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A CASE STUDY

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Evaluation of biochemical changes during the storage of poultry composts for effective land application

M. PRASANTHRAJAN, S. SHALINI, T. BALAJI AND P. VEERAMANI

ABSTRACT : An incubation experiment was conducted to assess the storability of poultry droppings compost for effective utilization and field application. In general, the nutrient content of the compost will vary depending upon the quantity and nutrient content of the manure, age of the compost and the method of storage. In our present study, we found that the storage of poultry droppings under normal condition did not influence the pH of the compost in the first 30 days but a slight reduction in pH (0.1 to 0.2) was observed between 30th day and 45th day. The Electrical Conductivity (EC) of the stored compost was increased but the level of increase was not exceeded 0.02 dS m^{-1}. A slight increase in total nitrogen content was recorded during storage of poultry compost and this might be due to moisture loss and reduction in volume. A slight decrease in total phosphorus and total potassium was also recorded in the stored compost during 75th and 90th day of storage. The microbial population was high between 30th and 45th day of storage. Compost contained a relatively large amount of micro-organisms associated to organic nitrogen mineralization which might have altered the chemical properties. There was no much variation in the nutrient status of the compost during first 45 days of storage and hence the poultry compost can be applied to land within 45 days after its maturity to derive maximum benefits.

KEY WORDS : Poultry compost, Storage, Biochemical changes

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INTRODUCTION

Composting is a method of solid waste management whereby the organic component of the solid waste stream is biologically decomposed under controlled conditions to a state in which it is stable and can be handled, stored, and applied to the land without adversely affecting the environment.

Today composting is a popular activity of numerous organic gardeners and farmers. Many community ordinances prevent the burning of leaves and refuse, and space for waste disposal is becoming scarce; therefore, numerous cities have turned to composting, which produces both a useful and an ecologically compatible product. Four criteria that must be considered for composting to be achieved include C/N ratio, moisture, temperature and aeration. Balancing nutrient requirements in composting is very similar to balancing feed nutrients in livestock production. In composting, the carbon to nitrogen ratio or C/N ratio is very important.

MEMBERS OF RESEARCH FORUM

Address of the Correspondence : **M. PRASANTHRAJAN,** Agricultural Research Station, Virinjipuram, VELLORE (T.N.) INDIA Email: prasanth_phd@yahoo.co.in

Address of the Coopted Authors : S. SHALINI, T. BALAJI AND P. VEERAMANI, Department of Chemistry, Nirmala College for Women, COIMBATORE (T.N.) INDIA

ADD. CHANGE :- T. BALAJI AND P. VEERAMANI, Agricultural Research Station, Virinjipuram, VELLORE (T.N.) INDIA

Carbon stimulates the growth in bacteria, actinomycetes and fungi, while nitrogen provides for the formation of proteins and enzymes. The optimum C/N ratio for these microbes is 30 parts carbon to 1 part nitrogen. Under normal conditions, a C/N ratio of compost mix above 30:1 restricts the composting process. When the C/N ratio reaches 10:1 or lower, nitrogen is converted to ammonia and is released into the atmosphere. The ideal C/N ratio for making compost is 25-30:1 and the matured compost will have the C/N ratio of 14:1.

Maturity of composts critically affects their successful utilization in agriculture. This is especially important when composts are applied immediately before planting or when they are used in container media. All immature composts induce high microbial activity in soil for some time after incorporation, creating the potential for oxygen deficiency and a variety of indirect toxicity problems for plant roots. The C/N ratio is often used as an index of compost maturity despite many pitfalls associated with this approach. The compost may likely to undergo some kind of changes in their chemical and biological composition due to environmental factors, even after maturity. For better utilization of compost, the present study was undertaken to assess the changes in compost quality parameters during their storage.

EXPERIMENTAL METHODS

An incubation experiment was conducted to assess the storability of compost for effective utilization and field application. Three matured composts namely, Compost 1 (poultry droppings + coir pith), Compost 2 (poultry droppings + paddy straw), Compost 3 (poultry droppings + coir pith + rock phosphate) were used in this study. A known quantity of these three composts (10 kg each) was taken separately in three plastic containers and stored in room temperature (25-30°C) under shade. Periodical samples were drawn from the composts to assess the storability and for effective utilization. Various chemical parameters namely, pH, EC, carbon, total nitrogen, total phosphorus and total potassium were analyzed by following standard analytical methods and the microbial activity was assessed by standard Flourescein diacetate (FDA) hydrolysis method given by Inbar *et al*. (1991).

Flourescein diacetate (FDA) hydrolysis :

The samples were weighed (1 g, wet weight) and moisture content was determined. The samples were placed in three different Erlenmeyer flasks (volume 125 ml) containing 20 ml of potassium phosphate buffer (60 mM, pH 7.6). Then 200 µl of FDA stock solution were added to each of the flask containing the medium buffer suspension. A control was maintained which contained only buffer solution. Stock solution consisted of FDA dissolved in acetone (2 mg ml^{-1}) and stored at cold condition. The flasks were shaken on a rotary shaker for 20 min at 90 rpm at 25°C and after that 20 ml of acetone were added to the suspension to stop the reaction. For one of the samples in each treatment (control), addition of acetone was made immediately after the addition of FDA. The mixture was filtered through a preplated number 1 Whatman filter paper to remove remaining medium residue. The amount of FDA hydrolyzed in the filtrate was determined by measuring the absorbance at 490 nm and by comparing concentrations with a standard curve.

The preparation of the standard curve was made by the addition of 0, 50, 100, 150 and 200 µl of FDA stock solution to 5 ml of phosphate buffer in screw cap tubes. The tubes were incubated in boiling water for 60 minutes to hydrolyze the FDA and thereafter, they were removed and left to cool. The hydrolyzed FDA was added to the 125 ml Erlenmeyer flasks containing 1 g (wet weight) of medium sample. An additional 15 ml of phosphate buffer was used to wash the fluorescein from the tubes and then, 20 ml of acetone was added to the suspension and the mixture was filtered as described above. The absorbance was measured at 490 nm.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present investigation are presented in Table 1 and 2.

The change in chemical characteristics of the composts during storage varied with the raw material used for making compost. Experiments to study the keeping quality of the compost showed that the storage did not influence the pH of the composts in the first 30 days of storage but a slight reduction in pH was observed during 30^{th} to 45^{th} day of storage. During this period, electrical conductivity of composts was progressively increased but the level of increase did not exceed 0.02 dS m^{-1}. Initial EC ranged from 1.27 to 1.46 dS m^{-1} and during 90^{th} day of storage it ranged from 1.27 to 1.48 dS

m^{-1}. Bunt (1976) reported that when nitrates are formed the EC increases and pH decreases. There were no much difference in the total nitrogen content but the level of total N content started to decline after 60th day of storage. Initial carbon contents of the three composts were 22.73 per cent, 23.06 per cent and 23.44 per cent which reduced to 22.60 per cent, 22.08 per cent and 22.35 per cent, respectively after 60th day of storage. A slight increase in total phosphorus content was observed and initially which was in the range of 1.83 to 2.01 per cent. The increase in phosphorus content of composts continued upto 60th day and then a slight decrease was observed in the later stage. During 90th day of storage, the phosphorus content ranged from 1.82 to 2.01 per cent. A slight decrease in the potassium content was recorded on 75th and 90th day of storage. Initially the total K content of the different composts were 1.39 per cent, 1.34 per cent and 1.39 per cent which was reduced to 1.36 per cent, 1.32 per cent and 1.37 per cent during 90th day of storage. The microbial activity during storage was high in the poultry droppings compost prepared using coir pith and rock phosphate. The highest microbial activity was measured between 30th and 45th day. There were less microbial activity in the poultry droppings and paddy straw

Table 1 : Changes in chemical composition and microbial activity during the storage of different composts

	pH						
	Initial	15th day	30th day	45th day	60th day	75th day	90th day
Compost 1	7.5	7.5	7.6	7.4	7.5	7.4	7.4
Compost 2	7.8	7.9	7.8	7.7	7.6	7.7	7.6
Compost 3	7.6	7.7	7.6	7.4	7.5	7.5	7.5
EC (dS m^{-1})							
Compost 1	1.31	1.32	1.31	1.33	1.32	1.32	1.32
Compost 2	1.46	1.46	1.44	1.45	1.47	1.47	1.48
Compost 3	1.27	1.28	1.28	1.27	1.29	1.28	1.27
Total N (%)							
Compost 1	1.91	1.93	1.93	1.91	1.90	1.88	1.89
Compost 2	1.89	1.88	1.89	1.87	1.88	1.86	1.86
Compost 3	1.97	1.96	1.94	1.96	1.97	1.95	1.94
Total carbon (%)							
Compost 1	22.73	22.70	22.67	22.67	22.63	22.63	22.60
Compost 2	23.06	23.00	23.06	23.02	23.02	22.08	22.08
Compost 3	23.44	22.40	22.40	22.38	22.38	22.36	22.35
Total P (%)							
Compost 1	1.85	1.87	1.87	1.85	1.87	1.85	1.85
Compost 2	1.83	1.83	1.82	1.84	1.83	1.81	1.82
Compost 3	2.01	2.04	2.02	2.03	2.01	2.03	2.01
Total K (%)							
Compost 1	1.39	1.38	1.37	1.39	1.38	1.38	1.36
Compost 2	1.34	1.32	1.34	1.35	1.35	1.33	1.32
Compost 3	1.39	1.37	1.38	1.38	1.38	1.37	1.37

Compost 1 - Poultry droppings + Coir pith; Compost 2 - Poultry droppings + Paddy straw; Compost 3 - Poultry droppings + Coir pith + Rock phosphate

Table 2 : Changes in chemical composition and microbial activity during the storage of different composts

	Microbial population						
	Initial	15th day	30th day	45th day	60th day	75th day	90th day
Compost 1	16	24	48	32	18	16	16
Compost 2	0	8	8	8	12	8	8
Compost 3	20	10	14	18	22	16	14

Compost 1 - Poultry droppings + Coir pith; Compost 2 - Poultry droppings + Paddy straw; Compost 3 - Poultry droppings + Coir pith + Rock phosphate

compost mix. Golueke (1991) reported that when the moisture drops to 25 per cent, all the microbial activities are drastically inhibited and ceases when it approaches 10 per cent.

The various chemical and biological changes in different poultry composts were examined during storage for effective utilization and the results confirmed that the storage had slight influence on nutrients, pH, EC and microbial populations. Prasanthrajan *et al.* (2014) worked on the influence of poultry composts on growth and yield attributes of sunflowerd and the results obtained were more or less similar to the present investigation.

Conclusion :

There was no much variation in the nutrient status of the compost during initial 45 days of storage and hence the compost can be applied to land within 45 days after its maturity to derive maximum benefits.

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