



Full Length Research Paper

## Evaluation of chemical compositions of *Citrulus lanatus* seed and *Cocos nucifera* stem bark

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### Abstract

The seed of *Citrulus lanatus* and *Cocos nucifera* stem bark were analyzed for their phytochemical, proximate, nutrient and anti-nutrient compositions. The results obtained from the analysis of both plants were compared. The result reveals that both plants contain substantial amount of saponins, tannins, flavonoids, terpenoids and phenol. The concentration of alkaloids and steroids present in the *C. lanatus* seed were significantly ( $p < 0.05$ ) higher compared with the level observed in *C. nucifera* stem bark. There was generally low percentage proximate fractions of *C. lanatus* seeds in terms ash and fibre and low percentage fractions of protein, ash, fats and fibre were observed in the *C. nucifera* stem bark. Protein and fats composition of *C. lanatus* seed were observed to be significantly ( $P < 0.05$ ) higher compared with the compositions present in *C. nucifera* stem bark. Iron was the most abundant micro element present ranging from 4.089  $\mu\text{g/g}$  in *C. lanatus* seed to 3.66  $\mu\text{g/g}$  in *C. nucifera* stem bark. This was followed by zinc; the values of magnesium were very traced in both plants. Results of analysis of *C. lanatus* seed and *C. nucifera* stem bark showed that the plants are rich in some vitamins such as vitamin A, E and C which were observed to be abundant while low concentration of vitamin B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> were observed in both plants. The anti-nutrient analysis of *C. lanatus* seed and *C. nucifera* stem bark revealed low level of phytate, oxalate, hemagglutinin and trypsin inhibitor ranging from 0.677 mg/100g to 2.370 mg/100g, 0.082 mg/100 g to 0.97 mg/100 g, 0.549 % to 0.690% and 0.456 mg/100 g to 0.550 mg/100 g respectively. This study has shown that *C. lanatus* seed and *C. nucifera* stem bark are good source of phytochemicals that are biologically important, thus they can be potential sources of useful drugs in the management of some ailments.

**Keywords:** Phytochemicals; Proximate; Nutrients; Anti-nutrients

### INTRODUCTION

Plants and their derivatives play key role in world health and have long been known to possess biological activity. Thirty percent of all modern drugs were derived from plants (Riaz *et al.*, 2010; Omoboyowa *et al.*, 2013). According to the World Health Organization, about 80% of the world's population relies essentially on plants for primary health care (Omoboyowa *et al.*, 2013). There is growing interest in exploiting plants for medicinal purposes especially in Africa (Adeniyi *et al.*, 2012). *Citrulus lanatus* (watermelon) contains significant amount of citrulline and after consumption of several kilograms an

elevated concentration was measured in blood plasma (Mendal *et al.*, 2005). Its single brown seed is high in certain fat and oil (oleic and arachidonic acid) valuable to industry, used in cooking and manufacturing of soap (Collins *et al.*, 2007). Watermelon flesh is rich sources of citrulline, which can be metabolized to arginine. This amino acid is a substrate for the synthesis of nitric oxide and it plays a role in cardiovascular and immune system (Collins *et al.*, 2007). *Cocos nucifera* commonly known as coconut palm is a member of the family arecaceae (palm family). It is found throughout the tropic and subtropical

area, it is known for its great versatility as a result of many uses of its various parts. The seed provides oil for frying, cooking and for making margarine, the coconut water contains sugar, dietary fibre, proteins, antioxidants, vitamins and minerals (Ravi, 2009), medicinally, n-hexane fraction of coconut peel contains novel anticancer compounds, young coconut juice has estrogenic-like characteristics, it can be used as intravenous hydration fluid, the tea from the husk fibre is used to treat severe inflammatory disorder (Sarian, 2010). This present study was design to evaluate the secondary metabolites, proximate, nutrients and anti-nutrient composition of *Citrulus lanatus* seed commonly discarded after consumption of the fruits and *Cocos nucifera* stem bark commonly used in alternative herbal medicine in Nigeria, in a view to highlight their pharmacological roles in traditional medicine.

## MATERIALS AND METHODS

### Plant material

The fresh *Citrulus lanatus* (watermelon) fruits used for this study were purchased from Eke market, Afikpo North Local Government Area of Ebonyi State, Nigeria. The seeds were removed from the pulp with the aid of a sterilized knife, the seeds were cleaned, air dried and carefully ground into a coarse form by the use of a mechanical blender. Coconut palm (*Cocos nucifera*) stem bark used for this study was collected from Ogbu Edda, Afrikpo South Local Government Area of Ebonyi State, Nigeria. It was harvested with a clean cutlass, air dried at room temperature for three (3) weeks, ground with a mechanical blender into coarse form..

### Preparation of fat free sample

Two grams (2 g) of the samples were defatted with 100 ml of diethyl ether using a soxhlet apparatus for 2 hours.

### Phytochemical Analysis

#### Phytochemical analysis

Chemical tests were carried out on the samples for the quantitative determination of phytochemical constituents.

#### Alkaloid determination

The alkaloid content was determined gravimetrically. Five grams of the sample were weighed into a 250 ml beaker and 200 ml of 20% acetic acid in ethanol was added and covered to stand for 4 h. This was filtered and the extract was concentrated using a water-bath to one-quarter of the original volume. Concentrated ammonium hydroxide

was added drop wise to the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitate was collected by filtration using Whatman filter paper No. 4 (125 mm) and weighed (Obadoni and Ochuko, 2001).

#### Saponin determination

Saponin content was determined using the method described by Obadoni and Ochuko, (2001). Twenty grams (20 g) of each ground samples were dispersed in 200 ml of 20% ethanol. The suspension was heated over a hot water bath for 4 h with continuous stirring at about 55°C. The mixture was filtered and the residue re-extracted with another 200 ml of 20% ethanol. The combined extracts were reduced to 40 ml over water bath at about 90°C. The concentrate was transferred into a 250 ml separator funnel and 20 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated. 60 ml of n-butanol was added. The mixture of n-butanol and extracts was washed twice with 10 ml of 5% aqueous sodium chloride. The remaining solution was heated in a water bath at about 90°C. The samples were dried in an oven at 100°C until a constant weight was obtained. The saponin content was calculated in percentage (Obadoni and Ochuko, 2001).

#### Tannin determination

Tannin content was determined going by the method described by Van-Burden and Robinson (1981). Five hundred milligrams of the sample was weighed into 100 ml plastic bottle. 50 ml of distilled water was added and shaken for 1 h in a mechanical shaker. This was filtered into a 50 ml volumetric flask and made up to the mark. Then 5 ml of the filtrate was pipette out into a tube and mixed with 3 ml of 0.1M FeCl<sub>3</sub> in 0.1 N HCl and 0.008M potassium ferrocyanide. The absorbance was measured in a spectrophotometer at 120 nm wavelength, within 10 min. A blank sample was prepared and the colour also developed and read at the same wavelength. A standard was prepared using tannin acid to get 100 ppm and measured (Van-Burden and Robinson, 1981).

#### Flavonoid determination

Flavonoid content was determined using the method described by Boham and Kocipai (1994). Ten grams of the ground samples were extracted repeatedly with 300 ml of methanol:water (80:20) at room temperature. The whole solution was filtered through Whatman filter paper No. 42 (125 mm). The filtrate was later transferred into a

crucible and evaporated to dryness over a water bath and weighed (Boham and Kocipai, 1994).

### Determination of total phenols

Total phenols were determined using the method described by Obadoni and Ochuko (2001). For the extraction of phenolic component, the fat free sample was boiled with 50 ml of ether for 15 min. 5 ml of the extract was pipette into a 50 ml volumetric flask, then 10 ml of distilled water was added. 2 ml of ammonium hydroxide solution and 5 ml of concentrated amyl alcohol were also added. The samples were made up to mark and left to react for 30 min for colour development. The absorbance of the solution was read using a spectrophotometer at 505 nm wavelengths (Obadoni and Ochuko, 2001).

### Cyanogenic glycoside determination

The method used was alkaline picrate method of Onwuka, (2005). 5 g of each sample A. and B were added 50 mL distilled water in a conical flask and allowed to stand overnight. To 1 mL of the sample filtrate in a corked test tube 4 mL of alkaline picrate was added and incubated in a water bath for 5 min. The absorbance of the samples were taken at 490 nm and that of a blank containing 1 mL distilled water and 4 mL alkaline picrate solution before the preparation of cyanide standard curve but there was no colour change in any of the corked test tube containing the sample A and B which is the indication of absence of cyanide in the sample i.e., colour changed from yellow to reddish brown after incubation for 5 min in a water bath (Railes, 1992).

### Proximate Composition Analysis

This was carried out according to the method of AOAC (1990)

### Moisture Content Determination

Two grams of each of the sample was weighed into dried weighed crucible. The samples was put into a moisture extraction oven at 105°C and heated for 3 hours. The dried samples was put into desiccators, allowed to cool and reweighed. The process was reported until constant weight was obtained the difference in weight was calculated as a percentage of the original sample

$$\text{Percentage moisture} = \frac{W_2 - W_1}{W_2 - W_3} \times \frac{100}{1}$$

Where

- $W_1$  = Initial weight of empty dish
- $W_2$  = Weight of dish + Un-dried sample
- $W_3$  = Weight of dish + dried sample

### Ash Content Determination

Two grams of each of the samples was weighed into crucible, heated in a moisture extraction oven for 3hour at 100°C before being transferred into a muffle furnace at 550°C until it turned white and free of carbon. The sample was then removed from the furnace, cooled in a desicator to a room temperature and reweighed immediately. The weight of the residual ash was then calculated as

$$\text{Percentage Ash} = \frac{\text{Weight of Ash}}{\text{Weight of original of sample}} \times \frac{100}{1}$$

### Crude Protein Determination

The micro kjeldahl method described by A.O.A.C (1990) was used. Two grams of each of the sample was mixed with 10ml of concentrated H<sub>2</sub>SO<sub>4</sub> in a heating tube. One table of selenium catalysts was added to the tube and mixture heated inside a fume cupboard. The digest was transferred into distilled water. Ten millimeter portion of the digest mixed with equal volume of 45% NaOH. Solution and poured into a kjeldahl distillation apparatus. The mixture was distilled and the distilled collected into 4% boric acid solution containing 3 drops of methyl red indicator. A total of 50ml distillate was collected and titrated as well. The sample was duplicated and the average value taken. The nitrogen content was calculated and multiplied with 6.25 to obtain the crude protein content. This is given as percentage Nitrogen

$$= \frac{(100 \times N \times 14 \times VF) T}{100 \times V_a}$$

Where

- N = Normality of the titrate (0.1N)
- VF = Total volume of the digest = 100ml
- T = Titre value
- V<sub>a</sub> = Aliquot volume distilled

### Crude Fiber Determination

Two grams (2g) sample and 1g asbestos were put into 200ml of 1.25% of H<sub>2</sub>SO<sub>4</sub> and boiled for 30 minutes. The solution and content then poured into Buchner funnel equipped with muslin cloth and secured with elastic band. This was allowed to filter and residue was then put into 200ml boiled NaOH and boiling continued for 30 minutes, then transferred to the Buchner funnel and filtered. It was then washed twice with alcohol. The material obtained washed thrice with petroleum ether. The residue obtained was put in a clean dry crucible and dried in the moisture extraction oven to a constant weight. The dried crucible was removed, cooled and weighed. Then, difference of

weight (i.e. loss in ignition) is recorded as crucible fiber and expressed in percentage crude fiber,

$$= \frac{W_1 - W_2}{W_3} \times \frac{100}{1}$$

Where

$W_1$  = Weight of sample before incineration

$W_2$  = Weight of sample after incineration

$W_3$  = Weight of original sample

### Fat Content Determination

Two grams of the sample was loosely wrapped with a filter paper and put into the thimble which was filled to a clean round bottom flask, which has been cleaned, dried and weighed. The flask contained 120ml of petroleum ether. The sample was heated with a heating mantle and allowed to reflux for 5 hours. The heating was then stopped and the thimbles with the spent samples kept and later weighed. The difference in weight was received as mass of fat and is expressed in percentage of the sample. The percentage oil content is percentage fat

$$= \frac{W_2 - W_1}{W_3} \times \frac{100}{1}$$

Where

$W_1$  = Weight of the empty extraction flask

$W_2$  = Weight of the flask and oil extracted

$W_3$  = Weight of the sample

### Carbohydrate Content Determination

The nitrogen free method described by A.O.A.C (1990) was used. The carbohydrate is calculated as weight by difference between 100 and the summation of other proximate parameters as

$$\text{Nitrogen Free Extract (NFE) percentage carbohydrate} \\ (\text{NFE}) = 100 - (\text{M} + \text{P} + \text{F}_1 + \text{A} + \text{F}_2)$$

Where

M = moisture

P = protein

$F_1$  = fat

A = ash

$F_2$  = crude fiber.

### Nutrients analysis

#### Mineral Determination

The major elements, comprising calcium, phosphorus, sodium, potassium, magnesium and trace elements (iron and zinc) were determined according to the method of Shahidi *et al.* (1999). The ground plant samples were sieved with a 2 mm rubber sieve and 2 g of each of the plant samples were weighed and subjected to dry ashing in a well-cleaned porcelain crucible at 550°C in a muffle

furnace. The resultant ash was dissolved in 5 ml of  $\text{HNO}_3/\text{HCl}/\text{H}_2\text{O}$  (1:2:3) and heated gently on a hot plate until brown fumes disappeared. To the remaining material in each crucible, 5 ml of deionized water was added and heated until a colourless solution was obtained. The mineral solution in each crucible was transferred into a 100 ml volumetric flask by filtration through a whatman No 42 filter paper and the volume was made to the mark with deionized water. This solution was used for elemental analysis by atomic absorption spectrophotometer. A 10 cm-long cell was used and concentration of each element in the sample was calculated on percentage of dry matter. Phosphorus content of the digest was determined colorimetrically according to the method described by Nahapetian and Bassiri (1975). To 0.5 ml of the diluted digest, 4 ml of demineralised water, 3 ml of 0.75M  $\text{H}_2\text{SO}_4$ , 0.4 ml of 10%  $(\text{NH}_4)_6\text{MO}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$  and 0.4 ml of 2% (w/v) ascorbic acid were added and mixed. The solution was allowed to stand for 20 min and absorbance readings were recorded at 660 nm. The content of phosphorus in the extract was determined.

### Vitamin Analysis

#### Determination of ascorbic acid (Vitamin C)

Vitamin C content was determined according to the method of Baraket *et al.* (1973). Five grams of the sample was weighed into an extraction tube and 100 ml of EDTA/TCA (2:1) extracting solution were mixed and the mixture shaken for 30 min. This was transferred into a centrifuge tube and centrifuged at 3000 rpm for 20 min. It was transferred into a 100 ml volumetric flask and made up to 100 ml mark with the extracting solution. 20 ml of the extract was pipetted into the volumetric flask and 1% starch indicator was added. These were titrated with 20%  $\text{CuSO}_4$  solution to get a dark end point (Baraket *et al.*, 1973).

#### Determination of vitamin A

One gram (1g) of the sample was weighed and macerated with 20mls of petroleum ether. It was evaporated to dryness and 0.2 ml of chloroform acetic anhydride was added and 2mls of TCA chloroform were added and the absorbance measured at 620nm. Then concentration of vitamin A was extrapolated from the standard curve.

#### Determination of vitamin E

One gram (1g) of the sample was weighed and macerated with 20mls of ethanol. One milliliter (1ml) of 0.2% ferric chloride in ethanol was added, then 1ml of 0.5%  $\alpha, \alpha$ -dipyridyl was also added, It was diluted to 5mls

with distilled water and absorbance was measured at 520nm. Then concentration of Vitamin E was extrapolated from the standard curve.

#### **Determination of niacin**

Niacin content was determined according to the method of Okwu and Josiah, (2006). Five grams of the sample was treated with 50 ml of 1 N sulphuric acid and shaken for 30 min. 3 drops of ammonia solution (0.1N) were added to the sample and filtered. 10 ml of the filtrate was pipetted into a 50 ml volumetric flask and 5 ml potassium cyanide was added. This was acidified with 5 ml of 0.02 N  $H_2SO_4$  and absorbance measured in the spectrophotometer at 470 nm wavelength (Okwu and Josiah, 2006).

#### **Determination of riboflavin**

Riboflavin content was determined according to the method of Okwu and Josiah, (2006). Five grams of the sample was extracted with 100 ml of 50% ethanol solution and shaken for 1 h. This was filtered into 100 ml flask; 10 ml of the extract was pipetted into 50 ml volumetric flask. 10 ml of 5% potassium permanganate and 10 ml of 30%  $H_2O_2$  were added and allowed to stand over a hot water bath for about 30 min. 2 ml of 40% sodium sulphate was added. This was made up to 50 ml mark with deionized water and the absorbance measured at 510 nm in a spectrophotometer (Okwu and Josiah, 2006).

#### **Determination of thiamine**

Thiamine content was determined according to the method of Okwu and Josiah, (2006). Five grams of the sample were homogenized with ethanolic sodium hydroxide (50 ml). It was filtered into a 100 ml flask. 10 ml of the filtrate was pipetted and the colour developed by addition of 10 ml potassium dichromate and read at 360 nm. A blank was prepared and the colour also developed and read at the same wavelength (Okwu and Josiah, 2006).

#### **Anti-nutrients analysis**

##### **Oxalate determination**

The oxalate content of the samples was determined using titration method. 2 g of each sample A and B were placed in a 250 mL volumetric flask suspended in 190 mL distilled water. 10ml 6MHCl solution was added to each of the samples and the suspension digested at 100°C for

1h. The samples were then cooled and made up to 250 mL mark of the flask. The samples were filtered and duplicate portion of 125 mL of the filtrate were measured into beaker and four drops of methyl red indicator was added, followed by the addition of concentrated  $NH_4OH$  solution (drop wise) until the solution changed from pink to yellow colour. Each portion was then heated to 90°C, cooled and filtered to remove the precipitate containing ferrous ion. Each of the filtrate was again heated to 90°C and 10 mL of 5%  $CaCl_2$  solution was added to each of the samples with stirring consistently. After cooling, the samples were left overnight. The solutions were then centrifuged at 2500 rpm for 5 min. The supernatant were decanted and the precipitates completely dissolved in 10 mL 20%  $H_2SO_4$ . The total filtrates resulting from digestion of 2 g of each of the samples were made up to 200 mL. Aliquots of 125 mL of the filtrate was heated until near boiling and then titrated against 0.05 M standardized  $KMnO_4$  solutions to a pink colour which persisted for 30 sec. The oxalate contents of each sample were calculated (Munro and Bassiro, 2000).

##### **Phytate determination**

The phytate of each of the samples was determined through phytic acid determination using the procedure described by Lucas and Markaka, (1975). This entails the weighing of 2 g of each sample into 250 mL conical flask. 100 mL of 2% conc HCl was used to soak the samples in the conical flask for 3 h and then filtered through a double layer filter paper 50 mL of each of the sample filtrate were placed in a 250 mL beaker and 107 mL of distilled water added to give/ improve proper acidity. 10 mL of 0.3% ammonium thiocyanate solution was added to each sample solution as indicator and titrated with standard iron chloride solution which contained 0.00195 g iron/mL and the end point was signified by brownish-yellow colouration that persisted for 5 min. The percentage phytic acid was calculated (Russel, 1980).

##### **Trypsin inhibitor determination**

One gram of each sample A and B were dispersed in 50 mL of 0.5 m NaCl solution. The mixture was stirred for 30 minutes at room temperature and centrifuged at 1500 rpm for 5 min. The supernatants were filtered and the filtrates used for the assay. Two mL of the standard trypsin solution was added to 10 mL of the substrate of each sample. The absorbance of the mixture was taken at 410 nm using 10 mL of the same substrate as blank (Prokopet and Unlenbruck, 2002). Alkaloid determinaton: 5 g of each of the samples were dispersed into 50 mL of 10% acetic acid in ethanol, the mixture were shaken and allowed to stand for 4h before filtration. The filtrate was evaporated to one quarter of the original volume.

**Table 1.** Phytochemical composition of methanol extract of *Citrulus lanatus* (Watermelon) seed extract

Phytochemical Composition	<i>Citrulus lanatus</i> (Watermelon) seed (mg/100g)	<i>Cocos nucifera</i> (coconut palm) stem bark (mg/100g)
Saponins	1.553 ± 0.0071	0.23 ± 0.04
Tannins	0.536 ± 0.0057	6.73 ± 0.03
Alkaloids	33.795 ± 0.035	3.42 ± 0.03
Flavonoids	2.310 ± 0.014	3.59 ± 0.01
Phenol	1.371 ± 0.042	0.21 ± 0.01
Cyanogenic glycoside	0.003 ± 0.00	0.002 ± 0.00

Data represented in Mean ± SEM

**Table 2.** Proximate composition of methanol extract of *Citrulus lanatus* (Watermelon) seed extract

Proximate Compounds	<i>Citrulus lanatus</i> (Watermelon) seed (%)	<i>Cocos nucifera</i> (coconut palm) stem bark (%)
Protein	27.535 ± 0.064	1.84 ± 0.00
Ash	4.138 ± 0.015	3.12 ± 0.00
Fats	48.06 ± 0.127	7.12 ± 0.00
Fibre	3.932 ± 0.078	1.64 ± 0.00
Moisture	6.933 ± 0.076	12.25 ± 0.01
Carbohydrate	9.407 ± 0.203	74.04 ± 0.04

Data represented in Mean ± SEM

Concentrated NH<sub>4</sub>OH was added to each of the samples dropwise to precipitate the alkaloid. The precipitate were filtered off with weighed filter paper and washed with 1% NH<sub>4</sub>OH solution. The precipitates in each case were dried at 60°C for 30 min and reweighed (Griffiths, 2000).

### Hemagglutinin determination

Two gram of each of the sample was added 20 mL of 0.9% NaCl and suspension shaken vigorously for 1 min. The supernatants were left to stand for 1 h the samples were then centrifuged at 2000 rpm for 10 min and the suspension filtered. The supernatants in each were collected and used as crude agglutinating extract.

### Statistical analysis

Three analytical determinations were carried out on each independent replication for every parameter. Three independent replicates (n = 3) were obtained from each treatment and the results presented in tables and are reported as means ± standard error of mean (SEM). Data were analysed by t-test (P < 0.05).

## RESULTS

Table 1 summarizes the quantitative determination of phytochemical constituents of *Citrulus lanatus* seed and *Cocos nucifera* stem bark. The result reveals that both plants contain substantial amount of saponins, tannins, flavonoids and phenol. The concentration of alkaloids

present in the *C. lanatus* seed were significantly (p<0.05) higher compared with the level observed in *C. nucifera* stem bark. The value of cyanogenic glycosides was very trace on both plants.

The result of proximate analysis of the seed of *C. lanatus* and *C. nucifera* stem bark were presented in table 2. There was generally low percentage proximate fractions of *C. lanatus* seeds in terms ash and fibre and low percentage fractions of protein, ash, fats and fibre were observed in the *C. nucifera* stem bark. Protein and fats composition of *C. lanatus* were observed to be significantly (P<0.05) higher compared with the compositions present in *C. nucifera* while the percentage moisture and carbohydrate composition in *C. nucifera* were revealed to be significantly (P<0.05) higher compared with the concentration of these proximate compounds in *C. lanatus* (table 2).

The mineral and nutrient contents of both plants are shown in table 3. Iron was the most abundant micro element present ranging from 4.089 µg/g in *C. lanatus* seed to 3.66 µg/g in *C. nucifera* stem bark. This is followed by zinc, which was present from 1.082 µg/g in *C. lanatus* seed to 3.50 µg/g in *C. nucifera* stem bark. The values of magnesium were very trace on both plants. Results of analysis of *C. lanatus* seed and *C. nucifera* stem bark showed that the plants are rich in some vitamins such as vitamin A, E and C which were observed to be abundant in both plants while low concentration of thiamine, riboflavin and niacin were observed in both plants.

The anti-nutrient analysis of *C. lanatus* seed and *C. nucifera* stem bark revealed low level of phytate, oxalate, hemagglutinin and trypsin inhibitor ranging from 0.677 mg/100g to 2.370 mg/100g, 0.082 mg/100g to 0.97

**Table 3.** Nutrients composition of methanol extract of *Citrulus lanatus* (Watermelon) seed extract

Nutrient compounds	<i>Citrulus lanatus</i> (Watermelon) seed	<i>Cocos nucifera</i> (coconut palm) stem bark
Zinc ( $\mu\text{g/g}$ )	1.082 $\pm$ 0.0085	3.50 $\pm$ 0.01
Iron ( $\mu\text{g/g}$ )	4.089 $\pm$ 0.037	3.66 $\pm$ 0.00
Magnesium (%)	0.023 $\pm$ 0.016	0.18 $\pm$ 0.00
Vitamin A (mg/100g)	34.21 $\pm$ 0.156	49.50 $\pm$ 0.01
Vitamin E (mg/100g)	20.62 $\pm$ 0.212	30.45 $\pm$ 0.04
Vitamin C (mg/100g)	22.095 $\pm$ 0.092	20.90 $\pm$ 0.09
Thiamine (mg/100g)	0.115 $\pm$ 0.0071	0.09 $\pm$ 0.14
Riboflavin (mg/100g)	0.135 $\pm$ 0.035	0.64 $\pm$ 0.04
Niacin (mg/100g)	1.332 $\pm$ 0.013	0.65 $\pm$ 0.06

Data represented in Mean  $\pm$  SEM

**Table 4.** Anti-nutrients composition of methanol extract of *Citrulus lanatus* (Watermelon) seed extract

Anti-nutrient Compounds	<i>Citrulus lanatus</i> (Watermelon) seed	<i>Cocos nucifera</i> (coconut palm) stem bark
Phytate (mg/100g)	0.677 $\pm$ 0.0057	2.37 $\pm$ 0.00
Oxalate (mg/100g)	0.082 $\pm$ 0.0042	0.97 $\pm$ 0.00
Hemagglutin (%)	0.549 $\pm$ 0.0085	0.69 $\pm$ 0.01
Trypsin inhibitor (mg/100g)	0.456 $\pm$ 0.0085	0.55 $\pm$ 0.00

Data represented in Mean  $\pm$  SEM

mg/100 g, 0.549 % to 0.690% and 0.456 mg/100 g to 0.550 mg/100 g respectively (table 4).

## DISCUSSION

The bioactive compounds observed to be present in both plants are known to exhibit medicinal as well as physiological activity (Sofowora, 1993; Adeniyi et al., 2012). The presence of alkaloid showed that both plants can be used as basic medicinal agents for their analgesic, antispasmodic and bactericidal effects (Stray, 1998; Okwu and Okwu, 2004). Flavonoids are potent water soluble antioxidants and free radical scavengers which prevent oxidative cell damage, have strong anticancer activity (Salah et al., 1995; Del-Rio et al., 1997). Flavonoids are also known to have anti-inflammatory, anti-allergic and anti-viral properties (Adeniyi et al., 2012). They can lower the risk of arthritis, osteoporosis, allergies and viral disease caused by herpes simplex virus, parainfluenza virus and adenovirus (Okwu, 2004; Adeniyi et al., 2012). Flavonoids can also prevent atherosclerosis, which is a disease characterized by the deposition of fats inside the arterial wall. Such deposition narrows the arteries and thereby, hinders blood flow to the vital organs of our body, like heart and brain. So, this disease increases the risk of heart attack and stroke. Flavonoids, by preventing atherosclerosis, lower the risk of coronary heart diseases (Adeniyi et al., 2012). High content of tannin decrease protein quality by decreasing digestibility and causes damage to the intending track (Sam et al., 2012). Dutta, (2003) reported that, tannins are responsible for the flavour in tea and it

use in the treatment of skin eruption and for other medicinal purposes due to their astringent properties. The presence of saponin is an indication that the plants possess the property of precipitating and coagulating red blood cells. Some of the characteristics include formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness (Sodipo et al., 2000; Okwu, 2004; Adeniyi et al., 2012). The level of cyanogenic glycoside was found to be in trace amount. The knowledge of the cyanogenic glycoside content of food is vital because cyanide being an effective cytochrome oxidase inhibitor interferes with aerobic respiratory system (Aina et al., 2012). Minerals are important for vital body functions such as acid, base and water balance. Iron is an important constituent of hemoglobin (Onwordi et al., 2009). Therefore, this is probably why some people use these plants to build-up hemoglobin, especially when they are recovering from sickness (Adeniyi et al., 2012). Zinc is needed in the body to help the pancreas produce insulin, to allow insulin to work more effectively and to protect insulin receptors on cells (Okaka and Okaka, 2001). Therefore the presence of zinc in the studied plants could mean that the plants can play valuable roles in the management of diabetes, which results from insulin malfunction. Magnesium ions are known hormone activators in type 2 diabetes, their presence in the studied plants can be beneficial in managing this disease. These plants are good source of vitamin C (ascorbic acids), vitamin A and vitamin E (Table 4). Natural ascorbic acid is vital for body performance (Okwu, 2004). Lack of ascorbic acid impairs the normal formation of intercellular substances throughout the body, including collagen, bone matrix and

tooth dentine. The pathological change resulting from this defect is the weakening of the endothelial wall of the capillaries due to reduction in the amount of intercellular substances (Adeniyi et al., 2012). Therefore, the clinical manifestations of scurvy hemorrhage from mucous membrane of the mouth and gastrointestinal tract, anemia, pains in the joints can be related to the association of ascorbic acid and normal connective tissue metabolism (Hunt et al., 1980; Okwu, 2004). This function of ascorbic acid also accounts for the requirement for normal wound healing (Adeniyi et al., 2012). As a result of the availability of ascorbic acid in both plants, they can be used in herbal medicine for the management of oxidative stress and prevent oxidative damage of the organs and tissues since vitamin A, C and E serve as antioxidants that can scavenge free radicals generated in the body. Phytic acid, a hexaphosphate derivative of inositol is an important, storage form of phosphorus in plant. Phytate is an anti-nutrient that interferes with the absorption of minerals from the diet. It causes calcium and zinc deficiency in man when in excess, the deficiency of these minerals results in Oteo-malacia, anaemia and rickets (Sam et al., 2012). The level of phytate in C.

lanatus seeds and C. nucifera stem bark were observed to be 0.677 and 2.37 mg/100 g. The low level of phytic acid could be attributed to the presence of an enzyme phytase which degrade phytic acid in plants (Aina et al., 2012). Oxalates are regarded as undesirable constituents of the diets, reducing assimilation of calcium, favoring the formulation of renal calcium (Fagboya, 1990). The low anti-nutrient content of the seed of Citrulus lanatus and Cocos nucifera stem bark is an indication of good diet and medicinal source.

## CONCLUSION

This study has shown that C. lanatus seed and C. nucifera stem bark are good source of phytochemicals that are biologically important, thus they can be potential sources of useful herbs in the management of some ailments. The trace amounts of anti-nutrient compounds indicate that the plants can serve as good dietary supplement. Also, these plants contain appreciable level of proximate compounds, vitamins and minerals that are readily available; they could be consumed to supplement the scarce or non-available sources of nutrients.

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