

Comparative Assessment of the Proximate Composition of the Stem, Leaf and the Rhizome of *Costus afer*.

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Abstract: Comparative studies on the phytochemical composition of the leaf, stem and rhizome of *Costus afer* were carried in the Food Science and Technology Laboratory in the Rivers State University, Port Harcourt. The various plant parts were collected from the surrounding fallow bush within the University campus and identified and labelled properly. It was observed that *C. afer* contains bioactive compounds capable of fighting oxidative related diseases. The proximate analysis indicates that the leaf, stem and rhizome contain appreciable amount of carbohydrate, crude fibre, ash, lipid and protein. The mineral components of *C. afer* include calcium, iron, sodium, phosphorus and potassium. However, it was observed that some anti-nutrients such as tannins, saponnins, oxalates, and cynogenic glycosides were present in both the leaf, stem and rhizome. This therefore suggests that *C. afer* could serve as a source of dietary fibre and the necessary energy required for metabolism. The presence of tannin, saponnin, oxalate and cynogenic glycosides portrays it as a potent plant with bioactive quality.

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I. Introduction.

Costus afer is a perennial rhizomatous herb that can grow up to the height of 4 m in undisturbed bushes in the tropical environment. It belongs to the family Zingiberaceae and a monocot, unbranched with creeping rhizomes found mainly in moist and shady forest of West and tropical Africa (Okoli, 2003). It is commonly known as the bush sugar cane and called by several local names in different places where it is found. The leaves of this plant are arranged spirally, simple and entire with closed green coloration and tinged with purple blotches. *Costus afer* is Pan tropical and consists of about 70 species with about 40 species found in the tropical America, 25 species in the tropical Africa and about 5 species found in South-East Asia (Aweke, 2007). Although generally regarded as a weed in cultivated farms this plant has been reported to possess certain attributes that qualify it a potent herb as extracts of the leaf, stem and rhizomes are used as herbal medications (Anyasor and Blessing, 2010). The African *C. afer* need a lot of breeding especially the large forest type that cannot be preserved in herbarium collections. It is also a vigorous grower and flowers and fruits all through the year under favourable soil condition (Iwu and Anyanwu, 2000). The common *C. afer* and *C. lucanusianus* J. Brain & K. Schum are closely related species in terms of the number of flowers enclosed by the bracts and the colour of the flowers. The only difference is that the inflorescence of *C. afer* is cone-like with each bract covering 2 flowers and the corolla is white with a yellow throat. However, *C. lucanusianus* has a globose inflorescence and each bract covers only 1 flower with a white corolla and a red lip and yellow throat. In Southern Nigeria, *C. afer* and *C. lucanusianus* are crossed to produce a hybrid. Traditionally, West Africa especially in the Southern parts various species of *C. afer* are found and are known to possess medicinal values and include *C. deistelli* K. Schum, *C. dubius* (Afzel). J.K Schum, *C. Englerianus* K. Schum, *C. Schlechteri* Winkler and the ornamental *C. spectabilis* (Frezl) K.Schum. The extract of the inflorescences and stems of all the species are consumed to treat cough and stomach upsets, leaf and stem extracts as eye drops to treat eye infections and nose drops to cure headaches (Neuwinger, 2000). These can be boiled and used as vapour bath to treat oedema and fever, or applied to treat urethral discharges, venereal diseases and jaundice and to prevent miscarriages (Moody and Okwagbe, 2003). The rhizome pulp is applied to abscesses, ulcers and Guinea worm to facilitate its maturity. The rhizome decoction of *C. dubius* is taken to treat epilepsy (Omokhua, 2011). The boiled leaves of *C. schlechteri* are also applied to small pox and are taken to treat diabetics. In Nigeria, most spiritual homes will always request for the juice from the stem which is usually very expensive to purchase and used for the prevention of certain diseases and possesses such properties as antioxidants, hormonal actions, stimulation of enzymes, interference with DNA replication and physical actions (Burkill, 2000). The stems are usually consumed especially during the dry season and in areas of water scarcity. The stems are very succulent and yield so much water which when taken has a peculiar cooling effects in man in areas of water scarcity (Iwu and Anyanwu, 2000). The juice from the stem is mixed with clay and rubbed on babies and adults to clear skin

rashes. The juice is also applied into the eyes to prevent measles, small pox and chicken pox from entering the eyes. The succulent leaves are also consumed by man and animals as vegetables and fodders. The rhizomes are boiled as pot herbs in combination with the flowers, leaves and stem as pot herbs. This work compared the proximate composition of the stem, leaf and the rhizome of *C. afer*. The knowledge of this will further expose farmers and plant breeders to the proper usage of the plant and therefore will bring about its conservation and prevent it from going extinct.

II. Materials And Methods.

Collection of leaf, stem and rhizomes of *Costus afer*

Whole *C. afer* plant was harvested from the fallowed bush of the Rivers State University Teaching and Research Farm and transported to the Department of Applied and Environmental Biology, Botany unit and identified by a Professor of Taxonomy.

Phytochemical analysis

The leaf, stem and rhizomes were separated from the whole plant and taken to the Food Science and Technology Laboratory for Phytochemical analysis. The proximate, mineral and anti-nutrient composition of these plant parts were analysed according to AOAC (AOAC,2005).

Results of the phytochemical analysis.

The results of the phytochemical composition of *C. afer* comprising the proximate, minerals and anti-nutrient composition of the stem, leaf and rhizome of *C. afer* are presented in Tables 1 to 3.

Proximate composition of *C. afer*

The results of the proximate composition of the leaf, stem and rhizome of *C. afer* is presented in Table 1. It was observed that all the analysed plant parts contain appreciable amount of moisture, ash, fibre, carbohydrate, lipid and protein. The moisture content of the leaf is higher than that of the rhizome and least in the stem. Ash content was highest in the stem followed by the rhizome and least in the leaf. Carbohydrate value of the leaf was higher than that of the stem and least in the rhizome. However, the leaf recorded highest values for lipid and protein followed by the stem and least in the rhizome.

Table 1: Proximate composition of the leaf, stem and rhizome of *Costus afer*.

Parameters	Values (%)		
	Leaf	Stem	Rhizome
Moisture	85.6±0.007 ^a	56.4±0.041 ^c	71.1±0.011 ^b
Ash	11.5± 0.120 ^a	14.6±0.023 ^a	13.0±0.060 ^a
Fibre	18.6±0.042 ^a	42.6±0.045 ^b	45.2±0.004 ^b
CHO	25.5±0.011 ^a	20.1±0.140 ^b	16.4±0.003 ^{bc}
Lipid	7.2±0.310 ^a	5.8±0.005 ^a	2.1±0.005 ^b
Protein	18.5±0.022 ^a	16.7±0.006 ^a	12.5±0.021 ^b

Values having the same alphabets are not significantly different.

Mineral composition of *C. afer*

C. afer contains essential minerals like calcium, iron, sodium, phosphorus and potassium. Calcium content of the stem was higher than those of the rhizome with the least value recorded by the leaf.

Table 2: Mineral composition of the leaf, stem and rhizome of *Costus afer*.

Parameters (mg/100g)	Values (%)		
	Leaf	Stem	Rhizome
Calcium	418±0.000 ^a	500±0.004 ^c	350±0.002 ^b
Iron	1.35±0.001 ^a	1.37±0.001 ^a	2.5±0.006 ^b
Sodium	11.5±0.050 ^a	21.5±0.003 ^b	12.2±0.001 ^a
Phosphorus	55.5±0.020 ^b	66±0.005 ^c	18±0.010 ^a
Potassium	201±0.002 ^b	211±0.001 ^c	113±0.003 ^a

Values having the same alphabets are not significantly different.

Results of the anti-nutrient composition of the leaf, stem and rhizome of *Costus afer* is presented in Table 3. It was observed that four phyto-chemical also classified as anti-nutrient elements were predominant in the leaf, stem and rhizomes of *Costus afer*. These phytochemicals are Tannins, Saponins, Oxalates and Cynogenic glycosides.

Table 3: Anti-nutrient composition of the leaf, stem and rhizome of *Costus afer*.

Parameters (mg/100g)	Values (%)		
	Leaf	Stem	Rhizome
Tannin	0.05±0.001 ^a	0.16±0.001 ^a	0.01±0.002 ^b
Saponin	1.65±0.001 ^a	1.80±0.001 ^a	0.85±0.006 ^b
Oxalate	3.5±0.050 ^a	3.0±0.003 ^{ab}	2.5±0.001 ^b
Cyanogenic glycosides	35.7±0.020 ^a	18.90±0.005 ^b	13.6±0.010 ^c

III. Discussion

The research conducted on the on the phyto-chemical composition of the leaf, stem and rhizome of *Costus afer* has shown that all the plant parts are reach in essential food nutrients required by man for proper body metabolism. The high moisture found in the leaf, stem and rhizome is commendable as it could be used as water supplement with special cooling effects in man in regions of water scarcity. *C. Afer* leaf also contains appreciable amount of ash, fibre, carbohydrate, lipid and protein an indication that it can be consumed as a vegetable alongside its pharmaceutical uses. It has been reported that the leaf sap is used to treat eye problem and as nose drops to treat headaches (Seraef, 2010). There are documentary research findings that the leaf extract is also inhibited the growth of certain bacteria such as bacillus, E. coli and P. mirabilis (Vasantharaj, 2013). However, the rhizome extracts of *C. afer* was found to be effective against Staphylococcus aureus and Salmonella typhimurium(Ariharan, 2012).Similarly, it was reported that the Igbos use the rhizomes of *Costus afer* as expectorants for the cure of asthma, fever, and bronchitis (Duraipanandiyan and Ignacinmethe,2015). The rhizomes of *C. afer* is rich in macro nutrients and Vitamin A, it also contains anti-oxidants components such as carotene and ascorbic acid that prevent disorder and cancer (Neuwinger, 2000).The stem of this potent plant is a delicacy in the rural areas in the Southern and Eastern Nigeria as it is consumed as sugar cane during the dry season especially in the farms. The crude stem extracts are quite expensive as most laboratories utilize it in performing experiments. It was also reported that the crude stem extract of *C. afer* administered to structozotocin induced diabetic male rats at different doses significantly reduced plasma glucose in a dose-dependent manner when compared to the control. In another study, the aqueous and methanolic extract of *C. afer* were found to be highly effective in reducing the blood glucose level (Rajesh, 2009).The high nutrient quality of most fruits and vegetables in the tropics are well documented(Achinehwu,1996).

IV. Conclusion.

This research has shown that *C. afer* is an important plant that has not been fully explored as it has not been integrated as a crop in the Nigerian farming system. The comparative study has revealed that both the leaf, stem and rhizome of the plant are very useful and rich in important plant nutrients with various uses. The implication of this finding is that *C. afer* is a plants whose parts are all useful and should thus be seen and treated as such.

V. Recommendation

In Nigeria and across the globe cultivated food crops are no longer satisfying the food requirement of the nation, the implication of this is that most of the plants growing in the wild can actually be supplemented for the cultivated crops considering their rich nutrient qualities. *Costus afer* falls within such plant categories that could be used as alternative source for sugar cane and is therefore recommended as not only as a food supplement but for both its medicinal and industrial uses.

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