

Evaluation of phytochemical, proximate and mineral element composition of stem of *Costus afer* (Bush cane)

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ABSTRACT

The Phytochemical, proximate and mineral element composition of the stem of *Costus afer* were investigated. Phytochemical analysis revealed the presence of saponins, alkaloids, glycosides, tannins, and steroids. The proximate composition indicated the following; moisture (33.6 %), crude fat (2.48 %), crude protein (14.02 %), carbohydrate (20.14 %), crude fiber (15.55 %), and ash (14.21 %). Mineral element determination (in mg/100 g) showed the presence of potassium (88.00), sodium (1.94), calcium (200.40), magnesium (191.39), and phosphorus (6.02). The anti-nutrients evaluated (in mg/100 g) were total oxalate (314.00), soluble oxalate (200.44), cyanide (24.40) and tannins (7.92). The presence of these phytochemicals in this plant, coupled with its low toxicity level obtained lends credence to the numerous beneficial roles of this plant in agriculture and folk medicine.

Keywords: Anti-nutrients, *Costus afer*, Mineral element Phytochemicals, Proximate composition.

INTRODUCTION

The plant *Costus afer* Ker (Zingiberaceae) is among the 150 species of stout, perennial and rhizomatous herbs of the genus *Costus*. It can be found in the forest belt of Senegal, South Africa, Guinea, Niger, Sierra Leone and Nigeria [1, 2]. *C. afer* is commonly called bush cane, Ireke omode (Yoruba-Western part of Nigerian), Opete (Igbo-Eastern part of Nigeria), Mbriem (Efik-Southern region of Nigeria). It bears white and yellow flowers. The stem, seeds and Rhizomes are harvested from the wild plant and they contain several bioactive metabolites [3].

Costus afer finds extensive use in folkloric medicine as a remedy for cough, rheumatic pains, sleepiness and cardiotoxic [4, 5]. Tea from the dried aerial parts is used for hypertension while the leaves are used as poultry feed additives to increase both the size and number of eggs of treated birds.

Previous studies carried out on different parts of *C. Afer* include: *invitro* and *invivo* pharmacological activities of leaf [6], leaf essential oil [7], topical anti-inflammatory activity [8], phytochemical composition and antioxidant activities of stem [9].

A few chemical studies have shown that the roots of *C. afer* contains oxalic acid, lanosterol, trigogenin, new diosgenin, stigmasterol, Sitosterol, costugenin [10] and a new steroidal saponin aferoside A [11].

The present study therefore aims at investigating the phytochemical, proximate and mineral element composition of the stem. The anti-nutrient composition has also been determined in this study.

MATERIALS AND METHODS

Fresh samples of *Costus afer* (bush cane) were collected within Uyo Local Government Area of Akwa Ibom State in Southern Nigeria. The plant part (stem) was identified at Department of Botany and Ecological studies of the

University of Uyo, Nigerian where a voucher specimen was also deposited. These stems were cut into pieces and air-dried for 5 days. This was subsequently followed by oven-drying at 40 °C for 2 days. The dried samples were ground into powder and stored in an air-tight container prior to analysis.

• **Phytochemical Analysis:** This was carried out to detect the presence or otherwise of some secondary metabolites in the sample and this done following the method of [12] and [13].

• **Proximate and Mineral Elements Composition:** Standard procedures as outlined by the Association of Official Analytical Chemists [14] were used to determine moisture, ash, crude protein, crude fat, crude fiber, carbohydrate content and some mineral elements present.

• **Anti-nutrient Composition:** Composition of cyanide, tannins, total and soluble oxalates was determined using standard methods as stated by Association of Official Analytical Chemists [14].

RESULTS AND DISCUSSION

Results of the different analyses carried out on the stem of *C. afer* are shown in the following section.

Table 1: Result of Phytochemical analysis on the stem of *Costus afer*.

Phytoconstituents	Detection
Alkaloids	+
Saponin	+
Steroids	+
Triterpenoids	+
Tannins	+
Flavonoids	-
Glycosides	+
Carbohydrate	+
Protein	+

+ Indicates presence, – Indicates absence

Table 2: Result of Proximate composition of stem of *Costus afer*.

PARAMETER	COMPOSITION OF DRY MATTER (%)
Moisture content	33.60
Ash content	14.21
Crude fat	2.48
Crude fibre	14.02
Crude protein	15.55
Carbohydrate	20.14

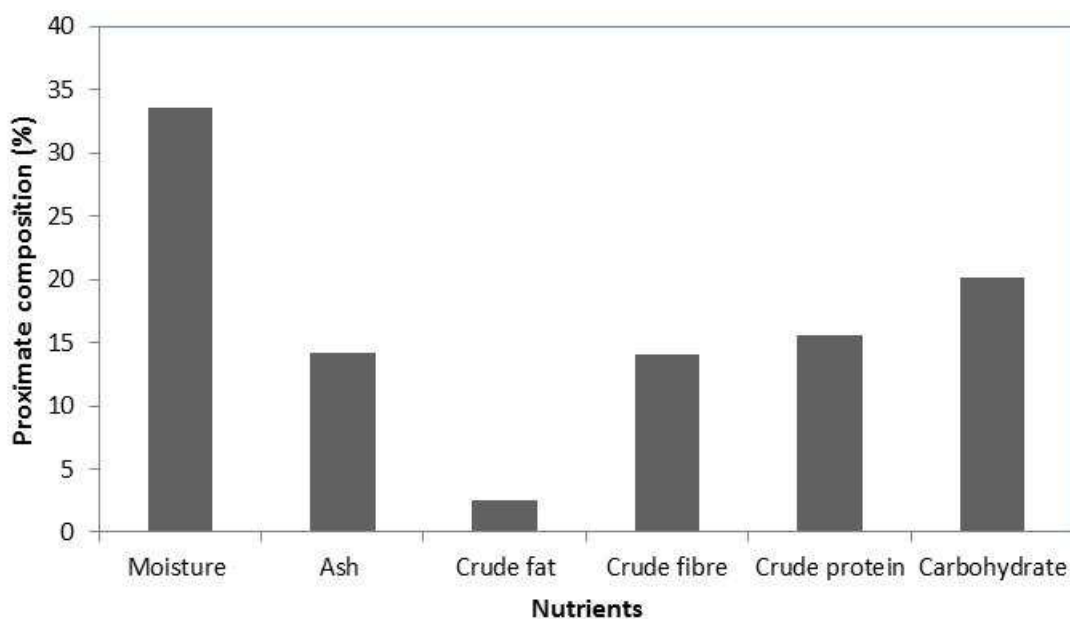
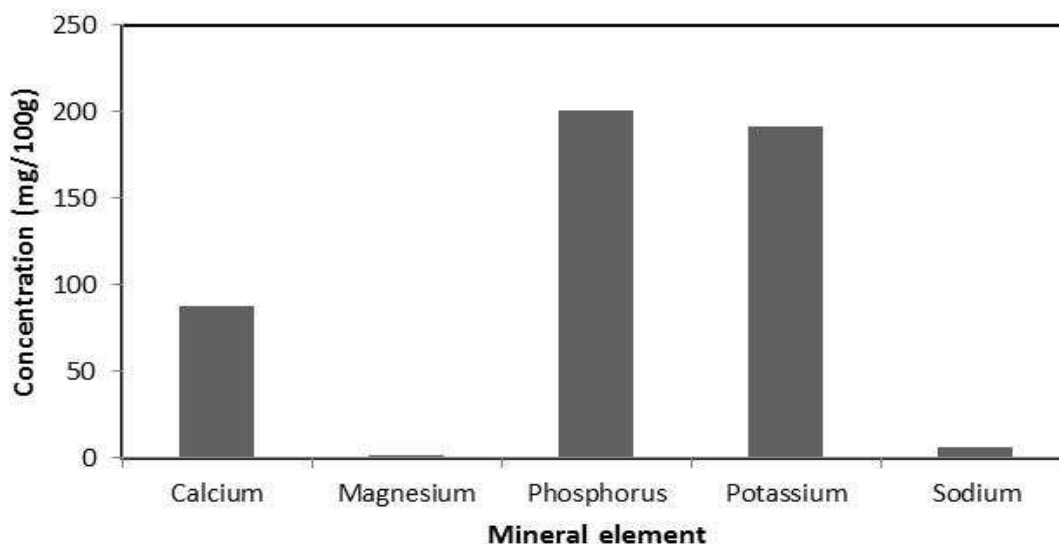
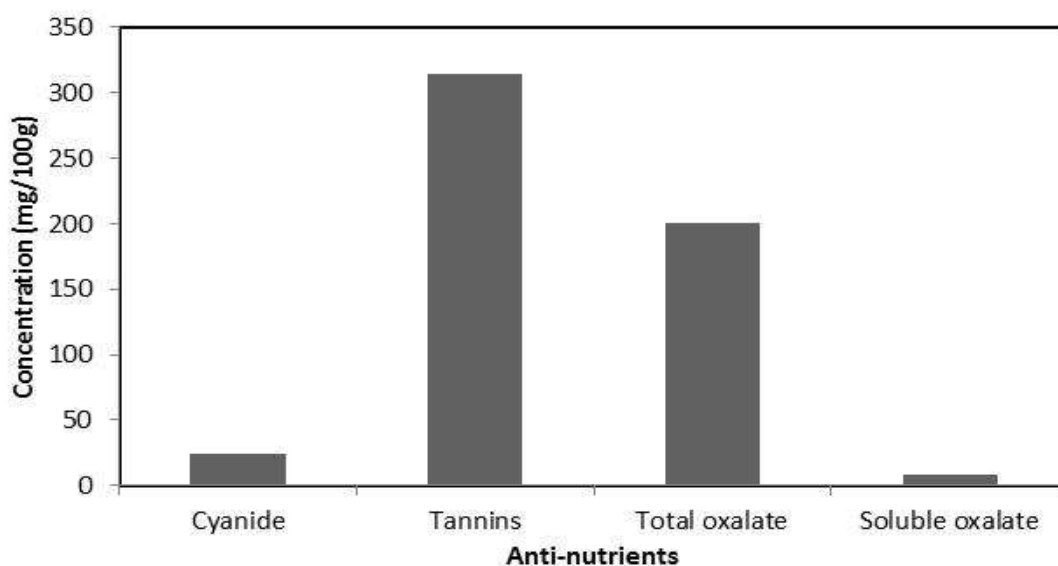


Fig. 1: Proximate composition of stem of *Costus afer*.

Fig. 2: Mineral element composition of stem of *Costus afer*.Fig. 3: Anti-nutrient composition of stem of *Costus afer*.Table 3: Mineral Element composition of stem of *Costus afer*.

ELEMENT	Mg/100 g
Calcium	88.00
Magnesium	1.94
Phosphorus	200.40
Potassium	191.39
Sodium	6.02

Table 4: Anti-nutrition composition of *Costus afer*.

Anti-nutrients	Mg/100 g
Cyanide	24.40
Tannins	314.00
Total oxalate	200.44
Soluble Oxalate	7.92

DISCUSSION

Phytochemical Analysis: The results of phytochemical analysis on the stem of *Costus afer* are presented in Table 1. These results indicate the presence of alkaloids, glycosides, tannins, steroids, terpenoids and saponins. Primary constituents such as carbohydrate and protein were also detected. The medicinal properties of the components have

been documented by earlier authors [15, 16,17]. The importance of alkaloids, glycosides, saponins, steroids, tannins and triterpenoids in various antibiotics used in treating common pathogenic strains has also been reported by [18].

Proximate composition: The results of the proximate composition of the stem of *Costus afer* are shown in Table 2. A pictorial representation of this result has been made in figure 1.

A moisture content of 33.6 % was obtained. The total ash content which is a measure of the non-volatile inorganic constituents remaining after ashing was found to be 14.21 %. This value is significantly low when compared to other succulent plants such as waterleaf which was found to be 18.62 % [19]. Thus *Costus afer* has shown to be a rich source of minerals. The crude fat content of *Costus afer* was found to 2.48 % per dry weight. This value is low when vegetables with values ranging from 10.00-12.14 %. Fats have been reported to have at least three important functions; physiological, culinary and nutritional functions [20].

Crude protein: The crude protein content of *Costus afer* is 14.02 % of dry weight. This value compares reasonably with previous reports on the crude protein contents of some Nigerian forage plants as documented by [21].

Crude fibre and carbohydrate:

The crude fibre and carbohydrate content of *Costus afer* were found to be 15.55 % and 20.14 %) of dry weight respectively. The carbohydrate content makes *Costus afer* a rich source of energy for the livestock.

Mineral Composition of *Costus afer*:

The results obtained for the elemental composition of *Costus afer* is given in table 3 and shown pictorially in figure 2.

Potassium (K):

The level of potassium in *Costus afer* was 88.00 mg/100 g. This result is low when compared to the potassium content in green vegetables (132 mg/100 g), cabbage (233 mg/100 g) and lima bean (650 mg/100 g) as earlier reported [22]. The main function of potassium in the body is the maintenance of the osmotic pressure and the acid-base equilibrium of the body. Potassium is also important in the formation of proteins and glycogen [23].

Calcium (Ca):

The result for the calcium content of *Costus afer* was 200.4 mg/100 g. This shows that contains appreciable amount of calcium. Plant requires calcium for the proper growth, good leaves and branches. Calcium is necessary for the development of bones and teeth. In addition, it has been reported to be helpful in the formation of blood, intra cellular and extra cellular fluids within and outside the cells of the tissues [24]. The result compares favourably with the calcium content of lima beans which ranges between 100-120 mg/100 g [22].

Magnesium (Mg):

The level of magnesium contained in the sample (*Costus afer*) was 191.39 mg/100 g. This value compared to the recommended daily intake of 60 – 200 mg is quite appreciable as a good source of magnesium. On its own, *Costus afer* can offer enough magnesium to cater for the activation of enzymes involved in Phosphorylation and its function skeletal structures.

Phosphorus (P):

The level of phosphorus found in the sample (*Costus afer*) was 6.02 mg/100 g. This amount was compared to the level found in most vegetables as shown by [25] is very low. This is therefore in conformity with the negative result obtained in the test for Phytic acid which is a pointer to the phosphorus content of any plant.

Anti-nutritive components of *Costus afer*.

Preliminary results for the anti-nutritional components of *Costus afer* are shown in Table 4 and depicted pictorially in figure 3.

Cyanide:

The Cyanide content in *Costus afer* was found to be 24.40 mg/100 g. The level of cyanide is comparatively low as compared to the cyanide level in Cassava (113 mg/100g) [26]. It has been reported that the level of cyanide that brings fatal livestock poisoning was has been at 210 – 312 mg/100 g [27]. This implies that this low cyanide content is less likely to cause livestock poisoning even when consumed in large quantities.

Oxalate:

The level of oxalate in *Costus afer* was found to be 314 mg/100g. Oxalate binds with calcium to form calcium-oxalate crystals which are deposited as urinary calcium (stones) that are associated with blockage of renal tubules [28]. However, it has been shown that the lethal dose of oxalate in man is between 2-5 g with an average of 3 g [19]. Therefore, the low level of oxalate in *Costus afer* is not likely to exhibit toxic effects in animals when consumed as fodders.

Tannins:

The composition of tannins ranked highest of all the anti-nutrients studied in this work. The amount of tannins contained in *Costus afer* was 7.92 mg/100 g. This value was compared to the tannin content of other plants like a pea leaf which is 10.7 mg is comparable [29]. The antibacterial properties of tannins have earlier been documented by earlier reports [17, 30].

CONCLUSION

Phytochemical analyses on the stem of *Costus afer* have shown the presence of active principles such as alkaloids, glycosides, saponins, tannins, steroids and triterpenes. Protein and carbohydrate were also detected. These active principles can be exploited and used as drug base in pharmaceutical industries.

An appreciable amount of mineral elements was also found to be present and in all, the concentrations of the elements in the analyzed sample are enough to meet the daily recommendations if taken regularly. Values obtained for proximate composition indicate that it is succulent and very rich source of energy for livestock.

The estimation of its toxicity property has indicated relatively low values; hence the stem of *Costus afer* is not expected to produce any adverse health effects when consumed. All these results lend credence to the numerous beneficial roles this plant is reputed for in folk medicine.

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