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Chemical Information from Proximate and Elemental Composition of *Acalypha hispida* Leaf

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Abstract *Proximate and elemental compositions of plant leaves can provide useful information on the nutritional benefits of the plant. Proximate and elemental analysis of Acalypha hispida leaves were conducted using official and recommended methods. The result obtained indicated that the plant leaf contain moisture (11.02%), crude fat (6.05%), total ash (10.17%), crude protein (13.17%), crude fibre (10.36%) and carbohydrate (48.65%). Analysis for the presence of some elements indicated the presence of essential elements, which included iron, zinc and copper. The toxic lead was also found to be present in the plant leaves as Fe, Zn, Cu and Pb. Iron had the highest mean concentration of 20.7mg/g while concentrations of Zn, Cu, and Pb were 0.230, 0.778 and 1.729 mg/g respectively. Concentration of these metal ions were within the tolerance and safe limits for the human nutrition.*

Key words: *Acalypha hispida leaf, proximate constituent, elemental constituent, chemical information*.

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1.0 Introduction

Plant analysis provides chemical information about plant and serves as a guide for their various utilization. Plants leaves have attracted several research interests in the food, pharmaceutical, metallurgical, corrosion and other industries Eddy and Udoh, 2005). Their usefulness can only be revealed if there are chemical data generated from chemical analysis (Eddy and Ekop, 2005). Chemical analyses of plant leaves are done to know their proximate, trace metals, heavy metal, mineral, phytochemical, vitamins, antioxidant, toxicants and other antinutritional factors. Proximate analysis concentrates on the content of moisture, carbohydrate, protein, ash, fat and oil (Eddy and Ekop, 2005). Information obtained from proximate analysis are most useful in ascertaining the nutritional level of plant materials since these are the major nutrients (Eddy and Ekop, 2005). However, such information does not conclude that such plant is suitable for human consumption because in addition to proximate content, other constituents

must be considered. Heavy metal contents of plants and plant materials as well as antinutritional factors are significant parameters in establishing their health benefit. For example, WHO (1998) recommends determination of heavy metals content of medicinal plants before administering them. Side effects and extreme toxicity link to toxicity of heavy metal ions in some unanalyzed herbal mixtures have been reported in several literatures. Some toxicants are natural to plants but toxic levels of heavy metal ions accumulate in plants through foliar absorption from heavy metal polluted soil. Heavy metals are those metals whose density is greater than 5 g/cm^3 (Odoemelam and Eddy, 2009). They are toxic above certain concentrations and include some trace metals such as zinc, manganese, selenium, iron (which are also useful to the body in minute concentration) and other d-block elements such as lead, cadmium, etc.

One of the greatest challenges facing proper utilization of plants is the knowledge of their chemical constituents. Several humans rely on traditional information about acceptability of plant leaves for treatment of certain diseases and for other purposes without seeking to know information on their chemical composition. Information acquisition on proximate and heavy metal content of plant leaves can significantly enhance utilization of abandoned species and can provide a guide to required processing techniques. Therefore, the present study is aimed at investigating the proximate and mineral composition of *Acalypha hispida* leaves. Most medicinal plants have been studied and their chemical constituents have been reported. However, literature is scanty on chemical const ituents of *Acalypha hispida* leaf except for phytochemical constituents. For example, Aboaba and Omotoso (2012) reported on toxicity and larvicidal activity of the essential oil from the leaves of *Acalypha hispida* leaves in South West Nigeria. Siraj *et al*. (2016) reported on the anti-inflammatory and antioxidant activity of the plant leaf and also reported on their polyphenol content. Their results indicated significant presence of active phytochemicals. Proximate and phytochemical composition of *Acalypha hispida* leaves of Edo state origin was investigates by Iniaghe *et al*. (2009) and found that the plant leaf contained moisture (11.02%), crude fat (6.15%), ash (10.32%), crude protein (13.78%), crude fibre (10.25%) and carbohydrate (44.48%). Eddy *et al.* (2009, 2011) link the corrosion inhibition properties of plants leaves to their chemical compositions consequently, the presence of some proximate components was found to synergistically interact with phytochemical and inhibit metal corrosion. This analysis was based on the fresh leaf of the plant and since the chemical composition of the plants may vary within and outside a region, there is need for progressive investigation to generates useful research data. To the best of our knowledge, literature on the mineral composition of the plant has not been reported elsewhere

2.0 Materials and Methods

2.1 Materials

The plant was obtained from Ibrahim Badamasi Babangida University, Lapai, main Gate, Niger State, Nigeria and was identified at the Herbarium unit of the Department of Biological Sciences, of Ahmadu Bello University, Zaria, as *Acalypha hispida*. The leaves were air dried to constant weight before they were grounded to a uniform sized powdered sample. Proximate and elemental analysis was carried out on dried sample of the *acalypha hispida* leaves.

All reagents used were of analytical grade and preparation of reagent and other solutions were carried out using double distilled water.

Standard solutions of zinc, copper, iron and lead were prepared by dissolving appropriate mass of zinc metal, copper (II) tetraoxosulphate, iron granules and lead metal in concentrated HCl, H_2SO_4, HCl, HCl and HNO_3 respectively. They were made up to mark and through serial dilution, various concentrations were obtained and used for atomic absorption spectrophotometry (AAS analysis).

2.2 Atomic absorption spectrometer (AAS) measurement.

The sample in the powdered form was accurately weighed and digested in (5:1) mixture of nitric acid and perchloric acid. After digestion, five drops of concentrated HCl was added. The solution was heated gently and then filtered. The residue was re-digested and the filtrate was collected. The filtrate was diluted up to 100 cm^3 with distilled water and was used for analysis using AA320N (SPSIC) model of atomic absorption spectrophotometer. A calibration curve was prepared using the serially diluted solution and from the calibration curve, concentration of the metal ion were estimated through extrapolation.

2.3 Proximate Analysis

2.3.1 Determination of moisture content

The moisture content was determined using the AOAC (1990) oven method. Empty clean dish was dried in an oven at a temperature of 105 °C for one hour and cooled in a desiccator. 2 g of the samples was put into the dish and heated in an oven for 24 hours. The dish was then removed from the oven, cooled in a desiccator and re-weighed. The difference in weight was recorded as the moisture content of the sample while the percentage moisture content was calculated using the following equation,

$$\%Moisture\ content = \frac{loss\ in\ weight\ (g)}{Weigh\ \ of\ sample} \times \frac{100}{1} \quad (1)$$

2.3.2 Determination of ash content

The method of AOAC (1990) was adopted to determine the percentage content. 2g of the dried samples were weighed into a pre-heated and cooled crucibles and incinerated in a muffle furnace (Lenton, England) at operation temperature of 550 °C for six hours. After cooling, the difference in weight was recorded as the ash content of the plant and the percentage ash content was calculated using equation 2

$$\%\ Ash = \frac{Weight\ of\ ash}{Weight\ of\ dry\ sample} \times \frac{100}{1} \quad (2)$$

2.3.3 Determination of crude fibre (AOAC, 1990)

In the determination of the fibre content of the sample, 2 g of the sample was weighed into a 1L conical flask containing 200 cm^3 of 1.25% H_2SO_4 and gently boiled for thirty minutes. The content was filtered and the residue was scraped back into the flask with spatula. 200 cm^3 of 1.25% NaOH was added and allowed to boil gently for 30 minutes. The content was filtered and washed thoroughly with hot distilled water.

The precipitate was rinsed with 10% HCl and twice with ethanol. The content was allowed to dry and the residue was scrapped into a crucible and dried overnight at 105 °C in a hot oven. It was removed and allowed to cool in a desiccator. The sample was re-weighed and ash at 600 °C for 90 minutes. The weight after ashing was used to estimate the percentage fibre in the sample in a furnace. This was finally cooled in a desiccator.

The percentage crude fibre was calculated using equation below.

$$\%\ Crude\ fibre = \frac{Weight\ of\ fibre}{Wei\quad of\ sample} \times \frac{100}{1} \quad (3)$$

2.3.4 Determination of crude lipid

AOAC (1990) method involving the use of Soxhlet extractor was adopted for crude lipid determination. 2 g of the dried samples were weighed into a porous thimble and the mouth was covered with cotton wool. The thimble was placed in an extraction chamber which was suspended above a receiving flask containing petroleum ether (B.P 40-60 °C the flask was heated on a mantle and the oil was extracted progressively for eight hours before removing the thimble from the Soxhlet apparatus. Solvent recovery was achieved by heating in a water bath and the flask containing the crude oil was disconnected, cleaned up and placed in an oven at 100 °C for thirty minutes. The difference in weight of the flask was used to calculate the percentage oil content of the sample according to equation 4,

$$\%\ Crude\ oil = \frac{Weight\ of\ extracted\ oil}{Weight\ of\ sample} \times \frac{100}{1} \quad (4)$$

2.3.5 Determination of crude protein

The method of AOAC (1990) was adopted using the Micro-kjeldahl apparatus recommended by AOAC (1990) was implemented for crude protein determination. The technique is based on the principle of determination of the nitrogen content of the materials and then multiplying it by a conversion factor.

2 g of the dried sample was weighed into kjeldahl digestion flask containing $NaSO_4$, $CuSO_4$ and selenium oxide in a ratio of 10:5:1. 10 cm^3 of concentrated tetraoxosulphate (iv) acid was added and the content was heated through the heater connected to the flask until the digestion was completed. After completion of digestion, the flask was cooled and the contents was diluted with 10 cm^3 distilled water, filtered into a 100 cm^3 volumetric flask and made up to the mark with distilled water 10 cm^3 of the aliquot was taken into the digestion flask and 20 cm^3 of 45% NaOH solution was added. The content was diluted to 200 cm^3 with distilled water and distilled using micro-kjeldahl distillation apparatus. In the distillation assembly, the distillate was directed to a flask containing 10 cm^3 boric acid solution indicator. After distillation, the distillate was titrated with standardized 0.01M HCl to the end point. Blank titration was also carried out.

$$\%\ Crude\ protein = \frac{T_V \times C \times 0.0014 \times V_1}{W \times V_2} \quad (5)$$

where T_V is the titre value of the acid, C is the concentration of the acid, V_2 is the volume of the aliquot used for titration, $V_1$is the volume of the

distilled water used for diluting the digest and F is the multiplication factor (F= 0.0014).

2.3.6 Determination of carbohydrate

The method of difference was used to estimate the carbohydrate content of the plant sample. Therefore, percentage carbohydrate was obtained using equation 6,

$$\%\, Carbohydrate = 100 - (crude\ protein + crude\ lipid + crude\ fibre + ash + moisture) \quad (6)$$

3.0 Result and Discussion

3.1 Proximate Composition

Results obtained for protein, carbohydrate, lipid, moisture, ash and **fibre** contents of *Acalypha hispida* leaves are recorded in Table 1.

Table 1: Proximate Composition of *Acalypha hispida* Leaf

Proximate	Composition (%)
Carbohydrate	48.65
Moisture	11.02
Ash	10.17
crude fibre	10.36
crude lipid	6.05
crude protein	13.17

The result obtained from proximate analysis of *Acalypha hispida* leaves indicate that the leaf of this plant is rich in carbohydrate (48.65%) compared to other proximate content of the plant leaves. The low moisture content recorded for the leaf can hinder the growth of microorganisms and increase its helf life (Adeyeye and Ayejuyo, 1994). The mean crude protein content of *Acalypha hispida* leaves was ~~is~~ 13.78%, which is close to those reported for some vegetables including *Heinsia crinite* (14.7%). However, this value is lower than those reported for *Amarantus candatus* leaf (20.59%) (Etuk *et al* 1998 Akindahunsi and Salawu, 2005), cassava leaves (*Manihot utilisima*) (24.88%), *Piper Guineesees* leaf (29.78%) and *Talmum traingulare* leaf (31.00%), which are protein rich leaves. (Akinda-hunsi and Salawu, 2005). The ash content of *Acalypha hispida* leaf was 10.17%. Ash content of food materials is a measured of its inorganic content because it is known that at the furnace temperature above 900 K, all the organic matter might have been destroyed, leaving behand, only the inorganic content (ref). The measured ash content is lower than that of *Talinum triangulare* leaf (20.05%) ref but is higher than those of *Occimum gralicimum* (8.00%) and *Hibiscus esculentus* (8.00%) (Akindahunsi and Salawu, 2005). The high ash content is an indication of the inorganic content of the plant leaves Consequently, the leaves of this plant is rich in elements (Anta *et al*., 2006). Mean concentration of the crude in *Acalypha hispida* leaf was found to be10.17%, which is moderate when compared to those of *Talinum triangulare* (5.90%), *Baseila alba 8.71. Amaranthus hybridus* (4.80%), *calchorus africanum* (4.20%) (Akindahunsi and Salawu, 2005; Ifon and Bashir, 1979). Although the nutritional role of dietary fibre has not been fully established, it is generally accepted as a component that functions effectively as roughage and increases the palatability of food by absorbing and retaining flavours (Antia *et al.,* 2006). Mean lipid concentration in the leaves of the studied plant (6.05%) was relatively low. A diet providing 1 -2 % of its energy caloric as fat is recommended as sufficient dosage for humans. Excessive fat with higher colories has been linked to several health issues including some cardiovascular disorders such as atherosclerosis, cancer and aging (Anti *et al*., 2006). The measured crude fibre content (10.36%) of *Acalypha hispida* leaves is high when compare to values reported for leaves of some vegetables such as *Talinum triangulare* (6.20%), *Piper guineeses* (6.40%), *Corchorus olitorius* (7.0%), bitter leaves (*vernonia amygdalina*), 6.5% (Akindahunsi and Salawu, 2005).

3.2 Elemental composition

Mean concentrations of iron, zinc, copper and lead ions obtained for sample of *Acalypha hispida* leaves are recorded in Table 2,

Table 2: Elemental composition of *Acalypha hispida* leaf

Element	Composition (mg/L)
Fe	20.7
Zn	0.230
Cu	0.778
Pb	1.729

Iron is an essential component of human hemoglobin and is also an essential element to animals because it facilitates the oxidation of carbohydrates, protein and fat and hence help to regulate body weight, which a is very important factor in diabetes. Results obtained indicated that the maximum mean concentration of Fe in *Acalypha hispida* leaves was 20.702 mg/L. This concentration indicates high concentration of iron when compared

to the dietary limit of Fe in food, which range from 10 – 60 mg/day (Kaplan *et al*., 1993). Low concentration of Fe in the body may lead to content causes gastrointestinal infection, nose bleeding and myocardial infarction (Hient, 1994). The physiological role of iron is the body is clearly associated with hemoglobin and in the transfer of oxygen from lungs to the tissue cells (Anand *et al*., 2014). Iron deficiency is the most prevalent nutritional deficiency in human (West, 1996) and is commonly caused by insufficient dietary intake, excessive menstrual flow or multiple births; in this case, it results especially in anemia.

Mean concentration of zinc ion in the leaf of the plant was 0.23 mg/g. Zinc is an essential trace element needed for healthy plant growth and is also useful in various biochemical and physiological processes including normal growth, brain development, behavioural response, bone formation and wound healing. Zinc deficiency in diabetic patient could impair power to perceive and loss of sensation to the skin. Recommended daily intake of zinc is in the range, 15 to 30 mg. Deficiency of zinc can lead to recurrent infections, lack of immunity and poor growth, male hypogonadism, skin changes, poor appetite and metal lethargy (Prasad, 2020). Cell growth and multiplication are enhanced by enzymes, whose activity is enhanced by zinc ion (Rosenkranz *et al*., 2017).

Copper is an essential enzymatic element for normal plant growth and development but can be toxic at excessive level. Phytotoxicity can occur if its concentration in plants is higher than, 20 – 100 mg/L DW (dry weight). Mean concentration of copper ion in *Acalypha hispida* leaf was 0.778 mg/g, which is below the permissible limit. Therefore, health challenges from excessive copper intake may not be easily achieved through the consumption of this plant leaf. Reported signs and side effects of excessive consumption of copper include fume fever, hair and skin decolouration, dermatitis, irritation of the upper respiratory track, metallic taste in the mouth, nausea, etc Cu may cause metal fumes fever with flu like symtoms, hair and skin decoloration, dermatitis, irritation of the upper respiratory track, metallic taste in the mouth and nausea (Kalicanin and Rasic, 2020)..WHO has recommended the lower limit of the acceptable range of copper as 20ug/mg body weight per day. Therefore, consumption of this plant leaf along will not constitute copper toxicity

Mean concentration of lead in *Acalypha hispida* leaf was found to be 1.729 mg/g. Lead is a heavy metal that is not needed by the body and can impair normal functioning of the liver, bones, blood, kidney and other soft tissue organs (Kleaassen and Doull, 2001). Lead can inhibit several biochemical actions of enzymes and can replace divalent metal in the system because of its position in the electrochemical series.

4.0 Conclusion

This study was conducted to investigate proximate and elemental composition of *Acalypha hispida* leaf. It is found that all the proximate contents are fully represented in this plant's leaf at concentrations that follows the following trend, Carbohydrate>Protein>moisture> fibre> ash>fat. Also, the trend for the elemental concentrations.

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