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Full Length Research paper

Analyzing the chemical makeup of *Cocos nucifera* stem bark and *Citrulus lanatus* seeds

Buraimoh* and Monye

Bayero University, Kano, Nigeria

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A phytochemical, proximate, nutritional, and anti-nutrient composition analysis was performed on the stem bark of Citrulus lanatus and Cocos nucifera seeds. The outcomes of the two plants' analyses were contrasted. The findings show that both plants have significant levels of phenol, flavonoids, terpenoids, tannins, and saponnins. Compared to the amount found in the stem bark of C. nucifera, the content of alkaloids and steroids in the C. lanatus seed was substantially ($p<0.05$) higher. In terms of ash and fiber, the proximate fractions of C. lanatus seeds were generally low, and the stem bark of C. nucifera showed low percentages of protein, ash, lipids, and fiber. The protein and fat content of C. lanatus seeds was found to be substantially ($P<0.05$) higher than that of C. nucifera stem bark. The most prevalent microelement was iron, which ranged from 3.66 µg/g in C. nucifera stem bark to 4.089 µg/g in C. lanatus seed. Zinc came next; magnesium levels in both plants were highly traced. The results of the examination of C. lanatus seeds and C. nucifera stem bark revealed that while both plants had low concentrations of vitamins B1, B2, and B3, they were rich in certain vitamins, including A, E, and C. Low levels of phytate, oxalate, hemaglutinin, and trypsin inhibitor were found in C. lanatus seed and C. nucifera stem bark, according to anti-nutrient analysis. These levels ranged from 0.677 mg/100 g to 2.370 mg/100 g, 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. According to this study, C. lanatus seeds and C. nucifera stem bark are good sources of biologically significant phytochemicals, which means they may one day be used to make effective medications to treat a variety of illnesses.

Key words: Phytochemicals; Proximate; Nutrients; Anti-nutrients.

INTRODUCTION

It has long been recognized that plants and their derivatives have biological activity and play a significant role in global health. Plants were the source of 30% of all contemporary medications (Riaz et al., 2010; Omoboyowa et al., 2013). Approximately 80% of the world's population primarily receives their medical care from plants, according to the World Health Organization (Omoboyowa et al., 2013). Particularly in Africa, there is increasing interest in using plants for therapeutic purposes (Adeniyi et al., 2012). Watermelon, or Citrulus lanatus, has a considerable amount of citrulline, and blood plasma levels showed an increased concentration after consuming several kilograms of the fruit (Mendal et al., 2005). Its solitary brown seed contains a lot of oleic and arachidonic acid, two types of fat and oil that are useful to industry and are used in soapmaking and cooking (Collins et al., 2007). Citruline, which can be converted to arginine, is abundant in watermelon flesh. This amino acid contributes to the immunological and cardiovascular systems and is a substrate for the generation of nitric oxide (Collins et al., 2007). The coconut palm, or Cocos nucifera, belongs to the Arecaceae family of palms. It is widespread in the tropic and subtropical regions and is renowned for its high degree of adaptability due to the numerous applications for its different sections. The coconut water contains sugar, dietary fiber, proteins, antioxidants, vitamins, and minerals, while the seed supplies oil for cooking, frying, and producing margarine (Ravi, 2009).In terms of medicine, young coconut juice possesses estrogenic-like properties, the n-hexane fraction of coconut peel includes new anticancer chemicals, it can be used as an intravenous hydration fluid, and the tea made from husk fiber is used to treat severe inflammatory disorders (Sarian, 2010). In order to highlight their pharmacological roles in traditional medicine, the current study was designed to

assess the secondary metabolites, proximate, nutrients, and anti-nutrient composition of Cocos nucifera stem bark, which is frequently used in alternative herbal medicine in Nigeria, and Citrulus lanatus seeds, which are frequently discarded after consumption of the fruits.

MATERIALS AND METHODS

Plant material

The fresh watermelon (Citrulus lanatus) fruits utilized in this study were bought from Eke market in the Nigerian state of Ebonyi's Afikpo North Local Government Area. A sterile knife was used to extract the seeds from the pulp, and then a mechanical blender was used to carefully grind the seeds into a coase form after they had been washed and allowed to air dry. For this study, stem bark from coconut palms (Cocos nucifera) was gathered from Ogbu Edda, located in the Afrikpo South Local Government Area of Ebonyi State, Nigeria. Using a clean cutlass, it was gathered, allowed to air dry for three weeks at room temperature, and then ground into a coarse consistency using a mechanical blender..

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

Gravimetric analysis was used to determine the alkaloid concentration. After weighing five grams of the sample into a 250 ml beaker, 200 ml of 20% acetic acid in ethanol was added, and the mixture was left to stand for four hours. After filtering, the extract was concentrated to a quarter of its initial volume in a water bath. Concentrated hydroxide of ammonium was added to the extract drop by drop until the precipitation was finished. According to Obadoni and Ochuko (2001), the entire solution was left to settle before the precipitate was filtered through Whatman filter paper No. 4 (125 mm) and weighed.

Saponin determination

Obadoni and Ochuko's (2001) approach was used to determine the saponin content. 200 milliliters of 20% ethanol were used to scatter 20 grams (20 g) of each powdered sample. For four hours, the suspension was cooked to roughly 55 degrees Celsius over a hot water bath while being constantly stirred. After filtering the mixture, 200 milliliters of 20% ethanol were used to remove the residue once more. Over a water bath at roughly 90 degrees Celsius, the combined extracts were reduced to 40 milliliters. After transferring the concentrate into a 250 ml separator funnel, 20 ml of diethyl ether was added, and the mixture was violently agitated. The ether layer was thrown away, but the aqueous layer was retrieved. The purifying procedure was carried out once more. N-butanol (60 ml) was added. Ten milliliters of 5% aqueous sodium chloride were used twice to wash the n-butanol and extract combination. In a water bath, the leftover solution was heated to roughly 90 degrees Celsius. The samples were dried at 100 degrees Celsius in an oven until their weight remained consistent. The proportion of saponin was determined (Obadoni and Ochuko, 2001).

Tannin determination

Tannin content was calculated using the Van-Burden and Robinson (1981) method. A 100 ml plastic bottle was filled with 500 miligrams of the sample. In a mechanical shaker, 50 milliliters of distilled water were added and agitated for one hour. This was adjusted to the proper level after being filtered into a 50 ml volumetric flask. Next, 5 ml of the filtrate was pipetted into a tube and combined with 0.008M potassium ferrocyanide and 3 ml of 0.1M $FeCl_3$ in 0.1 N HCl. Within ten minutes, the absorbance was measured at a wavelength of 120 nm in a spectrophotometer. The same wavelength was used to develop and read the color of a blank sample. Tannic acid was used to create a standard that was measured at 100 parts per million (Van-Burden and Robinson, 1981).

Flavonoid determination

Boham and Kocipai's (1994) approach was used to determine the flavonoid content. At room temperature, 300 milliliters of methanol:water (80:20) were used to repeatedly extract 10 grams of the powdered materials. Whatman filter paper No. 42 (125 mm) was used to filter the entire solution. Following that, the filtrate was moved into a crucible, dried out over a water bath, and weighed (Boham and Kocipai, 1994).

Determination of total phenols

Obadoni and Ochuko's (2001) method was used to determine total phenols. The fat-free sample was boiled for 15 minutes with 50 milliliters of ether in order to extract the phenolic component. Ten milliliters of distilled water were added after five milliliters of the extract had been pipetted into a fifty milliliter volumetric flask. Additionally, 5 ml of concentrated amyl alcohol and 2 ml of ammonium hydroxide solution were added. After being prepared to mark, the samples were allowed to react for 30 minutes in order to acquire color. A spectrophotometer set to 505 nm wavelengths was used to measure the solution's absorbance (Obadoni and Ochuko, 2001).

Cyanogenic glycoside determination

The alkaline picrate approach of Onwuka (2005) was the technique employed. In a conical flask, 5 g of samples A and B were combined with 50 mL of distilled water and left to stand overnight. Four milliliters of alkaline picrate were added to one milliliter of the sample filtrate in a corked test tube, and the mixture was then incubated for five minutes in a water bath. Before the cyanide standard curve was prepared, the absorbance of the samples was measured at 490 mm, as was that of a blank that contained 1 mL of distilled water and 4 mL of alkaline picrate solution. However, none of the corked test tubes containing samples A and B showed any change in color, which is a sign that there was no cyanide present in the sample; instead, the color changed from yellow to reddish brown after 5 minutes of incubation in a water bath (Railes, 1992).

Proximate Composition Analysis

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

Moisture Content Determination

A dried weighted crucible was filled with two grams of each sample. The samples were heated for three hours at 1050C in a moisture extraction oven. After being placed in desiccators to cool, the dry samples were weighed again. 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 sample were placed in a crucible, heated for three hours at 1000C in a moisture extraction oven, and then moved to a muffle furnace at 5500C until it was white and carbon-free. Following its removal from the furnace, the sample was promptly reweighed after being allowed to cool to ambient temperature in a desiccator. The weight of the residual ash was then calculated as

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

Crude Protein Determination

The A.O.A.C. (1990) micro Kjeldahl method was applied. In a heating tube, two grams of each sample were combined with ten milliliters of concentrated H2SO4. The tube was filled with one table of selenium catalysts, and the mixture was heated within a fume closet. Distilled water was used to hold the digest. An identical volume of 45% NaOH was combined with a 10-millimeter chunk of the digest. mixture then transferred onto a Kjeldahl distillation device. Three drops of methyl red indicator were added to a 4% boric acid solution after the mixture was distilled. Additionally, 50 milliliters of distillate were gathered and titrated. A duplicate of the sample was obtained, and the average value was calculated. The crude protein content was estimated by multiplying the nitrogen concentration by 6.25. This is given as percentage Nitrogen

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

Where

N = Normality of the titrate (0.1N)
VF = Total volume of the digest = 100ml
T = Titre value
Va = Aliquot volume distilled

Crude Fiber Determination

200ml of 1.25% H2SO4 was mixed with two grams (2g) of sample and one gram of asbestos, and the mixture was heated for half an hour. After that, the contents and solution were transferred into a Buchner funnel that was covered with muslin material and fastened with an elastic band. After letting it filter, the residue was placed in 200 milliliters of boiling NaOH, where it simmered for 30 minutes before being moved to a Buchner funnel and filtered. After that, it was given two alcohol washes. Petroleum ether was used to wash the material three times. After that, the residue was placed in a dry, clean crucible and dried in the moisture extraction oven until it reached a consistent weight. After drying, the crucible was taken out, let to cool, and weighed. Then, difference of weight (i.e. loss in ignition) is recorded as crucible fiber and expressed in percentage crude fiber,

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

Where

W_1 = Weight of sample before incineration W_2 = Weight of sample after incineration W_3 = Weight of original sample

Fat Content Determination

200ml of 1.25% H2SO4 was mixed with two grams (2g) of sample and one gram of asbestos, and the mixture was heated for half an hour. After that, the contents and solution were transferred into a Buchner funnel that was covered with muslin material and fastened with an elastic band. After letting it filter, the residue was placed in 200 milliliters of boiling NaOH, where it simmered for 30 minutes before being moved to a Buchner funnel and filtered. After that, it was given two alcohol washes. Petroleum ether was used to wash the material three times. After that, the residue was placed in a dry, clean crucible and dried in the moisture extraction oven until it reached a consistent weight. After drying, the crucible was taken out, let to cool, and weighed. The percentage oil content is percentage fat

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

furnace. The resulting ash was heated gradually on a hot plate until brown fumes vanished after being dissolved in 5 milliliters of HNO3/HCl/H2O (1:2:3). Five milliliters of deionized water were added to the leftover material in each crucible, and the mixture was heated until it became colorless. After passing through Whatman No. 42 filter paper, the mineral solution in each crucible was poured into a 100 ml volumetric flask, and the volume was adjusted with deionized water to reach the desired level. Using an atomic absorption spectrophotometer, this solution was utilized for elemental analysis. Each element's concentration in the sample was determined using a 10 cm-long cell and expressed as a percentage of dry matter. The digest's phosphorus content was ascertained colorimetrically using the technique outlined by Nahapetian and Bassiri (1975). Four milliliters of demineralized water, three milliliters of 0.75M H2SO4, 0.4 milliliters of 10% (NH4)6MO7O24.4H2O, and 0.4 milliliters of 2% (w/v) ascorbic acid were added to 0.5 milliliters of the diluted digest and mixed. After letting the solution remain for 20 minutes, absorbance measurements at 660 nm were taken. The extract's phosphorous content was ascertained. 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

Nitrogen Free Extract (NFE) percentage carbohydrate

$(NFE) = 100 – (M + P + F_1 + A + F_2)$

Where

M = moisture
P = protein
F_1 = fat
A = ash
F_2 = crude fiber.

Nutrients analysis

Mineral Determination

The Shahidi et al. (1999) method was used to determine the principal elements, which include calcium, phosphorus, sodium, potassium, magnesium, and trace elements (iron and zinc). Two grams of each ground plant sample were weighed and put through dry ashing after being sieved through a 2 mm rubber sieve in a well-cleaned porcelain crucible at 550°C in a muffle

Determination of riboflavin

This content of riboflavin was calculated using Okwu and Josiah's (2006) technique. 100 milliliters of a 50% ethanol solution were used to extract five grams of the material,

Vitamin Analysis

Determination of ascorbic acid (Vitamin C)

The Baraket et al. (1973) method was used to determine the vitamin C concentration. Five grams of the sample were mixed with 100 milliliters of EDTA/TCA (2:1) extracting solution in an extraction tube, and the mixture was shaken for 30 minutes. This was placed in a centrifuge tube and spun at 3000 rpm for 20 minutes. The extracting solution was then transferred into a 100 ml volumetric flask and added until the 100 ml threshold was reached. 20 milliliters of the extract were pipetted into the volumetric flask, and then 1% starch indicator was added. A 20% CuSO4 solution was used to titrate them in order to determine a dark end point (Baraket et al., 1973).

Determination of vitamin A

Twenty milliliters of petroleum ether were used to macerate one gram (1g) of the sample after it had been weighed. After drying it off, 0.2 ml of chloroform acetic anhydride and 2 ml of TCA chloroform were added, and the absorbance at 620 nm was recorded. Next, the standard curve was used to extrapolate the vitamin A concentration.

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% α,α-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

The niacin content was calculated using Okwu and Josiah's (2006) methodology. Fifty milliliters of 1 N sulfuric acid were added to five grams of the sample, and it was agitated for half an hour. After adding three drops of 0.1N ammonia solution, the sample was filtered. Five milliliters of potassium cyanide were added to a 50 milliliter volumetric flask containing 10 milliliters of the filtrate. Five milliliters of 0.02 N H2SO4 were used to acidify this, and the absorbance was measured at 470 nm using a spectrophotometer (Okwu and Josiah, 2006).

and it was agitated for one hour. Ten milliliters of the extract were pipetted into a 50 milliliter volumetric flask after this was filtered into a 100 milliliter flask. After adding 10 milliliters of 5% potassium permanganate and 10 milliliters of 30% H2O2, the mixture was let to stand over a hot water bath for approximately half an hour. 40% sodium sulfate

was applied in 2 milliliters. Deionized water was used to bring this up to the 50 ml level, and a spectrophotometer was used to detect the absorbance at 510 nm (Okwu and Josiah, 2006).

Determination of thiamine

The thiamine content was ascertained using Okwu and Josiah's (2006) methodology. 50 milliliters of ethanolic sodium hydroxide were used to homogenize five grams of the material. After filtering, it was placed in a 100 ml flask. After pipetting 10 milliliters of the filtrate, 10 milliliters of potassium dichromate were added to develop the color, and the reading was taken at 360 nanometers. The color also formed and read at the same wavelength after a blank was made (Okwu and Josiah, 2006).

Anti-nutrients analysis

Oxalate determination

The titration method was used to ascertain the samples' oxalate content. In a 250 mL volumetric flask suspended in 190 mL of distilled water, 2 g of samples A and B were added. Each sample received 10 milliliters of 6MHCl solution, and the suspension was digested for one hour at 100 degrees Celsius. After cooling, the samples were added until the flask reached the 250 mL threshold. After the samples were filtered, a duplicate portion of 125 milliliters of the filtrate was metered out and put into a beaker. Four drops of methyl red indicator were then added, and then concentrated NH4OH solution was added drop by drop until the solution became yellow instead of pink. After heating each piece to 90ºC, it was cooled and filtered to get rid of the ferrous ion-containing precipitate. After heating each filtrate to 90ºC once again, 10 mL of a 5% CaCl2 solution was added to each sample while being constantly stirred. The samples were cooled and then left overnight. After that, the solutions were centrifuged for five minutes at 2500 rpm. The precipitates were fully dissolved in 10 milliliters of 20% H2SO4 after the supernatant was decanted. Two grams of each sample were digested, yielding 200 milliliters of total filtrates. After heating 125 mL aliquots of the filtrate almost to boiling, it was titrated against 0.05 M standardized KMnO4 solutions to produce a pink color that lasted for 30 seconds. Each sample's oxalate content was determined (Munro and Bassiro, 2000).

Phytate determination

Using the method outlined by Lucas and Markaka (1975), the phytate content of each sample was ascertained by measuring its phytic acid. Two grams of each sample must be weighed and placed into a 250 mL conical flask. The samples were soaked in 100 mL of 2% concentrated hydrochloric acid for three hours before being filtered using double-layered filter paper. A 250 mL beaker was filled with 50 mL of each sample filtrate, and 107 mL of distilled water was added to provide or enhance the appropriate acidity. Each sample solution was titrated with a standard iron chloride solution containing 0.00195 g iron/mL after 10 mL of a 0.3% ammonium thiocyanate solution was added as an indicator. The end point was indicated by a brownish-yellow coloration that lasted for five minutes. The phytic acid % was computed (Russel, 1980).

Trypsin inhibitor determination

50 milliliters of 0.5 m NaCl solution were used to disseminate one gram of each of samples A and B. After 30 minutes of stirring at room temperature, the mixture was centrifuged for 5 minutes at 1500 rpm. The filtrates were utilized for the assay after the supernatants were filtered. Ten milliliters of each sample's substrate were mixed with two milliliters of the standard trypsin solution. Using 10 mL of the same substrate as a blank, the mixture's absorbance was measured at 410 nm (Prokopet and Unlenbruck, 2002). Alkaloid determination: 50 mL of 10% acetic acid in ethanol was mixed with 5 g of each sample, agitated, and left to stand for 4 hours before being filtered. A quarter of the filtrate's initial volume was evaporated.

To precipitate the alkaloid, concentrated NH4OH was applied dropwise to each sample. Weighed filter paper was used to remove the precipitate, and 1% NH4OH solution was used for washing. In each instance, the precipitates were reweighed after being dried for 30 minutes at 60ºC (Griffiths, 2000).

Hemaglutinin determination

Twenty milliliters of 0.9% NaCl were added to two grams of each sample, and the mixture was rapidly agitated for one minute. After letting the supernatants rest for an hour, the samples were centrifuged for ten minutes at 2000 rpm, and the suspension was filtered. Each sample's supernatants were gathered and turned into a crude agglutinating extract.

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

Phytochemical Composition	*Citrulus lanatus* (Watermelon) seed (mg/100g)	*Cocos nucifera* (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	*Citrulus lanatus* (Watermelon) seed (%)	*Cocos nucifera* (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

Statistical analysis

Each independent replication was subjected to three analytical evaluations for each parameter. Each treatment yielded three independent replicates (n = 3). The results are shown in tables as means ± standard error of mean (SEM). The t-test was used to analyze the data ($P < 0.05$).

RESULTS

The phytochemical components of Citrulus lanatus seeds and the stem bark of Cocos nucifera are quantitatively determined and summarized in Table 1. The findings show that both plants have significant levels of phenol, flavonoids, tannins, and saponnins. When compared to the amount found in the stem bark of C. nucifera, the concentration of alkaloids in the C. lanatus seed was substantially ($p<0.05$) higher. Cyanogenic glycosides had virtually little effect on either plant.

Table 2 displays the findings of the proximate analysis of the stem bark and seeds of C. nucifera and C. lanatus. In terms of ash and fiber, the proximate fractions of C. lanatus seeds were generally low, and the stem bark of C. nucifera showed low percentages of protein, ash, lipids, and fiber. The percentage moisture and carbohydrate composition in C. nucifera were found to be significantly ($P<0.05$) higher than the concentration of these proximate compounds in C. lanatus, while the protein and fat composition of C. lanatus was found to be significantly ($P<0.05$) higher than the compositions present in C. nucifera (table 2).

Table 3 displays the mineral and nutrient contents of both plants. The most prevalent microelement was iron, which ranged from 3.66 µg/g in C. nucifera stem bark to 4.089 µg/g in C. lanatus seed. After that, zinc was found in C. lanatus seeds at 1.082 µg/g and in C. nucifera stem bark at 3.50 µg/g. Magnesium levels on both plants were quite low. Vitamins A, E, and C were found to be abundant in both plants, according to the results of an investigation of C. lanatus seeds and C. nucifera stem bark. However, thiamine, riboflavin, and niacin were found to be low in both species.

The anti-nutrient analysis of *C. lanatus* seed and *C. nucifera* stem bark revealed low level of phytate, oxalate, hemaglutinin 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 (table 4).

DISCUSSION

It is well recognized that the bioactive substances found in these plants have both physiological and therapeutic effects (Sofowora, 1993; Adeniyi et al., 2012). Both plants' analgesic, antispasmodic, and antibacterial properties were demonstrated by the presence of alkaloids (Stray, 1998; Okwu & Okwu, 2004). Flavonoids have high anticancer properties and are powerful water-soluble antioxidants and free radical scavengers that stop oxidative cell damage (Salah et al., 1995; Del-Rio et al., 1997). Additionally, flavonoids are known to possess antiviral, anti-allergic, and anti-inflammatory qualities (Adeniyi et al., 2012). According to Okwu (2004) and Adeniyi et al. (2012), they can reduce the risk of adenovirus, parainfluenza virus, herpes simplex virus, and osteoporosis, as well as allergies.

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

Nutrient compounds	*Citrulus lanatus* (Watermelon) seed	*Cocos nucifera* (coconut palm) stem bark
Zinc (µg/g)	1.082 ± 0.0085	3.50 ± 0.01
Iron (µg/g)	4.089 ± 0.037	3.66 ± 0.00
Magnesium (%)	0.023 ± 0.016	0.16 ± 0.00
Vitamin A (mg/100g)	34.21 ± 0.156	49.50 ± 0.01
Vitamin E (mg/100g)	20.62 ± 0.212	30.45 ± 0.04
Vitamin C (mg/100g)	22.095 ± 0.092	20.90 ± 0.09
Thiamine (mg/100g)	0.115 ± 0.0071	0.09 ± 0.14
Riboflavin (mg/100g)	0.135 ± 0.035	0.64 ± 0.04
Niacin (mg/100g)	1.332 ± 0.013	0.65 ± 0.06

Data represented in Mean ± SEM

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

Anti-nutrient Compounds	*Citrulus lanatus* (Watermelon) seed	*Cocos nucifera* (coconut palm) stem bark
Phytate (mg/100g)	0.677 ± 0.0057	2.37 ± 0.00
Oxalate (mg/100g)	0.082 ± 0.0042	0.97 ± 0.00
Hemaglutin (%)	0.549 ± 0.0085	0.69 ± 0.01
Trypsin inhibitor (mg/100g)	0.456 ± 0.0085	0.55 ± 0.00

Data represented in Mean ± SEM

Additionally, flavonoids can stop atherosclerosis, a condition where fat deposits inside the arterial wall. This type of deposition causes the arteries to narrow, which prevents blood from reaching our body's essential organs, such as the heart and brain. Thus, this illness raises the risk of stroke and heart attack. Flavonoids reduce the incidence of coronary heart disease by reducing atherosclerosis (Adeniyi et al., 2012). Excessive tannin content damages the intended track and reduces digestibility, which lowers protein quality (Sam et al., 2012). According to Dutta (2003), tea's flavor is attributed to its tannins.

Because of their astringent qualities, they are used to treat skin eruptions and for other medical uses. The ability of plants to precipitate and coagulate red blood cells is shown by the presence of saponin. Some of the features include hemolytic activity, bitterness, cholesterol binding qualities, and the production of foams in aqueous solutions (Sodipo et al., 2000; Okwu, 2004; Adeniyi et al., 2012). It was discovered that the amount of cyanogenic glycoside was trace. Because cyanide is a powerful cytochrome oxidase inhibitor that interferes with the aerobic respiratory system, it is essential to know the amount of cyanogenic glycosides in food (Aina et al., 2012). Essential bodily processes like acid-base and water balance depend on minerals. According to Onwordi et al. (2009), iron is a crucial component of hemoglobin. Thus, this is most likely the reason why some people utilize these herbs to increase their hemoglobin levels, particularly throughout the healing process (Adeniyi et al., 2012). According to Okaka and Okaka (2001), zinc is necessary for the body to assist the pancreas make insulin, enable insulin to function more efficiently, and shield insulin receptors on cells. Consequently, the zinc content of the plants under study may indicate that the plants can be useful in the treatment of diabetes, which is brought on by insulin failure. The presence of magnesium ions in the plants under study may help manage type 2 diabetes as they are known hormone activators in the condition. Vitamins A, E, and C (ascorbic acids) are all abundant in these plants (Table 4). According to Okwu (2004), natural ascorbic acid is essential for bodily functions. Ascorbic acid deficiency disrupts the body's natural production of intercellular materials, such as collagen, bone matrix, and dentine of teeth. The pathogenic alteration brought on by this flaw is the capillaries' endothelial wall becoming weaker as a result of a decrease in intercellular chemicals (Adeniyi et al., 2012). Thus, ascorbic acid and proper connective tissue metabolism may be linked to the clinical signs of scurvy bleeding from the mucous membranes of the mouth and gastrointestinal system, anemia, and joint pain (Hunt et al., 1980; Okwu, 2004). This ascorbic acid activity also explains why normal wound healing is necessary (Adeniyi et al., 2012). Since vitamins A, C, and E are antioxidants that can scavenge free radicals produced in the body, the ascorbic acid found in both plants makes them suitable for use in herbal medicine to control oxidative stress and prevent oxidative damage to organs and tissues. One significant way that plants store phosphorus is through phytotic acid, a hexaphosphate derivative of inositol. An anti-nutrient called phytotate prevents minerals from the food from being absorbed. According to Sam et al. (2012), it produces a deficit of calcium and zinc in humans, which leads to rickets, anemia, and osteomalacia. Phytate levels in C. nucifera stem bark and C. lanatus seeds were found to be 2.37 and 0.677 mg/100 g, respectively. The presence of the enzyme phytase, which breaks down phytic acid in plants, may be the cause of the low phytic acid levels (Aina et al., 2012). Because they decrease calcium absorption and promote the formation of renal calcium, oxalates are considered unfavorable dietary components (Fagboya, 1990). Citrulus lanatus seeds and the stem bark of Cocos nucifera have low anti-nutrient content, which is a sign of a healthy diet and a potential source of medicine.

CONCLUSION

According to this study, C. lanatus seeds and C. nucifera stem bark are good suppliers of biologically significant phytochemicals, which means they may be used as herbs to treat certain conditions. The plants can be a beneficial dietary supplement, according to the trace levels of anti-nutrient chemicals. Additionally, these plants provide a significant amount of easily accessible proximate compounds, vitamins, and minerals that can be taken to supplement the limited or unavailable nutrient sources.

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