Proximate, vitamin and mineral composition of earthworm (*Hyperiodrilus euryaulos)* cultured indifferent Animal dung Media

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Abstract

The experiment to investigate the proximate, vitamin and mineral composition of earthworm (Hyperiodriluseuryaulos) cultured in different animal dung media was conducted using a completely randomized design for ten weeks. Rabbit, Poultry, Pig and Goat dungs were incorporated into garden soil after sterilizing in other to ensure that there was no earthworm or any insect alive in the substrate. Live earthworms were introduced into these different animal dungs which were designated as T_1, T_2, $T_3$and $T_4$for rabbit, poultry, pig and goat dungs respectively. Diet formulated with maize, palm kernel cake and wheat offal was evenly spread on the diet and then mixed with the substrate. At the end of the tenth week, the earthworms were harvested by hand picking. They were soaked in warm water to kill them and rinsed with cold water to remove sand. The dried and milled earthworms were analyzed for chemical composition. The result of the study revealed significant ($p<0.05$) differences in percentage dry matter, ash, ether extract, crude protein, crude fiber, and nitrogen free extract and Metabolizable energy. The earthworm cultured in goat dung (T_4) had the highest ($p<0.05$) crude protein percent of 38.49% while those from the rabbit dung (T_1) recorded 28.72%CP. The Sodium content of the earthworms cultured in rabbit droppings $T_1$was significantly ($p<0.05$) the highest recording 126.52mg, while others were 86.63, 86.40 and 93.73mg for poultry, pig and goat dungs respectively.1.74Vitamin A content of earthworms cultured in the different animal dung media were 1.74mg/100g DM, 2.10, 1.36 and 1.30mg/100g DM for the rabbit, poultry, pig and goat dungs respectively. The proximate composition of the earthworms cultured in the different animal dung media indicate that the earthworms except those cultured in the poultry droppings have high crude protein content and can be used to substitute fish meal in livestock diets. Moreover, the high content of ash in all the treatments suggests that they may be rich in minerals especially sodium.

Keywords: Animal dungs, earthworm, proximate composition, vitamin, mineral

Introduction

The high cost of poultry feed has been traced to increased cost of conventional feedstuffs especially protein feedstuffs such as fishmeal Atteh and Ologbenla (1993). This has necessitated the search for alternatives that are not conventional. Such unconventional feed ingredients that can replace fishmeal is earthworm (vermimeal). Growing earthworms in conjunction with livestock operations is often a successful way to diversify and to reduce the dependence on the costly fishmeal, thereby causing a tangible reduction in the cost of production of poultry and other livestock. Raising earthworms in the waste products of livestock and then feeding the animals with

crops that have been enhanced with worm castings completes a nutrient cycle. Many rabbit growers have developed a second income from the sales of earthworms by placing worm bins directly beneath the rabbit cages where the worms automatically receive manure as feed. Earthworms belong to the phylum Annelida, which means "ringed." The "rings" around worms are called segments (Guerero, 2004). Red worms have about 95 segments, while night crawlers have about 150. Earthworm bodies are streamlined, containing no protruding appendages or sense organs, to enable them to pass easily through soil. Worms have well-developed nervous, circulatory, digestive, excretory, muscular, and reproductive systems (Edwards and Lofty, 1972).

The head or anterior end of the earthworm has a prostomium, a lobe covering the mouth that can force open cracks in the soil into which the earthworm can crawl. Setae (bristles) on each segment can be extended or retracted to help earthworms move. Lubricating mucous, secreted by skin glands, helps worms move through soil and stabilizes burrows and castings.

Despite unusual perception, the earthworm has been used as food for humans. Due to high nutritive value and abundance of the proteins they are basic of healthy diet. The earthworm contains about 60-70 % of proteins (Guerrero *et al.*, 1984; Medina *et al*., 2003). These authors have also reported that the presence of essential amino acids, especially a tyrosine, is much higher in the body of earthworm than it is recommended by FAO. Besides the human diet, the earthworm has been used in the feeding of fish (Vassilli and Saurat, 2010) as well as the chicken (Taboga, 1980).

Materials and methods

Experimental location

The experiment was carried out at the rubber plantation farm of Michael Okpara University of Agriculture, Umudike. Mean annual rainfall is 2177/year and temperature range 22-36^{o}c. Relative humidity is about 50-90%. It is on elevation of 122m above sea level and latitude location of 5^{o} 29^{1} and 7^{o} 32^{1}. 4kg of animal dungs from four animal species (goat, rabbit, pig and Poultry) and treated garden soil were collected and mixed in a ratio of 2:3 manure to garden soil. They were mixed thoroughly with two liters of water and then introduced into the container. Each was put into rectangular plastic container (30 x 42.5x27cm). Each was replicated three times given a total of 12 experimental units. These containers were perforated for excess water to drain out. 1kg of diet was formulated using maize offal, wheat offal and PKC in a proportion of 0.35kg, 0.30kg and 0.35kg respectively and the feed was sprinkled on each soil/excreta. Twenty- five fry earthworms whose length and initial weights were recorded were introduced into the plastic containers. The containers which were covered with mosquito nets to prevent escape and from predators were kept under the rubber plant tree so as to provide optimum environment for growth. Water was sprinkled every evening to keep the soil moist or moderate for the earthworm to thrive. Harvesting was done after 10weeks of introduction of earthworms. It was done in the morning by hand picking to ensure effective recovering of the earthworm according to the method of Edwards and Niederer (1988) and Ugwumba *et al.* (2001). Harvested earthworms were thoroughly rinsed in water and kept in a bowl for 30 minutes to evacuate their guts after which they were oven dried at milled and taken to the laboratory for the chemical analysis (proximate, vitamin and mineral composition).

Statistical Model

$Y_{ij} = \mu + T_i + e_{ij}$

Y= Single observation
μ= Overall mean
$T_{i=}$ Effect of treatment
e_{ij} = random error assumed to be identically, independently distributed with zero mean and constant variance

The data obtained was subjected to Analysis of Variance (ANOVA) in a completely randomized design.

Results and Discussion

The proximate analysis of earthworm raised in different animal dung media

Table 1: Proximate composition of earthworm meal raised in different animal dung media

Parameters %	T1 (Rabbit)	T2 (Poultry)	T3 (Pig)	T4 (Goat)	SEM
Dry matter (%)	93.41[a]	92.20[b]	89.71[d]	91.80[c]	0.40
Ash (%)	45.29[a]	37.00[b]	18.02[d]	33.58[c]	2.98
Crude protein (%)	28.72[b]	13.03[d]	20.06[c]	38.49[a]	2.88
Ether extract (%)	5.30[c]	5.36[c]	6.38[a]	5.90[b]	0.14
Crude fibre (%)	1.08[d]	1.43[c]	2.73[a]	1.90[b]	0.19
NFE (%)	13.35[c]	35.37[b]	42.50[a]	11.93[d]	4.04
ME(Kcal/kg)	2347.52[d]	2439.69[c]	3175.58[a]	2839.94[b]	99.09

[a,b,c]Means across rows with different superscripts differ significantly at P<0.05; S.E.M: Standard Error of the Mean; NFE: Nitrogen free extract.

Different Table 1 shows the proximate composition of the earthworms cultured in rabbit, poultry, pig and goat dungs. The DM of the earthworms raised in the different animal dung media were 93.41%, 92.20, 89.71% and 91.80% for the rabbit, poultry, pig and goat dungs respectively. The crude protein content of the earthworms were 28.72%, 13.03, 20.06 and 38.49% for T_1, T_2, T_3 and T_4 respectively while, the nitrogen free extract for the groups were observed to be 13.35%, 35.37, 42.50 and 11.93% respectively for T_1, T_2, T_3 and T_4respectively.Metabolizable energy of 2347.52kcal/kg, 2439.69, 3175.58 and 2839.94kcal/kg were recorded for T_1, T_2, T_3 and T_4 respectively. There were significant ($p<0.05$) differences in all the proximate composition parameters evaluated among the different treatments. The earthworms cultured in the rabbit dung had the highest ($p<0.05$) DM and ash contents, while the highest ($p<0.05$) crude protein content was noted in those raised in goat dung. This suggests that the rabbit dung may be rich in ash and the earthworms in this medium were favored. The low fibre content (1.08%) of the T_1 group could be attributed to the coprophagy for which the rabbit is noted where the excreted soft faeces are eaten back, giving the rabbit the opportunity to digest and absorb more nutrients especially fibre content of the diet and excreting little in their dungs (solid faeces). However, crude protein of the dried earthworm showed that earthworm raised in goat manure (T_4) had significantly ($P<0.05$) highest crude protein (38.49%) compared to other treatment groups followed by those raised in rabbit (T_1) while the poultry droppings negatively affected the crude protein content of the earthworms cultured on them. The ether extract and crude fibre of the earthworms raised in pig manure (T3) was significantly ($P<0.05$) higher than the remaining treatment groups. However, the ether extract of the earthworms raised in rabbit (T1) and poultry (T2) were not significantly different ($P>0.05$) from each other. The nitrogen free extract (NFE) of earthworms raised in pig manure (T3) was significantly ($P<0.05$) higher than the

remaining treatment groups, followed by those raised in poultry (T2), rabbit (T1) and goat manure (T4) respectively. The result showed that the Metabolizable energy (3175.58 kcal/kg) of the earthworms raised in pig manure (T3) was significantly ($P<0.05$) higher than the remaining treatment groups. This could be attributed to the high ether extract of 6.38% observed in this group.

A proximate analysis of earthworms according to Edwards and Niederer (1988) revealed moisture content of 80.44%. A further analysis of freeze-dried earthworms according to Gurrero*et al.* (1984) recorded the following components: oil 6.8-7.1%, nitrogen 10.6 - 11.0%, protein 66.2 - 68.6% and ash 9.3 - 9.7%. They reported that on whole, live earthworms are less than 14% protein and that the freeze-dried product (after water is removed) compares favorably with defatted soy flour from the standpoint of amino acid availability. The lower crude protein observed in this experiment as compared to that by Gurrero *et al.* (1984) could be attributed to the different processing method applied. The harvested earthworms in this research were soaked in warm water to kill them and later subjected to oven drying which may have contributed to the reduced protein.

Table 2: Sodium and Vitamin A content of Earthworm raised in different animal dungs media.

Parameters %	T1 (Rabbit)	T2 (Poultry)	T3 (Pig)	T4 (Goat)	S.E.M
Sodium (mg/g)	126.52^{a}	86.63^{c}	86.40^{d}	93.73^{b}	4.89
Vitamin A (mg/g)	1.74^{b}	2.10^{a}	1.36^{c}	1.30^{c}	0.10

^{a,b,c}Means across rows with different superscripts differ significantly at $P<0.05$; S.E.M: Standard Error of the Mean

The earthworms cultured in the rabbit dung medium recorded the highest value for sodium 126.52 mg/g while the highest vitamin A content was observed in the earthworms cultured in the poultry dung medium. These results indicate that the earthworms cultured in various animal dungs are good sources of sodium which is one of the macro minerals that play vital roles in poultrynutrition. It implies that incorporating the earthworms cultured in rabbit dung into poultry ration will enhance acid-base balance (osmotic pressure regulation) in the birds. Sodium is associated with muscle contraction and proper functioning of the eye (Mcdonald *et al.* (1973).

Conclusion

Earthworm (*Hyperiodriluseuryaulos),* based on research findings has potential as a protein feed ingredient in poultry nutrition and is therefore, recommended to be used in livestock feed formulation so as to reduce the cost of production to the farmers as it could serve as an alternative to the expensive fish meal. Moreover, there is no known competition for this novel feed ingredient, between man and animals

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