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Vermicomposting of municipal solid waste using indigenous earthworm *Lampito mauritii* (Kinberg)

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Abstract

The overpopulation exploration developed and developing countries have led to the production of large quantities of municipal solid waste (MSW). The waste generated is consequently discharge into the atmosphere. In India enormous quantities of disposable organic wastes materials like MSW rich in nutrients were presented. Though macro nutrients (Nitrogen (N), Phosphorus (P) and Potassium (K), and micro nutrients are available more in MSW, it is not properly recycled (or) decomposed (or) bio-composting (vermicomposting). Raw MSW cannot be eaten directly by earthworms due to its offensive odour, heavy metals, water leachate *etc*. So the organic wastes such as dairy farm waste - cowdung and a sugar industrial waste - pressmud with soil high nutritive content were mixed in equal proportion and used as bedding material (BM).The experimental media were prepared on dry weight basis by mixing the MSW + BM in the following percentage: T_1 – 20% BM + 80% MSW, T_2 – 40% BM + 60% MSW, T_3 – 60% BM + 40% MSW, T_4 – 80% BM + 20% MSW, controls (BM alone) were also maintained separately. To observe the changes in pH, electrical conductivity (EC), organic carbon (OC) and macro nutrients (N, P, K) and carbon: nitrogen (C:N) ratio in the initial substrate and vermicomposts of earthworm from the above mentioned media at the intervals of 0, 15, 30, 45 and 60th day.The alteration of pH near neutral was observed in the vermicomposts of T_4 it might be due to higher acid production by vermicomposts. Higher EC values were achieved in the vermicomposts of T_4 it could be due to the higher mineralization by salts. The chemical analysis of vermicompost showed significant increase in the level of macro nutrients over worm unworked compost (initial) mixture. Among the different experimental proportions T_4 showed significant increase in the level of macro nutrients. Reduced content of organic carbon was observed in all the treatments but most reduction was found in T_4.The drastic reduction in C:N ratio were found in the vermicomposts. The large quantities of degradable organic waste available in municipalities and road sides can be vermicomposted along with any organic additives to convert into the valuable organic manure. In addition to this, it may be recommended that the vermicompost from MSW is utilized for sustainable organic agriculture.

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Introduction

In India, the generation of large volumes of municipal solid waste (MSW) are dumped into the nearby surroundings and this account per capita is estimated to increase at a rate of 1 - 33% annually (Shekdar, 1999). In such conditions, the total waste quantity generated in 2047 would be approximately more than five times of present level. Moreover, 40 - 60% solid wastes are of organic nature and open dumping of such garbage not only facilitates the breeding for disease vectors, e.g., flies, mosquitoes, cockroaches, rats, other pests and offensive odour *etc*. But at the same time also creates the issue of environmental pollution. Municipal wastes all are organic wastes is a mixed waste from residential, commercial, institutional and industrial sources. Municipal solid waste has a comfortable potential of 60 - 90%. It is typical composition includes paper, glass, wood, plastics, reusable goods, soil, chemicals, food waste, plant debris, textiles and rock with organic materials making up 50-70% of all municipal solid waste (Hemalatha, 2013). Ecological impacts such as land degradation, water and air pollution are related with improper management of municipal solid waste (Khajuria *et al.,* 2008). Vermicomposts are reported to have higher and more soluble level of major nutrients – nitrogen, phosphorus, potassium, calcium, and magnesium (Reddy and Okhura, 2004). Vermicomposting is a suitable way due to its high degree of macro nutrients (Narkhede *et al.,* 2010) as N, P and K to recycle the bio-organic waste which is found largest content in municipal solid waste. Long term application of inorganic fertilizers like high doses of ammonium sulphate and sulphur coated urea has led to soil acidification (Ma *et al.*, 1990), decrease in soil aggregate stability (Esterez *et al.*, 1996), pollution of underground water and decrease in earthworm population (Edwards and Bohlen, 1996) and decrease in soil respiration (Sharma, 2003).

Few studies are available on total MSW, management through vermicomposting. They are confined only along with cowdung. *i.e.,* MSW + CD using *L. mauritii* and *E. fetida* (Kaviraj and Sharma, 2003); MSW + horticultural waste (Sing and Sharma, 2003); market waste + cowdung (Karthikeyan *et al.*, 2007) and MSW + cowdung using *P. ceylanensis* (John Paul *et al.*, 2011). Hence the present attempt was made to vermicompost the MSW using the indigenous worm *L. mauritii* for a period of 60 days along with bedding material made with pressmud and cowdung to evaluate the quantity of N, P, K and observe the changes in pH, EC,OC and C:N ratio of the substrate (MSW) before and after vermicomposting.

Materials and methods

Lampito mauritii were collected from the agricultural fields in Vaiyur, nearby village to Annamalai University, Tamilnadu, India. The worms were stocked in cement tank and cow dung was used as substrate to maintain the earthworms. Moisture content of 60 - 70% was continuously maintained by sprinkling the water. This stock culture was covered with moisture gunny bag and maintained at room temperature (27± 2^{o}C) inside the animal house, Department of Zoology, Annamalai University, India.

Collection of organic wastes

MSW was collected from Sethiathope town Panchayat, Cuddalore District, Tamil Nadu. After removing the plastics, polythene, metal scraps and glass pieces MSW was dried and brought by using jute bags to the laboratory. Urine and straw free cowdung (CD) was collected from dairy yard at the Faculty of Agriculture, Annamalai University. It was sun dried, powdered and stored in jute bags. The pressmud was collected from M.R.K Co-operative Sugar Mill, Sethiathope. The collected pressmud was cured for a month to remove the odour. Then it was used for the preparation of Bedding Material (BM).

According to Tognetti *et al.* (2005) MSW that had been subjected to thermophilic pre-composting (15 – 30 days) prior to vermicomposting showed significantly higher levels of total nitrogen and total phosphorus. The cow dung and one month old cured pressmud was used for the preparation of bedding material and they were equally mixed on dry weight basis and kept as such for 15 days and used for the preparation of substrate for vermiculture.

Preparation of different experimental media – with Bedding Material (BM) and Municipal Solid Waste (MSW)

Combinations of bedding material (BM) and municipal solid waste (MSW) in four proportions were prepared in the following orders *i.e.* C_1 - BM alone (Control) 500g CD + 500g PM + 200g soil; 1. T_1 - 20% + 80% (BM + MSW) 200g BM + 800g MSW + 200g soil; 2. T_2 - 40% + 60% (BM + MSW) 400g BM + 600g MSW + 200g soil; 3. T_3 - 60% + 40% (BM + MSW) 600g BM +400g MSW+ 200g soil; 4. T_4 - 80% + 20% (BM + MSW) 800g BM + 200g MSW+ 200g soil mixed W/W. After the preparation of substrates in the above different proportions, water was sprinkled and kept as such for thermophilic composting for 15 days.

Inoculation of earthworms

After the completion of thermophilic composting fifteen grams of sexually mature, clitellate *L. mauritii* (approx. 65 days) were introduced in plastic troughs separately; containing 1 Kg substrate + 200 g of soil. Bedding material alone was used as control, separately used for C_1. Six replications in each experimental treatment have been maintained for 60 days.

Collection of vermicomposts samples for analysis

Samples were collected from all initial substrates (0-day) and vermicomposts on 15, 30, 45 and 60th days. Then the samples were air dried, sieved and stored in polythene bags for analysis.

Physico – Chemical analysis of vermicomposts samples

Analysis of physico – chemical parameters of pH and EC were determined by the method described by ISI Bulletin (1982). The organic carbon was determined by the empirical method followed by Walkely and Black (1934). The total nitrogen (N%), Total phosphorus (P%), Total Potassium (K%) content of the sample was estimated, by Kjeldahl method as per Tandon (1993), Colorimetric method was used for phosphorus estimation and flame photometric method was used for potassium. C:N ratio was calculated by dividing the percentage of carbon estimated for the manure sample with the percentage of nitrogen estimated for the same manure sample.

Statistical analysis

The data on various chemical characteristics of samples were computed and mean values with standard deviation (S.D). The statistical significance between treatments was analyzed by using two - way analysis of variance (ANOVA).

Results and discussion

The pH, EC, OC, N, P, K, C:N ratio and macronutrients in different MSW + BM mixtures, worm unworked initial (0 - day) compost and worm worked vermicompost of *L. mauritii* at different time intervals (15, 30, 45 and 60th days) are represented in the Tables 1 - 7.

Table 1. Variations in the pH of vermicomposts from MSW made by *L. mauritii* ($p<0.05$).

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	0 (Initial)	15	30	45	60
C_1	7.40±0.060	7.34±0.070	7.28±0.050	7.16±0.052	7.11±0.060 (–3.92)
T_1	7.89±0.052	7.83±0.072	7.76±0.042	7.71±0.051	7.64±0.070 (–3.17)
T_2	7.70±0.064	7.68±0.063	7.52±0.041	7.49±0.039	7.42±0.054 (–3.64)
T_3	7.53±0.063	7.5±0.052	7.44±0.048	7.24±0.047	7.25±0.055 (–3.72)
T_4	7.47±0.041	7.27±0.051	7.22±0.043	7.18±0.039	7.09±0.067 (–5.09)

C_1 – Control (BM alone), T_1– (20% BM + 80% MSW), T_2 – (40% BM + 60% MSW), T_3 – (60% BM + 40% MSW), T_4 – (80% BM + 20% MSW), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (+/–) – Percent change of increase or decrease over the initial.

Physical parameters

pH

The pH in the vermicomposts was reduced in all the mixtures (T_1 – T_4) and in controls (C_1) from initial day to 60th day and they are presented in Table - 1. Among the vermicomposts made by the T_4 was found to have maximum reduction in pH (*i.e.* - 5.09 the percent change over initial) followed by C_1 (- 3.92%), T_3 (- 3.72%), T_2 (- 3.64%) and minimum in T_1 (- 3.17%) on 60th day.

Table 2. Electrical Conductivity (dS/m) of the vermicomposts from MSW made by *L. mauritii* (p<0.05).

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	0 (Initial)	15	30	45	60
C_1	1.98±0.123	1.99±0.121	2.27±0.091	2.49±0.092	2.85±0.091 (43.94)
T_1	1.79±0.097	1.83±0.134	2.19±0.112	2.26±0.087	2.41±0.111 (34.64)
T_2	1.82±0.125	1.88±0.147	2.21±0.089	2.38±0.080	2.47±0.086 (35.71)
T_3	1.89±0.101	1.96±0.012	2.24±0.141	2.54±0.075	2.65±0.083 (40.21)
T_4	1.91±0.087	1.98±0.081	2.28±0.171	2.67±0.072	2.86±0.095 (49.74)

C_1 – Control (BM alone), T_1 – (20% BM + 80% MSW), T_2 – (40% BM + 60% MSW), T_3 – (60% BM + 40% MSW), T_4 – (80% BM + 20% MSW), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (+/–) – Percent change of increase or decrease over the initial.

The overall decrease of pH from the initial near alkaline towards slightly acidic conditions might be due to the decomposition of organic substrates by microbial activity resulting in the production of CO_2 and other intermediate species of organic acids in vermicompost (Elvira *et al.*, 1998). John Paul *et al.* (2011) reported, decrease in pH in all the substrates (different ratios of MSW + CD) after vermicomposting. They observed highest reduction in pH in the substrate which had higher percentage of CD with MSW as observed in our study. In the present study though the reduction in the pH was observed in the vermicomposts of *L. mauritii* earthworm. Highest reduction towards neutrality was observed in the vermicomposts of *L. mauritii* could be due to species – specific difference in their mineralization efficiency as suggested by Suthar and Singh (2008a).

Table 3. Organic carbon (%) level in the vermicomposts from MSW made by *L. mauritii* (p<0.05).

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	0 (Initial)	15	30	45	60
C_1	36.14±1.21	34.84±1.31	30.28±1.33	26.14±1.04	22.23±1.19 (–38.49)
T_1	38.37±1.16	37.63±1.45	34.56±1.24	30.89±1.14	27.47±1.27 (–28.41)
T_2	37.28±1.36	35.68±1.37	33.31±1.57	30.74±1.07	28.01±1.36 (–24.87)
T_3	36.22±1.44	34.81±1.29	30.74±1.28	27.42±1.41	24.94±1.49 (–31.14)
T_4	35.81±1.41	31.97±1.19	26.76±1.38	22.38±1.17	20.14±1.27 (–43.76)

C_1 – Control (BM alone), T_1 – (20% BM + 80% MSW), T_2 – (40% BM + 60% MSW), T_3 – (60% BM + 40% MSW), T_4 – (80% BM + 20% MSW), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (+/–) – Percent change of increase or decrease over the initial.

Electrical Conductivity (EC)

The EC values were increased over initial in control and in all treatments (vermicomposts of earthworm) and they are presented in Table - 2. The observed EC vales in the vermicomposts on initial (0)day were, 1.98 in C_1, 1.79 in T_1, 1.82 in T_2, 1.89 in T_3 and 1.91 in T_4. Finally the highest percentage change in EC values of vermicomposts observed in T_4 (49.74%), it was followed by C_1 (43.94%), T_3 (40.21%), T_2 (35.71%) and T_1 (34.64%) over the initial on 60th day. Wong *et al.* (1997) reported that a gradual increase in EC was observed with increase in decomposition time and it might due to the loss of weight of organic matter and release of different mineral salts in available forms (such as phosphate, ammonium and potassium). Jayakumar *et al.* (2009) observed increased EC in the vermicompost than worm unworked compost and during vermicomposting process, the soluble salt level increases due to the mineralization activity of earthworms and microorganisms in the organic substance and as well in the gut of earthworms. In the present observation, the EC level gradually increased from the initial substrates to worm worked vermicompost in all experimental ratios and control. Our work was supported by the studies of Rajasekar and Karmegam (2009); Karthikeyan *et al.* (2007) who observed the increased EC in the vermicomposts of market waste and MSW respectively.

Table 4. Nitrogen (%) level in the vermicomposts from MSW made by *L. mauritii* ($p<0.05$).

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	0 (Initial)	15	30	45	60
C_1	2.14±0.095	2.39±0.099	2.73±0.117	3.04±0.094	3.27±0.120 (52.80)
T_1	1.92±0.105	2.07±0.113	2.35±0.119	2.57±0.093	2.74±0.121 (42.70)
T_2	1.97±0.091	2.18±0.114	2.47±0.099	2.61±0.110	2.82±0.090 (43.14)
T_3	1.99±0.112	2.20±0.095	2.51±0.098	2.77±0.114	2.87±0.095 (44.22)
T_4	2.11±0.114	2.31±0.094	2.74±0.095	3.18±0.119	3.30±0.097 (56.40)

C_1– Control (BM alone), T_1 – (20% BM + 80% MSW), T_2 – (40% BM + 60% MSW), T_3 – (60% BM + 40% MSW), T_4 – (80% BM + 20% MSW), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (+/–) – Percent change of increase or decrease over the initial.

Table 5. Phosphorous (%) level in the vermicomposts from MSW made by *L. mauritii* ($p<0.05$).

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	0 (Initial)	15	30	45	60
C_1	1.35±0.051	1.41±0.039	1.54±0.053	1.62±0.051	1.70±0.057 (25.93)
T_1	1.29±0.052	1.36±0.052	1.44±0.054	1.50±0.053	1.54±0.051 (19.38)
T_2	1.30±0.049	1.38±0.055	1.47±0.051	1.52±0.054	1.58±0.052 (21.54)
T_3	1.32±0.047	1.40±0.041	1.51±0.045	1.57±0.047	1.63±0.049 (23.48)
T_4	1.33±0.053	1.43±0.045	1.53±0.046	1.62±0.040	1.74±0.039 (30.82)

C_1 – Control (BM alone), T_1 – (20% BM + 80% MSW), T_2 – (40% BM + 60% MSW), T_3 – (60% BM + 40% MSW), T_4 – (80% BM + 20% MSW), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (+/–) – Percent change of increase or decrease over the initial.

Organic Carbon (OC %)

The OC content of vermicompost and controls are presented in Table - 3. The OC content present in the substrate of C_1, T_1, T_2, T_3 and T_4 on initial day was 36.14, 38.37, 37.28, 36.22 and 35.81 respectively. The OC content gradually reduced (from 0 – 60th day). The minimum OC content was found in the veremicomposts of T_4 treatment whereas the maximum OC was observed in T_2. On the contrary the highest reduction in OC was observed in T_4 and lowest reduction in OC content was observed in T_2. The reduction in carbon in the worm worked substrates was higher than in the worm unworked substrates and it was due to the respiratory activity of earthworms and microorganisms (Suthar, 2007d). The percentages of organic carbon in the present investigation was reduced day - by - day while that of nitrogen was increased in the worm introduced substrates and this observation indicates that the process of composting was complete and the vermicomposts was ready for harvest. The present results are similar with previous findings of Kaviraj and Sharma (2003) in MSW + CD; Karthikeyan *et al.* (2007) in market waste + CD who observed the highest OC reduction in worm worked vermicompost over the initial substrates. In the present study, vermicomposts of the treatments vary in their OC content and this may be due to the differential feeding efficiency of the earthworms.

Table 6. Potassium (%) level in the vermicomposts from MSW made by *L. mauritii* ($p<0.05$).

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	0 (Initial)	15	30	45	60
C_1	0.66±0.025	0.74±0.027	0.86±0.034	1.03±0.019	1.10±0.037 (66.67)
T_1	0.78±0.027	0.91±0.036	1.10±0.039	1.16±0.022	1.23±0.041 (57.69)
T_2	0.75±0.036	0.84±0.031	1.09±0.034	1.14±0.023	1.21±0.036 (61.33)
T_3	0.73±0.025	0.81±0.034	1.08±0.036	1.13±0.036	1.20±0.027 (64.38)
T_4	0.71±0.036	0.81±0.029	1.05±0.021	1.11±0.027	1.19±0.022 (67.61)

C_1 – Control (BM alone), T_1 – (20% BM + 80% MSW), T_2 – (40% BM + 60% MSW), T_3 – (60% BM + 40% MSW), T_4 – (80% BM + 20% MSW), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (+/–) – Percent change of increase or decrease over the initial.

Macronutrients

The quantity of macronutrients increased in the composts of earthworm from 0 day to 60th day. The changes observed in N, P, K content out of various treatments are presented in Tables - 4 to 6.

Nitrogen (N %)

The content of total nitrogen on 0, 15, 30, 45 and 60th day vermicomposts of various mixtures are presented in Table - 4. Among the vermicomposts of *L. mauritii*, T_4 showed higher content of N (3.30 ± 0.097). The efficiency of different treatments was found to be ranked in the following order on the basis of percent change over the initial - T_4 (56.40%) > C_1 (52.80%) > T_3 (44.22%) > T_2 (43.14%) and T_1 (42.70%). The gradually increased content of N, P, K was observed in the vermicomposts obtained from all the experiments and control. Particularly vermicompost of T_4 by *L. mauritii* have been shown to posses higher N,P,K over the initial substrates where the effective decomposition of MSW was carried out by the combined action of earthworms and microbes as suggested by Garg *et al.* (2006). Zularisam *et al.* (2010) have reported that earthworms play a crucial role in enhancing and improving the nitrogen profile of the waste by the addition of mucus, nitrogenous casts and by facilitating microbial mediated nitrogen mineralization. Increased levels of N, P, K in the vermicomposts are in conformity the results of earlier worker (Review: Pandit *et al.*, 2011).

Phosphorus (P %)

The quantity of P present in the vermicomposts made by *L. mauritii* on 0, 15th, 30th, 45th and 60th day of earthworm are presented in Table - 5. The level of P content increased gradually in control and in all treatments. The maximum content of phosphorus was observed in T_4 (1.74), it was followed by C_1 (1.170), T_3 (1.63), T_2 (1.58) and T_1 (1.54) on 60th day in the vermicomposts of *L. mauritii.*

Increased phosphorus content in the vermicomposts is due to the mineralization and mobilization of phosphorus by bacterial and faecal phosphotase activity of earthworm (Krishnamoorthy, 1990). Ananthakrishnasamy *et al.* (2009) reported higher amount of phosphorous in vermicomposted flyash. Vermicomposting of MSW in the present study proved to be an efficient technology for providing better P quantity is in accordance with the result of Karthikeyan *et al.* (2007), Padmavathiamma *et al.* (2008), John Paul *et al.* (2011) who have made the vermicompost from market waste and MSW. Highest content of phosphorous was observed in T_4 - 80% + 20% (BM + MSW). This may be due to the difference in palatability and food preference of earthworms as suggested by Sarojini (2011).

Table 7. C:N ratio in the vermicomposts from MSW made by *L. mauritii* and ($p<0.05$).

Substrate Proportions	*L. mauritii*				
	Vermicomposting Days				
	0 (Initial)	15	30	45	60
C_1	16.89±0.95	14.58±0.96	11.09±1.17	8.60±0.95	6.79±0.98 (−59.77)
T_1	19.98±0.93	18.18±0.85	14.11±1.11	12.02±1.17	10.03±0.99 (−49.81)
T_2	18.92±1.12	16.37±0.89	13.49±1.10	11.78±1.12	9.93±1.16 (−47.52)
T_3	18.2±1.25	15.82±0.94	12.25±0.95	9.91±0.83	8.69±1.12 (−52.30)
T_4	16.97±1.10	13.45±0.94	9.77±0.89	7.04±0.93	6.10±0.99 (−64.10)

C_1 – Control (BM alone), T_1 – (20% BM + 80% MSW), T_2 – (40% BM + 60% MSW), T_3– (60% BM + 40% MSW), T_4– (80% BM + 20% MSW), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (+/–) – Percent change of increase or decrease over the initial.

Potassium (K %)

The quantities of potassium present in the vermicomposts made by *L. mauritii* are presented in Table- 6. The content of potassium increased in all observations from the initial value. The quantity of K on the initial day was 0.66, 0.78, 0.75 36, 0.73 and 0.71 in C_1, T_1, T_2, T_3 and T_4 respectively. The content of K on 60th day vermicomposts of *L. mauritii* are 1.10, 1.23, 1.21, 1.20 and 1.19 respectively in C_1, T_1, T_2, T_3 and T_4.

Solubilization of inorganic potassium in organic wastes by microorganisms through acid production was claimed by Premuzic *et al.* (1998). The previous study indicated enhanced potassium content in vermicompost by the end of the experiment (Manna *et al.*, 2003). Kaviraj and Sharma (2003) revealed 10% increase of total potassium by *E. fetida,* 5% by *L. mauritii* during vermicomposting of MSW and suggested that it was due to the influence of micro-flora. They added that acid production during organic waste decomposting by microorganisms solubilise the insoluble P and K and also the presence of microorganisms in the gut of earthworm play a major role in enhancing P and K level in the vermicomposts. The important acids in phosphorus solubilisation are carbonic, nitric and sulphuric. Suthar (2007c) suggested that earthworm processed waste material contains high concentration of exchangeable K, due to enhanced microbial activity during the vermicomposting process, which consequently enhanced the rate of mineralization.

C:N ratio

Vermicomposts obtained from all treatments show decline in the C:N ratio. The results are presented in Table - 7. In the vermicomposts of *L. mauritii,* maximum reduction in C:N was observed in T_4 (*i.e.* –64.10%), secondly in C_1 (−59.77%) and they were followed by T_3 (−52.30%), T_2 (−47.52%) and T_1 (−49.81%) on 60th day over the initial. From the beginning of the experiment there was a reduction in C:N ratio in the worm worked vermicomposts of all treatments and control. The highest reduction in the content of C:N ratio were observed in T_4 by *L. mauritii* reflected the efficient worm activity, leading to accelerated rate of decomposition and mineralization, thereby resulting in high grade, nutrient rich, good quality compost Vermicomposts all the samples from 0 day to 60th day showed better reduction in C:N ratio.

The loss of carbon as carbon dioxide through microbial respiration and simultaneous addition of nitrogen by worms in the form of mucus and nitrogenous excretory material lowered the C:N ratio of the substrate (Suthar, 2007a). The vermicompost of earthworm the highest mineralization on N, P, K are found in the vermicomposts of *L. mauritii.* Same way highest reduction pH, more EC and lower content of C were observed in the vermicompost of *L. mauritii.* That indicates that the vermicompost made by *L. mauritii* shows its superior quality. This is also supported by the lower C:N ratio.

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Conclusion

Our observations with the earthworm *L. mauritii* was found suitable for the vermicomposting of bedding materials (pressmud and cowdung) and municipal solid waste mixed with different proportions particularly (*i.e.*) T_4 - 80% + 20% (BM + MSW) 800g BM + 200g MSW mixed dry weight basis. In these treatment T_4 ratio worm worked composts (vermicomposts) is highest amount of nutrients content (pH, EC, OC, N, P, K and C:N ratio) were presented. The unutilized enormously available municipal solid waste (MSW) can be vermicomposted along with any organic additives convert into the valuable organic manure. In addition to this, it may be recommended that the vermicomposts from MSW can be utilized for organic farming.

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