Original Article

TIPS Trends in Pharmaceutical Sciences 2024: 10(3): 223-234.

Assesment of Nutraceutical Profiles and FTIRS Analysis of *Celosia argentea* (L.) Aqueous Leave Extract

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Abstract

The movement of nutrients and metabolites changes constantly in various plant organs and tissues during growth and development. *Celosia argentea*, a common vegetable in West and Central Africa is commonly cultivated for decorative use in regions like Malaysia in the tropics and subtropics. The objective of this research is to analyze the FTIR profile spectrophotometry, phytochemicals, mineral composition, vitamins, Proximate, and *in vitro* antioxidant activities of *Celosia argentea* leaves aqueous extract. Standard procedures were used to conduct Qualitative and Quantitative phytochemical screening and spectra infrared profile analysis. Minerals were determined with an inductively coupled plasma-optical emission spectrometer, while proximate and vitamins were analyzed using AOAC methods. The antioxidant activity was assessed using the DPPH method. The antioxidant activity is directly linked to the presence of hydroxyl groups in phenolic compounds. The phytochemical analysis showed that the aqueous leaf extract of *Celosia argentea* has a significant level of alkaloids, saponins, tannins, flavonoids, and glycosides. Mineral analysis indicated a higher amount of calcium (375.14 mg/100 g) and a lower amount of Lead (0.08 mg/100 g). The scavenging activity of *Celosia argentea* against DPPH increased as the concentrations increased. The maximum scavenging activity of *Celosia argentea* was observed to be 93. 83% at a concentration of 0.5 mg/ml. Vitamins A, C, and E are found in substantial amounts, with vitamin E having the highest concentration at 201.54 mg/100 g DW. In summary, this study shows that *Celosia argentea* leaves have therapeutic benefits because of their bioactive compounds, proximate, Vitamins, and minerals. *Celosia argentea* has strong antioxidant properties & effective against oxidative harm.

Keywords: *Celosia argentea*, DPPH, Minerals, Phytochemicals, vitamins. FTIRs.

Please cite this article as: Ibrahim M I*, Abubakar S, Alkasim SM, Olime MN, Ndukaire VO. Assesment of Nutraceutical Profiles and FTIRS Analysis of *Celosia argentea* (L.) Aqueous Leave Extract. Trends in Pharmaceutical Sciences. 2024;10(3):223-234. doi: 10.30476/tips.2024.104032.1257

1. Introduction

Plants are the primary source of medicine: Currently, a significant amount of medications come from plants. A considerable amount of these medications have been found using traditional plant uses gathered from ethnobotanical knowledge. The World Health Organization (WHO) suggests that currently 80% of the global population relies on herbal medicine for basic health care. Traditional healers have utilized plants for a long time to prevent or treat infectious illnesses. A significant number of these plants have been studied for their antimicrobial properties and numerous plant-based substances have been found to avoid

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Received: 24/07/2024; Accepted: 01/09/2024

the growth of harmful microorganisms. Studying plants and plant products for their effectiveness against resistant bacteria is a valuable pursuit. Currently, there is an increasing curiosity in exploring the chemical components of a medicinal plant and its effects on the body (1).

Celosia argentea, also called sokoyokoto by the Yorubas in southwestern Nigeria, is a yearly herbaceous plant belonging to the Amaranthaceae family. The leaves and stems are boiled in soups, sauces, or stews along with different ingredients (2). In India, honey-infused leaves are used on swollen areas and the seeds are utilized for managing diabetes mellitus (2). In Southeast Asia, flowers are utilized as a medicinal treatment for dysentery, hemoptysis, and menstruation issues (3). In Ethiopia and the Democratic Republic of Congo, seeds are used to treat diarrhea, dysentery, and muscle ailments. In Kenya, the Masai utilize the liquid extract as a body cleanser for those recovering from illness (3). *Celosia argentea* has external uses such as disinfecting, treating inflammation, dysuria, poultices for broken bones, ailments for the eyes and liver, mouth sores, blood diseases, and more (4). The objective of this study is to analyze the IR Spectroscopy, phytochemicals, mineral, Proximate, Vitamin contents, and antioxidant properties of *Celosia argentea* leaves aqueous extract (Figure 1).

2. Material and methods

2.1. Collection and identification

Freshly selected *Celosia argentea* leaves were collected from the staff quarters area of Sheda Science and Technology Complex (SHESTCO) in Abuja, Nigeria. After the leaves were identified and authenticated, they were washed and left to air dry at room temperature for two weeks. The dried leaves were crushed into a fine powder with an electric blender and kept in a cool, dry container until needed for analysis.

2.2. Preparation of leaves of Celosia argentea aqueous extract

150 g of *Celosia argentea* leaves were crushed into powder and then combined with 300 ml of distilled water in a glass bottle at a temperature of 25 °C. The bottles were sealed shut for three days and stirred from time to time each day before being filtered. The rotary evaporator was used to evaporate the extracts at temperatures lower than 50 °C in a water bath until a constant weight extract was achieved.

2.3. FTIR spectrum analysis

A FTIR spectrometer was used to identify the potential functional groups in the compounds found in the aqueous extract of *Celosia argentea* leaves. The aqueous extract of *Celosia argentea* leaves was combined with KBr salt and formed into a thin pellet. The spectrum results for the mixture were recorded using a Shimadzu FTIR Spectrometer 8000 series after placing them in a sample holder, with a scanning absorption range of 4,000 to 500 cm^{-1} (5).

2.4. Phytochemical Analysis

Qualitative and Quantitative analysis of Phytochemicals analysis was conducted on *Celosia argentea* leaves using water as a solvent. Alkaloids were tested using Mayor's test, while saponins were tested with the foam test. Tannins and phenols were screened using the Ferric Chloride test, flavonoids with the Sodium Hydroxide test, and glycosides with Legal's test (6-10).

Figure 1. *Celosia argentea* L.

2.5. Elemental analysis

Elemental analysis was conducted in three replicates according to (11) utilizing an Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES; Varian 710-ES series, SMM Instruments, Cape Town, South Africa). Determining elements involves using wavelengths, slits, and lamp current. The mineral contents results were reported as mg per 100 g of dry weight (DW).

2.6. Vitamins

2.6.1. Vitamin A

The samples were analyzed for retinol content using the method outlined by (12). In brief, 1 gram of the sample was crushed with 20 milliliters of petroleum ether. The mixture was left to react for 2 hours, then filtered, dried off, and finally treated with 0.2 mL of a mixture of chloroform and acetic anhydride (1:1 v/v). Afterwards, the mixture received an addition of 2 mL of 30% TCA-chloroform, and the absorbance at 620 nm was determined using a UV-3000 PC spectrophotometer. The retinol standard was prepared similarly. The vitamin A concentration in the sample was determined by using the equation from the standard curve (Equation 1).

$$Y = 0.001x+0.0008, R^2=0.9969 \quad \text{(Eq. 1)}$$

2.6.2. Vitamin C

The quantification of ascorbic acid (Vitamin C) was done through the titration method using 2, 6-Dichlorophenol-indo-phenol, sodium salt (DPIP) as outlined in reference (13). The 1 g samples were individually mixed with 40 of a buffer solution containing 1 g/L oxalic acid and 4 g/L sodium acetate anhydrous. The blend was titrated with a solution that had 295 mg/L DPIP and 100 mg/L sodium bicarbonate. The titration endpoint was determined when the original blue color vanished, and the findings were reported as mg per 100g of dry weight.

2.6.3. Vitamin E

According to the provided protocol by AOAC (14), it was used to analyze the vitamin E (α-tocopherol) content in the samples. 1 gram of the sample was crushed with 20 milliliters of ethanol. After filtering the solution with Whatman No. 1 filter paper, 1 mL of the filtered solution was mixed with 100 µL of 0.2% ferric chloride in ethanol and 1.0 mL of 0.5% α, α′-dipyridyl solution. Distilled water was added to the solution to increase the volume to 5 mL. UV-3000PC spectrophotometer was used to measure absorbance at 520 nm. The standard solutions had concentrations varying from 10 to 100 µg/mL. The vitamin E concentration in the samples was estimated by utilizing the standard curve equation (Equation 2).

$$Y = 0.0086x - 0.0216, R^2 = 0.9985 \quad \text{(Eq. 2)}$$

The vitamin E content in the samples was expressed as mg/100g DW.

2.7. DPPH (diphenyl-1-picrylhydrazyl) radical scavenging ability

The DPPH free radical scavenging activity of Celosia argentea leaves aqueous extract was determined using the DPPH method. This involved mixing 1ml of DPPH (0.01 mM in methanol) with 3.0ml of *Celosia argentea* leaves aqueous extract filtrate (concentrations ranging from 0.5 to 0.03125 mg/ml). After vortexing thoroughly, the reaction mixture was placed in the dark at room temperature for 30 minutes. The measurement of absorbance was done at a wavelength of 517 nm (15). The formula was used to determine the scavenging capacity (Equation 3):

$$DPPH\ scavenging\ activity(\%) = \left[\left(Abs_{control} - Abs_{sample}\right)\right] / \left(Abs_{control}\right)] \times 100 \quad \text{(Eq. 3)}$$

Where: Abscontrol is the absorbance of DPPH + methanol and Abssample is the absorbance of DPPH radical + sample (sample or standard).

2.8. Proximate

2.8.1. Moisture content

Air-oven was used to measure the moisture content by the procedures of the Association of Official Analytical Chemists (16). An empty weighing vessel was dried at 105 °C for 1 hour in a material test chamber and then weighed. The 5g dry sample was subsequently added to the container and dried in an oven at 105±1 °C until a constant weight was reached. After that, it was cooled in a desiccator and then weighed as W3. The amount of moisture present was determined by calculating

the percentage (Equation 4).

$$\%Moisture_{content} = W2 - W3 / W2 - W1 \times 100 \quad \text{(Eq. 4)}$$

Where W1 = weight of the empty vessel. W2 = weight of the vessel+ sample. W3 = weight of vessel + dried sample.

2.8.2. Ash content

The dry ashing method was used to determine the ash content (16). The porcelain crucible was dried for 1 hour at 105 °C, cooled in a desiccator, and then weighed to obtain weight (W1). The 2 g samples were put in the crucible that was weighed beforehand and weighed again as W2. The container and its contents were heated to 250 °C for 1 hour, then to 550 °C for 5 hours, cooled, and weighed (W3). The ash percentage was determined by calculation (Equation 5).

$$\%Ash_{content} = W2W3 / W2W1 \times 100 \quad \text{(Eq. 5)}$$

Where W1 = weight of a dried porcelain crucible. W2 = weight of the crucible + sample. W3 = weight of the crucible + ashed sample.

2.8.3. Crude lipid

The Soxhlet extraction technique was used to analyze crude lipid content (16). 100 mL of petroleum ether was used to extract the lipid content from the 5 g sample. The blend underwent filtration, and the lipid concentration was gathered in a previously weighed (W1) pristine container. Afterward, the sample underwent thorough lipid extraction using 100mL of petroleum ether for 24 hours. It was subsequently strained and poured into a beaker marked as (W1). The lipid content was evaporated to dryness using a steam bath and then dried in an oven at 40-60 °C before reweighing the beaker (W2). Lipid percentage was determined by calculation (Equation 6).

$$\%\ Crude\ lipid\ = W2 - W1 / Weight\ of\ original\ sample \times 100 \quad \text{(Eq. 6)}$$

2.8.4. Crude fiber

A revised version of the acid/base digestion technique outlined by (16) was employed to ascertain the dietary fiber. 5g of sample was treated with 100 mL of 0.25 M sulfuric acid solution through boiling under reflux for 30 minutes before being promptly filtered. The immiscible substance was washed four times with hot water to eliminate the leftover acid. The residue was subjected to the same process with 100mL of 0.31 M sodium hydroxide solution. The remaining residue was rinsed with water until all bases were removed. After being dried in an oven at 100 °C, the sample was cooled in a desiccator and its weight was measured (C1). The sample was heated in a muffle furnace at 550 °C for 5 hours, then cooled in a desiccator before being weighed (C2). The crude fiber percentage was determined as (Equation 7):

$$\%Crude\ fiber = C2 - C1 /\ Weight\ of\ sample \times 100 \quad \text{(Eq. 7)}$$

2.8.5. Determination of crude protein

The sample's total nitrogen content was analyzed using the micro Kjeldahl method (16). The sample (2 g) was digested in a Kjeldahl flask by heating 20 mL of concentrated H_2SO_4 and a Kjeldahl digestion tablet until a transparent solution was achieved. The filtered digest was poured into a 250 mL volumetric flask, filled up with distilled water to the mark, and prepared for distillation. Ammonia was extracted through steam distillation from the mixture containing 50mL of 45% NaOH solution. 150 mL of the distillate was gathered in a conical flask with 100 mL of 0.1 N HCl, while methyl orange served as the indicator. The acid in the receiving flask was reacted with ammonia and the percentage of nitrogen (N) was determined through back titration with 2M NaOH. The following equation is used to calculate nitrogen (Equation 8).

$$\frac{\left[\left(mL\ standard\ acid \times N\ of\ acid\right) - \left(mL\ blank\ of\ base\right)\right] - \left(mL\ STD:\ base \times N\ of\ base\right) \times 1:4007}{Weight\ of\ sample\ (g)} \quad \text{(Eq. 8)}$$

Where, N = normality, the percentage of crude protein was obtained by multiplying the nitrogen value by a factor of 6.25. % crude protein = Nitrogen in sample × 6.25.

2.8.6. Total carbohydrate content

The amount of carbohydrates was calculated by subtracting the combined total of crude protein, crude fiber, ash, and lipid from the total dry matter as (Equation 9):

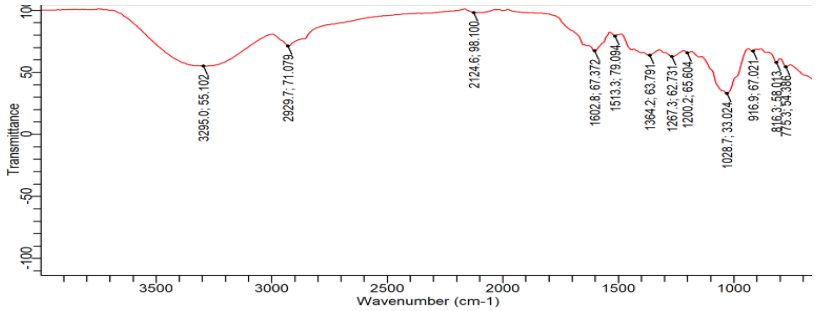

Figure 2. Infrared spectrum of aqueous leaf extract of *Celosia argentea*.

$$\%Total\ carbohydrate = 100 - (\%\ Moisture_{content} + \%\ Total\ Ash + \%crude\ fat + \%\ crude\ fiber + \%\ crude\ protein) \quad \text{(Eq. 9)}$$

2.8.7. Energy content

The samples' total energy was determined using the difference technique. To determine the caloric value, factors 4, 9, and 4 kcal were used for crude protein, crude lipid, and carbohydrate, adding the products of these factors to get the total value (Equation 10).

$$Energy\ value(kcal/100\ g) = (crude\ protein \times 4) + (crude\ lipid \times 9) + (total\ carbohydrate \times 4) \quad \text{(Eq. 10)}$$

3. Results and discussion

3.1 FTIR Profile Analysis of the Extracts

Infrared spectroscopy was used to predict the functional groups present in the leaf of aqueous extract of *Celosia argentea*. The bonds were identified through the analysis of the infrared absorption spectra. Table I and Figure 2, illustrate the occurrence of functional groups in the aqueous leaf extract of *Celosia argentea*. The intense peaks are found at 3295.0 cm^{-1}, suggesting the vibration of O-H stretching. The frequency vibration of the C-H bond in the alkyl group was observed at 2929.7 cm^{-1}. The amide peak corresponds to the stretching vibration of the C-O group at 1602.8 cm^{-1}. The C=O stretching peak at 1267.3 cm^{-1} is associated with the phenolic functional group. The IR spectra show that there is a low amount of phenolic in *Celosia argentea*. The aqueous leaf extract of *Celosia argentea* contains various groups including alkane, aromatic amine, primarily alcohol, and aromatic ring. The current research findings suggest that FTIR analysis indicates the presence of potential functional groups in the watery leaf extract of *Celosia argentea*. It can identify the plant part with the highest amount of phytoconstituents that can be utilized as a nutritious vegetable.

3.2. Phytochemical analysis

This research indicated the possible medicinal benefits of the aqueous extract of *Celosia argentea* leaves, as it was found to have flavonoids, phenolic compounds, saponins, glycosides, steroids, and alkaloids during qualitative phytochemistry analysis. The study's quantitative analysis revealed that the aqueous extract has a higher flavonoid content of 5.21±mg/100g. The scientific reason behind using *Celosia argentea* for treating various conditions like skin diseases, piles, dysentery, inflammation, and hematological and gynaecologic disorders could be due to the reported wide range of biological activities of Flavonoids. Consisting of anti-inflammatory, antibacterial, an-

Table 1. Infrared spectra peak values and functional groups of aqueous extract of *Celosia argentea*.

Functional group	Band (cm^{-1}) of *Celosia argentea*.	Type of vibration
Aromatic ring	775.3	C-H out of the plane bend
Primarily alcohol	1028.7	C-O stretch
Phenol	1267.3	C-O stretch
Aromatic amine	1364.2	C-N stretch
Alkene	1513.3	C=C stretch
Amide	1602.8	C=O stretch
Alkyl	2929.7	C-H stretch
Hydroxyl group	3295.0	O-H stretch

Table 2. Qualitative and Quantitative Phytochemical Analysis of *Celosia argentea* Aqueous Leaves.

Phytochemicals	*Celosia argentea* aqueous Leaves extract	Amount (mg/100g)
Tannins	+	2.15±0.04
Phenols	+	3.86±0.12
Saponins	+	1.82±0.73
Flavonoids	+	5.21±0.51
Alkaloids	+	1.63±0.07
Glycosides	+	0.74±0.21

Values are expressed as Mean ± Standard deviation.

tiviral, antiallergic, and cytotoxic antitumor properties, along with the ability to treat neurodegenerative diseases and have a vasodilatory effect (17). Tannins act as antioxidants, helping to prevent and repair cellular damage caused by free radicals' attack (17). There are two categories of tannins: hydrolyzable tannins and condensed tannins. Hydrolyzable tannins are capable of being broken down by either an acid or an enzyme to produce ester-like compounds made up of polymers of ellagic and gallic acids (18). Hydrolysable tannins display anti-angiogenic, anticancer, antioxidant, anti-ulcerative, and anti-inflammatory properties (18). On the flip side, condensed tannins come from catechins and flavan-3, 4-diols, and typically do not easily break down. Upon treatment with acids or enzymes, the compounds break down again into phlobaphenes (19). Saponins have been shown to possess properties such as lowering cholesterol, reducing inflammation, and acting as a cardiac depressant (19). Additionally, they have been found to effectively target and inhibit cancer cells without harming healthy cells (20). Additionally, saponins have been noted for their antimicrobial and antifungal properties (20), indicating the potential of *Celosia argentea* in treating fungal infections such as ringworm, guinea worm, skin diseases, and craw-craw. Saponins not only have antimicrobial and antifungal properties but also support digestion and improve nutrient absorption (21). Alkaloids possess a diverse array of physiological effects such as antibacterial, antimitotic, anti-inflammatory, analgesic, local anesthetic, hypnotic, psychotropic, and anticancer properties (21). Alkaloids like morphine, quinine, ephedrine, etc., have beneficial uses in dietary supplements and medications. They are an essential element in the process of organic synthesis (Table 2) (21).

3.3. Elemental mineral analysis result

Mineral elements in the diet are essential for proper and balanced human nourishment. They aid in numerous bodily functions, including but not limited to building and preserving healthy bones and teeth, maintaining muscle strength, and enhancing heart and brain function (22). The aqueous extract of *Celosia argentea* leaves analyzed in this study reveals high levels of calcium, potassium, sodium, magnesium, iron, zinc, and other minerals (Table 3). The sodium levels in *Celosia argentea* (94.02 mg/100 mg) were higher than in *Annona muricata* (69.49 mg/100 g) but lower than in *Vernonia amygdalina* (48.31 mg/100 g) according to sources (23). The amount of potassium in *Celosia argentea* leaf extract (213.21 mg/100 g) is significantly higher than that in *Annona muricata* (36.31mg/100 g) and *Vernonia amygdalina* (62.79 mg/100 g) (23). The calcium levels in *Celosia argentea* aqueous leaves extract (375.14 mg/100g) are lower than those found in *Annona muricata* (1118.30 mg/100 g) and *Vernonia amygdalina* (1264.18 mg/100 g) (23). Calcium plays a

Table 3. Mineral Composition of *Celosia argentea* aqueous Leaves extract (mg/100g).

Mineral	Amount (mg/100g)
Calcium	375.14±3.65
Magnesium	175.33±4.01
Potassium	213.21±5.08
Sodium	94.02±2.76
Phosphate	231.82±5.58
Iron	55.18±3.05
Zinc	12.44±0.90
Copper	4.11±0.76
Manganese	2.14±0.21
Chromium	0.49±0.05
Lead	0.08±0.01

Values are expressed as Mean ± Standard deviation.

crucial role in muscle contraction, as well as in the formation of bones, teeth, and blood clotting (24). Sodium and potassium, found in both intracellular and extracellular fluids, aid in regulating electrolyte balance and membrane fluidity. Inorganic mineral elements like potassium and calcium are recognized for their significant contributions to maintaining regular glucose tolerance and facilitating the release of insulin from the beta cells of the islets of Langerhans (25). The magnesium levels found in the aqueous extract of *Celosia argentea* leaves are lower at 175.33 mg/100 g when compared to the 961.9 mg/100 g of *Annona muricata* and 681.36 mg/100 g of *Vernonia amygdalina* (25). Magnesium is a component of chlorophyll and plays a crucial role in the development of Ischemic heart disease and maintaining calcium levels in bones (25). Certain minerals like magnesium are required as cofactors for enzyme catalysis within the body (25). The amount of zinc in *Celosia argentea* water leaves extract (12.44±mg/100 g) is significantly higher than in *Annona muricata* (0.83 mg/100 g) and *Vernonia amygdalina* (1.42 mg/100 g) (26). Zinc plays a role in the proper operation of the immune system (27) and is linked to protein metabolism. The leaves provide a high level of zinc, exceeding the RDA's recommended amount of 6.23 (27). The iron levels in *Celosia argentea* leaves extract (55.18±mg/100mg) were higher than in *Vernonia amygdalina* (32.20mg/100g) but lower than in *Annona muricata* (13.95 mg/100 g), according to Usunobun and Okolie (21). This could explain why the plant is already known locally for its role in regulating hemoglobin levels. Iron is a necessary trace element for the creation of hemoglobin, proper operation of the central nervous system, and the breakdown of carbohydrates, proteins, and fats (28). Iron is a necessary component in the transportation of oxygen and carbon dioxide in respiration or cellular metabolism, found in certain metalloenzymes, myoglobin, and hemoglobin (28). This hemoglobin with iron also acts as a buffer to control variations in blood pH (28). The study found copper levels to be 4.11± and manganese levels to be 2.14±. These trace elements are vital and required in very small quantities for biochemical functions in the human body. Manganese serves as a co-factor for numerous enzymes, playing a crucial role in the normal operation of the brain and the functioning of the nervous system in the entire body (29). Copper plays a vital role as a co-factor and component of various enzymes, necessary for the optimal functioning of organs and for boosting the immune system to combat infections (29). A lack of copper causes heart issues, while a shortage of manganese leads to bone issues, poor growth, and abnormal fat processing. The level of phosphate was 231.82, supporting *Celosia argentea* aqueous Leaves as a suitable source of phosphate in the diet since 118.3 mg of these leaves can supply the daily 1000 mg/day needed by adults (NHMRC, 2006). Phosphate is essential for cell development and upkeep, and aids in kidney function and recovery. It plays a role in creating adenosine triphosphate (ATP) and in producing DNA and RNA. It helps with calcium absorption and keeps the balance of acid and base in the body (30). In this study, the levels of lead and chromium were found to be 0.08± and 0.49±0.05, respectively. Increased levels of lead and chromium exceeding 0.3 mg/kg and 2.3 mg/kg respectively can result in hepatoxicity, according to the World Health Organization. They lead to the production of ROS, resulting in various damages and unwanted alterations in the liver (WHO).

3.4. In-Vitro Antioxidant Activity

The leaf's ability to scavenge DPPH radical is illustrated in Figure 3. The scavenging impact of aqueous extract from *Celosia argentea* leaves within the concentration range of 0.5-0.6125 mg/ml rose in correlation with the concentration. Celosia argentea and Vitamin C had the highest DPPH radical scavenging activity at a concentration of 0.5mg/ml, measuring 93.83% and 96.4% respectively. In terms of its ability to scavenge DPPH radicals, *Celosia argentea* leaf extract demonstrated a dose-dependent activity. When compared to the standard (Vitamin C), it is evident that *Celosia argentea* leaf extract can provide cellular protection against oxidative damage. The rise in DPPH radical scavenging with increasing concentration shows the strong antioxidant potential of *Celosia argentea*, supporting its use as an antidote by certain individuals.

3.5. Vitamins result

Table 4 shows the vitamin contents of Celosia argentea aqueous leaf extract. Vitamins are natural substances that support the body's growth

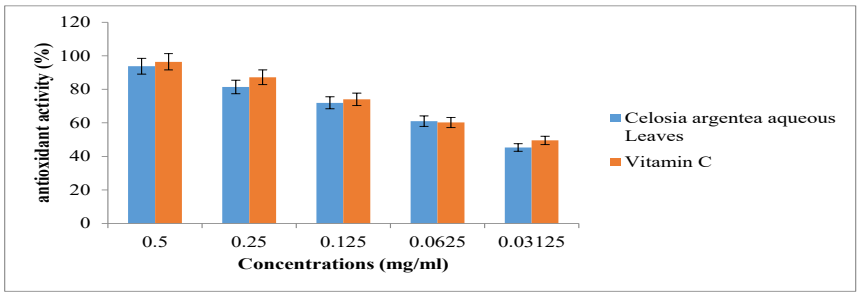

Figure 3. In-Vitro DPPH Antioxidant activity of *Celosia argentea* aqueous leaves extract.
Values are expressed as Mean ± Standard deviation.

and proper functioning through strengthening the immune system. Vitamin E (201.54) was found to be the most abundant vitamin among those examined in this research. Vitamin E's main biological role is to shield polyunsaturated fatty acids in cell membranes from free-radical harm during oxidative stress (31). A level of 32.42 was measured for the Vitamin A content, which is essential for the proper operation of the visual system, growth and development, upkeep of epithelial cellular integrity, immune function, and reproduction. With a vitamin C content of 11.81, it assists in the production of carnitine, hormones, collagen, and the absorption of iron. This substance is an antioxidant that dissolves in water and works by removing free radicals while also boosting the immune system, leading to improved health in humans. A lack of vitamin A can cause xerophthalmia and a lack of vitamin C can cause scurvy (32).

3.6. Proximate composition of Celosia argentea dry weight.

The moisture content, at 11.11%, indicates the water activity in various foods, which plays a role in preserving the cell's protoplasmic content and leaf texture (Table 5). It also enhances the function of water-soluble enzymes and coenzymes that play a role in plants' metabolic processes (33). Nevertheless, high moisture levels in foods are linked to microbial contamination and chemical degradation (33). The moisture level in ground *Celosia argentea* samples fell within the suitable range for preserving food. This outcome is similar to the results from (33) which stated the moisture content for the same species was 8.84%. Most leafy vegetables have protein content that falls between 1 to 7% of their fresh weight or 8 to 30% of their dry weight (34). The protein levels of *Celosia argentea* differ among the plants, as shown in this study. The protein content measured in this research was 19.43%, less than *Brassica oleracea* (24.32%) but more than *A. cruentus* (11.32%), *S. nigrum* (15.06%) and *Moringa oleifera* leaf (17.09%). This means that the aqueous extract of *Celosia argentea* can offer over 12% of the recommended dietary allowance (RDA) of protein for children, men, and women (34). Additionally, it has been documented that *Celosia argentea* protein includes all the crucial amino acids (33). Hence, *Celosia argentea* has the potential to be an excellent protein source to address protein deficiency (35). Fat found in food is one of the primary sources of energy in the human diet. It has a significant impact on how we taste food and aids in the absorption of certain fat-soluble vitamins within the body. Still, an abundance of saturated fat can result in elevated cholesterol levels, a primary fac-

Table 4. The vitamin contents of *Celosia argentea* aqueous leaf extract.

Vitamins	Quantity
Vitamin A ((µg /100 g DW))	32.42±2.09
Vitamin C (mg/100 g DW)	11.81±3.03
Vitamin E (mg /100 g DW)	201.54±16.2

Values are expressed as Mean ± Standard deviation.

Table 5. Result of Proximate Analysis of Celosia argentea aqueous leaves extract.

Parameters	Amount%
Moisture	11.11± 0.5
Protein	19.43± 0.32
Crude Fat	1.76± 0.24
Ash	17.04±0.63
Crude Fiber	21.15±0.48
Carbohydrate	29.43 ±0.11
calorific value (Kcal/100g)	211.28±0.21

Values are expressed as Mean ± Standard deviation.

tor in cardiovascular issues (35). Typically, green leafy vegetables are seen as a nutritious source of dietary fat due to their minimal fat content. The study found a crude fat content of 1.76% in *Celosia argentea*, indicating its potential for managing weight loss and certain chronic illnesses linked to high-fat levels. The quality of the elemental composition in a food sample is indicated by its ash content (33). The study found that the ash content was 17.04, which is less than the ash content reported by (34) (23.91%) and (34) (22.43%) for the same species. This suggests that *Celosia argentea* is rich in minerals and should be utilized to enhance the diet with micronutrients. Dietary fiber is essential for regulating bowel movements, preventing heart disease, and reducing cholesterol absorption. The percentage of fiber in *Celosia argentea* at 21.15% was greater than that in *Amaranthus cruentus* (8.45%) and *Solanum nigrum* (9.56%) (36). The significant amount of fiber found in the aqueous extract of *Celosia argentea* suggests that as the plant matures, its leaves and stem become more fibrous, potentially aiding in regulating intestinal transit, enhancing dietary bulk, and reducing the risk of metabolic disorders like colon cancer, obesity, and diabetes due to insufficient crude fiber consumption in humans (34). Carbohydrate is the main fuel for the body's functions. A total carbohydrate content of 29.43% was observed at a high level. This indicates that incorporating these vegetables into meals may improve nutrition by boosting the energy levels in the diet. The amount of carbohydrates in *Celosia argentea* leaves is greater than what was found in A. viridis (37) but less than in *Ocimum grattisimum* (55.42%) (37). Also, the estimated energy content of *Celosia argentea* leaf aqueous extract is high due to its abundant carbohydrates.

4. Conclusion

In summary, the study finds that the water-based leaf extract of *Celosia argentea* is abundant in phytoconstituents, minerals, and vitamins. FTIR also indicated the existence of polyphenol compounds in the water leaf extract of *Celosia argentea*. The extract of *Celosia argentea*'s leaves, when tested *in vitro* for antioxidant properties, exhibited significant scavenging activity against DPPH radicals with a value of 93.83%. The plant's high polyphenolic compounds could be responsible for its antioxidant activity. Therefore, this promising liquid extract from *Celosia argentea*'s leaves has valuable nutraceutical properties that can be used as a substitute for creating new drugs in medicine and pharmacology.

Acknowledgment

This profound appreciation goes to Dr. Ndatsu Yakubu of the Biochemistry laboratory of Ibrahim Badamasi Babangida University Lapai, Niger State for his support in the course of this work.

Conflict of Interest

The authors declare no conflict of interest.

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