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Vermicomposting OF Leaf Litter by *Lampito Mauritti* with a Note on its Physico-Chemical Features

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Abstract: The need to effectively deal with disposal of urban waste continues to be a challenge as population increases. The utilization of organic residuals reduces production costs and eliminates the need for landfill disposal. Vermicomposting is an appropriate alternative for the safe, hygienic and cost effective disposal of urban waste. Fruit and vegetable waste constitutes about 70,000 tonnes per annum which represents the significant amounts of Municipal Solid Wastes. The present investigation was aimed to analyse the various physicochemical parameters like pH, electrical conductivity, moisture content, organic carbon and C/N ratio in vermicomposting of leaf litter which are of importance in quick and efficient degradation of complex organic material into simple compounds during different intervals of time (15, 30 and 45 days) by *Lampito mauritti.* Vermicomposting of leaf litter by *Lampito mauritti* resulted in significant increase of pH, electrical conductivity, moisture content and organic carbon content as the composting time increases. The carbon nitrogen ratio resulted in significant decrease as the time period of composting increases.

Keywords: Leaf litter, vermicomposting, *Lampito mauritti*, organic carbon, carbon nitrogen ratio.

INTRODUCTION

Modernization and search for employment lead to the movement of people from rural areas to urban areas which results in the over crowd in the city. The disposal of city garbage in big metropolitan cities is a problem in the form of increasing costs, non-availability of land for compost making and labour requirement for composting operations which involve human contact with filthy and obnoxious materials[1]. The compost product obtained from the garbage is bulky and nutrient poor and not easy to market. As a result, this valuable waste is being utilized in an uneconomical and unhygienic manner. So appropriate disposal of waste is the most essential and beneficial from ecological and economic point of view [2].

Earthworms so far we called as 'farmer's friend can play a vital role in the present situation. Some species like *Lampito mauritti* play a significant role in decomposing organic matter and mineral cycling. Leaf litters represent a potential energy resource if they can be properly and biologically converted to organic matter. Vermicomposting is an easy and effective way to recycle leaf litter along with bioconvesion of organic waste materials into nutritious compost by earthworm activity. In this process worms help in transforming waste into high quality fertilizer.[3]

The action of earthworms in this process is both physical / mechanical and biochemical. The physical / mechanical processes include : substrate aeration, mixing, as well as actual grinding. The biochemical process is effected by microbial decomposition of the substrate in the intestines of the earthworms.[4]

Selection of earthworm species is very importance factor because only few species are able to survive and adjust to a particular type of environment. The epigeic earthworm *Lampito mauritti* can be cultured very well on leaf litters. This species is commonly used for breaking down organic matter and have a wide temperature tolerance and can live in organic wastes with a range of moisture content.[5] Hence, this species of earthworm was choosen for our study. The various physicochemical parameters like pH electrical conductivity, moisture content, organic carbon and carbon nitrogen ratio play a vital role in the decomposition of leaf litters during different time intervals of vermicomposting. Hence the present study was taken up to find out the levels of various physicochemical parameters like pH, electrical conductivity, moisture content, organic carbon and carbon nitrogen ratio during vermicomposting by *Lampito mauritti* at different time intervals.

MATERIALS AND METHODS

Collection and predecomposition of leaf litter

The leaf litters were collected from karunya university campus, Coimbatore, Tamilnadu. The collected leaf litters were chopped into small pieces and allowed to partial decomposition for 20 days. Then the waste was then mixed with cowdung in 3:1 ratio.

Collection and culturing of earthworm

The exotic earthworms *Lampito mauritti* were collected from Aarthi farm, Kondegoundampalayam village, Pollachi Taluk, Coimbatore, TamilNadu. The species were cultured at Karunya University Coimbatore, Tamilnadu

Vermicomposting of leaf litters

Pits of 0.75 x 0.75 x 0.75 m size were dug and floor of the pit was covered with a lattice of wood strips to provide drainage. Totally four pits were maintained for the experimental purposes The pit T_1 was maintained as control for leaf litter (without earthworm), T_2, T_3 and T_4 (with earthworm) were taken for composting of leaf litter. In each pit a total of 60 kgs of leaf litter was taken and in T_2, T_3 and T_4 pits the earthworm *Lampito mauritti* was released on the surface at the rate of 60 worms per square feet except control. Care was taken to avoid light, rainfall and natural enemies. In control as well as in experimental pits, the compost sample was taken on 15^{th}, 30^{th} and 45^{th} day respectively for the analysis of various physicochemical parameters like pH, electrical conductivity, moisture content, organic carbon and carbon nitrogen ratio.

The pH and electrical conductivity were measured by using pH meter and electrical conductivity meter. The pH and electrical conductivity present in the vermicompost was assayed by the method.[6] The organic carbon content was analysed titrimetrically by the method.[7] The moisture content was analysed according to the method.[8]

Statistical Analysis

Datas were anaysed by using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The various physicochemical parameters namely pH, electrical conductivity, moisture content, organic carbon and carbon nitrogen ratio play an important role in culturing and maintenance of healthy earthworm populations. These physicochemical parameters have to be monitored at different time intervals of vermicomposting for quick and efficient degradation of complex organic materials into simple substances. The various physico chemical parameters analysed in the vermicompost is given in Table 1 and Figure 1, Figure 2, Figure 3 and Figure 4.

pH

In leaf litter the level of pH was found to be increased gradually and reached the maximum on 45^{th} day of composting by *Lampito mauritti.* The level of pH was found to be significantly increased at 1% level on 15^{th} and 30^{th} day of composting of leaf litter by *Lampito mauritti.*

The leaf litters contain more quantities of citrus fruit peels which are acidic in nature and their pH value was also low before the inoculation of the earthworm. Further the pH was found to be increased towards neutral after the inoculation of the earthworm *Lampito mauritti*

Earthworms are sensitive to changes in pH and they prefer conditions of neutral reaction because earthworms thrive in environments rich in decaying organic matter. They are adapted to tolerate these pH fluctuations with little or no change in their activity levels. [9] Our results were in accordance with [10] who observed that pH values towards neutrality were maintained in the treatment inoculated with earthworms as compared to non-inoculated residues.

Earthworms find it difficult to survive if the pH falls below 6.0 and thus they migrate or are killed.

Table 1: Physico-chemical characteristics of leaf litters analysed during different time intervals of vermicomposting by Lampito mauritti

S.No.	Parameters	Control (without earhworm)	Decompostion time (days)		
			15	30	45
1.	pH	5.64	6.29*	6.32*	6.98^{NS}
2.	Electrical	6.66	6.92**	7.07^{NS}	7.09^{NS}
3.	conductivity	9.79	9.98^{NS}	9.99^{NS}	10.03^{NS}
4.	Moisture content	17.10	18.78*	19.08*	19.94*
5.	Organic carbon	12.10	10.56*	10.00*	9.78*
	Carbon nitrogen ratio				

Values are expressed as means of replicates- * P<0.01,** P<0.05

Figure 1

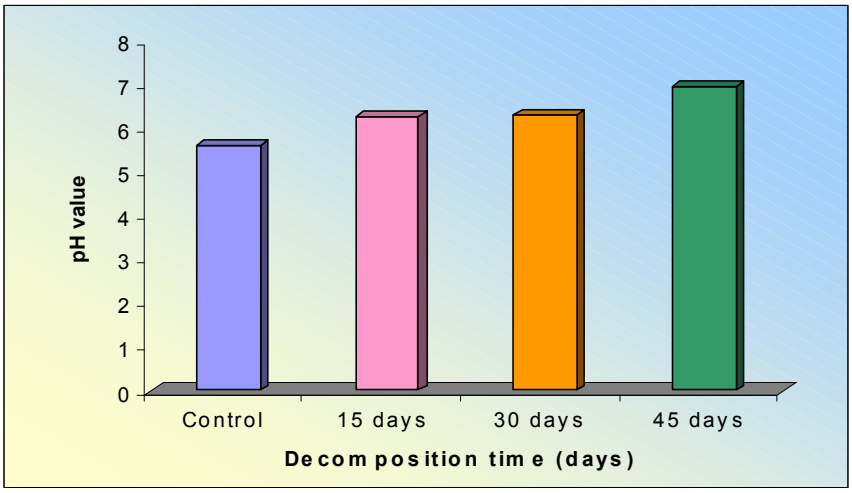


Figure 2

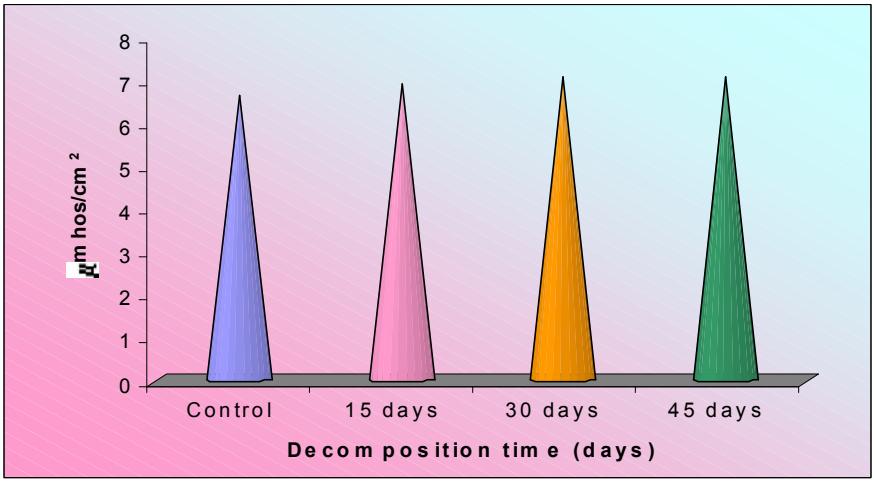


Figure 3

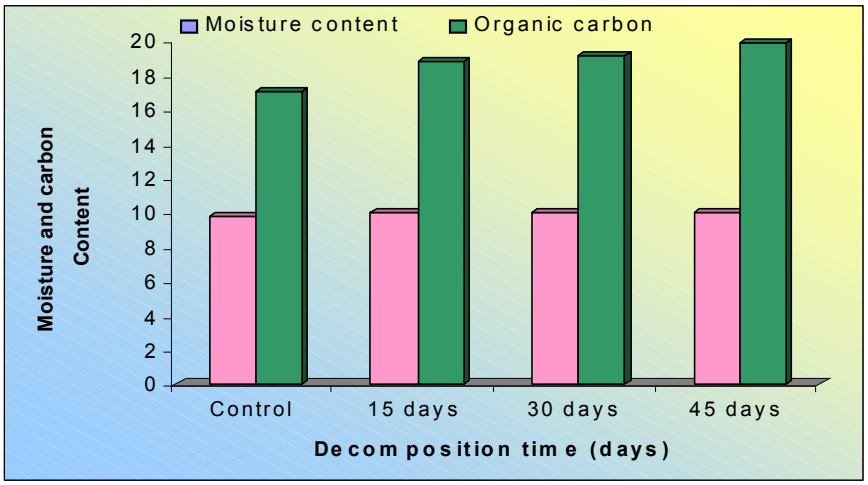
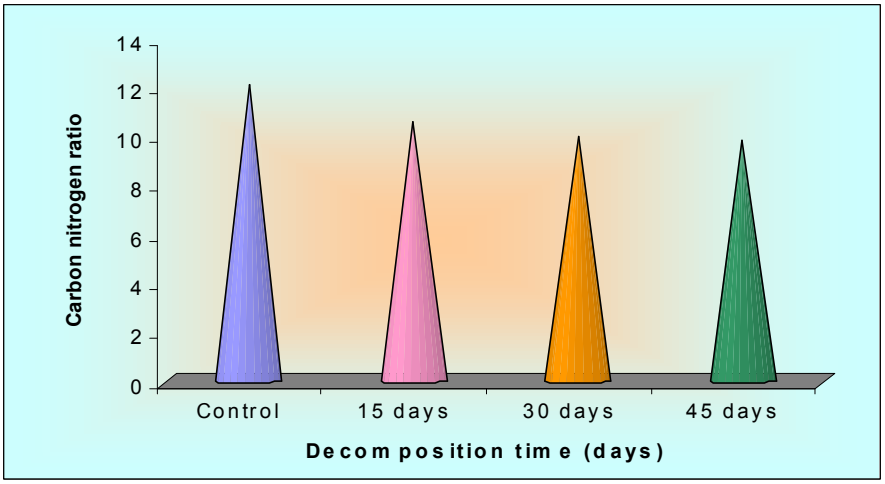


Figure 4



Electrical conductivity

The electrical conductivity of leaf litter was found to be significantly increased and reached the maximum on 45th day of composting by *Lampito mauritti.* The level of electrical conductivity was found to be significantly increased at 5% level on 15th day of composting by *Lampito mauritti.* Increase of electrical conductivity in the compost relative to that of control may be due to the freely available ions and minerals that got compounded during ingestion and defecation by the earthworms. Our results were similar to that of [11] who reported that the electrical conductivity was found to be increased in the vermicompost.

Moisture content

As shown in table 1 and figure 3, the level of moisture content in leaf litter was found to be maximum on 45th day of composting by *Lampito mauritti.* Moisture is critical to the survival of earthworm species because it is the moisture within worm's body that gives it shape, enables it to move and aids in the worm's ability to absorb oxygen.

Moisture levels have to be maintained at around 50% so that the microbial activity is high and the food matter is easy to feed upon. Excess water

leads to anaerobic conditions. Acidic conditions reduce productivity and cause migration.

The moisture content of leaf litter was found to be increased non significantly at 5% and 1% level on 15th, 30th and 45th day of composting by *Lampito mauritti.*

[12] reported the increase of moisture content of the casts is due to the addition of intestinal mucus and also because of the selective feeding of soil fractions enriched in organic compounds by the earthworms.

Organic carbon

The organic carbon content of leaf litter was found to be increased significantly and reached the maximum on 45th day of composting by *Lampito mauritti.* Organic carbon content was found to be increased significantly at 1% level on 15th, 30th and 45th day of composting by *Lampito mauritti.* The reason for increase of carbon content in the compost relative to that of control might be due to the selective feeding of the earthworm and secretion of mucus into the gastrointestinal tract by the earthworm.

Fig. 4

[13] reported that during composting, the organic carbon is lost as CO_2 and total nitrogen increases as a result of carbon loss.

[12] reported that the carbon contents of casts tend to be higher than in the surrounding soil, in part due to the addition of intestinal mucus, but also because earthworms may select soil fractions enriched in organic compounds.

Carbon nitrogen ratio

If the carbon nitrogen ratio is wider then the decomposition period increases and it takes time for the compost to be degraded efficiently and quickly. Hence after the inoculation of the earthworm *Lampito mauritti* the carbon nitrogen ratio becomes narrow and hence the compost is degraded quickly and efficiently.

There was a significant decrease in the carbon nitrogen ratio during composting of leaf litter by *Lampito mauritti* at different time intervals. Maximum carbon nitrogen ratio was observed on 15th day of composting by *Lampito mauritti.*

The carbon nitrogen ratio of leaf litter was found to be significantly decreased at 1% level on 15th, 30th and 45th day of composting by *Lampito mauritti* when compared to control. Combustion of carbon by the earthworms during respiration, production of mucus and nitrogen excrements, increases the levels of nitrogen and lowers the C/N ratio. This might be the reason for the decrease of C/N ratio in the compost relative to that of control.[14]

[4]suggested that for proper nutrition, carbon and nitrogen must be present in the substrate at the correct ratio. An appropriate C/N ratio is necessary for optimal earthworm digestion.

CONCLUSION

The present study was focussed to study the changes in various physicochemical parameters like pH, electrical conductivity, moisture content, organic carbon and carbon nitrogen ratio during the vermicomposting of leaf litter by *Lampito mauritti.* Our study, further confirmed *Lampito mauritti* was an efficient degrader of leaf litter. Analysis of various physico chemical parameters during composting by *Lampito mauritti* at different time intervals showed favourable changes in pH, electrical conductivity, moisture content, organic carbon and carbon nitrogen ratio which are proved to be an important criteria for monitoring the efficient and quick degradation of leaf litter into high quality organic manure, thus vermicomposting of leaf litter by *Lampito mauritti* holds promise to play a significant role both in cleaning the environment and building up of soil fertility for sustainable agriculture.

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