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Nutrient Release Pattern during Composting Poultry Manure

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Abstract: An incubation experiment was carried out under aerobic and anaerobic conditions to study the chemical changes during composting of poultry manure blended with sorghum straw. The incubation experiment was conducted in completely randomised block design with four replications for a duration of 75 days. Samples were drawn at fortnightly intervals and analysed for pH, N, P and C: N ratio in the substrate. The data revealed that composting of poultry manure blended with sorghum straw reduced the nitrogen loss as a consequence of widening the C: N ratio to a desirable level (18:1). This process led to retain larger amounts of N under aerobic decomposition. The mineralization of manure blended with straw was slower by two weeks (60 days) under anaerobic conditions in comparison to raw manure subjected to aerobic or anaerobic composting process (75 days). In addition to the changes in N, P content also increased during the decomposition process.

Key words: *Composting, poultry manure, aerobic decomposition, nutrients, C: N ratio*

INTRODUCTION

The poultry population in Tamil Nadu was estimated to be 86.6 millions with an output of 2.16 million tonnes of manure[8]. Poultry manure is rich in nitrogen as urine and solid wastes are excreted together. Poultry manure ferments quickly and vulnerable for gaseous loss of N to an extent of 50 % within 30 days [1]. However, the manure may be stored for a period of 30-60 days to widen the C: N ratio to a desirable level to apply to the crops prior to sowing. This waiting period causes loss of N around 50 %[1]. The unprocessed deep litter manure when stored in open air rapidly looses its N due to high proteolytic activity[9]. Thus, immediate processing of poultry manure is essential to prevent its rapid decomposition and loss of nutrients.

MATERIALS AND METHODS

Poultry manure composts were produced for this study using poultry manure, sorghum straw (a carbon source), cow dung and water. Poultry manure was collected from the farms of Veterinary College and Research Institute, Namakkal, Tamil Nadu. There were four treatments viz, poultry manure blended with straw with or without straw subjected to aerobic and anaerobic methods of composting in a completely randomised block design (CRBD) and replicated four times. The anaerobic composting process was accomplished by layers of 15 cm of poultry manure in a polythene sheet lined pit of 0.5 m^3 15 cm layer of poultry manure and chopped sorghum straw in a ratio 10:1 was overlaid. The pit was lined tightly with mud. In aerobic decomposition process, the same procedure was adopted except that the materials were turned for aeration once in 15 days. The chemical composition of poultry manure and sorghum straw is given in Table1.

Manure samples collected at 15 days intervals were dried, powdered and analysed for N and P contents as suggested by Hesse[3]. Organic carbon content was determined by the chromic acid wet digestion method[12].

RESULTS AND DISCUSSIONS

The poultry manure blended with straw @ 10:1 decomposed in 60 days and 75 days under aerobic and anaerobic conditions, respectively. The chemical changes that are taking place during decomposition are presented.

Nitrogen: The N contents of the manure declined linearly in the presence or absence of straw under aerobic and anaerobic decomposition processes (Table.2). However, the reduction was slow and steady in manure blended with straw. The loss in N reduced in the decomposition was 41.3 and 24.4 %, respectively, in aerobic and anaerobic methods of composting. In the presence of straw, the same values

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Table.1: Chemical composition of Poultry manure and Sorghum straw

Sl.No.	Characteristics	Poultry manure	Sorghum straw
1.	pH	6.0	--
2.	Organic carbon (%)	35.4	52.4
3.	Nitrogen (%)	3.2	0.4
4.	Phosphorus (%)	1.8	0.5
5.	Potassium (%)	1.6	0.3
6.	C: N ratio	11:1	131:1

Table.2: Effect of composting on the carbon (%), nitrogen (%) and C: N ratio of poultry manure

Treatments		Carbon content (%)					Nitrogen content (%)					C: N ratio				
		Days after incubation					Days after incubation					Days after incubation				
		15	30	45	60	75	15	30	45	60	75	15	30	45	60	75
Aerobic	Poultry manure		32.8	30.8	28.1	25.7	24	2.54	2.25	1.87	1.4	1.31	12.9	13.7	15	183184
	Poultry manure + straw	34.7	32.4	31.2	30.8	30.3	2.65	2.35	2.05	1.71	1.68	13.1	13.8	15.2	18	18
Anaerobic	Poultry manure	34.1	32.9	31.4	31.2	31	2.62	2.38	2.15	1.9	1.71	13	13.8	15	16.4	18.1
	Poultry manure + straw	35.5	34.7	34	33.8	33.5	2.71	2.56	2.3	2.01	1.87	13.1	13.6	14.8	16.8	17.9
	CD (5%)	1.4	1.5	2.1	2.4	3.1	0.15	0.12	0.13	0.12	0.1	NS	NS	0.25	1.1	NS

Table.3: Effect of composting on the pH and phosphorus content (%) of poultry manure

Treatments		pH					Phosphorus content (%)				
		Days after incubation					Days after incubation				
		15	30	45	60	75	15	30	45	60	75
Aerobic	Poultry manure	6	6.3	6.5	6.6	6.6	1.9	1.78	1.87	2.1	2.05
	Poultry manure + straw	6	6.2	6.7	7	7.1	1.9	1.96	1.96	2.05	2.01
Anaerobic	Poultry manure	6.1	6.2	6.2	6.5	6.6	1.85	1.88	1.9	1.86	1.94
	Poultry manure + straw	6.1	6.3	6.4	6.7	6.9	1.82	1.85	1.85	1.9	1.95
	CD (5%)	NS	NS	0.21	0.24	0.31	NS	0.1	0.11	0.13	NS

were circumvented to 28 and 13 %. The data indicated that blending of poultry manure with sorghum straw significantly reduced the loss of N during composting process. This suggests that the C: N ratio in poultry manure would have widened to a desirable level of 20:1 by the addition of carbon source through the straw. The loss of N under aerobic decomposition was more pronounced due to the volatilisation of ammonia from the poultry manure. This is in agreement with the reports of Krichmann[4] and Krichmann and Witter[5.6].

pH: The pH increased with the progression of the decomposition process regardless of aerobic and anaerobic methods (Table.3). At the end of the decomposition process, the pH was 6.6 and 7.0 in blended and raw manures, respectively, in both the methods of decomposition. This increase in pH during composting may be due to the formation of calcium carbonate during aerobic decomposition[7] or ammonium carbonate during anaerobic decomposition[2]. This is also in close agreement with the findings of Sims *et al.*[11] who reported that the pH of the aerobically produced poultry manure straw compost as 7.2.

Phosphorus: In general, phosphorus content increased slightly during the intermediate phases irrespective of the methods of decomposition or manure blending (Table.3). Phosphorus content was higher in aerobically produced compost than in anaerobically treated manure. Mixing straw had least effect on the total P content of the manure. Increase in the total P content of poultry-saw dust manure was observed by Nodar *et al.,*[10] up to 7 weeks. Krichmann and Witter[6] also observed a similar result and have reported an increase in total 'P' content due to aerobic decomposition than anaerobic decomposition.

The data suggested that poultry manure when blended with straw was found to be beneficial in reducing the loss of N regardless of composting methods. Manurial value of the poultry manure was higher in anaerobic than aerobic method of composting as indicated by the N and P contents of the poultry manure in addition to the desirable level of C: N ratio.

The data on C: N ratio clearly indicated that the decomposition of poultry manure with or without blending straw under aerobic and anaerobic conditions enhanced the values. However, the increase in C: N ratio was more pronounced and significant at 45 and

60 days after incubation. The C: N ratio reached a desirable level of 18 under aerobic decomposition in 60 days. On the other hand, the same level was achieved in anaerobic decomposition after 75 days suggesting that there is a rising of decomposing time by 15 days under anaerobic decomposition. The results are in conformity with the findings of Sims *et al.* [11].

Conclusion: The incubation experiment indicated that the composting of poultry manure blended with straw would enable to enhance the N, P and carbon status of the manure and thus improving its quality. Further, the desirable level of C: N ratio was achieved in 60 days under aerobic conditions while the anaerobic method of it was slower and took 75 days to reach the C: N ratio at a desirable level of 18. The study suggests that incubating the poultry manure with straw under aerobic condition is beneficial to improve the quality of the manure.

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