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Composting of leaf litter by traditional and modern bio-enhancers

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ABSTRACT

In the current scenario, solid waste generation is a common problem faced by most of the countries. Solid waste can be divided into organic and inorganic waste. Organic waste is a valuable raw material for producing nutrient-rich compost. Leaf litter is a potential organic waste which can be efficiently recycled by composting. Composting reduces the quantity of waste in a profitable way and minimises the problem of its disposal. In the present study, two composts were prepared using leaf litter and were analysed for physicochemical analysis to find out which compost is the best for agricultural purposes. Three groups taken for the study were Amrut Mitti containing leaf litter, cow dung, cow urine, jaggery, farm soil, tender and mature leaves; Culture Compost containing leaf litter, cow dung, cultures of bacteria and yeast; for control, farm soil was used. The results showed alkaline pH in Amrut Mitti and the control and acidic in Culture Compost. Electrical conductivity, available phosphorus and potassium were highest in Amrut Mitti and least in the control whereas moisture content, organic carbon, total nitrogen were maximum in Culture Compost and minimum in control.
Keywords: organic waste, leaf litter, composting, Amrut Mitti

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INTRODUCTION

Waste is an inevitable derivative of human activities. The quantity and complexity of solid waste produced is growing through economic growth, urbanisation and improved living standards in cities. If waste accumulates, it contributes to urban decay, puts stress on natural resources and leads to different health problems [1, 2]. India produces from two hundred grams to six hundred grams per person waste per day. Per year municipal solid waste is approximately 62 million tonnes whereas just 43 million tonnes is gathered while the remaining is left untreated [3].

One of the most significant intimidations for humans at present is the disposal of various organic wastes. Besides flower, food, fruits organic waste also include large amount of tree leaves, garden and farm waste. Leaves are potential sources of essential nutrients that include organic matter of high quality that should be returned to the soil. Twice as many minerals as manure are present in the leaves of most trees [4].

Leaf litter (dry leaves) is very seldom used for composting, and in Indian cities, towns and villages. It is mostly stacked up and burned to keep the areas clean. Burning vast amounts of leaf litter leads to air pollution and causes many health issues such as respiratory and heart diseases. Leaf litter can be efficiently utilized through composting which is one of the most promising methods to handle waste in a more economical way.

Composting has been used for many years as a method of recycling organic matter back into the soil to enhance soil structure and fertility. Composting is a natural process that transforms organic material into a dark rich product called compost. This substance is a wonderful soil conditioner [5]. In the present study, *Amrut Mitti* was prepared using leaf litter, traditional bio enhancers i.e. cow dung, cow urine, jaggery and Culture Compost was prepared using leaf litter, modern bio enhancers i.e. cultures of bacteria and yeast in powder form. Both the composts and control (farm soil) were analysed for physicochemical parameters to find out the most cost effective and agriculturally sustainable compost.

MATERIAL AND METHODS

The experiment was conducted in a plot near Krishna Vihar, Aligarh from March to July, 2017. Eight kg mixed leaf litter was collected from Sukhrawali village and PAC campus, Aligarh. The leaf litter was weighed, crushed by hands and was then used for the preparation of two different composts.

Preparation of different composts

Group 1- Control (Farm soil)
Group 2- *Amrut Mitti*
Group 3- Culture Compost

Rectangular beds were prepared for both the composts using bricks; tin shed with holes was used for covering the beds. For preparation of *Amrut Mitti*, firstly *Amrut Jal* was prepared which was a mixture of cow dung, cow urine, jaggery and water. *Amrut jal* was used for maintaining moisture and increasing microbial activity during the preparation of *Amrut Mitti*.

Amrut Jal

In a bucket, 10 litres water was mixed with 1 litre cow urine, 1 kg fresh cow dung and 50 gm jaggery. The solution was kept in shade for 3 days and covered with gunny bag. The solution was stirred 2 to 3 times every day in clockwise and anti clockwise direction and on each occasion it was stirred 12 times each in both the direction. On the fourth day the concentrated solution was ready. The solution prepared was diluted in 1:10 ratio with water.

Amrut Mitti

4 kg dry leaves were crushed and soaked in *Amrut Jal* in a plastic drum for 24 hours. The soaked dry leaves were spread in the rectangular bed then a thin layer of top soil collected from farm was spread over it. The same procedure was repeated and layers of leaf litter and top soil were spread alternatively until the heap reached over a height of 1 ft. The layers were pressed downwards by walking over it. *Amrut Jal* was sprinkled over the heap to maintain the moisture and microbial activity. The mixture was mulched with plant biomass. Then it was allowed to compost for 30 days. The heap of compost was mixed on every seventh day and was sprinkled with *Amrut Jal* whenever required. After 30 days the heap was composted. Varieties of seeds were collected on the basis of different tastes such as sweet, sour, pungent, astringent, salty and bitter. The seeds were soaked in *Amrut Jal* for 8 hours before sowing them on the composted heap. The heap was mulched with dry biomass and *Amrut Jal* was sprinkled occasionally for enhanced microbial activity and maintaining 63rd day, the entire plant was pruned and half inch of the stem was left without disturbing the roots. The cuttings were dried for 3-4 days and then they were crushed and immersed in *Amrut Jal* for 8 hours. The soaked cuttings were mixed into the heap and the heap was left for composting for 30 days, covered the heap with dried biomass. The heap was shuffled after every 7th day and *Amrut Jal* was sprinkled, whenever required to moisten the heap. After 30 days, *Amrut Mitti* was ready and mulched the moisture. The same process was followed for 21 days after the seeds were sprouted. Then the seedlings were pruned upto 25% and were spread over the heap. Second pruning was done after 42nd day upto 25% and matured plants collected were spread over the heap. On 63rd day, the entire plant was pruned and half inch of the stem was left without disturbing the roots. The cuttings was dried for 3-4 days and then they were crushed and immersed in amrut jal for 8 hours. The soaked cuttings were mixed into the heap and the heap was left for composting for 30 days, covered the heap with dried biomass. The heap was shuffled after every 7th day and amrut jal was sprinkled, whenever required to moisten the heap. After 30 days, amrut mitti was ready and mulched with biomass. It took 4 months and 20 days for the *Amrut Mitti* to be prepared.

Culture Compost

Four kg crushed leaf litter was used for the preparation of heap in the rectangular bed of bricks. Leaf litter and thin layer of cow dung were added alternatively. 20 gm composting culture powder was sprinkled after each 1 kg layer of leaf litter. The heap was shuffled after every 4th or 5th day to maintain proper aeration in the heap. Water was sprinkled intermittently whenever needed. The composting process was carried out for 3 months.

Control

For control farm soil was collected by random sampling. Same soil was used as input soil in the preparation of *Amrut Mitti*.

Both the composts and control were analysed and compared for physico-chemical parameters such as moisture content (MC), pH, EC, Organic Carbon (OC), Total Nitrogen (N), Available Phosphorus (P) and Potassium (K) at the IIS (deemed to be University), Jaipur laboratory. MC was done by oven method, pH and EC by Jackson method, OC by Walkley and Black method, N by AOAC method, P by Olsen's method and K by flame photometric method for soil [6] and composts [7].

The variations in physicochemical properties between the three groups were evaluated using ANOVA (one-way), followed by the comparison of means of all the physicochemical parameters based on the Tukey HSD test. SPSS version 25 was used for statistical analysis and statistical mean differences were considered to be significant at $p<0.05$.

RESULTS AND DISCUSSION

All the three groups were analysed for physicochemical parameters and compared to find out the group with the best physicochemical properties for further use in agricultural purposes. In all the groups, pH varied from 6.8600 to 8.2433, EC varied from 0.2633 to 3.2400, MC varied from 3.8867 to 15.8967, OC varied from 0.8667 to 8.5667, total N varied from 0.0023 to 0.9033, available P varied from 0.0050 to 0.1867, available K varied from 0.0500 to 1.0867 (Table 1).

pH

The pH was found to be higher in *Amrut Mitti* and control in comparison to Culture Compost. Absolute pH rise in *Amrut Mitti* could be due to the decomposition of nitrogenous substrate into ammonia [8]. Nitrogen and phosphorus mineralization into nitrites / nitrates and orthophosphates and bioconversion of organic matter into intermediate organic acid species may have reduced pH levels of Culture Compost [9]. Alkaline nature of compost is indicative of a successful composting method.[10]

According to a study, the pH of vermicompost collected from kitchen waste, garden waste and cow dung showed similar variations in the pH range of 6.34±0.06 and 8.13±0.06, respectively [11], which was within the optimum range for plant development [12].

Electrical Conductivity

In comparison with Culture Compost and control, *Amrut Mitti* had the highest EC, which may be attributed to the loss of organic matter, which most likely contributed to a higher concentration of ions that would have increased EC [13].

EC is inversely proportional to nutrient concentration [14]. Lower the EC, greater is the concentration of salts. Higher particle water carrying ability, cation exchange capacity and porosity results in higher EC [15].

Large EC values could be attributed to ammonium ion release [16]. The appropriate EC level required for compost should be lower than 4 ds /m for the improvement of agricultural soils [17]. The increased EC values might be due to the rise in the production of inorganic compounds and the release of ions [18].

Organic Carbon

Culture Compost had the highest OC% and control has the minimum OC% which could be due to microbial activity. Organic carbon is lost as CO_2 due to microbial respiration and mineralisation of organic matter [19].

Organic matter was used by the organisms *Rhizobium*, *Azotobacter* and *Lactobillus* and transformed into reusable fertiliser by enhancing the compost quality with increased organic carbon and nitrogen levels [20]. Organic content is directly proportional to carbon content [21].

Nitrogen

Maximum total nitrogen was found in Culture Compost followed by *Amrut Mitti* and minimum in control. That was because nitrogen becomes concentrated during composting, due to organic matter degradation [22]. High nitrate values suggested that there was no loss of nitrogen during the composting process [23].

It had also been proposed that agronomic benefit is demonstrated by an increase in nitrogen during composting [24].

Phosphorus and Potassium

Phosphorus and potassium content was higher in *Amrut Mitti* followed by Culture Compost and control. The improved P content level in *Amrut Mitti* and Culture Compost suggested phosphorus mineralization. The micro-organisms solubilizing P turned the insoluble P into soluble forms, making it more accessible to plants [25]. *Amrut Mitti* also contains cow urine, top soil, tender and mature leaves, which have various nutrients. Cow urine ingredients are 95 % water, 2.5 percent of urea, salts, 2.5 percent of minerals, enzymes, and hormones. It includes iron , calcium, carbonic acid, potassium, nitrogen , phosphorus, ammonia, manganese, sulphur, phosphate, potassium, uric acid, urea, cytokine, amino acids, enzymes, lactose, etc. The addition of cow urine to organic waste led to improved compost quality as it contains greater concentrations of major macro-and micro-nutrients and useful microflora such as Bacteria, Actinomycetes and Fungi [26].

The increase in potassium content could be due to the production of acid in the degradation of organic material by the microorganisms [27].

Table 1: Physicochemical parameters of different groups

Parameters	Various Groups		
	Control	***Amrut Mitti***	**Culture Compost**
pH	8.2433±0.01155*	7.4867±0.04163*	6.8600±0.03606*
EC(ds/m)	0.2633±0.00577*	3.2400±0.06000*	2.3733±0.06429*
MC(%)	3.8867±0.07024*	8.6633±0.04933*	15.8967±0.02517*
OC(%)	0.8667±0.05774*	3.1000±0.00000*	8.5667±0.05774*
N(%)	0.0023±0.00115*	0.4133±0.03055*	0.9033±0.00577*
P(%)	0.0050±0.00100*	0.1867±0.01528*	0.1133±0.02309*
K(%)	0.0500±0.00000*	1.0867±0.19140*	0.4400±0.04359*

Mean ± S.D.(standard deviation), * represents significance at 0.05 level

CONCLUSION

The study revealed that Culture compost was better than *Amrut Mitti* according to physicochemical analysis and it was prepared faster than *Amrut Mitti*. However, *Amrut Mitti* is a better choice for farmers because it can be prepared by harnessing local and natural resources available on the farm, which reduces reliance on chemical fertilisers. *Amrut Mitti* had higher amount of phosphorus, potassium in comparison to culture compost, organic carbon and nitrogen were also present in sufficient quantity, pH, EC values were also favourable for plant growth and it could be prepared in less than 5 months. Large amount of agricultural wastes such as wheat straw, rice husk can be utilised by the preparation of *Amrut Mitti*. The major problem of stubble burning in Punjab, Haryana and Western Uttar Pradesh which increases air pollution and degrade the soil quality can be resolved by utilising stubble in preparing *Amrut Mitti* on the field itself.

CONFLICT OF INTEREST

All the authors hereby declare that there is no conflict of interest regarding the publication of this article.

REFERENCES

1. CPCB, (2000b): Status of Solid Waste Generation, Collection, Treatment and Disposal in Metro cities.
2. NEERI (1994): National Environmental Engineering Research Institute; Solid Waste Management in Greater Bombay: Final Report.
3. Javedekar, P. (2016). Solid waste management system not adequate, *Article in Times of India*, New Delhi Edition Date 27 January 2016, 4.
4. Pandit, B.R., Subrahmanyam S.V.S. and Raghavendra Rao K.V., (1989). Indian Bot. Reptr. **8**: 118 - 120.
5. Tweib, S. A., Rahman, R. and Kalil, M. S. (2011). A literature review on the Composting. In *International Conference on Environment and Industrial Innovation IPCBEE*. **12**:124-127.
6. Thakur, R. K., Baghel, S. S., Sharma, G. D., Sahu, R. K., Amule, P. C. (2011). Caft on biotic and abiotic resources management for eco friendly and sustainable agriculture. 7-21.
7. Biofertilizers and Organic Fertilizers in Fertilizer (Control) Order, 1985 method. National Centre of Organic Farming, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India.
8. Cohen, S. and Lewis, H. B. (1949). The nitrogenous metabolism of the earthworm (Lumbricus terrestris). *Journal of Biological Chemistry*. **180**: 79-91.
9. Ndegwa, P. M., Thompson, S. A. and Das, K. C. (2000). Effects of stocking density and feeding rate on vermicomposting of biosolids. *Bioresource technology*. **71**: 5-12.
10. Tchobanoglous, J. A., Akker, V. D., Lathrop, A. L., Voelker, M. H. and Dearth, L.R. (1993). Importance of Fibre Strength to Sheet Strength. *TAPPI*. **41**: 416.
11. Wani, K. A. and Rao, R. J. (2013). Bioconversion of garden waste, kitchen waste and cow dung into value-added products using earthworm Eisenia fetida. *Saudi journal of biological sciences*, **20**: 149-154.
12. Goh, K. M. and Haynes, R. J. (1977). Evaluation of potting media for commercial nursery production of container-grown plants: 1. Physical and chemical characteristics of soil and soilless media and their constituents. *New Zealand Journal of Agricultural Research*. **20**: 363-370.
13. Kiefer, A. and Rivin, J. (2004). The Effects of Storage on the Quality of Vermicompost, University of Wisconsin System, Solid Waste Research Program.
14. Pathak, A. K., Singh, M. M. and Kumar, V. (2011). Composting of municipal solid waste: a sustainable waste management technique in Indian cities–A review. *International Journal of Current Research*, **3**:339-46.
15. Grisso, R., Aller, M., Holshouser, D. and Thomason, W. (2009). *Precision Farming Tools: Soil Electrical Conductivity*. Virginia Cooperative Extension Publication, Virginia. 442-508.
16. Hirai, M. F., Chanyasak, V. and Kubota, H. (1983). A standard measurement for compost maturity.
17. Kalamdhad, A. S., & Kazmi, A. A. (2009). Rotary drum composting of different organic waste mixtures. *Waste Management & Research*. **27**: 129-137.
18. Zhang, L. and Sun, X. (2016). Influence of bulking agents on physical, chemical, and microbiological properties during the two-stage composting of green waste. *Waste Management*. **48**: 115-126.

19. Cabrera, M. L., Kissel, D. E. and Vigil, M. F.(2005). Nitrogen mineralization from organic residues: Research opportunities. *Journal of Environmental Quality*.**34**: 75-79.
20. Beloso, M. C., Villar, M. C., Cabaneiro, A., Carballas, M., Gonzalez-Prieto, S. J., and Carballas, T. (1993). Carbon and nitrogen mineralization in an acid soil fertilized with composted urban refuses. *Bioresource Technology*. **45**: 123-129.
21. Jackson, M. L. (1956). *Soil chemical analysis advanced course: a manual of methods useful for instruction and research in soil chemistry, physical chemistry of soil fertility and soil genesis*.
22. Genevini, P., Adani, F. and Villa, C. (1997). Rice hull degradation by co-composting with dairy cattle slurry. *Soil Science and Plant Nutrition*. **43**: 135-147.
23. Pierre, V., Phillip, R., Margnerite, L., & Pierrette, C. (1982). Anti-bacterial activity of the haemolytic system from the earthworms Eisenia foetida andrei. *Invertebrate Pathology*. **40**: 21-27.
24. Vuorinen, A. H. and Saharinen, M. H. (1997). Effects of process conditions on composting efficiency and nitrogen immobilization during composting of manure in a drum composting system. In *International Symposium on Composting & Use of Composted Material in Horticulture.* **469**: 89-96.
25. Sangwan, P., Kaushik, C. P. and Garg, V. K. (2010). Vermicomposting of sugar industry waste (press mud) mixed with cow dung employing an epigeic earthworm *Eisenia fetida*. *Waste management & research*. **28**: 71-75.
26. Sharholy, M., Ahmad, K., Mahmood, G. and Trivedi, R. C. (2005). Analysis of municipal solid waste management systems in Delhi–a review. In: *Book of proceedings for the second International Congress of Chemistry and Environment, Indore, India*. 773-777
27. Hartenstein, R. and Hartenstein, F. (1981). Physicochemical changes effected in activated sludge by the earthworm *Eisenia foetida*. *Journal of Environmental Quality*. **10**: 377-381.

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