



TRACE ELEMENTS AND MAJOR MINERALS EVALUATION OF EARTHWORM CASTS FROM A SELECTED SITE IN SOUTHWESTERN NIGERIA

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ABSTRACT

Samples of dry earthworm casts lying on the soil surface were collected within the Ladoke Akintola University of Technology Ogbomosho campus randomly and were analyzed for the presence of trace elements using Atomic Absorption Spectrophotometer while flame photometer was used for major minerals analysis. The results showed that trace elements concentrations in earthworm casts were as follow: Fe, $1400 \pm 0.01\text{mg/kg}$, Mn, $79.00 \pm 0.03\text{mg/kg}$, Zn, 65.00 ± 0.01 Cu, 8.50 ± 0.02 , The mineral composition results showed that the earthworm casts contained K, $72500 \pm 0.03\text{mg/kg}$, P, $3450.00 \pm 0.04\text{mg/kg}$, Ca, $581.00 \pm 0.02\text{mg/kg}$, Mg, $45.50 \pm 0.01\text{mg/kg}$. When compared the results obtained from this research work with the results previously reported for some medicinal plants it shows that earthworm casts has the potentiality of being used as medicament in traditional medicine, the high contents of iron, zinc and manganese could make the earthworm cast a good antianaemic and antidiabetic agents.

Keywords: earthworm cast, antianaemic, antidiabetic, agents, medicament.

INTRODUCTION

Earthworms play an important role in the creation of healthy and productive “living” soils. They feed on organic matter and convert it into rich humus, a medium vital to the growth of healthy plants. The earthworm achieved the conversion by pulling down any organic matter deposited on the soil surface (plant waste, manure etc) for food or to plug its burrow. Once in burrow, the worms shred the leaf and partially digest it, then deposit their casting. Casts resist leaching but have the ability to retain moisture. Castings contain nutrients like nitrogen, potassium, phosphorus, calcium, magnesium, sulphur, trace elements, minerals, growth hormones, vitamins, act as a powerful biocide against disease and nematodes [1, 2].

Earthworms are potentially important vectors of microbial propagules since they live in the upper part of the soil profile and transport a large amount of soil through their bodies [3].

Microorganisms, ingested with the soil, are important components of the earthworm diet. Earthworms feed preferentially on fungi associated with plant remains [4, 5].

The results of various investigations have demonstrated that casting and excretion by worms may indirectly increase microbial populations [5, 6], enzyme activities and NPK enrichment in earthworm cast [5, 7].

Some studies are available on the microflora of the intestinal tract of earthworm [8, 9], but studies on the trace elements and major minerals evaluation of earthworm casts are scarce. In the present investigation, trace elements and major minerals of earthworm casts within Ladoke Akintola University of Technology, Ogbomosho was carried out to established its usefulness in traditional medicine and if possible as fertilizer.

MATERIALS AND METHODS

Sample collection and preparation

Samples of dry earthworm casts were collected randomly on the main campus of the Ladoke Akintola University of technology, Ogbomosho beside the Department of Science Laboratory Technology car park. The samples were cleaned with a piece of foam to remove dirt particles that might be present and was oven-dried to a constant weight at 60°C , ground into fine powder with porcelain mortar and pestle and stored in a labeled air tight bottle prior to analysis. Earthworm casts are normally found in both decayed and fresh plant materials (Figure-1 and 2).

Metal analysis

Some of the dried earthworm casts were weighed (2.0g) into a beaker, adding to it 60cm^3 of freshly prepared (1:1 V/V) mixture of HNO_3 : H_2O_2 solution and was covered with a watch glass for the initial reaction to subside (about 1hr). The mixture was then heated on a hot plate with temperature rising gradually up to 160°C .

Heating continued for about 2hrs, reducing the volume to about 5cm^3 . It was then allowed to cool, filtered into a 25cm^3 standard flask and made up to mark with distilled water ready for metal analysis [10]. Reagent blanks were prepared accordingly to test the purity of the reagents, while standards of the metals in solution were used to calibrate the instruments. Potassium, phosphorus, calcium and magnesium were determined using a flame photometer, while the other metals were determined using the Atomic Absorption Spectrophotometer (AAS) according to AOAC, [11].



Figure-1. Earthworm casts found under a decay plant root.



Figure-2. Earthworm casts found in the midst of weeds.

RESULTS AND DISCUSSIONS

Table-1 shows the trace elements composition of the earthworm casts, iron has the highest concentration, when compared with some medicinal plants previously reported by Ayoola *et al.*, [12] such as *Vernonia amygdalina* which has 277.30mg/kg of iron, although Iorungwa *et al.*, [2] reported lower iron content on a contaminated site, this is an indication that earthworm cast is a good source of iron. Considering the importance of iron to human such as in the formation of haemoglobin, the oxygen carrying pigment in the red blood cells, iron is used against anaemia, tuberculosis and disorder of growth [13].

The manganese content was found to be 79.00 ± 0.03 mg/kg in the earthworm casts, while in most medicinal plants contents of manganese ranged between 23 -37mg/kg (Ayoola *et al.*, [12]. On a contaminated site the manganese content was found to be 120mg/kg according to Iorungwa *et al.*, [2]. Since these plants contain this element in different concentrations, the quantity to be taken will depend on the therapeutic need of

the individual. The activity of this element is noticed in the metabolism of food which is incorporated into the bone. Manganese is necessary for the functioning of the pituitary gland, the pineal gland and the brain. It promotes hepatorenal function, combat anemia and also essential for growth [13].

Table-1. Trace elements composition of earthworm cast on dry weight basis expressed in mg/kg.

Element	Concentration (mg/kg)	*Literature (mg/kg)	**Literature (mg/kg)
Fe	1400 ± 0.01	277.30	1.0
Mn	79.00 ± 0.03	27.00	-
Zn	65.00 ± 0.01	74.50	50
Cu	8.50 ± 0.02	11.00	13.0

Results are means of three determinations

*Literature= Ayoola *et al.*, 2010 (*Vernonia amygdalina* leaf)

**Literature=Iorungwa *et al.*, 2013 (Contaminated site)

Table-2. Mineral composition of the earthworm cast on dry weight basis expressed in mg/kg.

Element	Concentration (mg/kg)	*Literature (mg/kg)	**Literature (mg/kg)
K	72500 ± 0.03	2889.00	125 ± 7.1
P	3450 ± 0.04	-	75.5 ± 21.9
Ca	581 ± 0.02	8612.50	2265 ± 26.2
Mg	45.50 ± 0.01	67.75	85 ± 7.1

Results are means of three determinations

*Literature=Ayoola *et al.*, [12] (*Carica papaya* leaves)

**Literature=Pommeresche *et al.*, [14] (Organic site k)

The zinc content was found to be 65.00 ± 0.01 mg/kg, this value can be compared with values reported for *Spondia mombin* (59.60mg/kg) and *Vernonia amygdalina* (74.50mg/kg) by Ayoola *et al.*, [12]. While Iorungwa *et al.* [2] also reported that zinc content on a contaminated site was 50.00mg/kg. Zinc is important for nerve function and male fertility. It is important for normal sexual development especially for the development of testes and ovaries; it is also good for the healthy functioning of the heart and normal growth [15].

The Copper content was found to be 8.50 ± 0.02 mg/kg. This value agreed comparatively with the value reported for *Spondias mombin* (13.00mg/kg), *Vernonia amygdalina* (11.00mg/kg) and *Momordica charantia* (21.00mg/kg) by Ayoola *et al.* [12]. Copper helps in the absorption of iron and it is important for cellular defense and protection of the mucous membranes, anti anemic and essential for the formation of iron and haemoglobin [13].

The result of the mineral composition clearly shows that earthworm cast contains rich source of mineral elements (Table-2) this result become so important when



the usefulness of such minerals such as K, P, Ca and Mg in the body are considered. Calcium is important in the formation of bones and teeth it is also useful in the coagulation of blood, the proper functioning of the heart and nervous system and the normal contraction of muscles [12].

Potassium is involved in the body fluids in relation with sodium; they regulate the acid-base balance. Another mineral useful to the bone is phosphorus. It is mineral pair of calcium, the two of them go hand in hand, they are bound together in the bone, teeth and ligament of the body. It is very important for nerves; it will produce the same bone diseases like calcium will produce [16]. Potassium is necessary for muscular weakness which is associated with malaria, and also shows down sclerosis of the vascular system. It contributes to the fight against bacteria and cleanses the digestive system [17].

The magnesium content was found to be 45.50 ± 0.01 mg/kg. This value agreed with the value reported for *Carica papaya* leaves; green leaf (67.75mg/kg), yellow leaf (28.55mg/kg) and brown leaf (35.35mg/kg) by Ayoola and Adeyeye [17]. Magnesium assist in the assimilation of phosphorus, lack of magnesium can be responsible for tetany, tuberculosis, diabetes, cancer and all nervous diseases [13].

CONCLUSIONS

From this study, therefore, it can be concluded that earthworm casts are good sources of important trace elements and major mineral elements needed for the growth and proper functioning of the body. The present and high contents of iron, manganese and zinc might make the earthworm casts a useful herbal medication.

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