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Evaluation on physico-chemical characteristics in vermicompost of sawdust with different animal manure

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ABSTRACT

The present work was carried out to evaluate the vermicompost of Sawdust with three different animal manures. Sawdust and animal manures such as cow manure, goat manure and poultry manure were collected and mixed separately with 1:2 ratio. The different substrate mixers were subjected to pre-decomposition for 21d. The pre-decomposed sawdust materials were taken in plastic troughs and introduced with microbial consortium (T1-b, T2-b and T3-b) and with adult clitellate earthworms Eudrilus eugeniae (T1-c, T2-c and T3-c) and combination with microbial consortium and earthworms, E. eugeniae (T1-d, T2-d and T3-d) of in various treatments and maintained control for all three animal manures (T1-a, T2-a and T3-a). The various physico-chemical parameters such as organic carbon, N, P, K, and C: N and C/P ratios were analysed at every 15 d interval up to 60 d.

Key words: Sawdust, composting, microbial consortium, earthworms, *Eudrilus eugineae.*

INTRODUCTION

Sawdust is a main organic waste in sawmill. It has a variety of practical uses including as mulch, an alternative to clay cat litter, a fuel, or for the manufacture of particle board. Sawdust may collect in piles and add harmful leachates into local water systems, creating an environmental hazard [1]. Composting has received increasing interest as a method for handling various types of animal manures. It is viewed as a viable means of producing environmentally friendly humus-like material, and an important way of protecting ground and surface waters from excessive loading of litter nutrients. Sawdust has been used over the years as a platform in poultry houses and mixed with dirt and chicken manure for composting [2, 3]. The C: N ratio has also been shown to be an important factor for minimizing nitrogen loss during the composting of poultry manure [4,5,6], yard trimmings [7] and cattle manure [8]. Vermicomposting is a non-thermophilic biological oxidation process in which organic material are converted into vermicompost which is a peat like material, exhibiting high porosity, aeration, drainage, water holding capacity and rich microbial activities [9,10,11], through the interactions between earthworms and associated microbes. The analysis of physico-chemical changes in vermicompost of sawdust with different animal manures is the main focus of the present study.

MATERIALS AND METHODS

Collection, processing and pre-decomposition of sawdust

The organic substrate, sawdust used in composting studies was collected from open dumping yard near Periyakulam, Theni District, Tamil Nadu, India. While the other organic substrates such as Cow dung, Goat manure and Poultry manure were collected from the private animal farm, Perumal kovil patti village, Theni District. All the substrate were immediately transported to the laboratory and used for vermicomposting. The sawdust sample was mixed separately with three different animal manures such as cowdung, goat manure and poultry manure in the ratio of 1:2. The different substrate mixers were filled in cement tanks and subjected to pre-decomposition for 21d [12,13]. Regular mixing, turning and sprinkling water were also done during pre-decomposition [14,15].

Composting of sawdust using microbial consortium and earthworms

Plastic troughs of 45cm x 35cm x 15cm size were filled with pre-decomposed sawdust with various organic manure such as cow dung, goat manure and poultry manure[16,17]. The microbial consortium (50 ml / kg substrate with 10^8cell per ml) and adult clitellate *E. eugeniae* (10 worms / kg substrate) were used for composting in various treatments. The troughs without microbial consortium and earthworms were served as control (T1-a, T2-a and T3-a). The moisture content of the vermibed was maintained at 60 to 80 percent and the substrate was turned once in a week and the experimental setups were maintained in a controlled environment for 60 d. Three replicates were maintained for each treatment. The composted substrates were removed from all the treatments and stored for further study.

Physico-chemical analysis in compost

The composted substrates were analyzed for various physicochemical parameters such as organic carbon, total nitrogen, total phosphorus, total potassium, C/N ratio and C/P ratio at the regular interval of every 15 days from 0d to 60d using standard procedures.

RESULTS AND DISCUSSION

The results of analysis of Organic carbon (OC), nitrogen (N), phosphorus (P) and potassium (K), C/N ratio and C/P ratio in composted materials of various treatments and in the control in different intervals (0, 15, 30, 45 and 60d) are given in Tables 1 to 8 and Figures 1 and 2. Two way ANOVA results showed that there was a significant difference in the physico-chemical characteristics such as of Organic carbon, nitrogen, phosphorus, potassium, C/N ratio and C/P ratios in the composted substrates of various treatments than the control. The physic-chemical analysis of the vermicompost produced in the present study showed a reduction in organic carbon level during composting in the various treatments. Thisresult are in agreement with the finding of [18], where they reported that the reduction in carbon content of sawdust when subjected to microbial degradation. The continuous decline in total organic carbon during the composting of sawdust with cattle manure [19].

Table 1: Changes of Organic Carbon content in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

Treatments	Organic carbon (%)				
	0d	15d	30d	45d	60d
T1- a	54.07±0.18	52.39±0.83	47.13±0.40	41.39±0.88	38.15±0.32
T1- b	54.07±0.18	50.77±0.73	46.74±0.23	39.62±0.46	33.00±1.00
T1- c	54.07±0.18	49.41±0.42	44.04±0.34	36.00±1.06	29.09±0.81
T1- d	54.07±0.18	47.10±0.51	41.83±0.48	31.09±0.67	25.14±0.29
T2- a	57.33±0.10	55.24±0.92	49.50±0.78	43.12±0.71	36.55±0.40
T2- b	57.33±0.10	53.17±0.25	47.10±0.93	40.22±0.36	34.68±0.87
T2- c	57.33±0.10	50.98±0.87	44.21±0.26	38.37±0.80	29.10±0.44
T2- d	57.33±0.10	48.80±0.64	42.00±1.00	32.18±0.84	27.09±0.91
T3- a	59.10±0.21	56.08±0.35	50.48±0.55	45.64±0.58	38.15±0.44
T3- b	59.10±0.21	54.72±0.67	48.13±0.62	40.56±0.38	35.66±0.52
T3- c	59.10±0.21	50.00±1.00	45.80±0.22	39.98±0.81	29.19±0.20
T3- d	59.10±0.21	49.55±0.95	43.24±0.31	34.29±0.77	28.35±0.61

Values are mean of three replicates ± standard error

Table 2: Two-way ANOVA showing the changes of Organic Carbon content in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

Source	SS	Df	MS	F	P	Significant level
Between the days	4723.73	4.00	1180.93	294.27	P<0.001	***
Between the treatments	487.34	11.00	44.30	11.04		
Error	176.58	44.00	4.01		P<0.001	***
Total	5387.64	59.00				

Table 3: Changes of Nitrogen content in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

Treatments	Nitrogen (%)				
	0d	15d	30d	45d	60d
T1- a	1.04±0.02	1.10±0.04	1.18±0.10	1.29±0.02	1.36±0.13
T1- b	1.04±0.02	1.15±0.01	1.22±0.07	1.33±0.01	1.42±0.10
T1- c	1.04±0.02	1.18±0.08	1.27±0.09	1.36±0.04	1.46±0.09
T1- d	1.04±0.02	1.21±0.06	1.30±0.04	1.41±0.05	1.53±0.07
T2- a	1.02±0.04	1.07±0.01	1.15±0.02	1.27±0.14	1.34±0.04
T2- b	1.02±0.04	1.12±0.05	1.20±0.06	1.31±0.08	1.40±0.05
T2- c	1.02±0.04	1.16±0.07	1.24±0.11	1.34±0.10	1.43±0.15
T2- d	1.02±0.04	1.19±0.03	1.28±0.02	1.39±0.02	1.50±0.08
T3- a	0.98±0.01	1.05±0.08	1.12±0.01	1.24±0.03	1.31±0.07
T3- b	0.98±0.01	1.09±0.05	1.17±0.09	1.29±0.05	1.36±0.10
T3- c	0.98±0.01	1.14±0.02	1.22±0.14	1.32±0.02	1.39±0.18
T3- d	0.98±0.01	1.17±0.06	1.26±0.12	1.36±0.16	1.47±0.13

Values are mean of three replicates ± standard error

Table 4: Two-way ANOVA showing the changes of Nitrogen content in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

Source	SS	Df	MS	F	P	Significant level
Between the days	1.18433	4	0.29608	489.88	P<0.001	***
Between the treatments	0.11877	11	0.0108	17.87	P<0.001	***
Error	0.02659	44	0.0006			
Total	1.32969	59				

Table 5: Changes of Phosphorous content in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

Treatments	Phosphorous (%)				
	0d	15d	30d	45d	60d
T1-a	0.73±0.03	0.79±0.01	0.85±0.06	0.92±0.04	1.06±0.11
T1-b	0.73±0.03	0.82±0.05	0.91±0.02	0.99±0.07	1.10±0.13
T1-c	0.73±0.03	0.86±0.02	0.95±0.04	1.05±0.01	1.16±0.09
T1-d	0.73±0.03	0.89±0.01	1.00±0.08	1.09±0.10	1.20±0.06
T2-a	0.69±0.05	0.76±0.02	0.81±0.01	0.89±0.06	1.02±0.08
T2-b	0.69±0.05	0.80±0.06	0.87±0.02	0.96±0.01	1.07±0.02
T2-c	0.69±0.05	0.84±0.04	0.92±0.02	1.06±0.08	1.11±0.03
T2-d	0.69±0.05	0.87±0.03	0.98±0.07	1.07±0.02	1.15±0.04
T3-a	0.65±0.02	0.72±0.01	0.78±0.05	0.86±0.07	1.00±0.09
T3-b	0.65±0.02	0.78±0.01	0.85±0.04	0.94±0.01	1.05±0.03
T3-c	0.65±0.02	0.81±0.05	0.90±0.09	1.00±0.03	1.08±0.01
T3-d	0.65±0.02	0.85±0.07	0.94±0.03	1.04±0.05	1.13±0.02

Values are mean of three replicates ± standard error

Table 6: Two-way ANOVA showing the changes of Phosphorous content in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

Source	SS	df	MS	F	P	Significant level
Between the days	1.16168	4	0.29042	345.71	P<0.001	***
Between the treatments	0.15298	11	0.01391	16.55	P<0.001	***
Error	0.03696	44	0.00084			
Total	1.35162	59				

Table 7: Changes of Potassium content in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

Treatments	Potassium (%)				
	0d	15d	30d	45d	60d
T1-a	0.84±0.01	0.89±0.02	1.04±0.05	1.11±0.10	1.17±0.09
T1-b	0.84±0.01	0.92±0.01	1.07±0.02	1.16±0.05	1.21±0.12
T1-c	0.84±0.01	0.96±0.05	1.13±0.03	1.20±0.04	1.26±0.09
T1-d	0.84±0.01	0.99±0.04	1.19±0.08	1.24±0.01	1.32±0.15
T2-a	0.81±0.03	0.87±0.06	1.00±0.03	1.08±0.02	1.15±0.13
T2-b	0.81±0.03	0.89±0.02	1.05±0.03	1.12±0.04	1.19±0.07
T2-c	0.81±0.03	0.92±0.01	1.10±0.02	1.18±0.06	1.23±0.02
T2-d	0.81±0.03	0.97±0.03	1.17±0.04	1.21±0.01	1.29±0.05
T3-a	0.80±0.02	0.85±0.05	0.97±0.08	1.05±0.05	1.11±0.10
T3-b	0.80±0.02	0.88±0.01	1.02±0.03	1.09±0.10	1.16±0.06
T3-c	0.80±0.02	0.90±0.01	1.08±0.05	1.14±0.02	1.20±0.04
T3-d	0.80±0.02	0.94±0.03	1.12±0.01	1.19±0.11	1.25±0.03

Values are mean of three replicates ± standard error

Table 8: Two-way ANOVA Table showing the changes of Potassium content in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

Source	SS	Df	MS	F	P	Significant level
Between the days	1.29369	4	0.32342	487.57	P<0.001	***
Between the treatments	0.12294	11	0.01118	16.85	P<0.001	***
Error	0.02919	44	0.00066			
Total	1.44582	59				

The percentage decrease of C/N and C/P ratios in different composts prepared from sawdust with three different animal manures in various treatments using microbial consortium and *E. eugeniae* are given in Figures 1 and 2 respectively. The C/N and C/P ratios were significantly decreased in all the treatments except control. The best C/N (16.43) and C/P (20.95) ratios were recorded in the treatment consists of sawdust + cowdung (1:2 ratio) + microbial consortium + *E.eugeniae* (Figures 1 and 2). The ideal C/N ratio of the raw materials for composting is generally considered to be around 30:1[20]. The compost materials were prepared based on C/N ratio through mixing sewage sludge**,** cattle manure and saw dust in five different proportions (R1, C/N 15; R2, C/N 20; R3, C/N 25; R4, C/N 30 and R5, control). They observed that the trial R4 with C/N ratio 30 using sewage sludge along with cattle manure and saw dust produced the best compost, showed higher loss in Total Organic Carbon (TOC), higher gain in total nitrogen and phosphorus, implying the total amount of biodegradable organic material is stabilized [21].

Fig 1: Changes of C/N ratio in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)

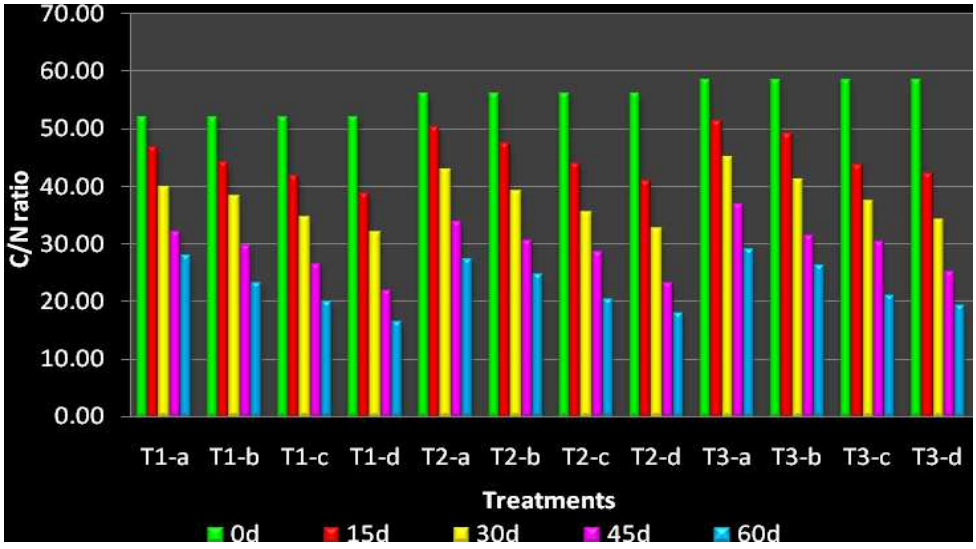
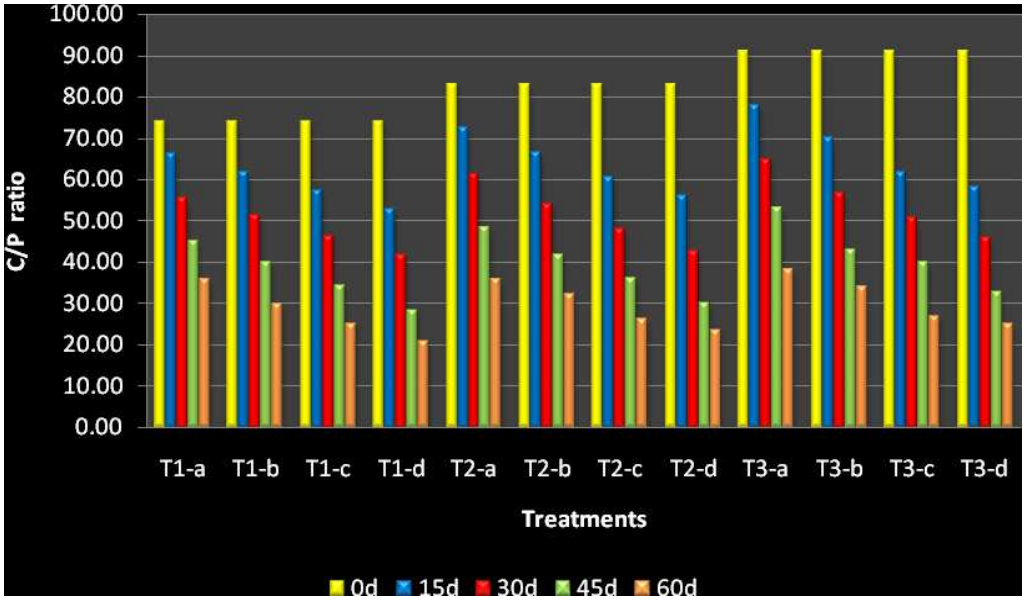


Fig.2: Changes of C/P ratio in composts prepared from sawdust with different animal manures in various treatments at different intervals (0 to 60d)



CONCLUSION

This study reveals that the vermicompost prepared from sawdust waste materials with different animal manures such as cowdung, goat manure and poultry manure using microbial consortium and earthworm, *E.eugeniae* has rich of NPK with lesser content of organic carbon. The vermicompost thus prepared in the study could be used as nutrient rich organic manure for sustainable agriculture practices in rural India**.**

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