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COMPARATIVE STUDY OF MACRO AND MICRO NUTRIENTS OF VERMICAST

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ABSTRACT

Worm cast is the thick black end product of the breakdown of organic matter by an earthworm. Worm castings are the richest natural fertilizer known to humans. The vermicasts were collected from Forestry Research Institute of Nigeria (FRIN) herbal garden and the nutrients of the vermicasts (carbonized and non-carbonized) were characterized using Atomic Absorbance Spectrophotometer (AAS). The data were subjected to ANOVA. It was revealed that most of the isolated elements were significantly different at 5% probability level except for P. The mean result obtained showed that the concentration of K, Ca, Mg, P and Zn in carbonized earthworm cast in cold extraction were 0.6 cmol/kg, 1.1 cmol/kg, 3.3 cmol/kg, 0.03 mg/kg and 0.1 mg/kg respectively. The concentrations of K, Ca, Mg, P and Zn in carbonized worm cast in hot extraction were 0.6 cmol/kg, 1.3 cmol/kg, 3.6 cmol/kg, 0.2 mg/kg and 0.4 mg/kg respectively. In non-carbonized worm cast in cold extraction, the concentration of K, Ca, Mg, P and Zn were 0.2 cmol/kg, 1.6 cmol/kg, 4.7 cmol/kg, 0.05 mg/kg and 0.2 mg/kg respectively. The concentration of K, Ca, Mg, P, Zn in non-carbonized worm cast in hot extraction were 0.3cmol/kg, 1.5 cmol/kg, 5.1 cmol/kg, 0.04 mg/kg and 0.5 mg/kg. The result showed variation in the amount of macro and micronutrients in the both samples of vermicasts (carbonized and non-carbonized). The carbonized vermicast contained significantly high amount of Zn (mg/kg) of the micronutrients in hot extraction while the amount of the macronutrients were significantly higher in non-carbonized hot and cold extraction. These mineral nutrients are associated to be used effectively for the management of some diseases which include cardiovascular disease, helminthiases, neuro associated diseases and pile.

Keywords: Vermicast**,** macro and micro-nutrients, diseases, remedies.

INTRODUCTION

Ethnobotany deals with the study of plants and fauna and culture of people living within an environment. According to World Health Organisation (2015), 80% of the world depends on medicinal plants, including fauna and usage of other organic matters. Worms are the greatalchemists, concentrating the important plant nutrients such as Nitrogen, Potassium, Phosphorus and Calcium into forms that are much more available to the plants than those in the parent materials (Abbot and Parker, 1981).

Studies on earthworm cast are important and based on the significant role earthworm played in ecosystem. The worm cast is a modern medicinal potential that has been used for treating various ailments since time immemorial for instance, anti-helminths and pile (Odewale and Lawal, 2017). Castings (vermicast) produced from earthworms contain important phytohormones like auxin and cytokinins, enzymes, vitamins and antibiotics, all important for plant health, and most importantly human health in the long run (Joshi and Kelkar, 1951; Jagtap *et al*., 2013). Vermicast is produced from organic materials that have taken up minerals in exactly the ratio in which they were needed to produce and sustain growth. The hormone “auxin”, naturally found in the casts comes from the worms themselves; more specifically from the mucus produced by glands along the worms’ body can influence plant growth and development as well as crop quality significantly when present at very low concentrations. Nutrients such as Calcium, Magnesium, Iron, Potassium, Sulfur and Phosphorus are stored in the worm humus. Therefore the minerals contained in castings are a natural balance such as is required for vigorous, healthy growth (Canellas *et al*, 2002). The Vermicast acts as a disease suppressor (Edwards and Arancon 2004). From previous elemental analysis carried out on the vermicast, trace elements (Zn, Cu, Mn and Fe) and major elements (K, Na, Ca, P and Mg) are found in the earthworm cast and they are of health benefits in herbal medicines (Odewale and Lawal, 2017). The nutrients and concentrations detected are higher than the Recommended Daily Allowance (RDA). However, no logical study has been undertaken to determine the efficacy of this natural cast as regards the human diseases management.

MATERIALS AND METHOD

Sample collection

The study was conducted in the Forestry Research Institute of Nigeria, Ibadan herbal garden. The worm casts used for this study were collected from the Forestry Research Institute of Nigeria herbal garden, Ibadan.

Sample Preparation

The vermicasts collected from the herbal garden were grouped into two. Group 1, the non-carbonized (not Ashed), and Group 2, carbonized (Ashed) at 500°C for 8 h. In carbonized group (0.3kg for ECCCE, 0.3kg for ECCHE) and non-carbonized groups (0.3kg for ECNCCE, 0.3kg for ECNCHE) were replicated three times and subjected to hot and cold extraction for investigation of organic compounds according to modified method of Haynes and Francis (1993).

1000ml of water was added to each 0.3kg of vermicast for cold extraction and 1000ml of hot water was added to each 0.3kg. It was left for 72 hours and the supernatant was filtered using 24cm cellulose nitrate membrane filters.

The absorbance of the obtained solutions was measured spectrophotometrically. Major elemental contents (P, Ca, Mg an K) and trace (Zn) elements were determined using T60 UV-Visible Spectrophotometer, flame photometer.

Note

ECCCE - Earthworm Cast Carbonized Cold Extraction
ECCHE - Earthworm Cast Carbonized Hot Extraction
ECNCCE - Earthworm Cast Non-Carbonized Cold Extraction
ECNCHE - Earthworm Cast Non-Carbonized Hot Extraction

Statistical Analysis

The data obtained were subjected to ANOVA in complete randomized design. Statistical significant differences were separated using Duncan Multiple Range Test where *p* values less than 0.05 were considered significant.

RESULT AND DISCUSSION

The study revealed significant differences in the amount of most isolated elements (Table 1) except for P which is not significantly different at 5% probability level. The content of K in

carbonized earthworm cast in cold extraction was 0.6 cmol/kg, 0.6 cmol/kg in carbonized worm cast in hot extraction, 0.2 cmol/kg in non-carbonized worm cast in cold extraction and 0.3 cmol/kg in non-carbonized worm cast in hot extraction. The amount of potassium in carbonized worm cast in hot and cold extraction is significantly higher than in non-carbonized worm cast in hot and cold extraction as shown in figure 3. The Adequate Intake for potassium is 4700 mg for both male and female. Potassium is necessary for the heart, kidneys and other organs to work normally (Manore, 2001). Low potassium is associated with a risk of high blood pressure, heart disease, stroke, arthritis, cancer, digestive disorders and infertility. Potassium deficiencies are common in people who abuse alcohol or drugs, smoke, use certain medicines such as diuretics, birth control pills. Good natural food sources of potassium include banana, avocado, citrus fruits, leafy, green vegetables, milk and potatoes (Manore, 2001).

Table 1: ANOVA for the isolated elements

		Sum of Squares	df	Mean Square	F	F-tab
P	***Treatment***	0.002	3	0.001	1.970^{ns}	4.07
	Error	0.002	8	0.000		
	Total	0.004	11			
K	***Treatment***	0.376	3	0.125	4.849*	4.07
	Error	0.207	8	0.026		
	Total	0.583	11			
Ca	***Treatment***	0.417	3	0.139	4.274*	4.07
	Error	0.260	8	0.033		
	Total	0.677	11			
Mg	***Treatment***	6.676	3	2.225	43.070*	4.07
	Error	0.413	8	0.052		
	Total	7.089	11			
Zn	***Treatment***	0.227	3	0.076	5.487*	4.07
	Error	0.173	8	0.022		
	Total	0.400	11			

*Significant and ns = not significantly different at 5% probability level

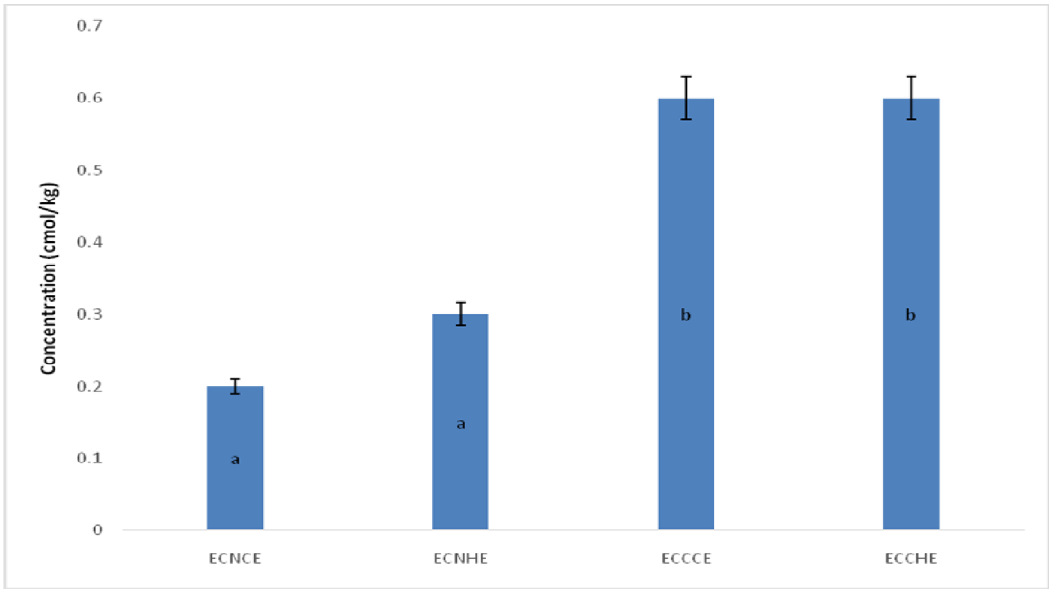

Figure 1: Potassium concentration of carbonized, non-carbonized, cold and hot extraction of earthworm cast

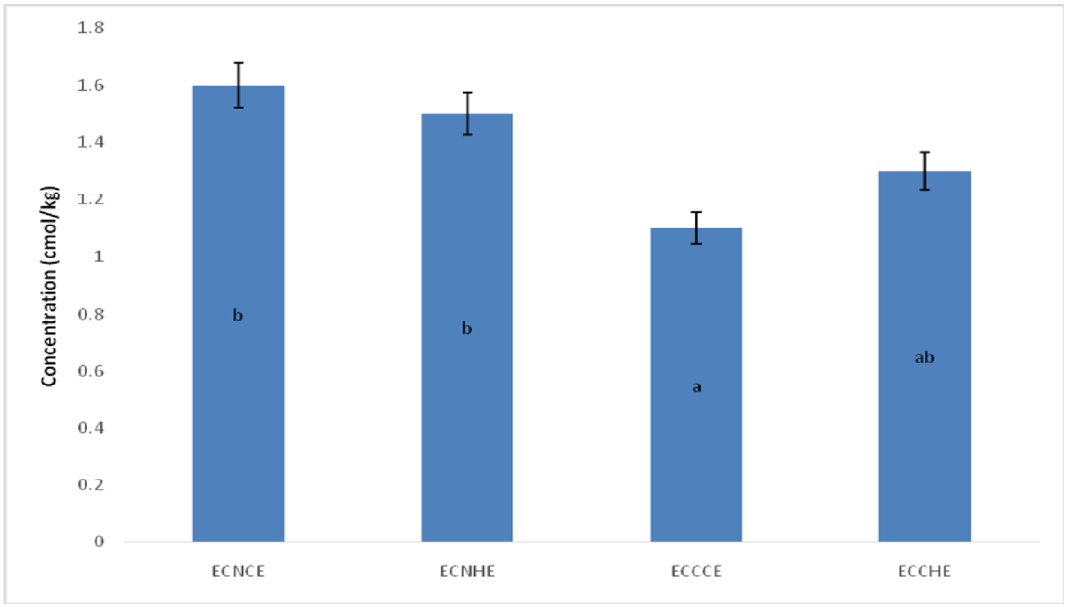

Figure 2: Calcium concentration of carbonized, non-carbonized, cold and hot extraction of earthworm cast

The content of Ca in carbonized earthworm cast in cold extraction was 1.1 cmol/kg, 1.3 cmol/kg in carbonized worm cast in hot extraction, 1.6 cmol/kg in non- carbonized worm cast in cold extraction and 1.5 cmol/kg in non-carbonized worm cast in hot extraction. The amount of calcium in non-carbonized worm cast in hot and cold extraction is significantly higher than in carbonized worm cast in cold extraction as shown in figure 2. However, the

amount of calcium in carbonized worm cast in hot extraction is not significantly different from non - carbonized worm cast in hot and cold extraction so also carbonized worm cast in cold extraction. The Adequate Intake (AI) for calcium is intended to provide optimal amounts for health particular for bone health and the prevention of osteoporosis. The daily recommendations; children 1-3 years(500 mg),youths 4-8 years(800 mg); youths and adolescents 9-18years(1300 mg) ; Adults 19-50(1000 mg) and adults 50 and older (1200 mg). The Tolerable Upper Intake Level (UL) is 2500 mg per day. The Daily Value (DV) for calcium is 1000 milligrams. Calcium content is highest in dairy product, leafy vegetables, beans (DGC, 2010). The vast majority of the body calcium, is found in the skeleton, where it gives strength by the formation of salts such as calcium phosphate, tooth formation, muscle contraction, regulation of nerve. Deficiency symptoms include osteomalacia, osteoporosis, rickets, muscle cramps and impaired muscle contraction (Clarkson and Haymes, 1995).

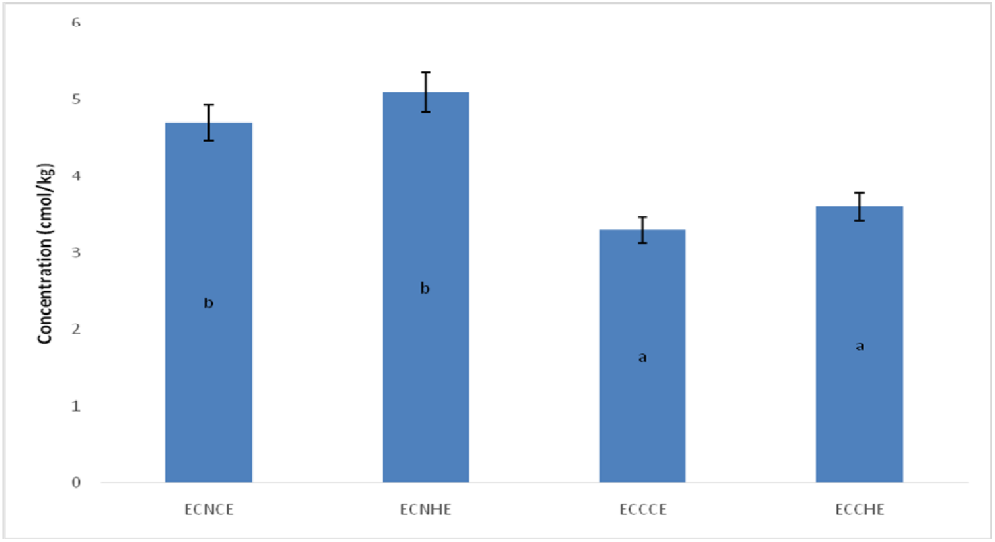

Figure 3: Magnesium concentration of carbonized, non-carbonized, cold and hot extraction of earthworm cast

The content of Mg in carbonized earthworm cast in cold extraction was 3.3 cmol/kg, 3.6 cmol/kg in carbonized worm cast in hot extraction, 4.7 cmol/kg in non- carbonized worm cast in cold extraction and 5.1 cmol/kg in non-carbonized worm cast in hot extraction. The amount of magnesium in non-carbonized earthworm cast in cold and hot extraction is significantly higher than in carbonized worm cast in cold and hot extraction as shown in figure 4. The adult RDA for magnesium is 400-420mg for men and 310-320 mg for women. The DV is 400 mg. The UL is 350 mg for magnesium in supplements and fortified foods

(Sojka and Weaver, 1995). Magnesium is widely distributed in foods, particularly nuts, seafood, green leafy vegetables, other fruits and vegetables, black beans and whole- grain products. Magnesium influences bone metabolism and helps prevent bone fragility. Certain health conditions such as kidney malfunction, prolonged diarrhoea, as well as the use of diuretics and excessive alcohol, may contribute to a deficiency state (Sojka and Weaver, 1995).

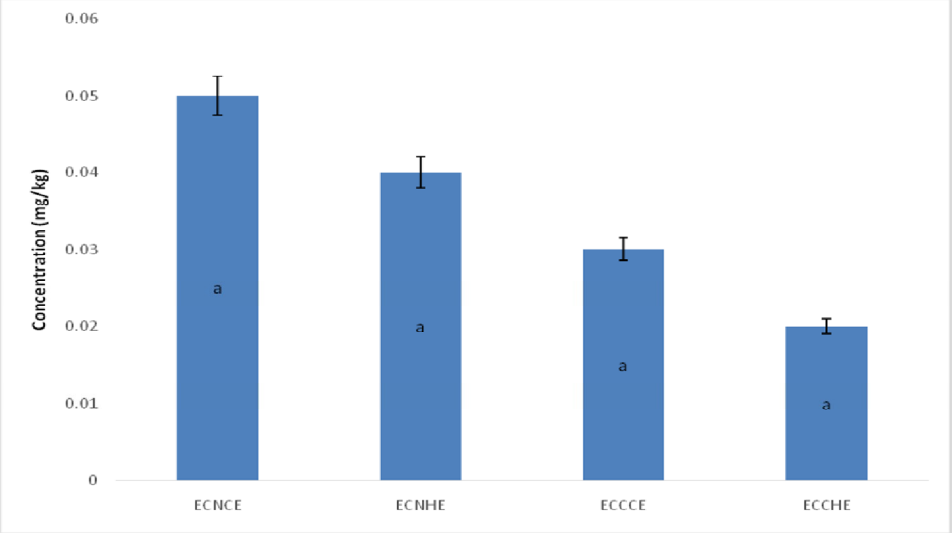

Figure 4: Phosphorus concentration of carbonized, non-carbonized, cold and hot extraction of earthworm cast

The content of P in carbonized earthworm cast in cold extraction was0.03 mg/kg, 0.02 mg/kg in carbonized worm cast in hot extraction, 0.05 mg/kg in non- carbonized worm cast in cold extraction and 0.04 mg/kg in non-carbonized worm cast in hot extraction. Phosphorus is the second most abundant mineral in the body after calcium. The adult RDA is 700 mg for both men and women. Higher amounts are needed between ages 9 and 18. The DV is 1000 mg. The UL for adults is 4 g but only 3 g between ages 1-8 and over 70 (Knochel, 1999). In human body, phosphorus occurs only as salt phosphate such as sodium phosphate involved in acid-base balance. Phosphorus combines with calcium to form calcium phosphate which is used for the development of bones and teeth. Because phosphorus are widely distributed in foods and hormonal control is effective, deficiency state are rare (Knochel, 1999). They have been known to occur in hospital patients with serious illnesses, recovering alcoholics, and in those who used antacid compounds for long period that decrease the absorption of

phosphorus. Excellent sources include seafood, meat, eggs, milk, cheese, nuts, dried beans and peas, grain products and a wide range of vegetables (Knochel, 1999).

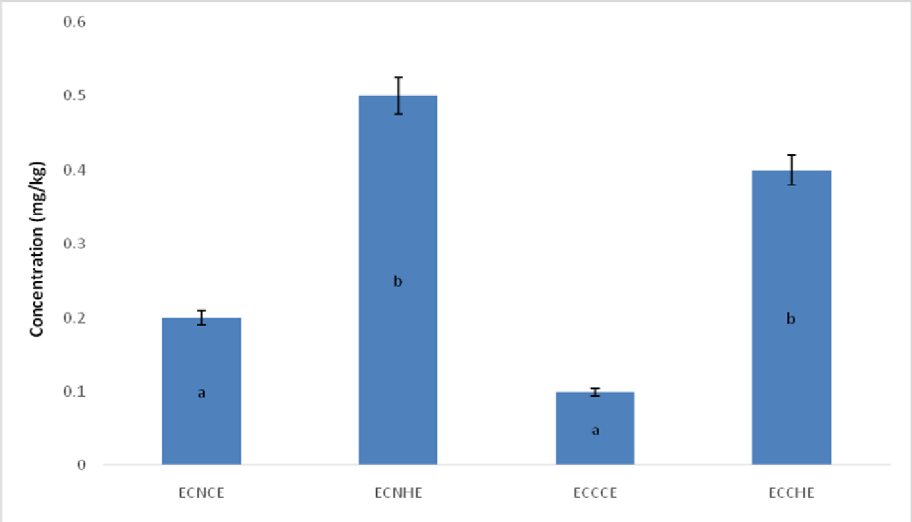

Figure 5: Zinc concentration of carbonized, non-carbonized, cold and hot extraction of earthworm cast

Good sources of zinc are found in animal protein, such as meat, milk and seafood, particularly oysters. People deficient of zinc may be at a risk of impairment of optimal growth (Micheletti, 2001). The content of Zn in carbonized earthworm cast in cold extraction was 0.1 mg/kg, 0.4 mg/kg in carbonized worm cast in hot extraction, 0.2 mg/kg in non-carbonized worm cast in cold extraction and 0.5 mg/kg in non-carbonized worm cast in hot extraction. The amount of Zinc in carbonized and non- carbonized earthworm cast in hot extraction is significantly higher than carbonized and non- carbonized earthworm cast in cold extraction as shown in figure 5. The Recommended Dietary Allowance (RDA) for Zinc is 11 mg per day for adult males and 8 mg per day for adult females. The Daily Value (DV) is 15 mg per day. The Tolerable Upper Intake Level (UL) for adults is 40 mg per day (Micheletti, 2001). Zinc is found virtually in all tissues in the body and is required for the activity of more than 300 enzymes and a wide variety of other body functions such as protein synthesis, the growth process, bone formation and wound healing. Munchi *et al*., 2010 reveals that clinical studies of patients diagnosed with stroke, which blocks oxygen flow and leads to injury of the brain revealed some interesting observations regarding alteration in zinc level. The observations by Munchi*et al*. 2010 were confirmed by another group of researchers who found that patients diagnosed with ischemic stroke had low levels of zinc upon

hospitalization and that zinc dysregulation plays a role in neuronal damage and death after ischemic brain injury (Bhatt *et al.*, 2011).

CONCLUSION

The study revealed that there are significant differences in comparison of the carbonized, non-carbonized, hot and cold extraction of the earthworm cast. However, there is no significant difference in phosphorus across the four groups. Present study shows that zinc present in earthworm cast with the Recommended Dietary Analysis (RDA) of the element in the body system wellness reveals that earthworm cast has potential properties for the management of cardiovascular and neuro-associated diseases. Zinc being an important micronutrient, its effects manifest throughout the entire lifespan, from neonatal brain development to the progression of neurological disorders, such as Alzheimer's disease, that primarily target the elderly population, serving as a reminder that zinc is an essential component of life. An alteration in magnesium level also may be linked to alterations in brain functions. Nutrients may contribute to neurological disorders if not provided in sufficient amount. These micro and macro nutrients present in this cast are indication that earthworm casts could be potential therapeutic agents; hencethe need for further pharmacological research is required.

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