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Research article

Trace Elements and Major Minerals Evaluation in *Strophanthus hispidus*,D.C.

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ABSTRACT

Strophanthus hispidus,D.C. is commonly used in treatment of oedema, as an arrowpoison, used in treatment of rheumatism and used as antidiabetic. The mineral contents of the plant have to be within permissible limit for its effectiveness. Using Atomic Absorption Spectrophotometer, this paper describes analysis of selected trace elements [viz. Chromium (Cr), Manganese (Mn), Nickel (Ni), Copper (Cu), Cadmium (Cd), Iron (Fe), Zinc (Zn) and Lead (Pb)] and major minerals [viz. Potassium (K), Sodium (Na), Calcium (Ca),and Magnesium (Mg)] respectively in root of *Strophanthus hispidus*,D.C.. Our results showed that trace element concentrations in the root of *Strophanthus hispidus*,D.C. were as follow:Ni,0.004ppm, Zn, 0.317ppm, Fe, 9.691ppm, Cd, 0.00ppm, Pb, 0.104ppm, Cr, 0.025ppm, Cu, 0.103ppm,and Mn, 0.925ppm.The major minerals analysis revealed in the plant, K,689.75ppm, Ca,31.50ppm Na,110.00ppm and Mg,108.25ppm. The study reports that the content of metals in tested plant sample were found to be low when compared with the limits prescribed by World Health Organization. The results obtained from the study were discussed with reference to established role of elements in physiology and pathology of human life. In conclusion, the tested plant parts taken in the present study was found to be safe.

Keywords: *Strophanthus hispidus,D.C.*, Trace Elements, Major Elements, Atomic Absorption Spectrophotometer, WHO.

Introduction

Generally, medicinal plants are important sources of traditional medicine for millions of people and additional inputs to modern medicine in terms of exploring and producing new drugs to meet the need for the overgrowing population of the planet [1]. Medicinal plants possess some important elements in small doses, which have both therapeutics and prophylactic properties. The elements are referred to as trace elements. Trace elements are required in plant mainly for the formation of pigments and enzymes in animals. They function mainly to facilitate certain vital metabolic processes. Many of these elements pair-up with vitamins in the metabolism of carbohydrates, fat, and protein. Metabolic disease will arise in the absence of trace elements.The plant SPH, popularly known as brown *strophanthus*, and hairy *strophanthus* in West Africa, including Nigeria, is indigenous to Africa [2]. A deciduous shrub of 5 m tall and up to 100 cm wide, having its stem bark dark grey in colour, with few lenticels, has been reported to have diverse medicinal uses; for example, in the Savannah Zone of West Africa, the latex and seeds of *Strophanthus hispidus* are used as arrow poison, while decoctions of root, stem bark or leaf are used externally to treat skin diseases, leprosy, ulcers, malaria, dysentery, gonorrhea and diabetes [3]. The leaves have been reported to possessed hypoglycemic properties [4]. Similarly, the anti-inflammatory properties of the aqueous of the root extract have been studied [5]. In Nigeria and Ghana, the root decoction is ingested to treat rheumatic diseases and diabetes, while in Togo; the root bark macerate is employed for treating oedema [3].Throughout the world, there is increasing interest in the importance of dietary minerals in the prevention of several diseases [6].Fortification refers to the addition of mineral nutrients to a commonly eaten food. Both iron fortification of wheat flour and iodine fortification of salt are examples of fortification strategies that have produced excellent results [7]. Minerals are of critical importance in the diet, even though they comprise only 4–6% of the human body. However, lack of knowledge of the elemental constituents of these medicinal plants often poses danger to consumers as some may contain toxic elements. Also, the dose rate of many of these medicinal plants is not well defined and left to the judgement of the users. This can sometimes cause problems to users, as the probability of taking overdose to speed up healing is highly elevated, ignorant of the dangers in doing so. Thus, screening of the elemental composition of these medicinal plants is highly essential [8]. The present study was undertaken to detect and determine concentration level of twelve different mineral elements in *Strophanthus hispidus* root.

MATERIALS AND METHODS

Sample collection

The root of *Strophanthus hispidus* was purchased herb seller in Mofere market in ondo,OndoState. The plant was identified at the Department of Crop, Soil and Pest Management, Federal University of Technology, Akure. The voucher specimen of tested plant parts was deposited in University Herbarium.

Sample preparation

The plant parts (root) were sorted out and surface contaminants of root were removed by washing with deionised water. It was dried for two weeks and then subjected to grinding for powder formation. The powder was stored in airtight glass containers and used for further analysis.

Determination of metal content

Digestion

0.5g powder of the root was dissolved in nitric acid and heated until the reddish brown fumes disappear. Perchloric acid was then added to the above solution and heated for 5 min. This was followed by addition of aqua regia and heated .The volume was then made up to 25ml in a standard flask by adding deionized water.

Preparation of calibration curve using standard compounds

Standard solutions were prepared for each element depending upon the linear working range, corresponding five dilutions were made and their absorbances were measured. Standard dilutions, for each metal, was prepared from their respective stock solutions (1000ppm) which is either available readymade or prepared from their respective salts. Calibration curves were plotted using standard operating procedure.

Sample analysis

Metal content in the digested root samples were analyzed for Cu, Zn, Cd, Mg, Ca, Cr,Mn,Pb, Fe, Cd, Na, and K. in triplicate using Perkin Elmer Atomic Emission Spectrometer (AA Analyst 400).at Central Chemical Laboratory of ObafemiAwolowoUniversity, Ile Ife, Nigeria. The instrumental conditions during the analysis of

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twelve metals are listed in **Table 1** mentioning details about parameters like wavelength (nm), slit setting (nm), light source, flame type and operating current, which are defined for respective metals

Table 1: Instrumental conditions for metal analysis by atomic absorption spectrophotometer mentioning details about parameters like wavelength (nm), slit setting (nm), light source, flame type and operating current

Metals	Wavelength (nm)	I E^{o}	Slit setting (nm)	Detection limit	Fuel flow
Ca	422.67	10 61	2.7/0.6	0.092	
Cd	288.80	4 69	2.7/1.35	0.028	
Cu	324.75	15 80	2.7/0.5	0.078	2000
Cr	357.87	25 97	2.7/0.8	0.078	
Fe	248.33	30(18) 65/66	1.8/1.35	0.11	1700
Mn	279.48	20 62	1.8/0.6	0.052	
Pb	283.31	10 75	2.7/1.05	0.025	
Ni	232.80	25 67	1.8/1.35	0.125	
K	766.49	12 101	2.7/0.45		
Na	589.00	8 84	1.8/0.6		
Mg	285.21	6(12) 74	2.7/1.05	0.0078	1500
Zn	231.86	15 (13) 6/47	2.7/1.8	0.018	1000

RESULTSAND DISCUSSION

The values of different metals present in the root samples (ppm) are listed in Table 2. The trace elements viz. Cu, Zn, Cd, Mg, Mn, Pb, Cr, and Fe and major minerals viz. K, Na Ca and Mg respectively have been determined by atomic absorption spectrophotometer. The order of concentration of elements showed the following trend: K > Na> Mg>Ca> Fe >Mn>Zn >Pb>Cu> Cr >Ni.

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Table 2. Concentrations (ppm) of trace and major elements in *Strophanthus hispidus* root

Ni	Na	Zn	K	Fe	Cd	Pb	Cr	Mg	Cu	Mn	Ca
0.004	110.00	0.317	689.75	9.691	Nd	0.104	0.025	108.25	0.103	0.925	31.50
±0.004	±0.002	±0.001	±0.041	±0.006	-	±0.010	±0.035	±0.002	±0.004	±0.004	±0.002

Average concentration of element ± standard deviation (n=3) (mg/kg).

Nd-not detected

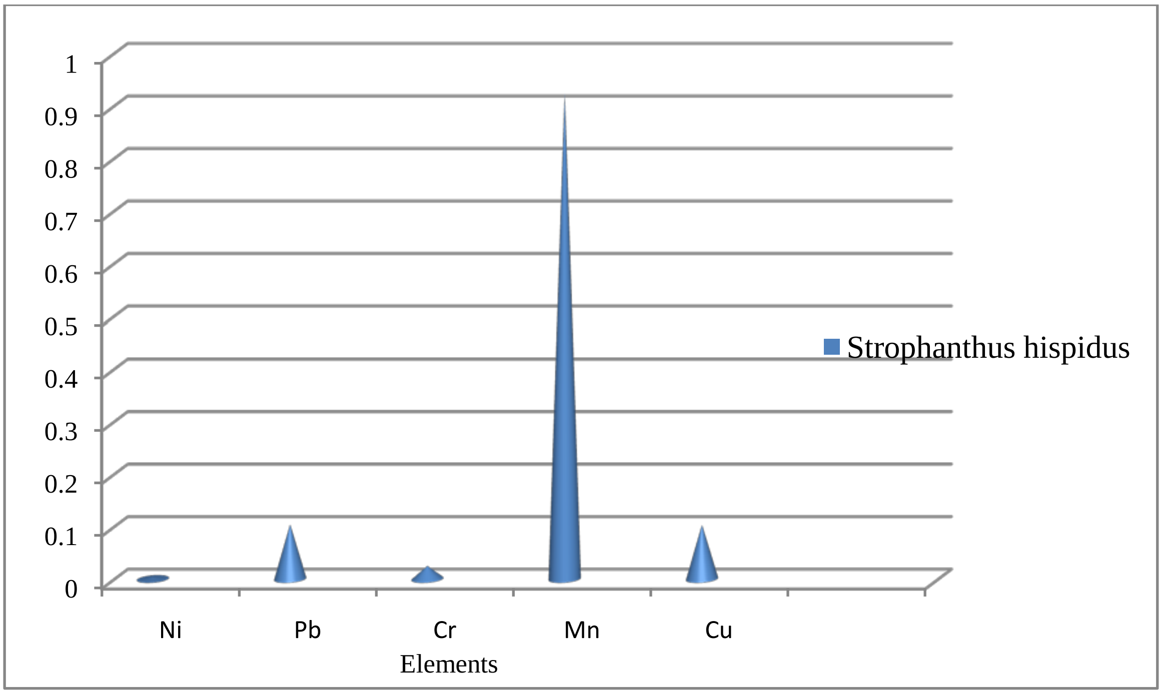

Figure 1. Concentration of Mn, Ni, Cu, Pb, Cr in *Strophanthus hispidus* root

Copper:

The content of Cu present in *Strophanthus hispidus* root was0.103ppm (Table2 &figure 1).The permissible limit set by FAO/WHO for copper in edible plants was 3.00ppm [10]. However, for medicinal plants the WHO limits not yet been established for Cu. Permissible limits for Cu set by China and Singapore for medicinal plants, were 20ppm and 150ppm, respectively [7]. Copper (Cu) is an essential redox-active transition element that play vital role in various metabolic processes. Being toxic, its quantity in plants should be very low [6]. It is essential to the human body since it forms a component in many enzyme systems, such as cytochrome oxidase, lysyl oxidase and an iron-oxidizing enzyme in blood. The observation of anaemia in copper deficiency is probably related to its role in facilitating iron absorption and in the incorporation of iron in haemoglobin. However,

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copper deficiency in humans is a rare occurrence. Copper could be toxic depending on the dose and duration of exposure [11]. Our results indicate that concentration of Cu was well below permissible limit.

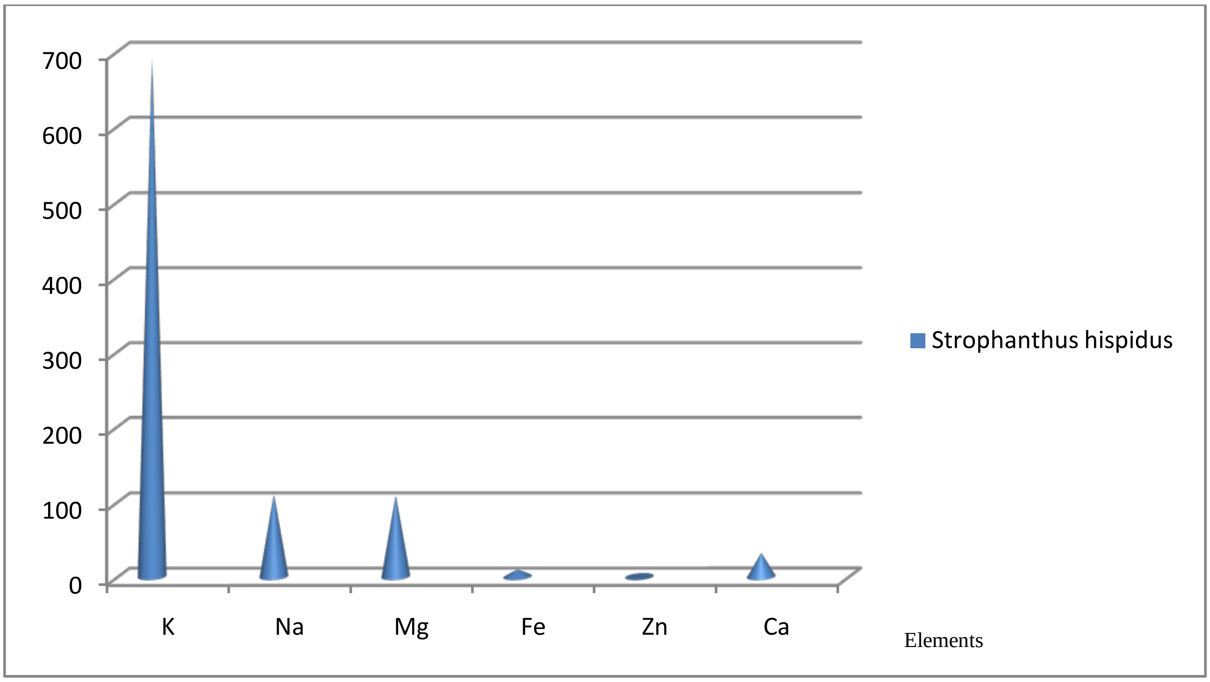

Figure 2. Concentration of K, Na,Ca, Mg, Fe, Zn in *Strophanthus hispidus* root

Sodium:

Concentration of Sodium element was observed to be 110.00ppm of *Strophanthus hispidus* root (Table2& figure 2) Sodium is essential to all living organisms. Sodium remains one of the major electrolytes in the blood. Without sodium the body cannot be hydrated, it would dry off. At the point when some vital processes are taking place sodium is not needed, too much of sodium will cause the cell to break down [12]. Sodium is of great importance for many regulation systems in the body. The minimum daily intake of Sodium is 2.4 g [13].

Potassium:

Concentration of Potassium was observed to be 689.75ppm in *Strophanthus hispidus* root,which happen to be the highest. Like Sodium, it also one of the major electrolyte in the blood. Potassium is of great importance for many regulation systems in the body. The minimum daily intake of Potassium is 3.5g [13].

Calcium:

Calcium is an important element because of its role in bones, teeth, muscular system and heart functions. It is required for absorption of dietary Vitamin B, for synthesis of neurotransmitter acetylcholine and is required for activation of enzyme pancreatic lipase [14].Calcium is necessary for the coagulation of blood, the proper functioning of the heart and nervous system and the normal contraction of muscles [6]. Our results indicate that the concentration of Calcium in the medicinal plant is 31.5ppm (Table2& figure 2)

Chromium:

Chromium is known to regulate carbohydrate, nucleic acid and lipoprotein metabolism and it potentiates insulin action [15]. Chronic exposure to Chromium may result in liver, kidney and lung damage [16]. Chromium also acts as an activator of several enzymes. Deficiency of chromium decreases the efficiency of insulin and increases sugar and cholesterol in the blood. Chromium deficiency can cause an insulin resistance, impair in glucose tolerance and may be a risk factor in atherosclerotic disease[6]. The chromium concentration in *Strophanthus hispidus* root was 0.025ppm that was below the permissible limit for chromium as set by FAO/WHO in edible plants, which is 2ppm.

Manganese:

The activity of this element is noticed in the metabolism of food, which is incorporated into the bone. Manganese is essential element required for various biochemical processes [17]. The kidney and liver are the main storage places for the manganese in the body. Manganese is essential for the normal bone structure reproduction and normal functioning of the central nervous system. Its deficiency causes reproductive failure in both male and female. Apart from physiological importance, experimental data have pointed out the pharmacological implication of this element especially in prevention and treatment of diabetes mellitus [18]. Our results indicate that the concentration of Manganese in the medicinal plant was 0.925ppm (Table2& figure 1)The permissible limit set by [10] for Manganese was 2ppm in edible plants [10]. However, the permissible WHO [7] limits for Manganese in medicinal plants have not yet been set.

Iron:

Iron is important for the formation of haemoglobin and plays an important role in oxygen and electron transfer in human body. Studies suggest that the intake of Iron in higher concentration is hazardous to health [6].In *Strophanthus hispidus* root studied, the amount of iron accumulated is in the medicinal plant is 9.691ppm. The permissible level set by WHO for Iron in edible plants was 20ppm [7].

Nickel:

The amount of Nickel concentration in the *Strophanthus hispidus* root analyzed is 0.004ppm(Table2& figure 1), which was below the permissible level of 1.63 set by WHO in edible plants. The permissible limits for medicinal plants have yet not been set. Nickel is considered highly mobile element within a plant. Accumulation of Nickel takes place only in the leaves. Nickel toxicity in human is not very common occurrence as its absorption by the body is very low [6].

Cadmium:

The amount of cadmium concentration in the *Strophanthus hispidus* root *analyzed* is below the detection limit of the instrument. Cadmium is toxic metal having functions in neither human body nor plants. Accumulation of Cadium in kidney leads to high blood pressure and renal diseases. Its accumulation also leads in damaging the nerve cells, inhibition of release of acetylcholine and activation of choline esterase enzyme, resulting in a tendency for hyperactivity of the nervous system [6].

Lead:

Lead has no biochemical or physiological importance and was considered as toxic pollutant. It causes a rise in blood pressure, kidney damage, miscarriages and subtle abortion, brain damage, decline fertility of men through sperm damage, diminishing abilities of children and disruption of nervous systems [6]. With reference to WHO [7], the permissible limit for lead set in edible plants was 0.43ppm.However, for medicinal plants the limit was 10ppm set by China, Malaysia, Thailand and WHO. The amount of lead concentration in the samples analyzed was in minimal amount and well below the permissible level. Our results show that the lead concentration was 0.104ppm(Table2& figure 1). The level of Lead obtained in the present study does not indicate a potential health hazard to users.

Zinc*:*

The concentration of Zinc was found to be 0.317ppm in the medicinal plant sample of *Strophanthus hispidus* root (Table2& figure 2). Zinc is essential to all organisms and has an important role in metabolism, growth, development and general well-being. It is an essential co-factor for a large number of enzymes in the body [6]. Zinc deficiency leads to coronary heart diseases and various metabolic disorders. Zinc Fortification programmes are being studied, especially for populations that consume predominately plant foods. Fortification of cereal staple foods is potentially attractive interventions that could benefit the whole population as well as target the vulnerable population groups, namely children and pregnant women. Such addition of zinc to the diet would decrease the prevalence of stunting in many developing countries with low-zinc diets, because linear growth will be affected by zinc supply in the body.

Magnesium:

Intracellular Magnesium deficiency is correlated with the impaired function of many enzymes utilizing high-energy phosphate bonds, as in the case of glucose metabolism[6].The concentration of Magnesium the was found to be 108.25ppm (table2 &fig.2) in the medicinal plant sample of which was below *Strophanthus hispidus* root the permissible level of 2000ppm.

CONCLUSION

In the present study, the results were compared with suitable safety standards and the levels of Mg, Ca, Zn, Cu, K, Ni, Mg, Cr, Na, Fe, Zn and Cd in tested part *Strophanthus hispidus* root s used were within the acceptable limits for human consumption. The content of toxic metals in tested plants was found to be significantly low. In conclusion, the tested plant parts taken in the present study were found to be safe. Moreover, further work is necessary to ascertain the clinical safety of extracts from the plants [19] and to determine appropriate concentration for the therapy to safeguard the health of the teeming mass of user who more often than not, does not consider these factors.

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