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Phytochemical and nutritional compositions of two varieties of *Anacardium occidentale L*

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Abstract

The study investigated phytochemical and nutritional composition of the two varieties of *Anacardium occidentale* (red and yellow varieties) apple, bark, leaves and nuts. Standard techniques were utilized to examine the samples. Phytochemicals, proximate analysis, mineral composition and vitamin content, were all determined on the samples. The obtained data from phytochemical analysis showed that in all the sixteen extracts: glycosides, flavonoids, phenol and protein were present in fifteen extracts except in acetone extract of the bark. Results of proximate analysis revealed that percentage ash contents of yellow varieties of the apple, nuts, leaves and bark had higher values of 8.54, 4.97, 3.51 and 2.51 % respectively than the red varieties. The mineral compositions of nuts, apple juice, leaves and bark from red and yellow varieties revealed highest potassium contents in the apple juice with the value of 41.28±4.31 mg. Generally, phosphorus had the highest value of 129.52±0.25 mg among the minerals studied followed by copper with a value of 61.28±0.01 mg in the nut of the red variety. The red varieties of the nut, apple, and leaves had higher vitamin C content than the yellow variety. The red varieties of the nut, apple, and leaves had higher niacin, (B3) than the yellow variety. The rich presence of these phytochemicals, minerals compositions and other nutritive values supports the use of the different parts of *Anacardium occidentale* in ethno-medicine and equally creates the possibility for their use in drug formulation.

Keywords: *Anacardium occidentale;* Mineral composition; Phytochemical; Proximate; Vitamin

1. Introduction

Anacardium is a Greek word meaning inverted heart, in reference to the form of the fruit. Cashew (*Anacardium occidentale* L.) is a tropical tree native to Brazil that is widely cultivated in Nigeria, India, Vietnam and East Africa.[1] The major product from cashew tree is cashew nut (real fruit) which is high in fat and protein, after plucking the nut from peduncle (cashew apple-pseudo fruit).[2] Cashew apple may be generically categorized into red and yellow kinds. Cashew Apple juice is rich in sugars [3] antioxidants [4, 5] and vitamin C and is extensively taken in Nigeria. They are rich in nutrients and useful plant components and make for a simple addition to many recipes. Cashews are rich in a number of nutrients. Calories, protein, fat, fiber, copper, magnesium, manganese, zinc: phosphorus, iron, selenium thiamine vitamin k, vitamin B6 related to advantages including weight reduction, better blood sugar management, and a healthier heart. [6] Cashew, like other nuts and seeds, are considered antioxidant powerhouses. Antioxidants are plant components that help keep the body healthy by neutralizing free radicals, which cause damage. As a consequence, inflammation is minimized. Several ethno botanical studies have focused on identifying medicinal plants species [7, 8] among these plant species.

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Anacardium occidentale L. has an important place [9]. Its leaves, bark, roots, stem are traditionally used for the treatment of numerous diseases such as, allergy, cough, stomach ache, diarrhea, skin infections. [9] Functional foods are nutrient-dense and connected to a number of major health advantages. They may prevent disease, avoid vitamin deficiencies, and encourage proper growth and development. Ingredients in functional meals give health benefits that go beyond their nutritional value. Some of them incorporate vitamins or other chemicals that are supposed to promote health. Functional foods include necessary nutrients that may assist in sickness prevention. Antioxidants are plentiful in some of them [10]. These molecules help in the neutralization of hazardous substances known as free radicals, preventing cell damage and chronic illnesses such as heart disease, cancer, and diabetes. These properties support its employment as a natural therapeutic and functional meals to boost health.

However, there is still paucity of information on the bioactive and nutritional contents of different parts of the two varieties of *Anacardium occidentale L* that might serve as functional food as well as other health benefits nutrient. Therefore, this study aimed at evaluating the phytochemical and nutritional compositions of different parts of the two varieties *of Anacardium occidentale L.*

2. Material and method

2.1. Sample Collection and Preparation of Plant Extracts

The samples which include apple, nut leaves and nut of ***Anacardium occidentale*** used for this study were collected from Cashew plantation located at Uturu, Abia State Nigeria. The leaves were cleaned with distilled water and air dried for two weeks at room temperature before being ground in a blender, filtered, and stored in an air tight jar. The nut was taken from the apple, bisected into two halves and edible part taken, air dried and stored at room temperature for two weeks which were stored in an air tight container. The barks were also dried at room temperature and all the samples ground with a blender and also stored in a tight containers, while the apple was washed with water and blended with a blender before being stored in a plastic bottle in the refrigerator.

2.2. Solvent Extraction

Ten (10) g portion of the powdered plants materials were each separately dispersed in 100 ml of each chloroform, hexane, acetone, and methanol. The solutions were left to stand at room temperature for 24 hrs and were filtered with Whatman No. 1 filter paper. Total of sixteen extracts were collected; each extract was placed into clean and air tight Eppendorf tube and kept in chilling condition in the refrigerator. From the corresponding extract 0.5 g was diluted in 5 ml of dimethyl sulfoxide (DMSO) and was used for preliminary phytochemical screenng.[11]

2.3. Qualitative Phytochemical Screening Test

2.3.1. Test for Carbohydrates (Molisch's test)

Three drops of Molisch's reagent was added to 2 ml portion of the various extracts. This was followed by addition of 2 ml of conc. H_2SO_4 to the bottom of the test tube. The mixture was then allowed to stand for two-three minutes. Formation of a red or dull violet colour at the interphase of the two layers will be a positive test.[12, 13]

2.3.2. Test for Alkaloids

0.5 ml of each extract was dissolved in 1 % HCl and filtered, the solution and filtrate were tested with Dragendroff's and Mayer' reagent separately. Appearance of turbidity is indication of the presence of alkaloids.[13]

2.3.3. Test for Cardiac gGycosides (Keller Kelliani's Test)

0.5 ml of each extract was treated with 2 ml of glacial acetic acid in a test tube and a drop of ferric chloride solution was added to it. This was carefully added with 1 ml concentrated H_2SO_4. A brown ring at the interface indicated the presence of deoxy sugar characteristic of cardenolides and below this layer greenish colour ring formed which turn into violet after sometime. [12, 13]

2.3.4. Test for Flavonoids (Alkaline Reagent Test)

1 ml of each extract was treated with 3-4 drops of 20 % NaOH solution. Formation of intense yellow colour, which becomes colourless on addition of dilute hydrochloric acid, indicates the presence of flavonoids. [12, 13]

2.3.5. Test for Phenols (Ferric chloride Test)

0.5 ml of each extract was treated with aqueous 5 % $FeCl_3$ 10 % Ferric chloride solution (light yellow). [12, 13]

2.3.6. Test for Quinines, HCl Test

The 1 ml of plant extract was taken. Then was added 2 ml of concentrated hydrochloric acid (conc. HCL). The formation of yellow colour indicated presence of quinine. [13]

2.3.7. Test for Proteins (1% Ninhydrin Solution in Acetone)

2 ml of filtrate was treated with 2-5 drops of ninhydrin solution placed in a boiling water bath for 1-2 minutes and observed for the formation of purple colour. [13]

2.3.8. Test for Terpenoids Salkowski Test

The 1ml of plant extract in a test tube was taken. Added 2ml chloroform in that extract. Along that, added carefully 3ml of sulfuric acid (conc.H_2SO_4) for formation of a layer. Formation of reddish brown colour indicated presence of terpenoids.[13]

2.3.9. Test for Saponins

5 ml of water was added to 1 ml of the extract in a test tube. The mixture was shaken vigorously and observed for the formation of persistent foam that will confirms the presence of saponins.[13]

2.3.10. Test for Sterols (Liebermann-Burchard test)

1 ml of each extract was treated with 1-2 drops of chloroform, acetic anhydride and conc. H_2SO_4 and observed for the formation of deep pink or red colour.[14, 13]

2.3.11. Test for Tannins (Braymer's test)

1 ml of each extract was treated with 10 % alcoholic $FeCl_3$ solution and observed for formation of blue or greenish colour solution. [14, 13]

2.4. Proximate Analysis

Moisture content, crude protein, fat, ash and fibre contents were determined in triplicates by standard Methods [15]. Moisture content was determined by heating 3.0 g of each sample to a constant weight in a crucible placed in an oven (Plus11 Sanyo Gallenkamp PLC, UK) maintained at 105 ^{o} C for 4 hr Ash. Ash content was determined by the incineration of 1.0 g samples placed in a muffle furnace (LMF4 from Carbolite, Bamford, Sheffield UK) maintained at 550 ^{o} C for 5 hours. Crude protein (% total nitrogen × 6.25) was determined by Khedjal method (Khedjahl 1883), using 1.0 g samples; crude fat was obtained by exhaustively extracting 5.0 g of each sample in a Soxhlet apparatus model number LTSW-5 using petroleum ether (boiling range 40 - 60 ^{o} C) as the extractant. [16]

2.5. Energy Value

Nuts samples (25 mg) was pelleted and ignited in a XRY- 1A oxygen bomb calorimeter at 25 ATP. This oxidized food caused a rise in temperature (t ^{o} C) of surrounding water in the calorimeter, and the temperature increase was used to estimate the energy value of the food. The length (L) of wire consumed from the ignited wire was estimated. The heat of combustion of the food expressed as gross energy was calculated using the expression:

Gross energy = (W × T-2.3L-V) / g.

Where W = Energy equivalent of calorimeter, T = Temperature rise, 233 = Constant heat of combustion of wire, G = Weight of sample in grams, V = Volume of gas generated.

2.6. Digestion and Analysis for Minerals

Analysis for sodium, potassium, calcium, sodium, phosphorus, copper, iron, magnesium, selenium, and zinc was carried out after wet digestion using the method. [15] metals were determined in the entire apple, nuts, leaves, and bark of the two varieties using atomic absorption spectroscopy (AAS 320N). Standard operating parameters was set and given in table 3. The hollow cathode lamps for Cu, k, Ca, Mg, P, Na, Zn and Fe were used as radiation sources and fuel was air acetylene. All the samples and standards were run.

2.7. Determination of Vitamins

2.7.1. Determination of Ascorbic Acid (Vitamin C) Content

Vitamin C was determined by using the procedure as outlined by Food Analysis Laboratory Manual Chapter 7 Vitamin C Determination by [17].

2.7.2. Determination of Niacin Content

Niacin content was determined according to the method of [18].

2.7.3. Riboflavin content was determined according to the method of [17]. Each of the samples (5 g) was mixed with 50 ml of 0.2 N HCl in a 100 ml conical flask, boiled for 1 hour, and cooled under tap water. The pH of the mixtures was adjusted to 6.0 using a 0.5 M NaOH solution and then readjusted to 4.5 using 1N HCl to facilitate precipitation of all interfering materials. It was diluted to the 100-ml mark of the flask and then filtered through a double-fold filter paper. Ten (10) ml of the filtrate was added to each of four separate test tubes. To each of the first two test tubes was added 1 ml of distilled water, while to each of the remaining two test tubes was added 1 ml of riboflavin standard (0.5 g/mml). One (1.0) ml of glacial acetic acid and 0.5 ml of 3% $KMnO_4$ were added to each of the tubes, and the tubes were shaken vigorously. Fluorescence was measured at 440 nm extinction and at 565 nm emission for the sample tube containing water, and then repeated on the same sample after mixing with 20 mg of $Na_2S_2O_4$. The fluorescence of the standard was also measured at 440 nm excitation and 565 nm emission. Riboflavin concentration was estimated using the formula:

µg Riboflavin / g sample = [(A – C) / (B – A)] x (S / V) x (F / W)

Where, A = Fluorescence of sample containing water, B = Fluorescence of sample containing riboflavin standard, C = Fluorescence of sample containing $Na_2S_2O_4$, S = Concentration of standard (µg / ml), V = Volume of sample extract used for fluorescence measurement, W = Weight (g) of sample used, F = Dilution factor.

2.8. Determination of Thiamine Content

The method of AOAC [17] was used to determine the thiamine content in the samples. Five grams of each of the samples was homogenised with ethanoic sodium hydroxide (50 ml). Each homogenate was filtered into a 100 ml flask, and 10 ml of the filtrate pipetted into a test tube to which 10 ml of potassium dichromate was added to develop colour. A blank sample was prepared and the colour also developed. Absorbance of samples was read at 360 nm. A standard solution was prepared using thalamic acid to get 100 ppm and serial dilutions of 0.0, 0.2, 0.4 and 0.8 ppm was made. This was used to plot a calibration curve from which thiamine contents of the samples was extrapolated using the absorbance value.

2.9. Determination of Total Phenol

Total phenol content was determined using Folin-ciocalteau method [19] Folin-ciocalteau method allows the estimation of all flavonoids, anthocyanins, and nonflavonoid phenolic compounds, including phenols and tannins, that is, all phenolics present in the sample [19]. The total phenol content of the various samples was determined by mixing 0.5ml aliquot of freshly prepared sample extract with equal volume of water, 0.5 ml Folin-Ciocalteu's reagent, and 2.5 ml of saturated solution of sodium carbonate (Na_2C0_3). The absorbance was measured after 40 min at 725 nm [20]. Garlic acid was used at concentrations of 0.0, 3.0, 6.0, 12.0, 18.0, 24.0 and 30.0 µg / ml to prepare total phenol standard curve. Total phenol content was extrapolated from the standard curve using the absorbance values and expressed as garlic acid equivalents (GAE / 100 g).

3. Results and discussion

The results of the extracts of the different parts of the samples of yellow and red verities screened for the presence of phytochemicals are presented in Tables 1 and 2, which show that various phytochemicals and selected nutritive contents, namely protein, saponins, sterols, phenols, tannins, terpenoids, quinones, alkaloids, flavonoids, carbohydrates, and cardiac glycosides, were present. Out of sixteen extracts screened, flavonoids, glycosides, phenols, and proteins were present in fifteen extracts except the acetone extract of the bark. Also, of the sixteen extracts, glycosides, flavonoids, phenols, proteins, and quinones were present in fifteen extracts except the acetone extract of the bark (Table 2). It is important to note that the present investigation showed that there is strong evidence that the apple, leaves, nut, and bark of *A. occidentale* are potential sources of carbohydrates, flavonoids, cardiac glycosides, alkaloids, and other diverse groups of phytochemicals. The bark and leaves of *A. occidentale* (Cashew) are traditionally used to treat many diseases such as vaginal discharge, common diarrhea, diabetes, weakness, muscular debility, urinary disorders, asthma,

eczema, psoriasis, scrofula, dyspepsia, genital problems, bronchitis, cough, intestinal colic, leishmaniosis, and venereal diseases. [21] The results of this work are in agreement with the research carried out by [22] which showed that the methanol extract of the leaves of *A. occidentale* screened for the presence of phytochemicals revealed that the extracts contain carbohydrates, proteins, flavonoids, alkaloids, and amino acids. The results showed that the plant *Anacardium occidentale (*apple juice, nuts, leaves, and bark) is a potential source of a diverse group of phytochemicals that could be employed for different purposes

Table 1 Results of Phytochemical and selected Nutritive content Screening of Different Extracts of Apple Juice, Bark, Leaves and Nut of *A. occidentale* Yellow Variety

phytochemicals	**Apple**				**Bark**				**Leaves**				**Nuts**			
	EX1 Chloroform	**EX 2 Hexane**	**Ex 3 acetone**	**EX 4 methanol**	**EX1 Chloroform**	**EX 2 Hexane**	**Ex 3 acetone**	**EX 4 Methanol**	**EX1 Chloroform**	**EX 2 hexane**	**Ex 3 acetone**	**EX 4 methanol**	**EX1 Chloroform**	**EX 2 hexane**	**Ex 3 acetone**	**EX 4 methanol**
Alkaloids	++	+	+	+	+	++	+	+	+	+	+	+	+	+	+	+
C. glycosides	+	+	+	+	+	+	_	+	+	+	+	+	+	+	+	++
Flavonoids	+	+	+	+	+	+	_	+	+	+	+	+	+	+	+	+
Phenols	+	+	+	+	+	+	_	+	+	+	+	+	+	+	+	+
Proteins	+	+	+	+	+	+	_	+	+	+	+	+	+	+	+	+
Saponins	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Steroids	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tannins	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	++
Carbohydrate	++	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Quinones	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Terpenoids	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	++

Table 2 Results of Phytochemical and selected Nutritive content Screening of Different Extracts of Apple Juice, Bark, Leaves and Nut of *A. Occidentale* Red Variety

phytochemicals	**Apple**				**Bark**				**Leaves**				**Nuts**			
	EX1 chloroform	**EX 2 hexane**	**Ex 3 acetone**	**EX 4 methanol**	**EX1 chloroform**	**EX 2 hexane**	**Ex 3 acetone**	**EX 4 Methanol**	**EX1 chloroform**	**EX 2 hexane**	**Ex 3 acetone**	**EX 4 methanol**	**EX1 chloroform**	**EX 2 hexane**	**Ex 3 acetone**	**EX 4 methanol**
Alkaloids	++	+	+	+	+	++	+	+	+	+	+	+	+	+	+	+
C. glycosides	+	+	+	+	+	+	_	+	+	+	+	+	+	+	+	++
Flavonoids	+	+	+	+	+	+	_	+	+	+	+	+	+	+	+	+
Phenols	+	+	+	+	+	+	_	+	+	+	+	+	+	+	+	+
Proteins	+	+	+	+	+	+	_	+	+	+	+	+	+	+	+	+
Saponins	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Sterols	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tannins	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	++
Carbohydrate	++	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Quinones	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+
Terpenoids	+	+	+	+	+	+	+	+	+	+	+	+	+	+	++	-

The results of the proximate compositions of cashew nuts, apples, leaves, and barks from red and yellow varieties of A. *occidentale* are presented in Table 3. The results revealed the percentage moisture contents were highest in the apple of the two varieties, with values of 18.00 and 18.98 % for the two varieties, respectively, and least in the bark, with values of 6.00 and 6.12% for the two varieties. There was no significant difference (p 0.05) in percentage moisture content or percentage ash content between the two varieties. Cashew Apple, Nuts, and Bark from the yellow variety had higher moisture (18.98%, 8.34%), and (6.12 %) than the red varieties (18.00 %, 7.77 %), and 6.0 %), respectively. The percentage ash contents showed that the yellow varieties of the apple, nuts, leaves, and bark had higher ash contents (8.54 %), (4.97 %), (3.51 %), and (2.51 %) than the red varieties of the apple, nuts, leaves, and bark, with values of (8.34 %), (4.87 %), 3.50 %), and (2.30 %), respectively.

Cashew apples, nuts, and leaves of the red variety had higher crude protein (19.10 %), (29.78 %), and (0.14 %) than the yellow variety (19.02 %), (27.54 %), and (0.12 %), respectively. The yellow variety of bark had a higher crude protein content (1.15 %) than the red variety (1.13%). Cashew nuts, leaves, and bark of the red variety had higher crude fiber (4.29 %, 3.50 %, and 1.50 %, respectively) than the yellow variety (2.87 %, 3.40 %, and 1.40%, respectively). The yellow variety of apple had higher crude fibers (12.68 %) than the red variety (12.58 %). There was no significant difference (p 0.05) in the percentage of crude protein and crude fiber between the two varieties. The yellow variety of leaves and barks had higher fat content (24.50 %) and 5.50 % than the red variety 24.00 % and 5.00 %, respectively. Cashew apples and nuts from the red variety had higher fat content (4.93 %) and (47.27 %) than the yellow varieties (4.84 %) and (45.0 %), respectively.

There was no significant difference ($p<0.05$) in percentage fat contents of the two varieties. The red cashew nut had higher energy value (138) than the yellow cashew nut (137).

Table 3 Results of Proximate Composition of Samples two Varieties of *A. occidentale*. Values are means ± standard deviation of triplicate determinations. Means with same superscript within the same column are not significantly different ($p>0.05$)

Parameters	Apple		Nuts		Leaves		Barks	
	Red variety	Yellow variety	Red variety	Yellow variety	Red variety	Yellow variety	Red variety	Yellow variety
Moisture content%	18.00 ± 1.01	18.98 ± 1.01	7.77^{a}±0.04	8.34^{b}±0.85	14.00 ± 1.01	13.98±1.01	6.00 ±1.01	6.12±1.01
Ash content %	8.34 ± 0.07	8.54 ± 0.07	4.87^{a}±0.35	4.97^{a}±0.07	3.50 ± 0.09	3.51 ± 0.09	2.30 ± 0.09	2.51 ± 0.09
Crude protein %	19.10±0.23	19.02±0.23	29.78^{a}± 0.25	27.54^{b}±0.85	0.14 ± 0.00	0.12 ± 0.00	1.13 ± 0.00	1.15 ± 0.00
Crude fibre %	12.58±0.47	12.68±0.47	4.29b±0.01	2.87^{a}±0.12	3.50 ± 0.09	3.40 ±0.09	1.50 ± 0.09	1.40 ±0.09
Fat Content %	4.93±0.35	4.84±0.35	47.27^{a}±2.2	45.0^{a}±0.35	24.00 ± 1.20	24.50±1.20	5.00 ± 1.20	5.50±1.20
Energy Value			138	137				

The low moisture content observed in the cashew nuts suggests that they could have improved shelf life. The low moisture content observed in this study is in agreement with the low moisture content of undefeated cashew nut flour (5.7%) reported by [23] and roasted cashew nut flower flour (5.9%) by[24]. The range of 4.87% to 4.97% observed in the ash content of the red and yellow specie of cashew is within the range of 2.74 – 4.14 reported by [26] but lower than 4.41% in [25] and higher than 2.91% and 3.38% reported by[24]. The high protein values observed in this study suggests that roast cashew nuts could be important sources of protein in the diet and its consumption could contribute immensely to an individual's protein requirement [26]. The protein content of 26.54% and 24.78 % observed in the nuts

from the red and yellow specie of cashew respectively is related to 26.15% observed by [24]. But higher than 17.5% reported by Griffin *et al.,* [27] and 21.8% observed by Ogungbenle *et al.,* [24] and lower than 27.31% in [25]. The fat composition of the samples did not differ considerably, with the red variety having more fat (44.27 %) than the yellow variant (40.05%). This corresponds to the fat level of 39.88-47.10 reported by Lima [26].

The mineral compositions of nuts, apples, leaves and bark from red and yellow varieties of cashew are presented in Table 4. The highest potassium contents occurred in the apple juice with the value of 41.28±4.31 mg in the red variety followed by 38.52±011 mg in the nut of the yellow variety, with the least value of 0.43±001 mg in the leaves of the yellow variety. Generally, phosphorus had the highest value of 128.62±0.17 mg among the minerals studied followed by copper (61.28±0.01 mg) in the nut and apple juice of the samples. There was no significant difference ($p<0.05$) in all the minerals tested in this study. The red varieties of the nut, apple, leaves had higher potassium, (39.52 mg), (41.28 mg), (0.46 mg) and (7.46 mg) respectively than the yellow variety (38.52 mg), (36.93 mg), (0.43 mg) and (7.43 mg). The yellow varieties of nuts, apple, leaves and bark had higher magnesium (37.57 mg), (43.44 mg), (21.30 mg), and (12.30 mg) respectively than the red variety, (36.87 mg), (42.60 mg), (21.30 mg) and (11.30 mg).

The red of nuts, apple, leaves and bark had higher phosphorus which ranged from 3.12 - 129.52 mg, than the yellow varieties The red varieties of nut, and leaves had higher zinc (2.24 mg), (4.47 mg), and (17.89 mg) respectively than the yellow variety, (1.19 mg), (3.55 mg) and 17.87 mg).

The yellow variety of the apple, leaves and bark had higher iron (44.80 mg), (48.00 mg), and (10.80 mg) than the red variety, respectively (35.10 mg), (46.20 mg), and (9.20 mg). The red variety of the apple, leaves and bark had higher sodium, (23.01 mg), (0.25 mg) and 3.25 mg) respectively than the yellow variety (21.03 mg), (0.23 mg), and (2.23 mg). The red variety of nut, apple and bark had higher calcium (3.28 mg), (1.28 mg), and (3.62 mg) respectively than the yellow variety. Copper levels were greater in the red varieties of nuts, apple, leaves, and bark (61.28 mg), (45.28 mg), (12.2 mg), and (6.2 mg), respectively, than in the yellow variety (60.88 mg), 44.28 mg), (11.8 mg), and 5.8 mg). These findings corroborate the mineral content of cashew nuts reported by Emelike et al., [24, 28, and 25].

Table 4 Results of Mineral Composition of Samples

Parameters	**Nuts**		**Apple**		**Leaves**		**Barks**	
	Red variety	Yellow variety	Red specie	Yellow variety	Red variety	Yellow variety	Red variety	Yellow variety
Potassium (mg)	39.52^{a} ±0.11	38.52^{a} ±0.11	41.28±4.31^{a}	36.93±1.15^{b}	0.46±0.01^{a}	0.43±0.01^{a}	7.46±0.01^{a}	7.43±0.01^{a}
Magnesium (mg)	36.87^{b} ±0.04	37.57^{a}±0.18	42.60±0.24^{b}	43.44±0.31^{a}	21.28±0.24^{b}	21.30±0.31^{a}	11.28±0.24^{b}	12.30±0.31^{a}
Phosphorus (mg)	129.52^{a}±0.25	128.62^{b} ±0.17	121.52^{a}±0.25	120.62^{b} ±0.17	0.12^{a}±0.25	0.11^{b} ±0.17	3.12^{a}±0.25	3.11^{b} ±0.17
Zinc (mg)	2.24^{b}±0.00	1.19^{a}±0.01	4.47±0.01^{a}	3.55±0.01^{b}	17.89±0.01^{a}	17.87±0.01^{b}	6.87±0.01^{a}	6.89±0.01^{b}
Iron (mg)	1.85^{b} ± 0.01	1.78^{a} ± 0.00	35.10±0.10^{b}	44.80±0.11^{a}	46.20±0.10^{b}	48.00±0.11^{a}	9.20±0.10^{b}	10.80±0.11^{a}
Sodium (mg)	19.02^{a}±2.1	21.21^{a} ±0.2	23.01±0.42^{a}	21.03±0.22^{b}	0.25±0.42^{a}	0.23±0.22^{b}	3.25±0.42^{a}	2.23±0.22^{b}
Calcium (mg)	3.28±0.01^{a}	2.98±0.01^{a}	1.28±0.01^{a}	0.86±0.01^{b}	1.22±0.51^{a}	1.25±0.10^{b}	3.62±0.51^{a}	3.25±0.10^{b}
Copper (mg)	61.28±0.01^{a}	60.88±0.01^{a}	45.28±0.01^{a}	44.28±0.01^{a}	12.2±0.01^{a}	11.8±0.01^{b}	6.2±0.01^{a}	5.8±0.01^{b}

Values are means ± standard deviation of triplicate determinations. Means with same superscript within the same column are not significantly different at $p>0.05$

Table 5 Results of Vitamins Compositions of Samples

Parameters	**Nuts**		**Apple**		**Leaves**		**Barks**	
	Red variety	Yellow variety	Red variety	Yellow variety	Red variety	Yellow variety	Red variety	Yellow variety
Vitamin C Mcg	35.51^{a} ± 0.13	35.37^{a} ± 0.52	57.51^{a} ± 0.13	57.37^{a} ± 0.52 1	28.60^{a} ± 0.13	26.20^{a}±0.52	14.40^{a} ± 0.13	14.20^{a} ±0.52
Niacin Mcg	1.87^{a} ±0.04	1.77^{a} ±0.04	11.87^{a} ±0.04	11.77^{a} ±0.04	0.12^{a} ±0.04	0.06^{b} ±0.04	0.12^{a} ±0.04	0.11^{b} ±0.02
Riboflavin Mcg	3.84± 0.13	3.82± 0.13	9.50± 0.13	9.2 0± 0.13	5.90± 0.13	4.90 ± 0.14^{b}	2.00± 0.13	2.90 ± 0.14^{b}
Thiamine Mcg	12.60±0.04	12.70±0.04	15.60±0.04	15.70±0.04	10.50±0.04	11.00±0.06	7.00±0.04	7.25±0.06

Values are means ± standard deviation of the triplicate determinations. Means with same superscript within the same Column are not significantly different (p>0.05)

The results of the vitamin content of the samples studied are presented in Table 5. The red varieties of the nuts, apples, and leaves had higher vitamin C levels (35.51 mcg, 57.37 mcg, 28.60 mcg, and 14.40 mcg, respectively) than the yellow varieties. The red varieties of the nut, apple, and leaf had higher niacin levels (B3) (1.87 mcg, 11.84 mcg, and 0.12 mcg, respectively) than the yellow varieties (1.77 mcg, 11.77 mcg, 0.06 mcg, and 0.11 mcg). The red varieties of the nuts, apples, and leaves had higher riboflavin (B_2) levels (3.84 mcg), (9.50 mcg), and (5.90 mcg), respectively, than the yellow varieties (3.82 mg), (9.20 mcg), and (2.00 mcg). The yellow varieties of the nuts, leaves, apple, and bark had higher thiamine (B1) levels (12.70 mcg), (15.70 mcg), (11.0 mcg), and (7.25 mcg), respectively, than the red varieties (12.60 mcg), (15.60 mcg), (10.50 mcg), and (7.00 mcg). There was no significant difference ($p > 0.05$) in the vitamin content of both samples.

Niacin a fat-soluble vitamin is known to be predominant in nuts and the apple and oily foods, which possesses neuro protective, anticancer and cholesterol lowering properties [29]. The Niacin content observed in this study is higher than the Niacin content of cashew nut flour reported by [27]. Riboflavin (vitamin B_2) works with the other B vitamins. It is important for body growth. It helps in red blood cell production. It also aids in the release of energy from proteins Riboflavin of cashew nuts from various origin, according to Rico et *al.,* [30] Thiamine (vitamin B_1) helps the body's cells change carbohydrates into energy. Vitamin B1, or thiamine, helps prevent complications in the nervous system, brain, muscles, heart, stomach, and intestines. It is also involved in the flow of electrolytes into and out of muscle and nerve cells.

4. Conclusion

The results of this study provided enough evidence that *Anacardium occidentale L,* of the two varieties, had shown significant levels of various functional food constituents that are the primary protective fruits in diet, besides providing essential nutrients. They are also reservoirs of bioactive compounds. Many of these bioactive compounds are reported to possess antioxidant, immunomodulatory, anti-osteoporotic, anti-hypertensive, antimicrobial, antidiabetic, and anti-cancer properties and therefore can be used to provide low-cost nutritional and dietary supplements for low-income groups. Cashew leaves and barkfibers in particular could also be used as a potential source of constituents in the development of nutraceuticals and functional foods for the control, management, and treatment of health disorders. The usage of cashew leaf and stem bark extract will have the added benefit of increasing value addition since the high zinc content of cashew functions as an anti-inflammatory, helping to protect and enhance the immune system against inflammatory disorders such as COVID-19.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to disclosed.

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