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Assessment of nutrient status of vermicompost of leaf litter using *Eisenia fetida*

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Abstract

The present study of 90 days was carried out to evaluate the nutrient status of vermicompost using *Eisenia fetida*. Three replicates of the substrate having cowdung+ leaf litter in ratio of 3:1 were maintained and the samples of substrate were collected on initial, 30th, 60th and 90th day of study for the analysis of carbon, nitrogen, potassium and phosphorus content. The reduction in organic carbon from 13.130% to 10.780% on 90th day while an increase in nitrogen, phosphorus and potassium content upto 17.90%, 44.73% and 18.24%, has been recorded respectively. C:N also marked significant decrease upto 32.60% that stamps the enhanced levels of nutrient due to earthworms' activity.

Keywords: *E. fetida*, nitrogen, phosphorus, carbon, potassium

1. Introduction

With the increasing population, waste management has become one of the major problems in recent years. Along with the massive waste production, the degradation in soil fertility is also a major concern. Darwin initially reported the utility of earthworms as nutrient enhancers in pedogenesis processes [1]. Use of vermicompost over the years helps in building up the soil's physical, chemical and biological properties restoring its natural fertility [2]. In the age of rapidly increasing waste, vermicomposting offers sustainable, ecofriendly and affordable technique for waste management [3]. India approximately produces 600 to 700 million tons of agricultural residues annually that remain unutilized [4]. The organic waste like leaf litter when mixed with cowdung offers a better substrate for vermicomposting. The feeding activity of earthworm leads to the changes in nutrient profile of organic waste. The nutrients like carbon, nitrogen, magnesium, phosphorus and calcium are converted into soluble and available forms [5]. Earthworms act upon the waste so as to aerate, crush, mix and degrade to convert it into nutrient rich manure [11]. The epigeic earthworm *Eisenia fetida* characterized by rapid growth rate, early sexual maturity and extensive reproductive capabilities has been extensively used for vermicomposting of different plant residues, city refuse and sewage sludge [6]. Pedestaled on the above mentioned facts, the present study has been designed to analyze the nutrient dynamics of vermicompost of leaf litter processed by *Eisenia fetida*.

2. Material and Methods

2.1 Collection of test animal

Earthworms collected from the Vermiculture unit of Department of Zoology, were reared on biogas slurry from Biogas plant of Department of Microbiology, CCS Haryana Agricultural University, Hisar.

2.2 Experimental set up:

Each tub containing 16 kg pre composted cow dung and leaf litter in the ratio of 3:1 in 40 L capacity plastic tubs were used for the process of vermicomposting. Percent moisture in the mixture was calculated by keeping 1 kg of mixture in oven at 60°C overnight. Moisture content was maintained between 40 to 45% and the temperature was not allowed to exceed 50-55°C. Twenty adult earthworms were weighed, washed and released in each tub after 15 days. All the tubs were covered with gunny bags and water was sprinkled every day to maintain moisture. Three replicates were maintained. The factors like aeration and temperature were maintained to support the process of vermicomposting. The samples of vermicompost were collected and analyzed for carbon, nitrogen, phosphorus and potassium by using standard methods at an interval of 30 days, on initial, 30th, 60th and 90th day of the experiment.

2.3 Chemical analysis

Total carbon was analyzed using dry combustion method [7]. The amount of total nitrogen has been assessed by Calorimetric method [8]. Vanadomolybdo-phosphoric yellow color method was used to analyze the total phosphorus [9]. Total potassium content of the substrate has been analyzed by using flame photometric method [10].

2.4 Statistical analysis

The reported data are the mean of triplicates and was subjected to ANOVA to analyze the significant differences using software 'OPSTAT', developed at the Computer Center, College of Basic Sciences and Humanities, CCS Haryana Agricultural University, Hisar.

3. Results and Discussion

During vermicomposting marked physical and biochemical changes were observed. The substrate changed to odorless, granular and dark color vermicompost. The changes induced due to feeding activity of earthworms marked vermicompost's utility as manure. The changes in nutrient status of vermicompost as assayed on 0, 30th, 60th and 90th day of the experiment is given in Table 1. The level of organic carbon has been found to be decreased whereas nitrogen, phosphorus and potassium increased. Organic carbon decreases gradually while the maximum decrease was recorded on 90th day. Initially organic carbon was 13.130% that reduced to

10.780% on final day of the experiment. Hence, a total of 17.890% decrease in organic carbon has been recorded. The results associated with the decreased carbon levels can be stamped by the findings of Bhardwaj and Sharma (2015) [13] and Yadav *et al.* (2017) [12]. Rapid respiration rate and loss of carbon as carbon dioxide may be the most probable reason for the loss in organic carbon content [14, 15]. Significant increase in the levels of nitrogen, phosphorus and potassium has been recorded from initial to the last day of the experiment. Nitrogen, phosphorus and potassium contents increased at the rate of 17.90%, 44.73% and 18.24%, respectively. Increased mineralization of the organic waste may be the reason of increased nitrogen content. However, symbiotic microbes may enhance the rate of mineralization of the substrate [16]. It may also be noted that the rate of increase in nitrogen content depends upon the type of substrate the worms act upon. Previous studies [17, 18] have also advocated the substantial increase in levels of nitrogen, phosphorus and potassium contents during vermicomposting. Solubilizing of phosphorus via phosphatase and microbial diversity present in earthworm gut may be the reason for increase in available phosphorus [19]. Acid production by the symbiotic microbial activity in earthworm's gut may be utmost reason for the available potassium [20]. The decrease in carbon nitrogen ratio has been noted during the experiment. C: N ratio below 20 is the marker for the utility of vermicompost as plant growth promoters [12].

Table 1: Changes in nutrient status during vermicomposting using *Eisenia fetida*

Sr. No.	Parameters	Nutrient status (%)			
		0 day	30 th day	60 th day	90 th day
1	Organic Carbon	13.130±0.24	12.273±0.119	11.350±0.142	10.780±0.287
2	Organic Nitrogen	1.073±0.029	1.130±0.017	1.203±0.026	1.307±0.023
3	C:N	12.236	10.201	9.434	8.247
4	Organic Phosphorus	0.210±0.021	0.270±0.012	0.307±0.009	0.380±0.026
5	Organic Potassium	0.121±0.001	0.131±0.002	0.140±0.001	0.148±0.002

4. Conclusion

The process of vermicomposting leads to significant reduction in odor and carbon content of the substrate. Increase in the nutrient status of vermicompost *i.e.*, 17.90% in nitrogen, 44.73% in phosphorus and 18.24% in potassium has been recorded. The physico- chemical changes induced due to the activity of *E. fetida* on the substrate so as to convert in vermicompost marks its utility as a good fertilizer for agroecosystems.

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