Journal of Agroecology and Natural Resource Management
p-ISSN: 2394-0786, e-ISSN: 2394-0794, Volume 4, Issue 1; January-March, 2017, pp. 24-27

http://www.krishisanskriti.org/Publication.html

Comparative Studies on the Levels of pH, Organic Carbon and Vitamin C at Periodic Intervals during Vermicomposting of Kitchen Wastes by *Eisenia foetida* and *Eudrilus eugeniae*

Evarani Kalita[1], Akshay Kumar Haloi[2], Mukul Ch. Borah[3], Barsha Das[4] and Janayita Biswa Sarma[5]

[1]Department of Zoology, Handique Girls' College, Guwahati-1, Assam
[2]Department of Zoology, Bajali College, Pathsala, Assam, Pin-781352
[3]Live Stock Production & Management, College of Veterinary Science, Khanapara, Guwahati, Assam
[4,5]Department of Zoology, Handique Girls' College, Guwahati-1,Assam
Email: [1]evaranikalita@yahoo.com, [2]akshayhaloi@yahoo.com, [3]mcborah58@gmail.com, [4]barsharock03@gmail.com, [5]janayitabs20@gmail.com

Abstract—*Disposal of wastes has become important for a healthy environment. In this regard recycling of organic wastes is viable. Recycling of wastes through vermicomposting reduces problems of disposal of organic wastes. The process of conversion of biodegradable waste material into organic manure using earthworm is called vermicomposting. In the present study an effort has been made to compare the levels of moisture content, pH, temperature, organic carbon and vitamin C at periodic intervals (30, 45 and 60 days) during vermicomposting of kitchen wastes by two earthworm species - Eisenia foetida and Eudrilus eugeniae . We also aimed to investigate final output of vermicomposting in comparison with the conventional method of composting. The study clearly indicates that both the species are not only capable for the degradation of kitchen waste to convert them into nutrient rich vermicompost, but at the same time reduce the quantity of waste. With periodic intervals organic carbon was found to be significantly decreased, but Vitamin C was significantly increased in vermicompost. Even the pH has become more neutral in vermicompost. Besides, in the present investigation we observed that Eisenia fetida is superior in performance over Eudrilus eugeniae.*

Keywords: *Vermicompost, Comparative study, Kitchen waste, Eisenia foetida, Eudrilus eugeniae , Vitamin C, Organi carbon*

1. INTRODUCTION

The urban Indian citizen generates nearly 700 grams of solid waste per person per day which is nearly 250 kg in a year [1]. Utilization of the waste material for productivity process is important for both economical and environmental reason [2]. Vermicompost is a cost effective, pollution free process by use of earthworms [3]. It is a simple biotechnological process of composting in which certain species of earthworms are used to enhance the process of wastes conversion in a better end product [4]. Earthworm not only converts garbage into valuable manure but keep the environment healthy. To save earth and to prevent the problems arises from waste material; the process of vermicomposting can be carried out in both small and large scale.

Compost piles break down materials using bacteria that thrive in high temperatures. These high temperatures kill off some of the microbes. But with vermicompost, waste is broken down aerobically at moderate temperatures. This permits a much wider spectrum of microorganisms to develop in the final product. It is these microbes that can convert nutrients in the soil to a form that is more readily absorbed by plants [5]. Vermicompost is a nutrient-rich natural fertilizer that works as soil conditioner. Its continued application over the years leads to the improvement in the quality of soil. It is a valuable soil amendment process with rich source of nutrients, vitamins, enzymes, antibiotics and growth hormones. So it also gives disease resistance power. Vermicompost contains nitrogen, phosphorous, potassium, calcium, sodium, magnesium, iron, zinc, manganese, copper, boron, and aluminum. The most important of these being the nitrogen, phosphorous, and potassium that they add to the soil.

Nearly 4,400 species of earthworms have been identified in the world, out of which only a few are used in vermicomposting. The growth rate and tolerance level of different species of earthworms to environmental changes differ from species to species in vermicomposting. Several epigeic earthworms, e.g., *Eisenia foetida* (Savigny), *Perionyx excavatus* (Perrier), *Perionyx sansibaricus* (Perrier), and *Eudrilus eugeniae* (Kinberg) had been identified by researchers which may be promising candidate to recycle the organic wastes [6-8]. Several workers also highlighted the importance of these earthworms in waste management, environmental conservation, organic farming and sustainable agriculture [9-12]. In a study[13], it was reported that kitchen waste can be used as a good bulking agent or good source of carbon in composting. In a comparative study, high amount of vitamin C was reported[14] in vermicompost produced by *Eisenia fetida* and *Eudrilus eugeniae* in comparison with compost. They observed high amount of vitmin C in 45 days of composting.

Scientists from the University of Exeter and Shimane University in Japan have proved for the first time that vitamin C is essential for plant growth. This vitamin helps plants cope with stress, photosynthesis and climate changes, and protects plants from ultraviolet rays. Plants cannot mature without vitamin C. German scientist Justus Von Liebig was responsible for the theory that Nitrogen, Phosphorous, and Potassium levels (N-P-K) are the basis for determining healthy plant growth. As N-P-K, elements such as carbon, hydrogen, oxygen, sulfur, magnesium, copper, cobalt, sodium, boron, molybdenum, and zinc are also important for plant development. Soil organic carbon is the basis of soil fertility. It releases nutrients for plant growth, promotes structure, biological and physical health of soil, and is a buffer against harmful substances [15]. Earthworms are also considered as suitable organisms for the degradation process since vermicomposting results in reduction of bulk density and reduced phytotoxicity in the composted end products.

The quality of final compost is also affected by the species of worm used in decomposition process. Therefore the main aim of the present study was to find out which of the two earthworm species (*Eisenia foetida* and *Eudrilus eugeniae*) is most efficient comparing their performance in the process of the bioconversion of Kitchen waste material in to the vermicompost.

2. MATERIALS AND METHODS

Collection of earthworms:

The earthworms species (*Eisenia foetida* and *Eudrilus eugeniae*) used in our study were collected from Vermiculture Unit, Kahikushi Agricultural Research Centre (Krishi Vigyan Kendra), Kamrup.

Methods of Collection and predecomposition of kitchen waste:

Kitchen waste materials were collected from household. The unwanted plastic materials were removed and then partial decomposition of these waste materials was done by spreading the materials under sunlight. The collected wastes were then chopped into small pieces so that it can become easier for worms to consume.

Methods of Vermicomposting:

Vermicomposting is done by various methods, among which Bed and Pit methods are more common. In our study, we followed the Pit method of vermicomposting Published by ICAR Research Complex for NEH Region, Umiam – 793103, Meghalaya.

Chemical analysis:

In the present study temperature was noted daily using thermometer, pH was recorded by digital pH meter, moisture content was measured gravimetrically, Organic Carbon was measured by Walkey-Black method [16] (1934) and Vitamin C was assayed by the method described by Sadasivam and Balasubramaniam[17] (1987).

Statistical analysis:

Statistical analysis was performed using the version generated by SAS System ('Local', X64_7PRO). With the help of this system Duncan's multiple range test was applied for comparison of the levels of all the experiments at different time intervals. Comparisons of the values were performed at the 0.05 level of probability.

3. RESULTS AND DISCUSSION

In the present study we observed that *Eisenia foetida* and *Eudrilus eugeniae* can be cultured very well on kitchen wastes. Results of all the experiments are depicted in table 1. It is generally known that epigenic species have a greater potential as waste decomposers than anecic and endogeic[18]. Since both the earthworm species are epigenic, the present investigation supports the earlier findings that *Eisenia foetida* and *Eudrilus eugeniae* are best for vermicomposting. The level of pH was found towards neutral; and organic carbon was found to be decreased with the advancement of vermicomposting period (30 to 60 days) irrespective of the earthworm species when compared with the compost. In different periodic intervals, results were significant at 5% level. In a study, lower level of pH was observed in vermicompost than normal compost irrespective of the source of organic waste[19]. Maximum decrease in organic carbon was observed in the vermicompost produced by *Eisenia foetida*. The results of the present study are also in agreement with the findings who reported decreased organic carbon, C/N and C/P ratios as the composting process progressed from 0 to 15, 30, 45, and 60 days[20].

Table 1: Results of different physio-chemical parameters in the vermicompost produced by *Eisenia foetida* and *Eudrilus eugeniae* at different time intervals.

Parameters	Decomposition time (Days)	Control (Without earthworm)	Vermicompost By *E.foetida*	Vermicompost *E.eugeniae*
Initial Wt	0	5kg^{a}	5kg^{a}	5kg^{a}
Final Wt	60	3.8 kg^{b}	2.1kg^{c}	2.3kg^{c}
Temperat	0	27^{a}	27^{a}	27^{a}
	30	26^{a}	25^{b}	25^{b}

ure	45	26^{a}	25^{b}	25^{b}
	60	27^{a}	25^{b}	25^{b}
pH	0	6.10^{a}	6.11^{a}	6.10^{a}
	30	6.5^{a}	7.12^{b}	6.89^{b}
	45	6.5^{a}	7.12^{b}	6.87^{b}
	60	6.55^{a}	7.14^{b}	6.98^{b}
Moisture	0	50%^{a}	50%^{a}	50%^{a}
	30	55%^{b}	68%^{c}	67%^{d}
	45	55%^{b}	69%^{c}	69%^{c}
	60	60%^{d}	75%^{e}	74%^{e}
Organic Carbon	0	-----------	--------------	------------
	30	31.24%^{a}	27.23%^{b}	27.42%^{b}
	45	29.08%^{b}	23.08%^{c}	24.34%^{c}
	60	21.22%^{d}	19.45%^{e}	19.72%^{e}
Vitamin C	0	----------	--------------	-----------
	30	0.051 µg/gm^{a}	0.081 µg/gm^{b}	0.076µg/gm^{b}
	45	0.072 µg/gm^{c}	0.094 µg/gm^{d}	0.091µg/gm^{d}
	60	0.077 µg/gm^{c}	0.108 µg/gm^{e}	0.102µg/gm^{e}

Values with different superscripts in the same row and same column for individual parameter differ from each other at $P < 0.05$; values with the same superscripts do not differ from each other at $P < 0.05$ (based on Duncan's multiple range test).

The level of vitamin C was significantly higher in vermicompost at different time intervals and reached maximum on the 60th day of composting when compared with the normal compost. Maximum increase was observed in the vermicompost produced by *Eisenia foetida*. In a study a significant increase in the level of Vitamin A, E and C was reported[14] at different time intervals in the vermicompost produced by *Eisenia foetida* and *Eudrilus eugeniae*. During their experiment they also observed that *Eisenia foetida* is superior in performance over *Eudrilus eugeniae*.

At different time intervals the moisture content was also found to be significantly increased in the vermicompost in comparison with the normal compost. A uniform temperature was observed in the vermicompost throughout the experimental periods. Controlling temperature to the worms' tolerance range is vital to both vermicomposting and vermiculture processes[21]. Worms can survive in a pH range of 5 to 9. The ideal moisture-content range for materials in conventional composting systems is 45-60%[22]. In contrast, the ideal moisture-content range for vermicomposting is 70-90% [23]. Maintaining the vermicomposting bins within these limits, the worms were found highly efficient to carry out the vermicomposting processes.

Finally, a significantly decrease amount of output was observed in the vermicompost irrespective of the species of earthworms. In general, outputs from vermicomposting processes can vary from about 10% to closer to 50% of the original weight of the inputs [23]. This will vary with the nature of the inputs and the system used. The greater the proportion of high-C inputs to high-N inputs, the greater will be the weight of final output as a proportion of input weight.

4. CONCLUSION

In every home, kitchen generates food waste for disposal. Disposing of these kitchen wastes in a garbage disposal adds to the burden of the waste-treatment system. From this garbage we can generate potentially valuable resource to our gardens and potted plants. Vermicomposting is the best way to convert our daily kitchen dustbin contents into nutrient-rich organic manure. Thus with the application of vermicomposting we will not only reduce waste, generated from our house but also contributing to an eco-friendly environment.

5. ACKNOWLEDGEMENTS

We thank the authorities of Handique Girls' College; Bajali College and Live Stock Production & Management, College of Veterinary Science, Khanapara, for providing lab facilities to carry out the experiments and statistical analysis.

REFERENCES

[1]. Sukumaran, P. "How to compost kitchen waste in 6. 5 steps". *THE HINDU*. Chennai, August,13, 2013.

[2]. Bharadwaj, A."Management of Kitchen Waste Material through Vermicomposting".*Asian J. Exp.Biol.* 1(1), 2010, pp 175-177

[3] Porkodi, P. and Amruththa, M. "Comparative Studies on the Nutrient Levels of Vermicomposts by *Eisenia fetida* and *Eudrilus eugeniae* and Their Effects on *Vigna radiate*". IOSR Journal of Environmental Science, *Toxicology and Food Technology* (IOSR-JESTFT) e-ISSN: 2319-2402, p- ISSN: 2319-2399, 8(12), Ver. II, 2014, pp. 78-82

[4] Gandhi,M ., Sangwan, V., Kapoor, K.K. and Dilbaghi, N. "Composting of household wastes with and without Earthworms", *Environment and Ecology* , 15(2), 1997, pp. 432–434.

[5] Edwards, C.A. "Interview with Dr. Clive Edwards". *In: Casting Call*; Peter Bogdanov, Ed., VermiCo, Merlin, Oregon, 4(1), 1999, June Issue.

[6] Singh, A. , Singh, R. V., Saxena, A. K. , Shivay, Y. S and Nain, L. "Comparative Studies on Composting Efficiency of *Eisenia foetida* (Savigny) and *Perionyx excavatus* (Perrier)". *Journal of Experimental Biology and Agricultural Sciences.*, 2014, 2(5), ISSN No. 2320 – 8694, pp. 508-517

[7] Pattnaik, S. and Reddy, M.V. "Nutrient Status of Vermicompost of Urban Green Waste Processed by Three Earthworm Species—*Eisenia fetida, Eudrilus eugeniae,* and *Perionyx excavates*". Research Article. *Applied and Environmental Soil Science*, 2010, pp.1-13, Article ID 967526, doi:10.1155/2010/967526

[8] Rajendran, M. and R. Thivyatharsan, R. "Performance of Different Species of Earthworms on Vermicomposting". *International Journal of Research in Agriculture and Food Sciences.* 2(3), 2014, pp.1-6, ISSN 2311 -2476

[9] Senapati, B. K. "Vermibiotechnology: An option for recycling of cellulosic waste in india". In: New trends in Biotechnology.

(Eds. SubbaRao, M. S., Balgopalan, C. and Ramakrishnan, S. V., Oxford and IBH publishing Co. Pvt. Ltd., 1992, pp. 347-358.

[10] Bhawalkar, U.S. "Turning Garbage into Gold. An Introduction to Vermiculture Biotechnology". *Bhawalkar Earthworm Research Institute*, Pune , 1993.

[11] Ghatnekar, S.D., F.K. Mahavash and Ghatnegar, G.S. "Management of solid waste through vermiculture biotechnology", *Ecotechnology for pollution control and Environmental Management.* 1998, pp. 58- 67.

[12] Talashikar, S. C., and Powar, A. G. "Vermibiotechnology for ecofriendly disposal of wastes.Ecotechnology for pollution control and environment management". Indian. ***J. Environ. Ecoplan***, 1998. 7(3), pp. 535-538.

[13] Suriyanarayanan. S., Mailappa, A.S., Jayakumar, D., Nanthakumar, K., Karthikeyan, K.and Balasubramania, S. "Studies on the Characterization and Possibilities of Reutilization of Solid Wastes from a Waste Paper Based Paper Industry". Global. ***J. Environ .Res.*** , 2010, 4 (1), pp. 18- 22

[14] Prabha, M.L., Jayraaj I.A., Jeyaraaj, R. and Srinivasa, R.D. "Comparative Studies on the levels of Vitamins during Vermicomposting of fruit wastes by *Eudrilus eugeniae* and *Eisenia foetida*"*. Applied ecology and environmental research.* 5(1), 2007 pp. 57-61.

[15] Sikora, L. J. and Stott, D. E. "Soil Orgnic Carbon and Nitrogen. In: Doran J.W.. Jones, A.J., editors". *Methods for assessing soil quality.* Madison, WI., 1996, pp.157-167

[16] Walkey, A. and Black, I.A. "An examination of the Degtjareff method for determining soil organic matter and prepared modification of the chronic acid titration method". *Soil Science,* 1934, 37(1), pp.29-38.

[17] Sadasivam,S. and Balasubramaniam, T. "Practical Manual in Bio-chemistry". TNAU, 1987, Coimbatore p 17.

[18] Gajalakshmi, S. and Abbasi, S. A. "Earthworms and vermicomposting". *Indian Journal of Biotechnology,* 3, October 2004, pp 486-494

[19] Chowdappa, P., Biddappa, C. C. and Sujatha, S. "Effective recycling of organic waste in arecanut (Areca catechu L.) and cocoa (Theombrome cacoa L.) plantation through vermicomposting"*, Indian J Agric Sci,* 69, 1999, pp. 563-566.

[20] Swati Pattnaik, S. and Reddy, M.V. "Nutrient Status of Vermicompost of Urban Green Waste Processed by Three Earthworm Species—Eisenia fetida, Eudrilus eugeniae, and Perionyx excavates", *Applied and Environmental Soil Science*, Vol. 2010,2010, Article ID 967526, 13 pages, http://dx.doi.org/10.1155/2010/967526

[21] Edwards, C. A. "The Use of Ear hworms in the Breakdown and Management of Organic Wastes".In: Edwards, C.A. (ed). *Earthworm Ecology.* St. Lucie Press, Boca Raton, 1998, pp. 327-354

[22] Rink, R. (Editor), Authors: Maarten van de Kamp, George B. Wilson, Mark E. Singley, Tom L. Richard, John J. Kolega, Francis R. Gouin, Lucien Laliberty, Jr., David Kay, D.W. Murphy, Harry A. J. Hoitink, W.F. Brinton. "On-Farm Composting Handbook". Natural Resource, Agriculture, and Engineering Service (NRAES-54), Ithaca, NY., 1992.

[23] Munroe, G. "Manual of On-Farm Vermicomposting and Vermiculture", Organic Agriculture Centre of Canada, pp. 01-56.