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Comparative analysis of some selected minerals in *Costus afer* leaf and stem in Abakaliki, Nigeria

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Abstract

The study was carried out to evaluate the level of some mineral in *Costus afer* leaf and stem as it is been used in recently use in ethnomedicine for the treatment of diseases and also consume as vegetable by humans. The composition were evaluated using a standard method of AOAC, 2006. The result revealed a significant amount of heavy metals in the leaf in the order of calcium (74.52 ± 0.01 mg/g) > magnesium (31.71 ± 0.02 mg/g) >sodium (22.33 ± 0.02 mg/g) >manganese (7.31 ± 0.01 mg/g) >phosphorus (9.03 ± 0.02 mg/g) >potassium (6.91 ± 0.01 mg/g) >zinc (2.02 ± 0.01mg/g) >Nickel (0.26 ± 0.01 mg/g) >Iron (0.22 ± 0.01 mg/g) >lead (0.11 ± 0.02 mg/g) while the stem is in the order of calcium (70.23 ± 0.02 mg/g) >magnesium (37.64 ± 0.01) >potassium (16.45 ± 0.04 mg/g) >sodium (14.13 ± 0.02 mg/g) >phosphorus (10.42 ± 0.02 mg/g) > manganese (8.04 ± 0.04 mg/g) >zinc (2.23 ± 0.28 mg/g) >Iron (1.07 ± 0.01 mg/g) >lead (0.61 ± 0.01 mg/g) >nickel (0.24 ± 0.02 mg/g). Base on the result analyzed it is concluded that the plant can be used as an alternative and complimentary therapy for many oxidative stressed diseases and could be incorporated in nutraceutical, provided further scientific studies on the pharmacological and toxicological aspects are carried out.

Keywords: *Costus afer*, medicinal plants, minerals, nutraceuticals

Introduction

Medicinal plants play a great role on human life. They are used traditionally for the treatment of diseases and modern drugs production. They are used worldwide in the treatment of various type of diseases like, fungal, bacterial and skin infection, respiratory problems, malaria, diabetes (Chan, 2003) [7]. Medicinal plant are used for different purposes, they are use as food for nutritional purpose, as constituent of cosmetics for maintaining healthy skin and as medicine for treatment of diseases. The chemical composition of this plant may also be toxic when the concentration exceeds recommended standard like, Na, Ca, Ni, and P which are essential trace nutrient that the body require in certain amount. The purpose of the current study was to quantify mineral concentration in *Costus afer* leaves and steam. The level at which *Costus afer*, is used in ethnomedicine, there is a need to explore the chemical composition of this plant and make the impact on health known to the general public. This study will help inform the health care providers, physician, technician, etc on the minerals composition of the plant.

Source: http://www.google.com/search

Fig 1: *Costus afer* leaf and stem

Materials and Methods

All materials, chemical and reagent used were of analytical standard.

Instrument and Apparatuses

Flame atomic absorption spectrophotometer model Perkin Elmer 400 was used for analyzing the aforementioned minerals. All glass wares were soaked in 3 M HNO_3 for the whole night, washed with deionized water, and rinsed with double distilled water to minimize the chances of interferences.

Sample Collection and Preparation

Samples of *Costus afer* (Leaf and Stem) were obtained at Ebonyi State University, Nigeria, were dried in a shade at room temperature (22-25 °C). The dried samples were crushed, powdered and homogenized using an agate mortar and pestle. The powdered, samples were kept in polyethylene sampling bags separately for further processing.

Samples Digestion

HNO_3 and H_2O_2 was produced as homogenous solutions with a strength ratio of 2:1. Each sample was preweighed at 1 g, then dried, powdered, and then dissolved in this solution. The sample solution was heated on a hot plate at 130 °C until the volume was lowered to 3 ml in order to boost the solubility. The mixture was then chilled and filtered using Whatman 42 filter paper into a 25 mL volumetric flask. The filtrate was diluted to the appropriate level as described by Matusiewick (2003) [10].

Methodology

A modified version of the AOAC standard method was used to estimate minerals using an Atomic Absorption Spectrophotometer (AOAC, 2006) [9]. The concentration of each element was measured in the sample solutions in the sample bottles. A distinct cathode discharge lamp for each element was utilized to identify that element. Each element being analyzed has a certain wavelength of radiation that the discharge lamp generates. Only a pure sample of the element that has been electrically stimulated to create an arc spectrum on it can provide this specificity.

A nitrous oxide (N_2O)-acetylene flame was used by FAAS to examine all of the sample solutions. The ignition chamber's temperature, which reached about 2700 C, improved the reducing conditions for the targeted heavy metal's atomization. Each sample solution was nebulized, turned into an aerosol, combined with flame gases, and then transformed into atomic form. Aspiration was limited to a small portion of the sample, about 5%, which significantly reduced interferences (Arslan and Tyson, 1999) [5]. All the sample solutions were analyzed for the estimation of trace heavy metals like sodium (Na), calcium (Ca), nickel (Ni), phosphorus (P), potassium (K), magnesium (Mg), manganese (Mn), iron (Fe), zinc (Zn), and lead (Pb).

Statistical Analysis

Statistical analysis was done using statistical package (SPSS) version 22.0. The results of replicate measurements were presented as mean± standard deviation.

Results

The comparative result of *Costus afer* leave and stem showed minerals in this order Ca>Mg>Na>K>P>Mn>Zn>Fe>Ni>Pb. With the etem having higher concentrations across minerals except for Ca, Na and Ni.

Table 1: comparative analysis of some minerals in *Coustus afer* leave and stem

Sample	*Costus afer* leaf (mg/g)	*Costus afer* stem (mg/g)
Na	22.33 ± 0.02	14.13 ± 0.02
Ca	74.52 ± 0.01	70.23 ± 0.02
Ni	0.26 ± 0.01	0.24 ± 0.02
P	9.03 ± 0.02	10.42 ± 0.02
K	6.91 ± 0.01	16.45 ± 0.04
Mg	31.71 ± 0.02	37.64 ± 0.01
Mn	7.31 ± 0.01	8.04 ± 0.04
Fe	0.22 ± 0.01	1.07 ± 0.01
Zn	2.02 ± 0.01	2.23 ± 0.28
Pb	0.11 ± 0.02	0.61 ± 0.01

The result is express as mean ± Standard deviation of triplet determination

Discussion

The comparative result analyzed, indicated that *C. afer* leaf and stem have an appreciable amount of mineral. The mineral analysis revealed that the level of calcium, magnesium, sodium, manganese in *C. afer* leaf and stem where appreciably high compared to other but the stem had higher amount of phosphorus, potassium magnesium manganese compared to the leaf. These minerals are essential to the body system for disease control and prevention (Aliyu *et al*., 2015) [2]. The presence of these minerals may account for the ethnomedical use of *C.afer* in treatment and management of inflammatory disease. Potassium and calcium are important for the growth and maintenance of strong bones, muscular function, and synthesis of enzymes and normal physiological function of the body (Aliyu *et al*., 2015) [2]. The mineral contain of potassium in the leaf and stem of *C.afer* was (6.91 ± 0.01mg/g and 16.45±0.04 mg/g) respectively. This result is low compared to the result reported by Stane and Williams, (1977) [15]. The calcium contain in both the leaf and stem of *C. afer* was (74.52±0.01mg/g and 70.23 ± 0.02 mg/g) respectively. Therefore, there is an agreement with the result reported by Anyasor *et al.* (2014) [3]. Sodium also help in the maintenance of acid-base balance in the body and osmotic pressure (Arif, 2022) [4]. Magnesium serves as a co-factor for enzymes activation and biological structure promoter (Arif, 2022) [4]. Phosphorus is also very important in the formation of bones and teeth and enable the bipolarity of lipid membranes and circulating lipoprotein and it activate enzymes catalysis (Ross *et al.,* 2020) [13]. Sodium and magnesium concentrations in leaf and stem of *C.afer* as reported in this research is in conformity with the data reported while phosphorus is low when compared to the result reported by Akpabio *et al*., (2011) [1]. Manganese is and important modulator of cell functions and play a vital role in the control of diabetes mellitus (Atila *et al*., 2021) [6]. Nickel serves as a co-factor of important antioxidant enzymes such as superoxide dismutase though it is in a small amount in both the leaf and stem as 0.26mg/kg and 0.24mg/kg respectively (Singh and kumar, 2021) [14]. Lead concentration 0.11mg/kg and 0.61mg/kg in leaf and stem respectively, may not lead to any health deterioration or hazard in the body of consumers since it is lower than the permissible limit of 30mg/kg lead for vegetable as peported by Aliyu *et al.*, (2015) [2]. The result obtained in this research is a conformity to the result reported by Anyasor *et al.*, (2014) [3] while the result of manganese and Nickel is higher than the one reported by Anyasor *et al.*, (2014) [3]. Iron participate in the production of red blood cells, it is a part of heamoglobin-oxygen binding process, which facilitate the transport of oxygen to cell. It serve as cofactor for enzymes, it involved in the synthesis of collagen and elastin (Gupta, 2014) [8]. Zinc which is one of the trace mineral required by the body plays an important role in the creation of DNA, growth of cells, building proteins, healing damage tissues and supporting a healthy immune system (Prasad AS, 1985) [12]. The result of zinc as seen in the present research shows a very low level when compared to the work of Ozioma *et al*. (2021) [11], which recorded a high concentration in *Tridax procumbens*. With respect to the findings of this research and reviewed importance of minerals in medicine, the integration of medicinal plants as *C. afer* will be of great interest in advancement in ethno medicinal practices.

Conclusion
The data from the studies shown that the *C.afer* leaf and stem could serve as an important source of minerals and nutrients. Based on the result analyzed it is concluded that the plant can be used as an alternative and complimentary therapy for many oxidative stressed diseases, provided further scientific studies on the pharmacological and toxicological aspects are carried out.

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