International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

# Pollution Control Through Biotic Interaction of Earthworm

**Jyoti**

Dept. of Zoology, Govt. P.G. Nehru College, Jhajjar, M. D. U. Rohtak

**ABSTRACT**
In view of the environmental problems generated by the large scale production of solid waste, increasing attention is now being paid to the recycling of solid waste as a good source of nutrients for increasing agricultural production. Earthworm participation enhances natural biodegradation and decomposition of solid waste from 60 to 80% thus significantly reducing the composting time by several weeks. This would not only provide a renewable, supplementary source of nutrients but also help overcome the pollution problem. The action of worms accelerated the decomposition of selected wastes. To reduce the cost of disposal of solid waste and best utilization, it was planned to convert the solid waste into a valuable vermicompost. In the present study, the decomposition of three waste cow dung, kitchen waste and agricultural waste was studied after 60 days at the interval of 15 days in laboratory conditions. The Indigenous species of earthworm Metaphire posthuma and Lampito mauritii produced significant changes in all the selected parameters like PH , organic matter, total nitrogen and phosphorus in the three type of waste.

**Keywords:** Biodegradation, Renewable, Pollution, Vermicompost, Indigenous, Parameter.

## INTRODUCTION
The generation of waste materials is increasing proportionately with the growth of human population and increasing pace of industrilisation. Earthworm with their marvellerus capability of ingestion, digestion and excretion are nature's most useful converters of wastes. Earthworms play major role in the biological treatment of waste through stabilization of organic waste into humus like substances, vermicompost. During vermicomposting various types of organic wastes are converted into vermicompost which is used for land restoration practices on one hand and on other hand it has been applied for the control of solid waste pollution that is a consequence of increasing population. Earthworms are elongated, cylindrical, segmented animals classified within the phylum Annelida and class oligochacta. There are more than 8,300 species of earthworm have been described in the world (Reynolds and Wetzel, 2010) and about 590 species are found in India (Julka et al., 2009).

## EFFICIENCY OF EARTHWORM IN VERMICOMPOSTING
Fernandez et al. (2010) studied the life cycle and reproductive traits of earthworm *Aporrectodea trapezoids* including incubation period, number for hatchlings, mortality rate, their features, viability and sexual and parthenogenenetic reproduction was observed in earthworms up to 490 days under controlled conditions. Cocoon morphology, cocoon development, hatching success and fecundity was studied for the selections of appropriate species for vermicomposting. The ability of single individual earthworms to

produce cocoons was also studied in eight earthworm species found in rubber plantation in Tripura and observed that *Pontoscolex corethrurus* (Muller) might be useful for waste land reclamation and to increase plant productivity. (Chaudhuri and Bhattacharjee, 2011).

## MATERIALS AND METHOD

***Collection of material***:

The nutrient medium was prepared by sun drying and grinding of the organic wastes. The grinded waste material was mixed with cattle dung and was subjected aerobic composting to initiate microbial activity for 10 days. During pre-composting process, the waste materials were decomposed aerobically by the active role of microorganisms.

**Physiochemical analysis**:

Waste samples were collected from the container by randomly mixing the waste and bedding soil. The sample dried at $110^0$C for 5 hours were passed through 2.0 mm sieve. During the composting process the material was analysed for different physiochemical parameter such as pH, organic matter, phosphorus as per standard methods (APHA, 2005), total nitrogen by Kjeldahl method (Jackson, 1973), potassium by flame photometric method (Simard, 1993). During the experiment the samples were examined at regular interval of 15 days up to 60 days vermicomposting.

## STATISTICAL ANALYSIS

Standard Deviation –

$$\delta = \sqrt{\frac{\Sigma y^2 - \left(\Sigma y^2\right)^2 / N}{(N-1)}}$$

Where $\delta$ = Standard deviation

$N$ = Number of observations

Standard Error - The standard error of the mean is a measure of the reliability.

SEM = $\frac{S}{\sqrt{N}}$ of the mean calculated from a set of observations.

**Three Way Analysis of Variance**

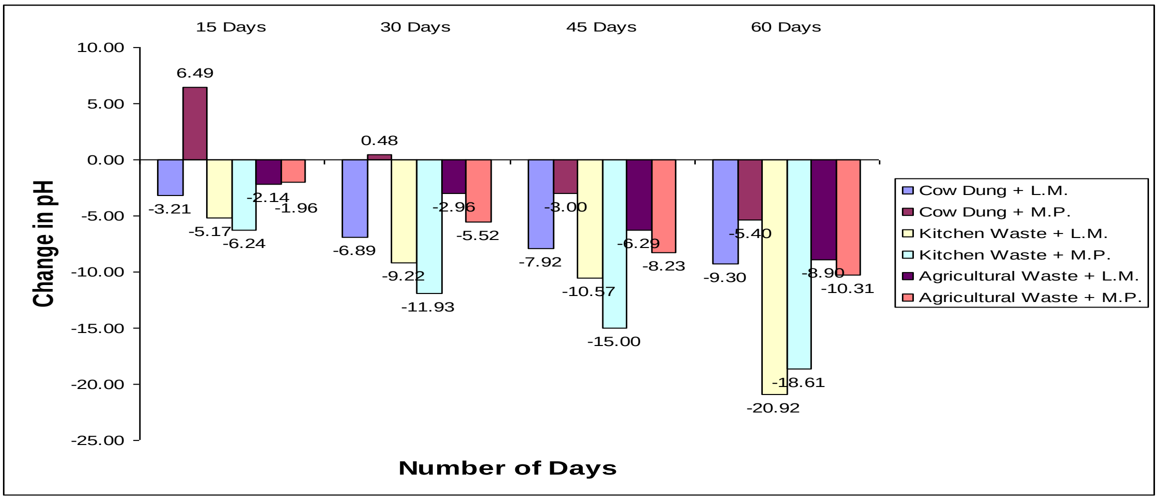
A three-way analysis of variance (ANOVA) test of significance was used to evaluate the level of significance of difference between the vermicomposts produced by three substrates (cow dung, kitchen waste and agriculture waste) and control samples with respects to nutrient parameters. The data were analysed on software package statistica, version 7.0 programmes.

nutrients for increasing agricultural production. Earthworm participation enhances natural biodegradation and decomposition of solid waste from 60 to 80% thus significantly reducing the composting time by several weeks. The action of worms accelerated the decomposition of selected wastes. To reduce the cost of disposal of solid waste and best utilization, it was planned to convert the solid waste into a valuable vermicompost.

**RESULTS AND DISCUSSION**

The variation of pH, organic matter, nitrogen and phosphorous in feed material was analysed for every 15 days. The physical and chemical parameters were changed in final vermicomposts with respect to initial feed substrate which revealed the potentiality of *Metaphire posthuma* and *Lampito mauritii* in bioconversion of organic solid waste into nutrient rich vermicompost. The pH value was slightly basic in all combination of initial feed mixtures tend to neutral in final vermicompost. Maximum alteration was observed in kitchen waste and minimum in cow dung with respect to initial pH values of the substrates after 60 days of vermicomposting. The decomposition of organic matter produces 'organic acids' that lower the pH of the vermicomposts.

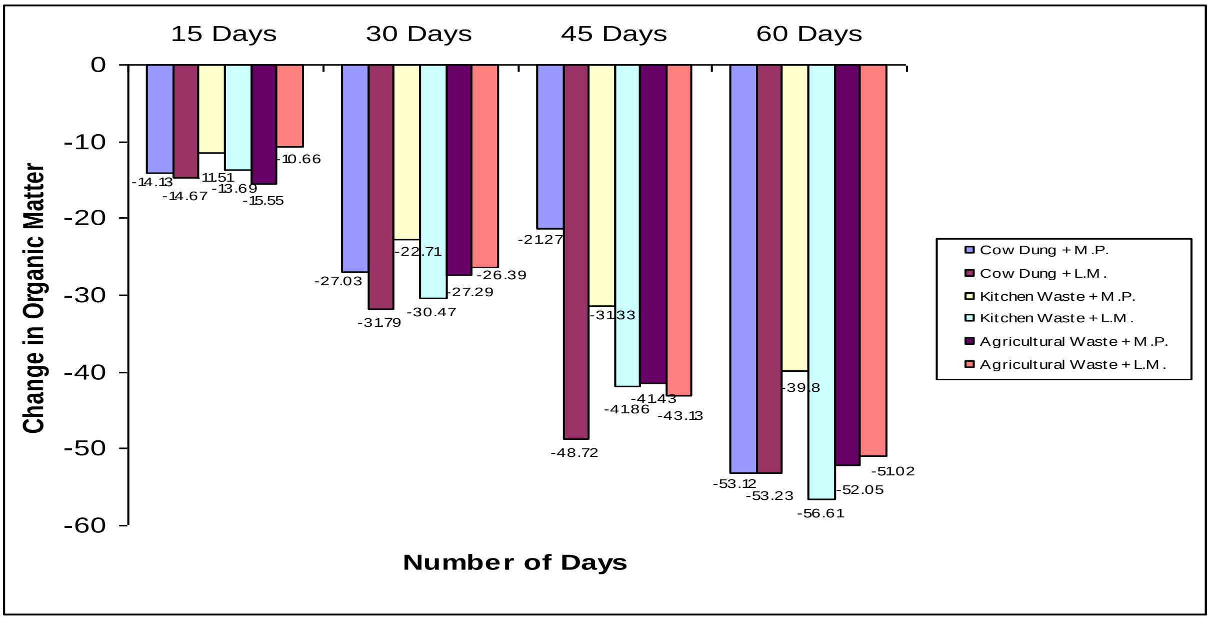
Fig. **1: Alteration in pH of Three Wastes Using *Lampito mauritii* and *Metaphire posthuma***




The decreases in pH in earthworm gut by microbial activity were observed by Nath et al. (2009). Several studies had revealed that the most species of earthworms prefer a pH of about 7.0 (Panday and Yadav, 2009). A decrease in pH was recorded in cow dung vermicomposting using *Eisenia fetida* and *Lampito mauritii* (Suthar, 2008a) and in kitchen wastes (Narayan, 2000). Elvira et al. (1998) have concluded that production of $CO_2$ and organic acids by microbial decomposition during vermicomposting lower the pH of substrates.

The nutrient status of vermicompost varies greatly depending upon the organic matter on which earthworms feed. Earthworms break and homogenize the ingested material through muscular action of their foregut. The total organic carbon is metabolized into carbon dioxide through respiratory activities of worms and microorganisms and mineralization of organic matter. Carbon evaporates in the form of carbon dioxide with the action of earthworms and microorganisms responsible for the loss of organic carbon from the organic wastes (Prakash and Karmegam, 2010).

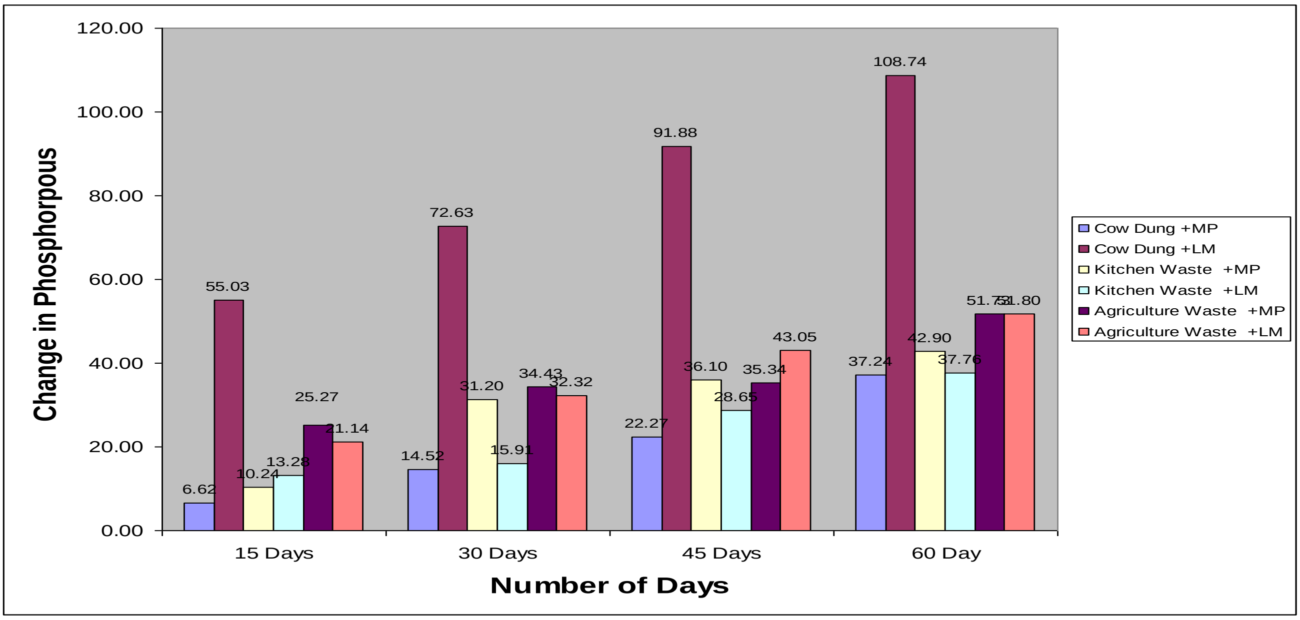
**Fig. 2: Alteration in Organic Matter of Three Wastes using *Lampito mauritii* and *Metaphire posthuma***




Jilani (2007) reported a decrease in organic carbon and organic matter from 33% to 23% and from 57% to 39.65% respectively, in windrow method of composting of municipal solid waste. The subsequent fall in carbon level was probably due to substrate mineralization, brought about by the metabolic activity of the growing earthworm biomass and associated mircoflora (Karmegam and Daniel, 2000).

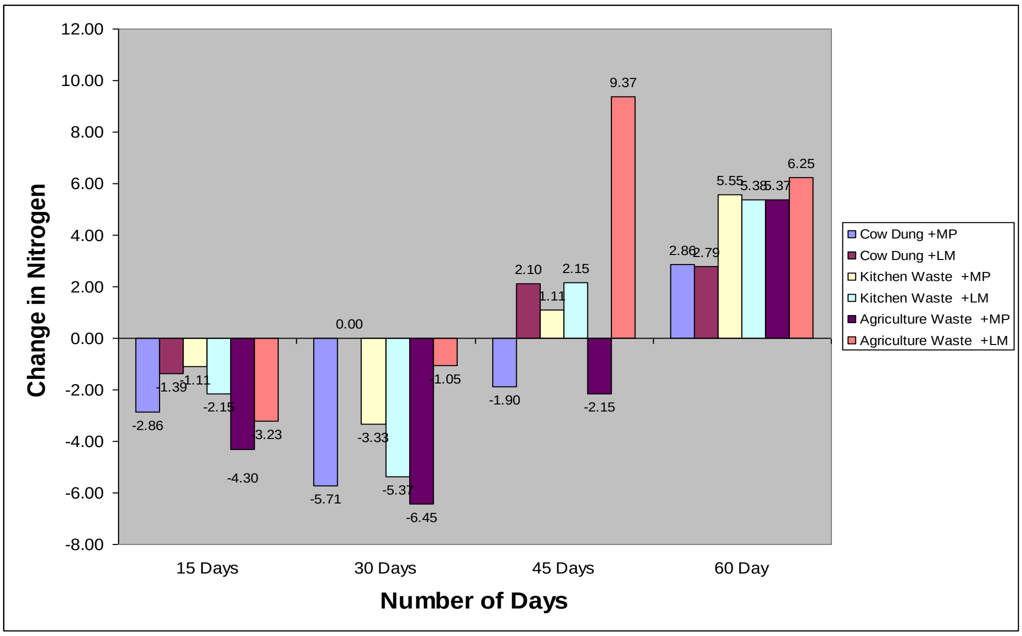
After vermicomposting, all vermibeds showed higher concentration of phosphorous than initial substrates. *Lampito mauritii* was found superior as compared to *Metaphire posthuma* in terms of phosphorous increment. The unavailable forms of phosphorous transformed into the easily available form for plants through the action of worms during vermicomposting (Ghosh et al., 1999). Release of available phosphorous content from feed material may be due to the earthworm gut enzyme phosphatases and P-solubilizing microorganism present in worm casts (Suthar and Singh, 2008). It is possible that break down of these organic compounds in vermicomposting enhanced the total phosphorous level. A significant increase of 0.81% to 42.2% total available phosphorous in final vermicompost have been reported by Chauhan and Singh (2012).

**Fig. 3: Alteration in Phosphorous of Three Wastes using *Lampito mauritii* and *Metaphire posthuma***




Nitrogen contents of the vermicomposts obtained from different substrates were significantly higher compared to their initial status in the substrates. Increase in nitrogen is due to the breakdown of the protein and some from nitrogen fixation by the microorganisms under favorable aerobic conditions. The concentration of carbon decrease in the form of carbon dioxide as from the starting phase of active composting due to bacterial respiration. The final fate of major part of nitrogen in a composting biomass is to get mineralized into nitrate and a little portion of it will be lost as ammonia gas during the rise of temperature.

**Fig. 4: Alteration in Nitrogen of Three Wastes using *Lampito mauritii* and *Metaphire posthuma***



The maximum highest significant Kjeldhal nitrogen in vermicompost of cow dung may be due to the mineralization of high organic matter containing protein which might be responsible for nitrogen addition in the form of micronutrients (Kaushik and Garg, 2003). Earthworms enhanced the nitrogen levels of the substrate during digestion in their gut adding their nitrogenous excretory products, mucus, body fluid and enzymes in vermicomposting process (Suthar, 2007).

The vermicompost prepared by both earthworm species showed a substantial difference in nitrogen content, which could be attributed directly to the species specific feeding preference of individual earthworm species and indirectly to mutualistic relationship between ingested microorganisms and intestinal mucus (Suthar and Singh, 2008).

As the carbon content of the vermicomposts was significantly decreased from initial status of the substrates and nitrogen content was significantly increased compared to initial level, so decrease in C: N ratio was observed.

## CONCLUSION

From the present study, It can be concluded that vermicomposting mediated by earthworms is an ecofriendly waste management technology and resulting in the bioconversion from waste to wealth. Changes in the chemical composition of the feeding substrates confirmed the role of earthworm activity in increasing soil fertility. It may supply an opportunity for employment where accumulation of food waste, paper, cardboard, agricultural waste, manures and bio solids are problematical, vermicomposting offer good potential to turn waste material into a valuable soil amendment. Composting by earthworm is proving to be environmentally preferred process over the normal microbial composting and much more over the landfills, as it is rapid and nearly odourless process, can reduce composting time significantly and there is no emission of green house gas methane. All-in-all, the vermicompost is believed to be very good organic fertilizer and soil conditioner.

## REFERENCES

1. APHA (2005). Standard method for examining water and wastewater. 21st eds., Washington, D.C.
2. Chaudhari, P.S. and Bhattacharjee, S. (2011). Reproduction biology of eight tropical earthworm species of rubber plantations in Tripura, India. *Tropical Ecology*. **52**(1): 49-60.
3. Chauhan, H.K. and Singh, K. (2012). Effects of binary combinations of buffalo, cow and goat with different agro wastes on reproduction and development of earthworm *Eisenia fetida* (Haplotoxida: Lumbricidae). *World Journal of Zoology*. **7**(1): 23-29.
4. Elvira, C., Sampedro, L., Benitez, E. and Nogales, R. (1998). Vermicomposting of sludges from paper mill and dairy industries with *Eisenia andrei*: A Pilot Scale Study. *Bioresour. Technol.* 63: 205–211.
5. Fernandez, R., Novo, M., Gutierrez, M., Almodovar, A. and Diazcosin, D. (2010). Life cycle and reproductive traits of the earthworm *Aporrectodea trapezoides* (Duges, 1828) in laboratory cultures. *Pedobiologia*. 53: 295 – 299.
6. Ghosh, M., Chattopadhya, G.N. and Baral, K. (1999). Transformation of phosphorus during vermicomposting. *Bioresource Technology*. 69: 149-154.

7. Jackson, M.L. (1973). *Soil chemical analysis*. 1st edition. Pranctice Hall of India, Private Limited, New Delhi, India,
8. Jilani, Seema (2007). Municipal solid waste composting and its assessment for reuse in plant production. *Pak. J. Bot.* 39(1): 271-277.
9. Julka, J.M., Paliwal, R. and Kathireswari, P. (2009). Biodiversity of Indian earthworms-an overview. In: *Proceedings of Indo-US workshop on vermitechnology in human welfare*. Edwards, C.A., Jayaraaj, R., Jayraaj, I.A. and Achagam, R. (eds.), Coimbatore, India. pp: 36–56.
10. Karmegam, N. and Daniel, T. (2000). Utilization of some weeds as substrates for vermicompost preparation using an epigeic earthworm, *Eudrilus eugeniae. Asian J. Microbial. Biotech. Env. Sc*. 2(1-2): 63-66.
11. Kaushik, P. and Garg, V.K. (2003). Vermicomposting of mixed solid textile mill sludge and cow dung with epigeic earthworm *Eisenia foetida*. *Bioresour. Technol*. 90: 311–316.
12. Nath, G., Singh, K. and Singh, D.K. (2009). Chemical analysis of vermicompost/vermiwash of different combinations of animal, agro and kitchen wastes. *Australian Journal of Basic and Applied Science*. 3: 3672-3676.
13. Narayan, J. (2000). Vermicomposting of biodegradable wastes collected from Kuvempu University campus using local and exotic species of earthworm. In: *Proceedings of a National Conference on Industry and Environment*, Karad, India. pp: 417-419.
14. Panday, S.N. and Yadav, A. (2009). Effect of vermicompost amended alluvial soil on growth and metabolic responses of rice (*Oryza sativa* L.) plants. *Journal of Eco-friendly Agriculture.* 4 (1): 35-37.
15. Prakash, M. and Karmegam, N. (2010). Vermistabilization of pressmud using *Perionyx ceylanensis* Mich. *Bioresour. Technol*. 101: 8464-8468.
16. Reynolds, J.W. and Wetzel, M.J. (2010). Nomenclatura Oligochaetologica. Supplementum Quartum. *A catalogue of names*, descriptions and type specimens of the oligochaeta. *Illinois Natural History Survey special Publication.* Chicago.
17. Simard, R.R. (1993). Ammonium acetate extractable elements. In: *Soil sampling and methods of analysis.* Martin, R., Carter, S. (eds), *Lewis* Publisher, Boca Raton, Florida, USA. pp: 39-43.
18. Suthar, S. (2008a). Microbial and decomposition efficiencies of monoculture and polyculture vermireactors based on epigic and anecic earthworms. *World Journal of Microbial Technology.* 24: 1471-1479.
19. Suthar, S. and Singh, S. (2008). Feasibility of vermicomposting in bio stabilization of sludge from a distillery industry. *Sci. Total Environ.* 394(2-3): 237-243.
20. Suthar, S. and Singh, S. (2008). Vermicomposting of domestic waste by using two epigeic earthworms (*Perionyx excavatus* and *Perionyx sansibaricus). International Journal of Environment Science and Technology*. 5(1): 99-106.
21. Suthar, S. (2007). Influence of different food sources on growth and reproduction performance of composting epigeic: *Eudrilus engeniae*, *Perionyx excavatos* and *Perionyx Sansibaricus*. *Applied Ecology and Environmental Research*. 5(2): 79-92.