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BIOMANAGEMENT OF DISTILLERY SOLID WASTE USING EARTHWORM *EUDRILUS EUGENIAE*

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ABSTRACT

The feasibility of vermicomposting technology to stabilize the distillery industry sludge mixed with a bulking agent (cow dung) in different proportions viz. 60:40, 70:30 and 80:20 were tested using earthworm *Eudrilus eugeniae* for 45 days. The vermitreated sludge was evaluated for different physicochemical parameters and all vermibeds expressed a significant increase in pH, total nitrogen, total potassium, total phosphorus, total calcium and total magnesium. The total organic carbon and electrical conductivity and C/N ratio decreased significantly. The distillery sludge is used with appropriate bulking material for earthworm feed. The feasibility of earthworms to enhance the nutrient profile in sludge might be useful in sustainable agricultural fields.

INTRODUCTION

In a developing country like India distillery industries have become a major source of pollution, as 88% raw materials are converted into wastes and discharged into the water bodies, causing water pollution. The waste water from distillery carry appreciable organic load, the spent wash Brown in colored, highly acidic with very offensive odour, which pose serious environmental problems (Gosh *et al.* 2003). India where a lot of solid organic waste is available in different sectors with no death of manpower the environmentally acceptable vermicomposting technology using earthworms *Eudrilus eugeniae* can very well be adopted for converting waste into wealth. Considerable work has been carried out on vermicompost of various organic materials and it has been established that epigeic forms of earthworms can hasten the composting process to a better quality of composts as compared with those prepared through traditional methods. The viability of using earthworms as a treatment or management technique for numerous organic wastes has been investigated by a number of workers (Hand *et al*. 1988; Logsdon, 1994; Madan *et al.* 1988; Singh and Sharma, 2002). Similarly a number of industrial wastes have been vermicomposted and turned into nutrient rich manure (Sundarvadivel, 1995). Hand *et al*. (1988) defined vermicomposting as a low cost technology system for the processing or treatment of organic wastes. During this process the important plant nutrients such as nitrogen, potassium, phosphorus, total organic carbon, calcium, magnesium

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present in the feed materials are converted through microbial action into forms that are much more soluble and available to the plant (Ndegwa and Thompson, 2001). The investigations have established the viability of using earthworm *E. eugeniae*, as a treatment technique for numerous waste distillery sludge and cow dung producing organic fertilizer. Vermicomposting results in the bioconversion of the waste into two useful products such as earthworm biomass and vermicompost. The former can be used as a protein source whereas the vermicompost is considered as excellent manure.

MATERIALS AND METHODS

The earthworms *Eudrilus eugeniae* were collected from one of the earthworm unit at Nasiyanur in Erode. The Distillery waste was collected from a sugar factory associated with a distillery in Erode. The cow dung was collected from cattle shed at near study area in Erode. Vermicompost beds were prepared using wooden box (80 x 40 x 25cm) containing distillery sludge with cow dung in different ratios. (60:40, 70:30 and 80:20 ratio) respectively with 3 replicates for 45 days. Twenty five numbers of earthworms were introduced into each tray. The bedding was kept moisturized (65% to 80%) throughout the experiment by regular watering. The parameters such as pH, electrical conductivity, C:N ratio, total organic carbon, total nitrogen, total phosphorus, total potassium, total calcium and total magnesium were analyzed.

Statistical analysis

Tow-way analysis of variance (ANOVA) was computed using SPSS (Version No.10). Statistical significance was set at <0.05.

RESULTS

The pH was analysed in a mixer which was distillery waste and cow dung in three different proportions. Thereafter the earthworms were introduced into the mixer and allowed to remain mixed and wet for about 45 days. The pH was analysed at different time intervals (at 0, 15, 30 and 45 Days). The pH of the vermicompost showed a significant (0.000) and gradual increase from 0 day to 45 days (Table 1). The Electrical Conductivity of the vermicompost showed a gradual decrease in different time intervals, when vermicompost allowed to take place for a longer time (Table 1). Statistical analysis revealed that the decrease was significant (0.000). The Total Organic Carbon was gradually reduced after its initial analysis at 0 day (Table 1). The reduction in organic carbon was statistically significant (0.0002). Regarding the higher Total Nitrogen content, was observed after 0 day (Table 2). The accumulation of nitrogen during the period was significant (0.000). The analysis of the content of total P showed significant (0.000) increase which is directly proportional to the increasing time (Table 2). The total K content significantly (0.001) increased due to the accumulation of potassium after 0 day (Table 2). In the present study C/N ratio was 14.27 to 20.5% and this indicated that the vermicompost was superior in qualities (Table 3). Statistically significant results were obtained. A steady increase in the total Ca and total Mg was noted in the waste mix after 0 day (Table 3). The increase in Ca was significant (0.0001) whereas Mg increase was significant (0.003).

DISCUSSION

The reason for the increased pH might be the buffering action of the humus which was produced as a result of vermicomposting process (Allison, 1973). The electrical conductivity gradually decreased in vermicompost. This situation might be due to the utilization of available soluble salts at the beginning, utilized by growing population of microorganisms for the synthesis of microbial biomass (Talashilkar, 1986). The total organic carbon significantly decreased in vermicompost. Similar results were reported by Kumar and Singh (2001). According to them, due to the increased microbial activity, the available organic carbon, utilized for the oxidation processes in the vermicompost. The higher total nitrogen content was recorded in the vermicompost. The reason for this increase came from the study of Mathur *et al.* (1986). They stated that the vermicompost conserves the nitrogen content by causing a decrease in the number of denitrifying bacteria and stimulating the growth of nitrogen fixing microflora. The significantly total phosphorous was increased in all the combinations. This may be due to the addition of phosphate in the vermicompost by phosphobacteria (Kumar and Singh, 2001). The higher level of total potassium was regarded in vermicompost. The reason for more effective humification of the earthworms left in the waste mix. The results of the present study is consistent with the previous study done by Sathisha (2000). The C/N ratio was significantly decreased in all combinations of

Table 1. Vermicomposting of pH, Electrical conductivity (dsm^{-1}) and Total Organic Carbon (%)

Days	pH			EC(dsm^{-1})			TOC%		
	60:40	70:30	80:20	60:40	70:30	80:20	60:40	70:30	80:20
0 day	6.1±0.02	5.9±0.01	5.7±0.01	0.67±0.01	0.679±0.01	0.685±0.02	40±1	42±0.76	43.5±1
15 days	6.9±0.07	6.75±0.11	6.42±0.2	0.552±0.02	0.564±0.03	0.566±0.02	38.5±0.75	39.5±1.5	41.5±1.5
30 days	7.1±0.1	7.04±0.08	6.92±0.1	0.411±0.02	0.426±0.02	0.427±0.01	34.5±1.5	35.01±1	38.5±1
45 days	7.14±0.2	7.23±0.1	7.17±0.1	0.382±0.01	0.388±0.01	0.391±0.02	32.25±1.2	36±1	38.25±1.25

Table 2. Vermicomposting of Total Nitrogen (%) Total Phosphorous (%) and Total Potassium (%)

Days	TN%			TP%			TK%		
	60:40	70:30	80:20	60:40	70:30	80:20	60:40	70:30	80:20
0 day	1.7±0.2	1.5±0.13	1.2±0.1	0.9±0.02	0.8±0.01	0.6±0.01	1.41±0.1	1.66±0.1	1.82±0.13
15 days	2.1±0.1	1.74±0.1	1.6±0.4	1.2±0.01	1±0.01	0.9±0.01	1.65±0.1	1.99±0.1	1.9±0.15
30 days	2.43±0.07	2.23±0.1	1.9±0.1	1.4±0.01	1.2±0.01	1.03±0.01	1.8±0.1	1.96±0.1	2.0±0.1
45 days	2.64±0.06	2.4±0.1	2.26±0.1	1.8±0.02	1.65±0.01	1.35±0.05	2.2±0.1	2.1±0.1	2.41±0.1

Table 3. Vermicomposting of C:N ratio,Total Calcium (%) and Total Magnesium (%)

Days	C:N			TCa%			TMg%		
	60:40	70:30	80:20	60:40	70:30	80:20	60:40	70:30	80:20
0 day	21.5±0.9	24.85±1.2	29.39±0.85	1.31±0.14	1.27±0.09	0.96±0.13	0.96±0.05	1.0±0.15	1.06±0.12
15 days	18.33±0.4	22.7±1.8	25.93±1	1.4±0.07	1.26±0.08	1.05±0.16	1.26±0.08	1.07±0.01	1.08±0.01
30 days	14.19±1.2	16.59±0.7	20.57±0.9	1.45±0.11	1.41±0.12	1.25±0.12	1.3±0.05	1.1 ±0.15	1.11±0.12
45 days	12.27±1.1	15.10±1.1	16.92±0.9	1.72±0.11	1.66±0.01	1.47±0.08	1.4±0.06	1.26±0.01	1.16 ±0.01

vermicompost. C/N is considered to be one of the simple indices to evaluate compost maturity (Barve, 1993). Generally the C/N ratio of the vermicompost ranged from 11 to 20%. The total calcium and total magnesium increase might be due to the loss of organic carbon and reduction of total mass of the vermicompost materials during the composting process (Anand, 1998).

CONCLUSION

The concluded vermicomposting earthworms appeared to modify the degrading activity of the waste. This was reflected by the lower electrical conductivity, total organic carbon and carbon nitrogen ratio as well as by a more gradual release of total nitrogen, total phosphorous, total potassium, total calcium and total magnesium, which made the vermicomposts more suitable substrates for agriculture purpose.

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