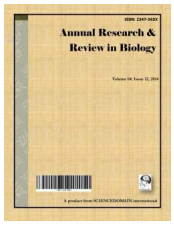

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# Nutritional Evaluation of Various Parts of *Canna indica* L.

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Authors KO and CAA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author KO managed the analyses and literature searches of the study. Both authors read and approved the final manuscript.*

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## ABSTRACT

The nutritional composition of the leaf, rhizome and seed of *Canna indica* L. were examined. The nutritional composition of *C. indica* plant showed that the rhizome of *C. indica* contains 50.66% moisture, 4.17% carbohydrate, 4.81% protein, 2.85% ash, 4.35% lipid and 33.16% fibre. The leaf on the other hand, contains 87.54% moisture, 2.19% carbohydrate, 4.59% protein, 3.40% ash, 1.08% lipid and 1.18% fibre. The seed contains 13.95% moisture, 41.15% carbohydrate, 11.60% protein, 1.90% ash, 7.50% lipid and 23.90% fibre. However, the protein, carbohydrate, lipid and fibre content of the seed were high when compared to the rhizome and the leaf of *C. indica* while the leaf had more moisture and ash content. This study shows that *C. indica* has a high nutritional content which differs among the leaf, seed and rhizome. The seed had more nutritional value than the rhizome and the leaf of *Canna indica.*

*Keywords: Canna; proximate composition; seed; leaves; rhizome.*

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## 1. INTRODUCTION

*Canna indica* L. is a species of the *Canna* genus, belonging to the family *Canna*ceae. *C. indica* commonly known as Indian shot or *Canna* represents an important floral material of all urban areas. It is often planted in large areas, such as squares, areas along roads, parks and green spaces in front of representative buildings in order to get strong effects [1]. According to Kessler, it can be seen in dump sites, abandoned gardens and moist places [2]. This plant is considered a weed by some individuals but it has so many economic uses. It is an invasive plant and even regarded as a weed [3]. It is a well known plant with less known scientific data. Each and every part of it is useful having medicinal activity. The qualitative analysis revealed the presence of the biomolecules such as flavonoids, phenolic compounds, saponins, steroids, tannins and terpenoids [1,4]. Seed juice of *C. indica* is used to relieve ear aches. The flowers are said to cure eye diseases [1,5,6]. The leaves of *C. indica* showed a significant analgesic activity and the rhizomes showed a good anthelmintic activity against *Pheritima posthuma* [7]. *Canna* species can be used for the treatment of industrial waste waters through constructed wetlands. It is effective for the removal of high organic load, color and chlorinated organic compounds from paper mill wastewater [8,9]. The underground rhizomes possess starch and are eaten as food [3]. They are also used as a substitute for arrowroot starch, which is used in feeding sick people [8]. *C. indica* is also a highly valued medicinal plant. The decoction of the roots with rice is used in treating gonorrhea and amenorrhea [1].

The proximate composition of plant includes the total protein, fat, carbohydrate, ash, fibre and moisture content [10]. It was reported that the nutrients and biochemical in plants play an important role directly or indirectly in sustaining humans and providing energy needed for life processes [11]. Maria [3] reported that *C. indica* possess nutritional properties. The nutritional content of some wild edible plants from Iran and India have high nutritional compositions [12]. *Solanum indicum* and *Asparagus officinalis* have high fat content with varying protein content [12]. Der-juin et al. [13] reported that the nutritional composition of a plant vary with agro-climatic conditions, humidity and species of the plant. Medicinal plants species in the humid region of North-west Pakistan possess more moisture, ash and fat while those in the sub-humid regions possess more carbohydrates and proteins [10]. According to Abolaji et al. [11], it is essential to determine the nutritional and phytochemicals inherent in various plant parts due to the variation in the quantity present and its pharmacologically implications. *Canna indica* has been widely used in traditional medicine for the treatment of many illnesses [4]. The usefulness of the leaf, seed and rhizome of *C. indica* cannot be over-emphasis. It is therefore necessary to evaluate the proximate composition of the various parts (leaf, seed and rhizome) of *C. indica*.

## 2. MATERIALS AND METHODS

### 2.1 Collection of Plant

Mature *C. indica* plant was collected from the field in Ozuoba, Rivers State and properly identified by the Curator at the University of Port Harcourt Herbarium.

### 2.2 Proximate Analysis

Proximate analysis (moisture, ash, protein, carbohydrate and lipid content) was determined using standard method of AOAC [14]. Fibre was determined by difference.

#### 2.2.1 Determination of crude protein (Kjeldahl method)

Plant samples weighing 0.1 g were put into different conical flasks, 3 g of digestion catalyst and 20 ml of concentrated sulphuric acid was added into the flask. The flasks were then heated gently to boil in a fume chamber, until charred particles disappeared and clear greenish grey solution was obtained. The resulting solution in the conical flask was heated for an additional 20 minutes and allowed to cool. The digest was diluted with water to 100 ml capacity and 20 ml was then measured into a distillation flask and this was connected to a condenser adapted to a receiver beaker containing 10 ml of 2% boric acid with 2 drops of double indicator. NaOH (40%) was added to the digest, the distillation flask was then heated to distil the nitrogen present as ammonia. The boric acid in the receiver was titrated with standard 0.1N hydrochloric acid. The volume of HCl used was recorded as titre value. The formula for the calculation of total Nitrogen is:

$$\%\text{Nitrogen} = \frac{\text{Titre value x } 1.4 \text{ x } 100}{1000 \text{ x } 20 \text{ x } 0.1}$$

Titre value = Volume of Hydrochloric acid used.
1.4 = Nitrogen equivalent in relation to the normality of HCl used in titration.
100 = Total volume of digest dilution
100 = Percentage factor
1000 = Conversion factor from gram to milligram.
20 Integral volume of digits analyzed or distilled
0.1 = The weight of sample in gram digested

$$\%\ \text{Crude01 protein} = \%\text{Nitrogen X } 6.25$$

### 2.2.2 Determination of carbohydrate (CleggAnthrone method)

Plant samples weighing 1 g were put into a 250 ml volumetric flask. Distilled water (10 ml) and 13 ml of 62% perchloric acid was added and the mixture was shaken in order for it to homogenize completely. The flask was made up to 250 ml with distilled water; the solution formed was filtered through a glass filter paper. Filtrate (10 ml) was collected and transferred into a 100 ml test tube; this was also diluted to volume with distilled water. The hydrolyzed solution was pipetted into a clean test tube and 5 ml of Anthrone reagent was added, they were then mixed together. The whole mixture was read at 630 nm wavelength using the 1 ml distilled water and the 5 ml anthrone prepared as blank. Glucose solution of 0.1 ml was also prepared and this was treated with the anthrone reagent. Absorbance of the standard glucose was calculated using the formula below:

$$\%\text{CHO} = \frac{25 \text{ x Absorbance of sample}}{\text{Absorbance of standard glucose x 1g of sample used}}$$

### 2.2.3 Determination of moisture using the air oven method

Samples weighing 1 g were placed in a clean dry porcelain evaporation dish. This was placed in an oven to maintain a temperature of 105℃ for six hours. The evaporating dish was cooled to room temperature in a desiccator and re-weighed.

$$\%\ \text{Moisture} = \frac{\text{weight of fresh sample} - \text{weight of dried sample}}{\text{Weight of sample used}} \text{ X } \frac{100}{1}$$

### 2.2.4 Determination of lipid by soxhlet extraction method

Samples weighing 2 g was inserted into a filter paper and placed into the soxhlet extractor. The extractor was fitted into a pre-weighed round bottomed dry distillation flask and the solvent acetone was added into it through the condenser. The extractor and the flask were held in place with a retort stand clamp. Cold water was passed into the condenser via the rubber tubing and the flask was heated such that the solvent refluxed continuously within the enclosure. The lipid in the solvent chamber was extracted through this process of continuous refluxing. After the lipid had been extracted completely from the sample, the condenser and the extractor were disconnected, the acetone solvent was distilled off and the lipid concentrate was cooled in the oven and re-weighed.

$$\%\ \text{Lipid} = \frac{\text{Weight of flask and extract} - \text{Weight of empty flask}}{\text{Weight of sample extracted}} \text{ X } \frac{100}{1}$$

### 2.2.5 Determination of ash by furnace method

The dried sample weighing 1 g was placed into a porcelain crucible which had been preheated and weighed. The crucible was inserted into a muffle furnace and regulated to a temperature 630C. After three hours it was removed from the furnace and allowed to cool to room temperature, and then it was re-weighed.

### 2.2.6 Determination of fibre

The fibre content was determined by difference. The other five proximate components were summed and the value gotten was subtracted from 100% giving the fibre content (100 - per cent estimated proximate components represented the per cent fibre in the sample).

## 2.3 Statistical Analysis

Data obtained from the experiment were subjected to statistical analysis using Microsoft Excel (2010).

## 3. RESULTS AND DISCUSSION

## 3.1 Proximate Composition

The proximate composition showed that the rhizome of *C. indica* contains 50.66% moisture, 4.17% carbohydrate, 4.81% protein, 2.85% ash, 4.35% lipid and 33.16% fibre. The leaf on the other hand, contains 87.54% moisture, 2.19% carbohydrate, 4.59% protein, 3.40% ash, 1.08 % lipid and 1.18% fibre. The seeds contain 13.95% moisture, 41.15% carbohydrate, 11.60% protein, 1.90% ash, 7.50% lipid and 23.90% fibre (Table 1).

**Table 1. Proximate composition of the different parts of *C. indica***

| Parameters | Rhizome | Leaf | Seed | Methods |
|---|---|---|---|---|
| Moisture | 50.66 ± 0.00 | 87.55 ± 0.08 | 13.95 ± 0.03 | Air Oven |
| Carbohydrate | 4.17 ± 0.00 | 2.19 ± 0.74 | 41.15 ± 0.74 | CleggAnthrone |
| Protein | 4.81± 0.00 | 4.60 ± 0.30 | 11.60 ± 0.30 | Kjeldahl |
| Ash | 2.85 ± 0.07 | 3.40 ± 0.14 | 1.90 ± 0.00 | Furnace |
| Lipid | 4.35 ± 0.07 | 1.08 ± 0.07 | 7.50 ± 0.14 | Soxhlet extraction |
| Fibre | 33.16 ± 0.01 | 1.18 ± 0.17 | 23.90 ± 1.21 | |

*Result is expressed as mean ± standard deviation*

The proximate composition showed that the rhizome of *C. indica* had the highest fibre content (33.16%) compared to the leaf andm seed. High crude fibre content (44.09%) was also found in the medicinal plant –*Blighia sapida* [11]. Darsini et al. [1] reported that the rhizomes of *C. indica* are given to sick people with stomach complaints. This may be due to the high fibre content. Muhammad et al. [15] also reported that the fibre content seen in some plants supports the regularity of the bowel, maintains normal cholesterol and blood sugar levels. The seeds of *C. indica* had a high carbohydrate and lipid content (41.15%) than the leaf and rhizome. Oluwole et al. [16] also observed that the unripe seeds of *Persea americana* had a high carbohydrate (15.74%) and lipid (29.12%) content. Muhammad et al. [15] also reported high lipid content in the seeds of *Neocarya macrophylla* than the other parts of the plant. They further reported that lipids are used by cells, organs and tissues to provide energy and also for their secretions. Therefore, seeds with high lipid content can be ground and added to animal feed to improve their nutritional composition. The seeds of the medicinal plants such as *Xylopia aethiopica, Parinari polyandra* and *Blighia sapida* also showed a high carbohydrate content of 87.62%, 31.25% and 61.37% compared to the other parts of the plant [11]. Der-juin [13] also reported that *Pepromia pellucida* have a high carbohydrate content of 46.58%. The presence of high percentage of carbohydrate in plants is beneficial because carbohydrate make up a major class of natural organic compounds that are important for the maintenance of plant and animal life. High ash content (3.40%) was seen in the leaves of *C. indica* compared to other parts of the plant. Similar results were seen in *N. macrophylla* (5.52%) [15] and *Peperomia pellucida* (31.22%) [13], the leaves of these plants had higher ash content than the other parts of the plant. Muhammad et al. [15] also reported that plants with high ash content will have nutritionally important minerals. The result also shows that the seeds of *C. indica* had higher protein content (11.60%) than the other plant parts. The results obtained in this study varied with the work of Jun et al. [17], who examined the feeding value of silage prepared from aboveground parts of edible *canna* and compared it with that from corn at the yellow ripe stage. They reported that crude protein contents (9.9-11.2%), acid and neutral detergent fibers (30.5-33.8, 54.6-63.4%) and crude ash and fat (16.0-18.0, 3.1-3.6%) in *Canna* silage were higher, but non-structural carbohydrate (6.6-16.0%) was lower than in corn silage. The medicinal plant *Parinari polyandra* also have a high protein content of 7.90% [11]. Muhammad et al. [15] reported a higher value of protein in the seeds of *N. macrophylla* (23.24%), which was higher than the protein in the other parts of the plant. The leaves of *C. indica* contain 87.49% moisture which is higher than 50.66% and 13.95% found in the seeds and the rhizome respectively. High moisture content was also seen in the leaves of *Peperomia pellucida* (93.14%). The leaves of *C. indica* are used to wrap food locally; this may be due to its high moisture content.

## 4. CONCLUSION

The protein, carbohydrate, lipid and fibre content of the seed were high when compared to the rhizome and the leaf of *C. indica* while the leaf had more moisture and ash content. This study shows that *C. indica* has a high nutritional content which differs among the leaf, seed and rhizome. The seeds had more nutritional value than the rhizome and the leaf of *C. indica*.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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