerated with reduced temperature of 200°c at which the samples were carefully placed in a dessicator to cool further. Then at room temperature, the samples were reweighed.

% Ash = weight difference / original sample weight × 100.

Fat contents of selected fruits

Standard method of the A.O.A.C (2000) was used. Crude fat was determined by exhaustively extracting 5.0g of sample in a soxhlet apparatus using petroleum ether (boiling point range 0f 40-60°c) as the extractant.

Carbohydrate contents of selected fruits

Total carbohydrate was determined by difference method according to A.O.A.C (2000).
Carbohydrate = (100-(%protein+%fat+%ash+%fibre)).

Determination of minerals

The method described by Onwuka (2005) was used in the determination of mineral content. Half gram (0.5g) of the dried milled samples were weighed into a pre- acid rinsed digest tube.1 10cm³ of 6M HCl was added and heated to dryness in a water bath. The residue was dissolved in a mixture of 10cm³ of 6M HNO acid, warmed on a water bath and filtered using a Whatman filter paper into 100cm³ calibrated flasks. The filter paper was washed with distilled water and the filtrate diluted with the distilled water and made up to the 100cm³ marks. The digest was for the determination of calcium and potassium by the flame photometry method.

Sodium (Na) and Potassium (k) contents of selected fruits

Sodium and Potassium were determined by flame photometry. The standard solutions were prepared separately and diluted to contain in series 10,8,6,4, and 2 ppm of each of the test mineral element (Na and K) respectively.

The air and gas inlets were opened and the self ignition knob was pressed to obtain the flame. The flame was adjusted to a blue colour; the appropriate filler was selected and put in a plate after flushing the system, the standards of the elements were aspired into the instrument and sprayed over the flame.

Their respective optical densities were recorded and the reading of the standard reference curve which were used to extrapolate the respective mineral content.

Na and K content (mg/long sample) = 100/10 × X/10³ × Ve/Vc × D.
Where W= weight of sample
X=concentrated of Na derived from concentration in ppm (parts per million).
Ve= total extract volume.

D=dilution factor where applicable.

Calcium (Ca) contents of selected fruits

Calcium ion contents which were contained in the extract were determined by verante EDT complexiometric titration (Pearson and James, 2000). A measured aligust 20mls was dispensed in a separate conical flask of the masking agent (Potassium Terroc anide) was added in to the content of each flask shaken to dissolve, 20mls of ammonia buffer was added to one of the flask to raise the pH to 12.0 (point where calcium alone forms complex with EDTA).

To the flask at pH 10.0 (ca) Ericrome back T indicator was added to the mixture, titrated against 0.02N EDTA solution, titration was done until the colour changed from purple to a deep blue end point, the reagent black was also titrated as a control selechrome. Dark blue (an indicator) was added to the other flask at pH 12.2 and titrated against 0.2N EDTA solution until the same colour change was observed. The element was calculated as shown above:

$$Emg/100g - \frac{(100 \times Vf \times N)}{W \times Va} T\text{- }Bik$$

Where Emg = equivalent weight of the test sample

w= weight of sample 5.0g (100ml)

Vf= total digest volume (100ml)

n = NORMALITY OF EDTA titrant (0.02N)

T = sample titre

BIK = Blank filter

Iron content of selected fruits

The determination of iron will be according to Onwuka (2005). 2g of each sample were digested with 20ml of acid solution and 650ml concentrated HNO_3, 80ml perchloric acid (PCA). The solution was heated, the digest was diluted with distilled water 100ml marked for atomic absorption spectrophometer reading. A standard solution of iron was prepared and was used to the calibration concentration.

Iron calculation

$$Fe\ (Mg)\ 100g = \frac{Vf \times X \times 100 \times D}{Va \times 108 \times 10}$$

D = dilution

X= concentration

Vf =total volume of extract

Va = volume of extract used

Determination of vitamins (Ascorbic acid)

Vitamin C was determined using the method described Iheko and Deha, (2003). 5grams of the samples were first homogenized using acetone solution; the solution was filtered after crushing. The filtrate was extracted by petroleum spirit using separating funnel. The absorbance of the solution will be determined using spectrophotometer at wave length of 480mm. Vitamin C content of the samples will be determined by the Baraket titrimetric method.

Thiamine (Vitamin B1) content of selected fruits

5g of the samples were homogenized with ethanolic sodium hydroxide (50ml), it was then filtered into a 100ml flask, 10ml of the filterate was pipetted and the colour (orange, red) changes and read at 420nm wavelength. A standard solution was prepared using thiamic acid to get 100ppp and several dilutions of 0.0, 0.2, 0.6 and 0.8pp were made and used to plot the calibration curve.

Determination of phyto-chemicals and Anti-nutrients

This was done by the alkaline precipitation gravimetric method described by Harborne, (1973).

Flavonoid content of selected fruits

This was determined according to the method of Harborne, (1973). 5gram of the sample was boiled in 50ml of 2M HCl solution for 30mins under reflux. It was allowed to cool and then filtered through Whatman No 42 filter paper. A measured volume of the extract was treated with equal of ethyl acetate starting with drop. The flavonoid precipitated was recovered by filtration using weighed filter paper. The resulting weight difference gave the weight of flavonoid in the sample.

Tannin content of selected fruits

The method of Swain, (1979) was used for the determination of tannin contents of each sample. 0.2g of finely ground sample was measured into a 50ml beaker. 20ml of 50% methanol was added and covered with paraffin and placed in a water bath at 77-80°c for 1hr and stirred with a glass rod to prevent lumping. The extract was quantitatively filtered using a double layered Whatman No. 1 filter paper into a 100ml volumetric flask using 50% methanol to rinse. This was made up to mark with distilled water and thoroughly mixed. 1ml of sample extract was pipette into 50ml volumetric flask, 20ml distilled water, 2.5ml Folin-Denis reagent and 10ml of 17% NA2CO3 were added and mixed properly. The mixture was made up to mark with distilled water, mixed well and allowed to stand for 20mins when a bluish-green colouration developed. Standard Tannic Acid solutions of range 0-10 ppm were treated similarly as 1ml of sample above. The absorbencies of the Tannic Acid Standard solutions as well as samples were read after colour development on a spetronic 21D spectrophotometer at a wavelength of 760nm.

Percentage tannin was calculated using the formula:

$$\text{Tannin (\%)} = \frac{\text{Absorbance of sample} \times \text{Dilation factor}}{\text{Weight of sample} \times 10{,}000}$$

Phytate content of selected fruits

Phytic acid (inositol hexaphosphoric acid) forms insoluble salts with essential minerals like calcium, iron, magnesium and zinc in them unavailable for absorption into the blood stream (Bingham, *et al., 2001)* have shown that about half the phytic acid phosphorus content taken by man is excreted unchanged, thus remaining unavailable for utilization. The knowledge of phytate content can be made use of in calculating the quantity of phosphorus available out of the total phosphorus in a diet. Phytic acid and its hydrolysis products are associated with inhibition of calcification in rats (Robert and Yudkin, 2000).

Saponin content of selected fruits

The spectrophotometer method of Brunner (1984) was used for saponin analysis. 1g of finely ground sample was weighed into a 250ml beaker and 100ml isobutyl alcohol was added. The mixture was shaken on a UDY shaker for 5h to ensure uniform mixing. Thereafter, the mixture was filtered through a Whatman No. 1 filter paper into a 100ml beaker and 20ml of 40% saturated solution of magnesium carbonate added. The mixture obtained with saturated $MgCO_3$ was again filtered through a Whatman No.1 filter paper to obtain a clear colourless solution. 1ml of the colourless solution was pipette into 50ml volumetric flask and 2 ml of 5% $FeCl_3$ solution was added and made up to mark with distilled water. It was allowed to stand for 30mins for blood red colour to develop. 0-10ppm standard saponin solutions were prepared from saponin stock solution. The standard solutions were treated similarly with 2ml of 5% FeCl solution as done for 1ml 3 above. The absorbances of the sample as well as standard saponin solution were read after colour development.21D Spectrophotometer at a wavelength of 380nm.

Percentage saponin was calculated using the formula:

$$\text{Saponin (\%)} = \frac{\text{absorbance of sample} \times \text{Average gradient} \times \text{Dilution Factor}}{\text{Weight of sample} \times 10{,}000}$$

Alkaloid content of selected fruits

This was done by the alkaline precipitation gravimetric method described by Harborne, (1973). A measured weight of the samples was dispersed in 1% acetic acid solution in ethanol to form a ratio of 1:10.

Statistical Analysis

The data obtained from different analyses were subjected to statistical analysis which include: Analysis of variance (ANOVA), Multiple comparison test (Turkey and Duncan Test), Descriptive mean using the SPSS version 20 (American standard).

RESULTS AND DISCUSSIONS

Table 1: Proximate composition of kola nut and three other local spices (alligator pepper, pepper fruit and garlic)

Sample	Moisture %	Crude Protein %	Ether extract %(fat)	Ash	Fibre	Carbohydrate
KN- R	$24.23^{a}\pm0.04$	$1.56^{h}\pm0.03$	$1.43^{f}\pm0.02$	$1.19^{g}\pm0.005$	$4.20^{f}\pm0.017$	$67.39^{e}\pm0.05$
KN-D	$6.10^{g}\pm0.017$	$1.70^{g}\pm0.02$	$1.25^{g}\pm0.03$	$1.28^{g}\pm0.01$	$4.87^{e}\pm0.01$	$84.86^{a}\pm0.06$
GL- R	$20.39^{d}\pm0.02$	$8.95^{a}\pm0.01$	$1.69^{e}\pm0.02$	$4.40^{b}\pm0.04$	$2.24^{h}\pm0.01$	$62.35^{g}\pm0.1$
GL-D	$8.40^{e}\pm0.017$	$8.10^{b}\pm0.005$	$1.12^{h}\pm0.003$	$4.96^{a}\pm0.08$	$2.61^{g}\pm0.02$	$74.80^{c}\pm0.1$
AG-R	$16.11^{d}\pm0.02$	$5.91^{d}\pm0.04$	$2.36^{c}\pm0.03$	$3.11^{a}\pm0.02$	$6.11^{d}\pm0.02$	$66.39^{f}\pm0.03$
AG-D	$5.81^{h}\pm0.01$	$6.42^{c}\pm0.02$	$2.21^{d}\pm0.02$	$3.55^{d}\pm0.005$	$6.72^{c}\pm0.03$	$75.30^{b}\pm0.01$
PPF-R	$20.07^{c}\pm0.03$	$3.43^{e}\pm0.03$	$6.10^{a}\pm0.01$	$3.31^{e}\pm0.02$	$8.62^{b}\pm0.01$	$58.46^{h}\pm0.03$
PPF-D	$7.27^{f}\pm0.01$	$3.16^{f}\pm0.05$	$5.71^{b}\pm0.01$	$3.77^{c}\pm0.02$	$9.31^{a}\pm0.03$	$70.78^{d}\pm0.1$
LSD	0.02021	0.02528	0.02128	0.03043	0.01856	0.06053

± = standard deviation,

Mean score with different letters along the column are significantly different ($P<0.05$)

KN- R - Kola-nut (Raw)
KN-D - Kola-nut (Dry Milled)
GL- R – Garlic (Raw)
GL-D – Garlic (Dry Milled)
AG-R – Alligator Pepper (Raw)
AG-D – Alligator Pepper (Dry Milled)
PPF-R – Pepper fruit (Raw)
PPF-D – Pepper fruit (Dry Milled)
LSD –least significant different

The result in Table 1 showed the proximate composition of kola nut and three local spices subjected to drying and milling processes. There was significant difference ($p<0.05$) on the properties of the samples examined. In each type of samples under investigation, the values discovered from the raw samples differed when compared to dried powder obtained from the same material. The moisture content of raw kola nut recorded 24.23% and was the highest value, followed by garlic (20.39%) raw sample and 16.11% was found in raw alligator pepper. These values were reduced significantly to 6.10% (dry milled kola nut), 8.40% (dry milled garlic) and 5.81% (dry milled alligator pepper). The variation observed in raw and dried samples of each material showed the effect of drying process on the composition of the materials. Higher moisture content of the raw materials under investigation is an index of spoilage and short shelf-life (Dewole *et al*., 2013). The low moisture content discovered in dry milled samples was an advantage in the keeping quality of materials during off- season. The crude protein content was varied comparing the raw and dried materials together. Garlic recorded the highest value of crude protein; the value was actually reduced from 8.95% (raw) to 8.10% dry milled sample. The changes observed could be as a result of the effect of drying which might have caused slight loss due to denaturation. However, garlic has played an important dietary as well as medicinal role in human history (Lawson, 1998). Alligator pepper changed protein content from 5.19% (raw) to 6.42% dried sample. In this material (garlic), the drying process caused an increase in protein content due to moisture removal. The effect of protein denaturation depends on the degree of heat treatment (temperature) and extent of exposure (time) to heat energy generated during drying process. Therefore, 70°c drying temperature used in this work may have mild effect on protein content as observed in alligator pepper. Kola nut had the least value of crude protein, the value increased from 1.56% to 1.70% after drying.

The ether extract (crude fat) varied between raw and dried samples of the same material. The highest ether extract value was contained in pepper fruit (raw sample) which was decreased to 5.71% dry milled sample. Similar observation were discovered in crude fat content of alligator pepper (2.36% (raw) to 2.21% (dry milled)), garlic (1.69% (raw) to 1.12 % (dry milled)), and as well as kola nut (1.43% to1.25% dry milled). The decrease in fat content of the materials discovered could be due to loss during drying. The materials used in this work are known as good sources of dietary fat.

The ash content of food stuff is a measure of dietary mineral elements important in human nutrition (Onyeka, 2008). There was increased concentration of minerals as the moisture was reduced due to drying process. However, the highest ash content was discovered in garlic (4.40% (raw) to 4.96% (dry milled)), followed by 3.31% to 3.77% in pepper fruit. The least value was recorded in kola nut (1.19% (raw) to 1.25% (dry milled)). The indication from this result showed that garlic, alligator pepper, and pepper fruit are better sources of mineral elements unlike kola nut.

The crude fibre of pepper fruit sample was the highest, ranging from 8.62% to 9.31%, the next was 6.11% to 6.72% in alligator pepper. The least fibre content was recorded in garlic with a value ranging from 2.24% to 2.61%. The importance of dietary fibre in human nutrition is enormous. It helps against constipation, watery stool and provides roughages in the body system.

The carbohydrate content of raw and dried sample varied significantly. The highest value of 84.80% was detected in kola nut (raw sample), and the least (58.46%) was discovered in raw pepper fruit. This result does not correspond to that in the work of Odebunmi *et al.,* (2008), maybe due to different methods used in the sample preparation or amount of time and temperature the sample was subjected to before analysis was carried out on it.

4.2 Table 2: Mineral contents and water soluble vitamins of Kola nut and three other local spices (alligator pepper, pepper fruit and garlic)

Sample treatment	Sodium mg/100g	Calcium mg/100g	Potassium mg/100g	Iron mg/100g	Vitamin C mg/100g	Thiamine mg/100g
KN- R	$13.43^{a}\pm0.01$	$6.72^{c}\pm0.02$	$28.13^{e}\pm0.013$	$0.66^{g}\pm0.001$	$17.65^{d}\pm0.02$	$0.182^{c}\pm0.002$
KN-D	$13.09^{b}\pm0.01$	$5.910^{d}\pm0.01$	$29.87^{d}\pm0.01$	$0.071^{g}\pm0.001$	$7.24^{h}\pm0.01$	ND
GL- R	$4.58^{f}\pm0.017$	$27.86^{a}\pm0.5$	$68.94^{c}\pm0.01$	$5.46^{a}\pm0.005$	$87.56^{b}\pm0.02$	$0.282^{b}\pm0.002$
GL-D	$5.56^{d}\pm0.01$	$28.45^{a}\pm0.00$	$68.02^{c}\pm0.02$	$5.10^{b}\pm0.006$	$12.45^{f}\pm0.02$	$0.021^{f}\pm0.001$
AG-R	$0.138^{h}\pm0.001$	$0.18^{e}\pm0.002$	$0.69^{f}\pm0.005$	$1.76^{d}\pm0.02$	$22.05^{c}\pm0.04$	$0.485^{a}\pm0.00$
AG-D	$0.56^{g}\pm0.005$	$0.27^{e}\pm0.001$	$0.71^{f}\pm0.01$	$1.89^{c}\pm0.002$	$8.21^{g}\pm0.01$	$0.124^{d}\pm0.001$
PPF-R	$7.30^{c}\pm0.004$	$23.74^{b}\pm0.03$	$89.25^{b}\pm0.01$	$0.24^{e}\pm0.005$	$138.55^{a}\pm0.02$	$0.081^{e}\pm0.001$
PPF-D	$5.45^{e}\pm0.016$	$23.35^{b}\pm0.17$	$91.45^{a}\pm0.00$	$0.18^{f}\pm0.001$	$15.46^{e}\pm0.01$	ND
LSD	0.00936	0.17815	0.01099	0.00509	0.01765	0.00102

± = standard deviation,

Mean score with different letters along the column are significantly different (P<0.05)

KN- R - Kola-nut (Raw)
KN-D - Kola-nut (Dry Milled)
GL- R – Garlic (Raw)
GL-D – Garlic (Dry Milled)
AG-R – Alligator Pepper (Raw)
AG-D – Alligator Pepper (Dry Milled)
PPF-R – Pepper fruit (Raw)
PPF-D – Pepper fruit (Dry Milled)
LSD –least significant different
ND-Not Detected

The result in Table 2 showed the micro – nutrients (minerals and water soluble vitamins contents of kola nut and three other local spices subjected to drying process at 70°c. The statistical analysis conducted showed that there was significant difference (p< 0.05) on the micro- nutrients investigated on both raw and dry milled samples from different used. Some of the raw materials are good sources of calcium, potassium, iron and sodium while others are poor sources. In addition, effect of drying process also caused changes observed when comparing raw and dry milled sample of same material.

Kola nut contained 13.09- 13.43mg/100g sodium which was the highest value compared to other spices. Pepper fruit raw sample contained 7.30mg/100g sodium and was reduced to 5.45mg/100g sodium after drying process. The least value of sodium recorded was 0.32-0.56mg/100g and was discovered from alligator pepper. This variation in sodium could be attributed to the compositional content of the materials used which varied in both nature and chemical constituents.

However, the lower sodium discovered in garlic and alligator pepper is an advantage over other samples, because sodium has a direct relationship with hypertension in human (Ayoola *et al*., 2011).

In terms of calcium content of the materials under investigation, garlic had the highest value of 28.45mg/100g of dried powder, followed by 23.74mg/100g in pepper fruit and the least value of 0.18mg/100g which was detected in raw alligator pepper sample. The higher calcium content discovered in garlic and pepper fruit indicates their potential as reasonable sources among others. Dietary calcium is an important nutrient in bone formation and development (Onyeka, 2008). Therefore, this spice becomes important when the usefulness of such minerals like calcium, potassium, iron and sodium are required in the body system.

Okwu (2004) stated that iron is a component of haemoglobin which helps in oxygen transport and play very important role in man's metabolism. However, the highest value of 5.10-5.46mg/100g iron was discovered in garlic and 1.76- 1.89mg/100g was found in alligator pepper. Kola nut (raw and dry milled) samples recorded the lowest ranges of 0.066-0.071mg/100g iron. The indication from this result implies that kola nut could be a poor source of iron among the materials under investigation in this work.

The result of water soluble vitamins revealed the presence of vitamin C and thiamine analyzed. Pepper fruit (raw) contained the highest value of 138.55mg/100g of vitamin C which was reduced to 15.46mg/100g after drying and milling process. Similarly, garlic (raw) was reduced from 87.56mg/100g to 12.46mg/100g. Kola nut (raw) had the least value of 17.65mg/100g of vitamin C. The indication from the result clearly showed the richness of vitamin C in pepper fruit. The reduction observed in vitamin C content of the dry milled samples could be due to loss as a result of heat sensitivity (heat labile) of ascorbic acid during drying process (at 70°c). Nutritionally, vitamin C plays an important role in the prevention of and treatment of scurvy, wound healing and support various biochemical processes in the body system.

The thiamine content of the materials was also affected by the drying process. The value of 0.485mg/100g was reduced to 0.124mg/100g in alligator pepper. Also, thiamine content of garlic changed from 0.282mg/100g to 0.021mg/100g. Kola nut and pepper fruit lost thiamine content from 0.182mg/100g and 0.081mg/100g respectively to a non- detectable value after drying process (100% loss). The loss could be attributed to the effect of drying conditions (i.e. temperature and time) used. Generally, the stability of chemical components (micro-nutrients) in food materials depends on a number of factors during handling, sample preparation, processing and storage.(Onyeka, 2008). However, Uhegbu *et al.,* (2011) suggested that critical conditions cannot alter the vitamin composition of kolanut. This difference may be attributed to the differences in methods applied during processing of samples prior to the analysis.

4.3 Table 3: Anti-nutrients and Phyto-chemical content of kola nut and three other local spices

Sample treatment	Saponin %	Flavonoid %	Tannin %	Phytate %	Alkaloid %
KN- R	$6.19^{a}\pm0.02$	$0.183^{g}\pm0.001$	$8.642^{c}\pm0.002$	$0.671^{d}\pm0.001$	$10.263^{a}\pm0.003$
KN-D	$4.43^{b}\pm0.01$	$0.066^{h}\pm0.001$	$5.444^{d}\pm0.004$	$0.321^{e}\pm0.001$	$8.20^{b}\pm0.001$
GL- R	$2.46^{c}\pm0.001$	$13.622^{a}\pm0.002$	$38.451^{a}\pm0.001$	$2.461^{a}\pm0.002$	ND
GL-D	$1.66^{d}\pm0.01$	$8.562^{b}\pm0.001$	$22.322^{b}\pm0.003$	$1.181^{b}\pm0.001$	ND
AG-R	$1.24^{e}\pm0.01$	$7.281^{c}\pm0.001$	$4.280^{e}\pm0.001$	$0.082^{f}\pm0.002$	$0.383^{e}\pm0.003$
AG-D	$0.98^{g}\pm0.002$	$4.192^{d}\pm0.001$	$0.861^{g}\pm0.001$	$0.021^{h}\pm0.001$	$0.028^{f}\pm0.00$
PPF-R	$1.05^{f}\pm0.009$	$3.463^{e}\pm0.002$	$1.321^{f}\pm0.001$	$0.963^{c}\pm0.001$	$1.186^{c}\pm0.001$
PPF-D	$0.43^{h}\pm0.001$	$1.221^{f}\pm0.002$	$0.224^{h}\pm0.001$	$0.051^{g}\pm0.001$	$0.944^{d}\pm0.00$
LSD	0.00910	0.00134	0.00178	0.00121	0.00133

± = standard deviation,

Mean score with different letters along the column are significantly different (P<0.05)

KN- R - Kola-nut (Raw)
KN-D - Kola-nut (Dry Milled)
GL- R – Garlic (Raw)
GL-D – Garlic (Dry Milled)
AG-R – Alligator Pepper (Raw)
AG-D – Alligator Pepper (Dry Milled)
PPF-R – Pepper fruit (Raw)
PPF-D – Pepper fruit (Dry Milled)
LSD –least significant different

ND-Not Detected

Table 3 showed the phyto-chemical composition of kola nut and three local spices dried at 70°c. Significant difference (p<0.05) was discovered in the phyto-chemical constituents of materials studied. There was reduction in values of phyto-chemical properties when comparing the raw and dry milled samples. The changes could have been due to the effect of heat treatment (i.e drying) used. Kola nut contained the highest saponin value of 6.19%, followed by 2.46% in garlic. The least saponin content was discovered in pepper fruit (1.05%). The dry milled kola nut had 4.43% lower compared to the raw sample. Similarly, flavonoid of garlic (raw) was the highest at 13.622% and was reduced to 8.562%. Alligator pepper changed in its flavonoid content from 7.281% to 4.192%. The lowest value of flavonoid (0.066-0.183%) was discovered in kola nut. This result showed the effect of the drying temperature on the properties of phyto-chemicals examined. The tannin content of garlic was the highest at 38.45% and was reduced to 22.32% dry milled sample. The tannin content of kola nut was reduced from 8.6425 to 5.444% after drying process, pepper fruit recorded the lowest tannin content and changed value from 1.321% to 0.224%. Despite the change in the phyto- chemical composition as a result of drying processes, the quantity obtained is still biologically active. Dreosti (2000) stated that phyto- chemicals are biological compounds found in plants in small amounts, which are not established nutrients but contribute significantly to protection against degenerative diseases. The phytate content was equally by drying process. The values obtained from raw samples reduced after drying. However, garlic recorded 2.461mg/100g which was later reduced to 1.181mg/100g. Pepper fruit changed in its phytate content from 0.963mg/100g to 0.051mg/100g dry milled sample. The least phytate content was found in alligator pepper. The variation observed could be the effect from different chemical properties of the raw materials used. Alkaloid was found in kola nut, alligator pepper and pepper fruit only. The alkaloid content varied significantly ($p< 0.05$), Kola nut had the highest value at 10.263% of raw sample, and was reduced to 8.20% after drying. The lowest value was recorded in alligator pepper (0.028%) after drying process. Enemor *et al*., (2014) said that alkaloids are wide and varied in structure and function. Most alkaloids are physiologically and pharmacologically-functionally useful, some have deleterious effects and may cause growth depression in animals. Therefore, the decreased amount discovered as a result of drying process is an advantage nutritionally.

CONCLUSION

The selected samples in this research have showed a great deal of benefits: nutritionally, physiologically and pharmacologically if ingested in adequate amounts. The use of these materials both traditionally and in orthodox medicine cannot be extensively stressed due to their functionalities and the presence of biologically active compounds which help in preventing degenerative diseases.

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