Bioactive and Nutritional Potential of *Commelina diffusa*: A Comprehensive Study

*Abstract*

This study characterized the proximate, mineral, vitamin, and amino acid composition in the aerial parts of *Commelina diffusa.* The nutritional properties of the plant were estimated exploiting benchmark methods. The crude protein content was 17.39 ±0.04 %, crude fat (11.60±0.03%), and carbohydrate (37.04±0.05%). The calcium (321.26±12.01mg/100g), potassium (721.51±7.12mg/100g), manganese (47.19±3.16mg/100g), sodium (64.04±11.08mg/100g), molybdenum (1.38±0.12mg/100g), iron (57.10±2.15mg/100g), selenium (48.26±11.05mg/100g), magnesium (18.17±0.03mg/100g), zinc (29.37±1.16mg/100g), phosphorus (237.28±13.05mg/100g), and iodine (1.30±0.03mg/100g). The vitamin C content characterized (64.21±5.01mg/100g), E (21.27±3.15mg/100g), B1 (19.31±3.00mg/100g), B2 (24.16±2.19mg/100g), B3 (33.26±1.26mg/100g), B5 (13.91±1.03mg/100g), and B6 (21.83±3.04mg/100g). The glutamate level was 17.27±1.03mg/100g, arginine (13.63±2.10mg/100g), lysine (11.02±1.06mg/100g), phenylalanine (9.31±0.38mg/100g), alanine (8.31±1.17mg/100g), serine (8.26±2.01mg/100g), methionine (7.21±0.01mg/110g), aspartate (6.11±1.23mg/100g), tyrosine (6.28±1.03mg/100g), valine (5.03±0.10mg/100g), glycine (4.82±0.23mg/100g), isoleucine (4.61±1.21mg/100g), histidine (2.93±0.28mg/100g), threonine (3.56±1.20mg/100g), and leucine (2.38±1.03mg/100g). The result revealed that the aerial parts of *Commelina diffusa* has a good shelf-life, high carbohydrate content, moderately and acceptable values for crude protein and lipid.

Keywords: *Commelina diffusa*, High performance liquid chromatography, proximate parameters, vitamins, mineral, amino acids

1. **INTRODUCTION**

Herbalism proceeds to frolic a pivotal function in the treatment diseases in Africa, where there are very few resources and majority of persons lack access to classic treatments [1]. Many of these plants are employed in treating different human and animal ailments [2]. The reparative application of autochthonous plant products for ethnopharmacological and wholesome intention has fascinated the inquisitiveness of scientists, thus galvanizing researchers to characterize the bioactive ingredients in plants [3]. Plants with restorative health capacity have and elicit indispensable food constituents including; carbohydrates, amino acis, and lipids, vital for proper body building and mediation of diverse physiological, metabolic, and morphological processes [2]. *Commelina diffusa* has become a subject of analytical probing due to its innumerable of Tales-based applicability in Indigenous Medicaments in Nigeria and other African countries.

*Commelina diffusa* is classed into the Commelinaceae family, which have been exposed to multiplicity of screening arising from its diverse medicament potentials. The plant seen in steamyl and warm temperate regions globally. *C. diffusa* it is used in Time-honored Practice of medication as a urinary stimulant, antihémorrhagic, antivenin and Cardiotonic herb to enhance Cardiac electrical activity recording [4].

Bioactive compounds such as carbohydrates, fats, amino acids and minerals are among main classes of nutrients. Carbohydrates are very essential nutrient widely distributed in both natural and processed foods. They scale from glucose, fructose and galactose to starch [5, 6].

In Africa and America, the leaf, stem, and aerial parts *C. diffusa* are employed as curative agents against many diseases such respiratory tract infections, hemorrhoids, and conjunctivitis, but complete evaluation of its bioactive and nutritional potentials is still under investigation. The study seeks to estimate the bioactive and nutritional capacity of *Commelina diffusa* in order to verify the energy and nourishing potential of the aerial parts of the plant.

1. **MATERIALS AND METHODS**

**2.1 Collection of Sample**

The aerial parts of *Commelina diffusa* were harvested from Toru-Orua community in Sagbama Local Government Area of Bayelsa State. The fresh aerial parts of *Commelina diffusa* were harvested, thoroughly washed using slow running tap water and were air dried under shade. The dried aerial parts were pulverized into coarse powder, which weighed 217g.

**2.2 Proximate Analysis**

All proximate indices were estimated based on universal methods described in AOAC [9].

**2.3 Estimation of Moisture Content**

The moisture content was estimated employing the AOAC [9] methods. Here, 2 g of the sample was scaled into a pre-labelled beaker and oven dried at a temperature of 130°C. The sample was raised after 1 h:30 min, 2 h, 2 h -30 min, and 3 h , and was quantified again until steady mass was attained. All sampling and analysis were in three data points [8]. The moisture content was then calculated as follows:

Sample weight – moisture content = dry matter

% moisture content = Dry matter x 100 (1)

Wt of sample

**2.4 Estimation Ash Content**

The ash content scaled adopting the AOAC [9] method. Here, the sample was prepared and weighed into preweighed, porcelain crucible. The sample was transferred to a muffle furnace and ashed at 550°C for 8 h. The crucible was cooled in desiccators and assessed. The ash content was calculated as follows:

% Ash = Wt of Ash x 100 (2)

Wt of sample

**2.5 Estimation of Crude Lipid**

The crude lipid content was weighed out following the 920.39 of AOAC [9] method. In this case, 8 g of the sample was dissolved into a 200 cm3 beaker containing hydrochloric acid. The content of the beaker was heated in a water bath for 1 h. The resulting mixture cooled and extracted with petroleum ether in a separating funnel. The mixture was then heated again to dryness and the weight collected after cooling. The crude lipid content was estimated using the relationship below:

% fat = Wt loss of sample (extract) x 100 (3)

Wt of sample

**2.6 Estimation of Crude Protein**

The crude protein content of the sample was measured using the method described by Nuwamanya *et al.* [10]. The method entails using Dumas combustion procedure involving analysis of nitrogen content by taking about 0.3 g of sample and using the conversion factor:

% protein = % N × 6.25 (4)

**2.7 Estimation of Crude fibre**

The crude fibre content was analyzed employing the 962.09 of AOAC [9] methods. Here, 0.5g of the sample was boiled in 50 mL of 0.3 M H2SO4 under reflux for 30 min, followed by filtering through a 75 mm sieve under suction pressure. The filtrate was rinsed using distilled water to remove acid impurity. The residue was boiled in 100 mL, 0.25 M sodium hydroxide under reflux for 20 min and filtered under suction. The insoluble portion was washed with hot distilled water to free the alkaline. The insoluble portion was evaporated to a steady weight in the oven at 100 ℃, for 2 h, which was cooled in the desiccator. The sample was ashed in a muffle furnace to subtract the mass of ash from the fibre after then the % of fibre was determined

**2.8 Estimation of Mineral Contents**

Mineral contents of the plant determined based on Martin-Prevel *et al*. [11] method. Iron, phosphorus, copper, lead, cobalt, nickel, molybdenum, iodine, selenium, manganese, including zinc were evaluated colorimetrically. The levels of each metallic ion in the plant’s aerial parts computed on a crispy weight base.

**2.9 Amino Acid Estimation**

Amino acid contents ensue investigated based on the Vázquez-Ortiz *et al*. [12] method. Powdered samples, 5mg were dissected using chloride acid (6 M). Succeeding dissecting, the acidic component was evaporated to dryness by mean of rotary evaporator. The mixture ensue resuspended on 3 milliliters of trisodium citrate (Na₃C₆H₅O₇) cushion (PO42-) (pH 2.1). The resulting mixture was achieved adding O-phthalaldehyde, 7.5mm to the specimen on borate reagent. High performance liquid chromatography method was pegged by external and internal standards. The amino acid standard is made up of fifteen amino acids, utilized to estimate elusion timing for the various proteins. As well, internal standard αaminobutyric was introduced into protein reference standard and specimen in order to normalize as well as determine the protein concentration. A slope moving region of CH3COONa including CH3OH elute specimen for protein detachment conduit C18 column reversed-phase C22H48OSi particles. Fluorescence discrement was garnered by an excitation-emission wavelength of 360 and 455 nm respectively. Star Chromatography work station (Varian version 5.51) software ensue adopted to attain protein peak integration. The amino acid level of the specimen was characterized in order to guessimate the protein content high performance liquid chromatography by employing Micro Kjeldahl method AOAC [9].

**2.10 Chromatographic Estimation of water soluble vitamins**

Chromatographic examination was displayed employing the Seal *et al*. [13] method. The mobile phase contains acetonitrile and0.01% v/v aqueous trifluoro acetic acid (A and B), the column was thermostatically regulated at a constant temperature while the insertion volume was presented at 20μl. A slope elutriate was displayed by changing the amount of liquid A to solvent B. Whole characterization period for each specimen was 20 min. Chromatograms of all the vitamins were captured employing a UV light at 290nm. Identification of the analyte was performed in same manner that followed spotting of phenolic acids and flavonoids, while data were reported as means ± standard error (n=3).

**2.11 Statistical Analysis**

All data constituted as means ± standard error, were scrutinized employing Statistical SPSS (window version 17.0). Illustrative data were carried out through one way ANOVA and multiple comparison was performed adopting Turkey Post hoc at (p≤0.05) confidence interval.

1. **RESULTS**
   1. **Proximate composition of *Commelina diffusa***

Table 1 indicates the proximate composition of *Commelina diffusa*. Analysis of *Commelina diffusa* for proximate parameters presented that crude protein content was 17.39 ±0.04 %, crude fat (11.60±0.03 %), crude fibre (12.42±0.01 %), carbohydrate (37.04±0.05 %), and ash (6.73±2.04 %) as shown in Table 1. The carbohydrate was highest in percentage followed by crude protein, moisture, crude fibre, crude fat, while the least was ash content.

Table 1 Proximate composition of *Commelina diffusa* (n=3)

|  |  |
| --- | --- |
| Proximate Parameters | Concentration (%) |
| Crude protein | 17.39 ±0.04 |
| Moisture contents | 14.82±0.05 |
| Crude fat | 11.60±0.03 |
| Crude fibre | 12.42±0.01 |
| Carbohydrate | 37.04±0.05 |
| Ash content | 6.73±2.04 |

Parameters were reported in mean and standard error (M±SE). n=3

**3.2 Mineral composition of *Commelina diffusa***

Table 2 presents the mineral composition of the aerial parts of *Commelina diffusa.* Characterization of *C. diffusa* for mineral contents unraveled the presence of calcium (321.26±12.01 mg/100g), potassium (721.51±7.12 mg/100g), manganese (47.19±3.16 mg/100g), sodium (64.04±11.08 mg/100g), molybdenum (1.38±0.12 mg/100g), iron (57.10±2.15 mg/100g), selenium (48.26±11.05 mg/100g), magnesium (18.17±0.03 mg/100g), zinc (29.37±1.16 mg/100g), phosphorus (237.28±13.05 mg/100g), lead (0.09±0.01 mg/100g), copper (7.15±1.07 mg/100g), and iodine (1.30±0.03 mg/100g) (Table 2). Analysis of the aerial parts of *C. diffusa* showed the presence of thirteen minerals in which potassium was highest in concentration followed by calcium, phosphorus, sodium, iron, selenium, manganese, zinc, magnesium, copper, molybdenum while the least was iodine (Table 2).

Table 2 Mineral composition of *Commelina diffusa* (n=3)

|  |  |
| --- | --- |
| Minerals | Concentration (mg/100g) |
| Calcium | 321.26±12.01 |
| Potassium | 501.51±7.12 |
| Manganese | 47.19±3.16 |
| Sodium | 64.04±11.08 |
| Molybdenum | 1.38±0.12 |
| Iron | 57.10±2.15 |
| Selenium | 48.26±11.05 |
| Magnessium | 18.17±0.03 |
| Zinc | 29.37±1.16 |
| Phosphorus | 237.28±13.05 |
| Lead | 0.09±0.01 |
| Copper | 7.15±1.07 |
| Iodine | 1.30±0.03 |

Parameters were reported in mean and standard error (M±SE). n=3

**3.3 Vitamin Composition of *Commelina diffusa***

Analysis of *C. diffusa* for vitamin composition unraveled eight vitamins such as vitamin B6, C, B5, B2, B1, B3, A, and E. Vitamin C concentration was observed to be highest in the aerial parts of *Commelina diffusa* followed by vitamin B3, vitamin A, B2, B3, vitamin E, B1 and the least was vitamin B5 while the mean total 247.18±20.78mg/100g (Table 3).

Table 3 Vitamin Composition of *Commelina diffusa* (n=3)

|  |  |  |
| --- | --- | --- |
| Vitamins | Concentration (mg/100g) |  |
| Vitamin B6 | 21.83±3.04 |  |
| Vitamin C | 64.21±5.01 |  |
| Vitamin B5 | 13.91±1.03 |  |
| Vitamin B2 | 24.16±2.19 |  |
| Vitamin A | 31.04±2.01 |  |
| Vitamin B1 | 19.31±3.00 |  |
| Vitamin B3 | 33.26±1.26 |  |
| Vitamin E | 21.27±3.15 |  |
| Total | 247.18±20.78 |  |

Parameters were reported in mean and standard error (M±SE). n=3

**3.4 Amino acid composition of *Commelina diffusa***

Table 4 shows the amino acid contents of *C. diffusa*. Analysis of the aerial parts of *Commelina diffusa* for amino acid composition showed the presence of sixteen amino acids in which glutamate (17.27±1.03 mg/100g) was observed to be highest in concentration followed by arginine (13.63±2.10 mg/100g), lysine (11.02±1.06 mg/100g), phenylalanine (9.31±0.38 mg/100g), alanine (8.31±1.17 mg/100g), serine (8.26±2.01 mg/100g), methionine (7.21±0.01 mg/110g), aspartate (6.11±1.23 mg/100g), tyrosine (6.28±1.03 mg/100g), valine (5.03±0.10 mg/100g), glycine (4.82±0.23 mg/100g), isoleucine (4.61±1.21 mg/100g), Histidine (2.93±0.28 mg/100g), threonine (3.56±1.20 mg/100g), while the least was Leucine (2.38±1.03 mg/100g) (Table 4).

Table 4 Amino acid composition of *Commelina diffusa*

|  |  |
| --- | --- |
| Amino acid | Concentration (g/100g prot) |
|  |  |
| Methionine | 7.21±0.01 |
| Alanine | 8.31±1.17 |
| Lysine | 11.02±1.06 |
| Threonine | 2.61±0.21 |
| Valine | 5.03±0.10 |
| Phenylalanine | 9.31±0.38 |
| Leucine | 2.38±1.03 |
| Aspartate | 6.11±1.23 |
| Serine | 8.26±2.01 |
| Glycine | 4.82±0.23 |
| Glutamate | 17.27±1.03 |
| Isoleucine | 4.61±1.21 |
| Tyrosine | 6.28±1.03 |
| Arginine | 13.63±2.10 |
| Histidine | 2.93±0.28 |
| Total | 113.34±12.50 |
| Total |  |
|  | 99.89±4.12 |

Parameters were reported in mean and standard error (M±SE). n=3

1. **DISCUSSION**

The % crude protein value 17.39 ±0.04 falls within the value for some legumes Oguezi *et al*. [13]. The moisture content was 14.82±0.05 %, which falls within the range of some legumes in agreement with that reported by [14]. Since the life of a seed largely revolves round its moisture content and see ds are most suitably harvested and dried immediately to reach a moisture content of 12 to 13%. Therefore, *Commelina diffusa* could be said to have a good shelf-life. The % Fat content of 11.60±0.03 compared favorably with that of Faba bean, chickpea, but greater than that of [14]. The % Crude fibre content value 12.42±0.01 compared moderately with the Recommended Dietary Intake (RDI) of total fibre of 19-38 %. This % fibre content has been confirmed by literature that legumes contain just the right amount of fibre to prevent constipation when eaten and help improve digestion by Oguezi *et al*. [13]. The % Carbohydrate content of 37.04±0.05 was found to be within the range of values 14-70 for most legumes Oguezi *et al*. [13] and also met the Acceptable Macronutrient Distribution Range. The % ash content of 2.63 agreed with the value reported for a legume (groundnut seed) and comparable to the values for chickpea and mung bean as reported by Adeyeye [15].

The mineral composition of *C. diffusa* in mg/100g are shown in Table 2, revealed potassium was 501.51±7.12 mg/100g which is the most abundant mineral in the plant, which according to literature was widely distributed in plants and was rarely deficient in diet [16]. The calcium 321.26±12.01 mg/100g, which is the second most abundant mineral in the aerial parts of *C. diffusa*, an important macro mineral essential for strong bones and teeth. The mineral phosphorus composition was 237.28±13.05, which is the third most abundant mineral in the *C. diffusa*, an important macro mineral essential for DNA synthesis. The mineral sodium was 64.04±11.08 mg/100g was found to be the fourth abundant mineral in the aerial parts of *C. diffusa*. Sodium and potassium work in tandem throughout the body. Potassium naturally balances the metabolic action of sodium such that diets low in potassium and high in sodium increase the risk of high blood pressure and cardiovascular diseases [17]. The mineral iron composition was 57.10±2.15, which is the fifth most abundant mineral in the *C. diffusa*, an important macro mineral essential for haemoglobin synthesis as well as important for its role in oxygen and electron transport. The mineral selenium was 48.26±11.05 mg/100g, which is the sixth most abundant mineral in *C. diffusa*, and correspond with the report of Sudeshna *et al*. [18] on the nutritional composition, mineral content, antioxidant activity and quantitative estimation of water soluble vitamins and phenolics by RP-HPLC in some lesser used wild edible plants. The mineral zinc composition was 29.37±1.16, which is the seventh most abundant mineral in the *C. diffusa*, which is vital for the production of hormone. Magnesium 47.19±3.16 mg/100g, which is the eighth most abundant essential mineral in the aerial parts of *Commelina diffusa,* and is important for variety of cellular metabolic activities and sometimes has the ability to replace a portion of the body calcium [19].

Vitamin C is well known for its antioxidant properties and it aids in the inhibition of infection and metal induced poisoning. Vitamin C is also employed by the body for the prevention of scurvy and maintenance of healthy skin. The vitamin C content characterized (64.21±5.01 mg/100g) from the aerial parts of *Commelina diffusa* is far much higher than the vitamin C values obtained by Blessing *et al.* [20] for pumpkin (3.47–4.39 mg/100 g), Igeli *et al*. [21] for *Vernonia calvoana* (11.33 mg/100 g) and by Misra and Misra [22] for *Moringa oleifera* and *Ipomoea aquatica* (2.17 mg/100 g and 0.34 mg/100 g respectively). The high vitamin C content determined in the aerial parts of *C. diffusa* is suggestive that the aerial parts of the plant could be an excellent antioxidant therapy against oxidative stress-induced damage and preventive medicaments against scurvy. Vitamin E (Alpha-tocopherol) is a lipophilic-free radical scavenger found in this plant, helps to protect sebaceous fatty acids from oxidative stress-related free radical damage. Oxidation has been implicated in health conditions or diseases such as ageing, arthritis, obesity, diabetes and cancer [23]. Thus, the high vitamin E (21.27±3.15 mg/100g) level estimated in *C. diffusa* might function in prophylactic measures against the aforementioned diseases. The vitamin B1, B2, and B3 contents of *C. diffusa* were 19.31±3.00 mg/100g, 24.16±2.19 mg/100g, and 33.26±1.26 mg/100g respectively. Thiamine (B1) is required for carbohydrate metabolism, the synthesis of energy and the stimulation of appetite [24, 25]. The level of vitamin B1 and B2 observed in the aerial parts of *C. diffusa* is indicative that plant could be a source appetite stimulating and antioxidant drugs. Vitamin B3 plays an important role in DNA repair and metabolism. The B3 content in *C. diffusa* the plants was much higher than that recorded by Hassan *et al*. [26] and is comparable to some wild edible fruits like *Docynia indica* (0.38 mg/100 g), *Elaeagnus latifolia* (0.29 mg/100 g) and *Myrica esculenta* (0.46 mg/100 g) [12]. Pantothenic acid remained undetected in the green leafy vegetables studied by Hasan *et al.* [26]. Pantothenic acid (B5) is a component of CoA required in fatty acid metabolism. RDA for pantothenate is 5 mg/day, which is far lower than the (13.91±1.03 mg/100g) value of B5 characterize from *C. diffusa*, thus surely be confirming that the aerial parts of the plant could fulfil the required vitamin B5 supplement to the diet. The vitamin B6 (pyridoxine) content of the aerial parts of *Commelina diffusa* was 21.83±3.04 mg/100 g, which is higher than the values estimated in edible vegetables reported by Igile *et al.* [21] for the leafy vegetable, Akah and Onweluzo [27] for elephant grass (2.40 mg/100 g), Vernonia calvaona (0.56 mg/100 g), and Hasan *et al.* [26] for Lagennaria vulgaris (0.755 mg/100 g) and Amaranthus viridis (0.07 mg/100 g).

Table 4 shows the amino acid contents of *C. diffusa*. Analysis of the aerial parts of *Commelina diffusa* for amino acid composition showed the presence of sixteen amino acids in which glutamate was observed to be highest in concentration followed by arginine, lysine, phenylalanine, alanine, serine, methionine, aspartate, tyrosine, valine, glycine, isoleucine, Histidine, threonine, while the least was Leucine (Table 4). Essential amino acids are cannot produced by the human body and must be obtained through diet, include histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Non-essential amino acids, which can be synthesized by the body, include alanine, arginine, asparagine, aspartic acid, cysteine, glutamic acid, glycine, proline, serine, and tyrosine [28]. Finkelstein *et al.* [28] reported the presence of significant levels of essential amino acids in various medicinal plants like **Moringa oleifera** (moringa), **Withania somnifera** (ashwagandha), and **Ocimum sanctum** (holy basil). These plants, widely used in Ayurvedic medicine, provide a wide spectrum of essential amino acids critical for immune function and overall health [28]. The values of the amino acid compositions estimated in *C. diffusa* were higher than those determined by Wellington *et al*. [29] in the aerial pats of *Leonurus cardiaca.* The amino acid profile as revealed in this is appealing that the studied plant could be a source of amino acid supplements for enhancing body protein contents through diet.

1. **Conclusion**

This present study revealed that *Commelina diffusa* is rich in nutritional values, minerals, vitamins, and amino acids. The medicinal plant has several potential submission in the creation new medicaments. *Commelina diffusa* is endowed with perceptible magnitude of nutrients, vitamins, minerals, and proteins, which might offer to the nutrient and energy prerequisite of man when the plant is taken for Reparative purposes in certain disease conditions.

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