J. Chem. Soc. Nigeria, Vol. 49, No. 4, pp 606 - 614 [2024]

PHYTOCHEMICAL, PROXIMATE AND MINERAL ANALYSIS OF LEAVES AND TUBERS OF *Icacina trichantha*

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ABSTRACT

This study presents an analysis of the phytochemical, proximate, and mineral composition of the leaves and tuber of *Icacina trichantha* using standard analytical procedures. Phytochemical screening of hexane, ethyl acetate, and methanol extracts revealed the presence of alkaloids, saponins, flavonoids, tannins, and glycosides. Proximate analysis indicated that the crude protein contents of the leaves and tubers were 26.97% and 10.94%, respectively. The crude fibre content was 43.25% in the leaves and 10.50% in the tubers. Carbohydrate content was significantly higher in the tubers (73.64%) compared to the leaves (22.37%). Mineral analysis showed that the leaves contained 1111 mg/100g of potassium, 338 mg/100g of magnesium, 290 mg/100g of calcium, and 21.14 mg/100g of iron. In contrast, the tubers contained 382 mg/100g of potassium, 191 mg/100g of magnesium, 163 mg/100g of calcium, and 14.24 mg/100g of iron. While the tubers had higher carbohydrate content, the leaves contain higher levels of crude protein, crude fibre, potassium, calcium, magnesium, and iron. These findings suggest that, beyond their medicinal applications, the leaves and tubers of *Icacina trichantha* possess valuable nutritional properties, indicating their potential as alternative food sources.

Keywords: *Icacina trichantha*, phytochemical, proximate, minerals

INTRODUCTION

Icacina trichantha (false yam), is a member of the *Icacinaceae* family. This small, drought-tolerant perennial shrub has upright, leafy shoots that emerge from a large, fleshy tuber that is underground. These tubers, which resemble big turnips or beet roots, give the plant vital moisture and energy, allowing it to endure up to four years without rain. The plant, which is native to West and Central Africa, is known by different names among the Ibos and Yorubas: Eriagbo by Ibos [1], and Gbegbe by the Yorubas [2] in Nigeria. The tuber can be eaten raw or turned into flour to use in porridge, pastes, and soups. In order to soften and get rid of the bitter elements, it is traditionally prepared by washing, slicing, and

ISSN 0795 - 22066

soaking in water for several days. The tuber is ground and sieved to yield flour that is either creamy-yellow or greyish-white after it has been sun-dried [3]. Studies on the flour's nutritional makeup and anti-nutritional elements (like hydrogen cyanide, oxalates, tannins, phytates, and alkaloids) have shown that it contains minerals like potassium, sodium, and calcium as well as lipids, proteins, and carbohydrates (primarily starch) [3,4]. No data exists in the literature on the phytochemical, proximate and mineral contents of the leaves of the plant. In this study, the phytochemical, proximate and mineral contents of the leaves and tuber of the plant are investigated and compared.

MATERIALS AND METHODS

Sample Collection and Extraction

Fresh leaves and tubers of *Icacina trichantha* were collected from the Botanical Gardens of the University of Ibadan. The plant materials were authenticated by Mr. Owolabi, a taxonomist associated with the Garden. The tubers were sliced into small pieces. Both the leaves and tubers were dried under mild sunlight for six weeks. One-kilogram portions of the dried leaves and tubers were subjected to sequential extraction using hexane, ethyl acetate, and methanol. The extraction process involved the following steps: Each plant material was first extracted with hexane. The residue from the hexane extraction was subsequently extracted with ethyl acetate. Finally, the residue from the ethyl acetate extraction was extracted with methanol. The extracts were concentrated to dryness using a rotary evaporator.

Phytochemical Screening of Extracts

Phytochemical screening of the extracts was performed using standard procedures [5-9].

Proximate and Mineral Analysis of Plants

Proximate analysis, including the determination of total ash, dry matter, crude fibre, protein, and fat contents, was conducted using standard methods of the Association of Official Analytical Chemists [10]. The procedures are detailed below.

Determination of Moisture Content

A crucible was dried in an oven, cooled in a desiccator, and weighed (W_1). One gram of the sample was placed in the crucible, and the combined weight was recorded (W_2). The crucible containing the sample was dried in an oven at 105°C for 2-3 hours until a constant weight was achieved (W_3). The moisture content was calculated using the formula:

$$\%\ Moisture\ Content = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Determination of Ash Content

A crucible was dried in an oven, cooled in a desiccator, and weighed (W_1). Two grams of

the sample were placed in the crucible, and the combined weight was recorded (W_2). The crucible was ashed in a muffle furnace at 500-600°C for 4-5 hours until a whitish residue was obtained (W_3). The ash content was calculated using the formula:

$$\% \, Ash = \frac{W_3 - W_1}{W_2 - W_1} \text{ x } 100$$

Determination of Crude Protein Content

Two grams of the sample were mixed with 10 ml of concentrated H_2SO_4 and one selenium catalyst tablet in a heating tube. The mixture was heated in a fume cupboard until clear, and then diluted with distilled water. Ten milliliters of the digest were mixed with an equal volume of 45% NaOH solution and distilled in a Kjeldahl apparatus. The distillate was collected in a 4% boric acid solution with three drops of methyl red indicator and titrated. The nitrogen content was calculated and multiplied by 6.25 to obtain the crude protein content:

$$\% \, Nitrogen = \frac{(100 \times N \times 14 \times VF)T}{100 \times V_a}$$

Where: N= Normality of the titrate (0.1N); VF= Total volume of the digest= 100 ml; T= Titre Value; Va= Aliquot Volume distilled

Determination of Fat Content

0.5 grams of the sample were placed in a Soxhlet extractor using Whatman filter papers. The weight of a 250 ml round-bottom flask was recorded (W_1), and petroleum ether was added (W_2). The setup was boiled on a heating mantle for 4-6 hours. The flask weight after extraction was recorded (W_3). The fat content was calculated using the formula:

$$\% \, Fat = \frac{W_3 - W_2}{W_2 - W_1} \text{ x } 100$$

Determination of Crude Fiber Content

0.4 grams of the defatted sample were boiled with 25 ml of dilute sulfuric acid for 30 minutes and filtered. The residue was boiled with 100 ml of dilute sodium hydroxide for 30 minutes, filtered, and washed with distilled water, ethanol, and petroleum ether. The residue was dried in an oven at 105°C (W_1), then ashed in a muffle furnace at 300-400°C for 1 hour (W_3). The fiber content was calculated using the formula:

$$\% \, Crude \, Fibre = \frac{W_2 - W_3}{W_1} \text{ x } 100$$

Determination of Carbohydrate Content

The carbohydrate content was determined by difference, subtracting the measured protein, fat, ash, and water contents from the total weight of the sample.

Mineral Analysis

Eleven grams of each sample were weighed, ashed in a muffle furnace at 550°C for 3 hours, and cooled in a desiccator. The white ash was dissolved in 5 ml of 20% HCl solution and

heated gently for 30 minutes. The clear solution was filtered and diluted to a suitable concentration for analysis using an Atomic Absorption Spectrophotometer [11].

RESULTS AND DISCUSSION

The phytochemical screening results for the extracts are summarized in Table 1. The hexane, ethyl acetate, and methanol extracts of the leaves and tubers of *Icacina trichantha* revealed a wide array of phytoconstituents. The hexane extract of the tuber tested positive for saponins, flavonoids, and alkaloids. Conversely, the ethyl acetate extract exhibited the presence of tannins, resins, saponins, alkaloids, and terpenoids. These variations are attributable to the different polarities of the solvents used for extraction: hexane is non-polar, ethyl acetate has medium polarity, and methanol is polar. Consequently, the phytoconstituents are distributed across these extracts according to their polarities.

Furthermore, the phytochemical profiles of the leaves differ significantly from those of the tuber. For instance, the hexane extract of the leaves tested positive for a greater number of phytochemicals compared to the hexane extract of the tuber.

Table 1: Phytochemical Screening of Extracts of Leaves and Tubers of *Icacina trichantha*

TESTS	ICTHE	ICTEE	ICTME	ICLHE	ICLEE	ICLME
Tannins	-	+	-	+	+	+
Glycosides	-	-	+	+	-	-
Resin	-	+	+	+	+	+
Saponins	+	+	-	+	+	+
Phlobatannins	-	-	-	-	+	+
Flavonoids	+	-	+	+	+	-
Sterols	-	-	-	+	+	+
Phenols	-	-	-	-	-	-
Carbohydrates	-	-	+	+	-	-
Alkaloids	+	+	-	+	+	+
Terpenoids	-	+	-	+	-	+

1- ICTHE **2**-ICTEE **3**-ICTME **4**-ICLHE **5**-ICLEE **6**-ICLME + = Present; - = Absent

Phytochemicals are responsible for the broad range of pharmacological activities displayed by plants, and thus, the extracts are expected to exhibit varying bioactivities due to differences in their phytoconstituents. Flavonoids are known to possess anti-inflammatory, antioxidant, cardioprotective, antimicrobial, antithrombotic, anticancer, and antiatherogenic effects [12]. Saponins, recognized as anti-nutritional phytochemicals, can reduce the uptake of nutrients, including cholesterol and glucose in the gut, suggesting potential applications in treating diabetes and cardiovascular diseases. Alkaloids have been documented to exhibit muscle relaxant, antioxidant, anticancer, antimicrobial, and amoebicidal activities [13-14].

The proximate and mineral compositions of the leaves and tubers are detailed in Table 2. The leaves exhibited higher crude protein (26.97%), crude fibre (42.25%), and ash content (7.20%) compared to the tubers, which had values of 10.94%, 10.50%, and 3.60%, respectively. In contrast, the tubers had a significantly higher carbohydrate content (73.64%) than the leaves (22.37%).

The mineral content of the leaves was also found to be higher than that of the tubers. Specifically, the leaves contained 1111 mg/100g of potassium, 290 mg/100g of calcium, 338 mg/100g of magnesium, 21.14 mg/100g of iron, 0.76 mg/100g of copper, and 6.83 mg/100g of zinc. The corresponding values for the tubers were 382 mg/100g, 163 mg/100g, 191 mg/100g, 14.24 mg/100g, 0.33 mg/100g, and 5.11 mg/100g, respectively.

The results obtained are in reasonable agreement with those reported by [15], who found that flour produced from tubers had 11.7% moisture, 10.3% protein, 0.7% fat, 74.5% carbohydrate, 2.8% ash, 150 mg/100g calcium, and 7 mg/100g iron.

The findings underscore the nutritional value and potential health benefits of *Icacina trichantha*. Crude fibre, present in significant amounts in the leaves, is associated with increased gut motility, constipation prevention, weight loss facilitation through reduced food consumption, and improved glycaemic index of carbohydrate-rich foods and lipid profiles [16]. Protein, abundant in the leaves, is crucial for preventing the loss of muscle strength and mass [17]. Carbohydrates, the body's primary energy source, provide essential fuel for the brain, kidneys, heart muscles, and central nervous system. The low crude fat content observed in this study is beneficial for reducing the risk of hypercholesterolemia and related cardiovascular diseases [18]. A diet with 1-2%

of its caloric energy from fat is sufficient for human health [19].

Table 2: Proximate and Mineral Analysis of the Tubers and Leaves of *Icacina trichantha*

Compositions	**ITL**	**ITT**
Moisture (%)	0.19 ± 0.02	1.30 ± 0.01
Crude protein (%)	26.97 ± 0.01	10.94 ± 0.01
Ash (%)	7.20 ± 0.03	3.60 ± 0.01
Crude Fibre (%)	43.25 ± 0.01	10.50 ± 0.00
Crude Fat(%)	0.02 ± 0.00	0.02 ± 0.00
Carbohydrate (%)	22.37 ± 0.01	73.64 ± 0.01
K (mg/100 g)	1111.00 ± 0.10	382.00 ± 0.21
Ca(mg/100 g)	290.00 ± 0.01	163.00 ± 0.25
Mg (mg/100 g)	338.00 ± 0.11	191.00 ± 0.03
Fe (mg/100g)	21.14 ± 0.02	14.24 ± 0.01
Cu (mg/100g)	0.76 ± 0.02	0.33 ± 0.00
Zn (mg/100g)	6.83 ± 0.00	5.11 ± 0.02

*Values are in duplicate determinations; ITL-*I. trichantha* leaves; ITT- *I. trichantha* tuber; CJL- *C. jagus* leaves; CJT- *C. jagus* bulb

The ash content, indicative of mineral content, highlights the importance of these plant parts as sources of essential minerals. Potassium is necessary for fluid balance, nerve impulse conduction, regular heartbeat, and cell metabolism [20]. Calcium contributes to bone formation, blood clotting, metabolic processes, and muscle contraction [21]. Magnesium supports the health of the nervous system [22]. Iron is crucial for red blood cell formation and numerous cellular reactions, although its catalytic ability can generate free radicals, contributing to its toxicity [23]. Copper is a vital cofactor for forming proteins like cuproprotein [24], while zinc acts as an antioxidant enzyme and a cofactor for

superoxide dismutase (SOD), essential for the body's immune system and cell growth and development [24].

CONCLUSION

This study evaluated the phytochemical, proximate, and mineral constituents of the leaves and tuber of *Icacina trichantha*. The hexane, ethyl acetate, and methanol extracts revealed the presence of various phytoconstituents, which are likely responsible for the plant's pharmacological properties. Notably, while the tuber had a higher carbohydrate content, the leaves contained significantly greater amounts of crude protein, crude fiber, potassium, calcium, magnesium, and iron. These results underscore that, in addition to their medicinal uses, the leaves and tubers of *Icacina trichantha* offer substantial nutritional benefits, highlighting their potential as alternative food sources.

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