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Macromineral Profile of Four Species of Earthworm *Hyperiodrilus africanus*, *Eudrilus eugeniae, Libyodrilus violaceus* and *Alma millsoni* from Nigeria

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Abstract: The macro mineral profile of four Nigerian species of earthworm; *Hyperiodrilus africanus, Eudrilus eugeniae, Libyodrilus violaceus* and *Alma millsoni* was conducted. using the atomic absorption spectrophotometer. Five macro minerals calcium, magnesium, potassium, sodium and phosphorus were determined. Comparatively *H. africanus* recorded the highest mean Ca (0.494 ±0.038%) while *A. millsoni* recorded the lowest (0.318±0.034%). *Hyperiodrilus africanus* also recorded the highest mean Mg (0.154±0.015%) whereas *L. violaceus* recorded the lowest (0.118±0.017%). *Alma millsoni* recorded the highest mean K (0.045±0.003%) whereas *H. africanus* recorded the lowest (0.027±0.002%). The highest mean Na (74.209±13.699 ppm) was recorded by *A. millsoni* while the lowest (19.813±2.087 ppm) was recorded by *H. africanus.* Also *A. millsoni* recorded the highest mean P (0.701±0.022%) while *H.africanus* recorded the lowest (0.456±0.034%). A significant difference was observed in the mean % Ca, % Mg, % K, ppmNa and % P between the four species of earthworms ($p<0.01$). The study revealed that these five macro minerals which are requirements of animals were well represented and adequate in the earthworms. Therefore, the use of meal prepared from these species as mineral supplement in fish diets could be encouraged.

Keywords: Macro-mineral, profile, earthworm, diet, supplement

INTRODUCTION

The potential value of earthworm as a protein source had been established by several authors (Stafford and Tacon, 1988; Edwards and Niederer, 1988; Orozco *et al.*, 1988; Ortega *et al.*, 1996). Mattson *et al.* (2002) had also suggested that earthworm provide a substantial nutrition to the animals consuming them. Furthermore, the studies of Albarran (1996), Dynes (2003) and Vielma-Rondon *et al.* (2003) had shown that not only could earthworm serve as a rich protein source but also as a source of essential amino acids, especially lysine which is limiting in many basic foodstuffs and that the amino acid composition of earthworm meal is very similar to that of fishmeal and potentially superior to that of meat meal.

Most of these assertions above were based on the proximate values of foreign species of earthworm from Europe, America and Asia such as *Eisenia fetida*, *Allolobophora*, *Lumbricus terrestis*, *Dendrodrilus subrubicundus* and not much information is available on the nutritive value of Nigerian earthworms and especially on their mineral profile of earthworm. Therefore, since the drive of animal farmers worldwide is to source for cheaper means of nutritive dietary supplement which may replace fishmeal wholly or partly in animal diet and also supply micro and macro-nutrients, and taking into consideration that the value of different species of earthworm as supplement in animal dietary formulation had been rated high, it therefore became necessary to establish the mineral profile of four species of earthworm commonly found in southwestern Nigeria.

This study is therefore aimed at establishing the macromineral profile of four earthworm species namely *Hyperiodrilus africanus*, *Eudrilus eugeniae*, *Libyodrilus violaceus* and *Alma millsoni.*

MATERIALS AND METHODS

Study location: The study was conducted in Olabisi Onabanjo University, Ago-Iwoye, Ijebu North area of Ogun State, SW Nigeria between the month of April to August, 2008.

Study animal: Three species of earthworm belonging to the Eudrilidae namely *Hyperiodrilus africanus, Eudrilus eugeniae* belonging to the subfamily Eudrilinae; *Libyodrilus violaceus* belonging to the subfamily Pareudrilinae and *Alma millsoni* a limicolous (marsh dwelling) earthworm belonging to the family Glossoscolecidae were studied.

Collection and diagnosis of earthworm: Collections were made in the months of August to October during which the adult stages of the earthworms were available. Digging and hand sorting method was used in the collection. Collection of *A. millsoni* and *L. violaceus* was

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Table 1: Descriptive statistics of the macromineral profile of the four species of earthworm in this study

Earthworm species	Statistics	% Ca N=10	% Mg N=10	% K N=10	ppm Na N=10	% P N=10
Libyodrilus violaceus	Mean	0.395	0.118	0.028	23.120	0.508
	SD	0.091	0.018	0.002	9.9620	.099
	Range	0.27-0.50	0.09-0.14	0.026-0.031	15.43-50.04	0.38-0.64
Hyperiodrilus africanus	Mean	0.494	0.154	0.027	19.813	0.456
	SD	0.039	0.016	0.002	2.087	0.034
	Range	0.45-0.58	0.12-0.18	0.024-0.030	16.95-23.36	0.41-0.51
Eudrilus eugeniae	Mean	0.476	0.148	0.032	39.896	0.528
	SD	0.055	0.026	0.003	21.649	0.041
	Range	0.41-0.60	0.10-0.19	0.028-0.035	17.02-71.74	0.47-0.58
Alma millsoni	Mean	0.318	0.146	0.045	74.209	0.701
	SD	0.034	0.019	0.003	13.699	0.022
	Range	0.25-0.36	0.12-0.18	0.039-0.049	49.36-92.01	0.67-0.74

Table 2: Analysis of variance of the macromineral profile between the four species of earthworms

		Sum of Squares	df	Mean Square	F	Sig.
% Ca	Between Groups	0.196	3	0.065	18.602	0.01
	Within Groups	0.127	36	0.004		
	Total	0.323	39			
% Mg	Between Groups	0.008	3	0.003	6.515	0.01
	Within Groups	0.014	36	0.000		
	Total	0.022	39			
% K	Between Groups	0.002	3	0.001	102.563	0.01
	Within Groups	0.000	36	0.000		
	Total	0.002	39			
ppm Na	Between Groups	18605.225	3	6201.742	32.643	0.01
	Within Groups	6839.560	36	189.988		
	Total	25444.785	39			
% P	Between Groups	0.339	3	.113	34.258	0.01
	Within Groups	0.119	36	.003		
	Total	0.457	39			

Table 3: Duncan's multiple range test of level of significant of the macromineral profile of the earthworm species

Macrominerals	Earthworm species				
	Hyperiodrilus africanus	*Eudrilus eugeniae*	*Libyodrilus violaceus*	*Alma millsoni*	P-value
% Ca	0.494^{a}	0.476^{a}	0.395^{b}	0.318^{c}	P = 0.01
% Mg	0.154^{a}	0.148^{a}	0.146^{a}	0.118^{b}	P = 0.01
% K	0.274^{c}	0.318^{b}	0.284^{c}	0.448^{a}	P = 0.01
% P	0.456^{c}	0.528^{b}	0.508^{bc}	0.701^{a}	P = 0.01
ppm Na	19.813^{c}	39.896^{b}	23.120^{c}	74.209^{a}	P = 0.01

Mean with the same superscript in a row are not significantly different

made along banks of streams with high humus. *H. africanus* and *E. eugeniae* were collected from friable soils. Identification of the species was done using the description of Owa (1992).

Mineral Analysis: Ten samples (replicate) each of the different species collected from different locations were washed free of debris after sorting and were placed in papier mache separately to gut void them. These were placed in separate beaker of water and temperature of the water was raised gradually until the earthworms died in a relaxed form. These were then transferred onto aluminum tray and dried in the microwave oven for 45 min. The mineral analysis was conducted on the dried samples.

The earthworm species were analyzed for mineral using spectrophotometric procedures specifically atomic absorption spectrophotometer (AAS) (AOAC, 1995). Five macro minerals namely calcium, potassium, sodium, phosphorus and magnesium were determined

Data Analysis: Data obtained from this study were subjected to statistical analysis using the SPSS package version 11.0.

RESULTS

Comparatively *H. africanus* recorded the highest mean % Ca (0.494±0.038) while *A. millsoni* recorded the lowest (0.318±0.034). Also *H. africanus* again recorded the highest mean % Mg (0.154±0.015) while *L. violaceus* recorded the lowest (0.118±0.017). *A. millsoni* recorded the highest mean % K (0.045±0.003) while *H. africanus* recorded the lowest (0.027±0.002). The highest mean ppm Na (74.209±13.699) was recorded by *A. millsoni* while the lowest (19.813±2.087) was recorded by *H. africanus*. Also *A. millsoni* recorded the highest mean % P (0.701±0.022) while *H. africanus* recorded the lowest mean % P (0.456 ± 0.034) (Table 1, Fig. 1 and 2).

The mean % Ca, % Mg, % K, ppm Na and % P were significantly different between the four species of earthworm in this study ($p<0.01$) (Table 2 and 3).

DISCUSSION

Implication of the Observed Trend in earthworm physiology: The trend observed in this study showed that the friable soil dwellers *Hyperiodrilus africanus* and *Eudrilus eugeniae* contained a higher concentration of calcium and magnesium than *Libyodrilus violaceus* and *Alma millsoni* both which are limicolous (marsh dwellers). The higher occurrence of these two macrominerals in *H. africanus and E. eugeniae* suggests that these species of earthworm probably have a higher capacity of storage of these macrominerals in their tissues as suggested by the presence of calcium gland in them (Owa, 1992).

They probably require these minerals more than the limicolous (marsh dwellers) for their day to day physiological activities. It may be because they have to burrow or chew their way through hard packed soil unlike the soft loamy soil, which the marsh dwelling earthworms burrow through and these may also suggests why they appear to be more active than the limicolous earthworms. For in order to perform these various physiological bioactivities, the earthworm must maintain a constant firing (electrical potential) of the nerve and muscle cells and needed for this is the higher calcium and magnesium concentration. Calcium and Magnesium have been shown to be involved in regulating nervous excitability and muscular contraction i.e. maintaining the electrical potential in nerve and muscle cells (Ganong, 1995).

The higher occurrence of potassium and phosphorus in *A. millsoni* and *L. violaceus* both marsh dwellers may be traced to the habitat of these earthworms. The floodplain where these species are mostly found is known to be high in nutrients such as phosphorus as stated by Owa and Olojo (2003) that such limicolous environments which they refer to as fertile region are yearly renewed by alluvial deposits resulting from annual floods. The higher phosphorus and potassium concentration in *A. millsoni* and *L. violaceus* suggests that both species are liable to contain a higher concentration of crude protein and crude fat since phosphorus plays important role in energy metabolism affecting carbohydrates, lipids and protein. Also potassium is important in DNA and protein synthesis (Ganong, 1995) Apart from this potassium is important in cell volume regulation (Ganong, 1995), this is very important to earthworms such as *A. millsoni* and *L. violaceus* which dwell most of the time in marshy environment where they must regulate their cellular volume for them to thrive in such environment.

In addition to the above sodium was found to be in higher concentration in *A. millsoni* which may still be indicative of the marshy environment in which this earthworm dwells. Sodium is the major cation of the extracellular fluid which in conjunction with potassium forms the Na+-K+ pump which effectively maintains Na+ as an impermeant extracellular solute (Bray *et al.,* 1999)

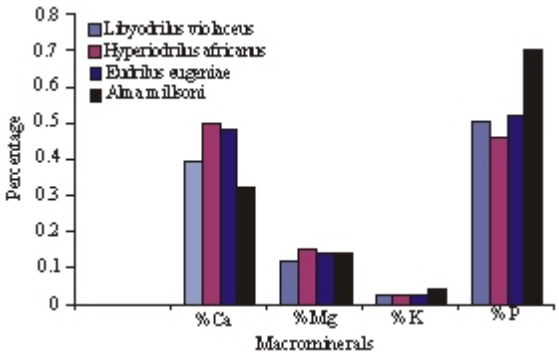

Fig. 1: Comparative percentage macrominerals in the earthworm species

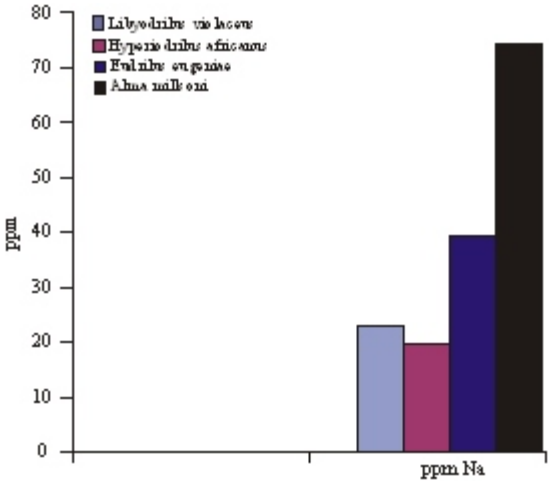

Fig. 2: Comparative Na (ppm) in the earthworm species

and helps in regulating flooding of the internal environment.

Generally the result of the macro mineral profile revealed that there were individual differences and variations in the mineral contents among the four species of earthworms in this study. Compared to the study obtained by Bay (2002) on *Perionyx excavatus* in which a mean percentage Ca and P of 0.11 and 0.12 % respectively were reported, this present study recorded a higher range of mean percentage Ca (0.32-0.49%) and P (0.46-0.70%).

The utilization, metabolism, storage and physiological implication of these minerals in these earthworms are not yet totally understood.

Implication of the observed trend in Soil fertility: Furthermore, it can be said that the friable soil dwellers *E.eugeniae and H. africanus* also serve as reservoir for calcium and magnesium, which they contribute to the soil environment either directly by death (Brady and Weil, 1999) or indirectly through cast production as it has been shown by studies that earthworm castings contain more of

these macro minerals than their surrounding soil (de Vleeschauwer and Lal, 1981). On the other hand *Alma millsoni* having a higher concentration of phosphorus will help to increase the availability of this mineral in the soil and thereby contributing to soil fertility.

Implication of the trend in dietary supplementation: This study revealed that most of these five macro minerals are well represented and adequate in the earthworms. Since these minerals are required in small amount and some below detection level by fish and other animals, the use of these earthworm powder as mineral supplement in fish diets could be encouraged especially in this age of organic farming where most international studies are pushing towards reduction or doing away totally with synthetic compounds as feed additives in animal diets. I suggest that more thought should be given to this veritable and cheap means of obtaining these minerals.

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