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Bioconversion of market wastes by aerobic composting process

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ABSTRACT

We live in the society that consume more resources and do less for the conservation. The people, in the heavily populated countries have also learnt to live amidst smelly rubbish heaps, which can otherwise be utilized as manure. Though we know composting technique, we restrict ourselves within vegetable and animal wastes. The present study would help the government and NGOs, in managing the solid waste through composting. In view of the above points, study was carried out at Tamil Nadu Agricultural University, to decompose fruits and vegetables waste, generated at market. The waste from market was collected and composted aerobically in heaps. Potential microbial consortia and nitrogen, phosphorous sources were used for composting. The complete degradation was achieved at the end of the ninth week. The finished material had 2.20, 0.18 and 1.85 percent of nitrogen, phosphorous and potassium respectively. The compost was subsequently inoculated with aerobic free living nitrogen fixing bacterium, *Azotobacter chroococum* for further enrichment.

KEYWORDS

Waste management;
Compost;
Market wastes;
Compost enrichment;
Compost heaps;
Aerobic composting.

INTRODUCTION

India, as a result of its diverse agro-climatic conditions is one of the leading producers of Fruits and Vegetables. About 27 million tones of Vegetables are produced and are being sold in the Market[9] Much of the solid wastes, generated in Markets are dumped in unsightly, uncontrolled and smelly polluting open dumps. Since these wastes are rich in nitrogen, potassium, and do not contain any toxic substances, it can be transformed into compost and safely used as manure.

MATERIALS AND METHODS

Collection and preparation of materials for composting

Waste was collected from the market situated at Ukkadam, in Coimbatore. It contained Onion, Tomato, Pumpkin, Mango, Beans, Brinjal, and Yam etc. The waste after removing the non degradable materials was kept in well elevated place. Since the moisture content of the material was more than 70 percent, size reduction was not able to be achieved.

Pure cultures of *Aspergillus* sp and *Bacillus* sp were obtained from the dept of agricultural microbiology, Tamil Nadu Agricultural University and they were subsequently cultured in the broth. To prepare the mixed microbial inocula, about 250ml of the broth from each culture was mixed together with the 3kg of un-sterilized soil and was used for waste degradation. As nitrogen source, Urea and poultry droppings were used @ 500g each, per 100kg of waste materials. And 1000g of rock phosphate was also used per heap, as a phosphorus source. All the above mentioned nutrients were uniformly mixed with 3kg of un-sterilized soil. So to prepare microbial inoculants and nutrient mixture for the entire one heap, totally 6kg of soil was used. The total quantity of nutrients and microbial resources required, for every 100kg of wastes were mixed separately. After mixing they were equally divided into three parts.

Heaping methodology

In order to create favorable environment for faster biodegradation, about 100kg of wastes were heaped to a height of 1 meter. Initially the compost heap was formed by spreading about 15kg of wastes over that, 1kg of soil plus microbial consortia was evenly sprinkled, again 15kg of waste was added, and over that 1kg of nutrients soil mixture was spread. Like that totally six layers of wastes sand witched with 3 layers of nutrient sources and 3 layers of microbial consortia in an alternate manner were formed; finally 10kg of waste material was added over the nutrient layer to complete one heap. All the four sides of the heap were tapered to form about narrower width at the top than the base. So that the shape of the heap would be in trapezoidal (Figure 1). Temperature of the heap was recorded daily with the help of Thermometer (Mercury).Turning of heap was given at fort-nightly interval. Whenever moisture content decreased below 40 percent, water was sprinkled, to bring it to 60percent. For analyses, samples were drawn from the heap once in a week and analyzed for their chemical and biological properties. For analyses ten samples of approximately 20 gram each, were taken from various sites of the compost heap at weekly intervals from that a representative sample was derived and shade dried, powdered, sieved and used for chemical analysis.

Enrichment with biofertilizer

After composting when the temperature of the heap had stabilized around 30^0C, it was enriched with the biofertilizer, *Azotobacter chroococum* at 250g. kg^{-1} of compost. It was allowed for enrichment for another 15days with adequate aeration and moisture.

RESULTS AND DISCUSSION

Preliminary analyses

Initially the moisture content of the material was more than 60 percent. And the pH was 5.33. It had a very high level of nitrogen (1.45 percent) and potassium (1.00 percent). The organic carbon and carbon

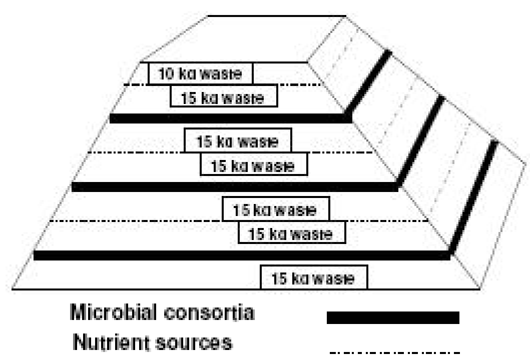

Figure1 : Diagrammatic representation of compost heap

TABLE 1 : Changes in physico-chemical properties of market wastes during composting

Parameters	Composting Periods in Weeks								
	W1	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**
Moisture (%)	72.60	63.75	57.33	60.00	58.03	50.57	41.59	37.00	30.71
Temperature(°C)	32.76	47.10	60.66	57.23	33.20	29.63	28.56	28.80	28.60
pH	5.07	6.91	7.12	7.48	7.62	7.76	7.84	8.02	8.36
EC(dSm-1)	0.52	0.72	0.80	0.80	0.82	0.89	1.06	1.19	0.87
Organic carbon(%)	42.22	38.02	35.03	33.06	32.05	28.95	28.51	28.42	28.41
Total N (%)	1.83	1.90	1.95	1.99	2.01	2.06	2.13	2.17	2.20
Total P (%)	0.09	0.10	0.11	0.12	0.13	0.15	0.16	0.17	0.18
Total K (%)	0.99	1.11	1.18	1.33	1.47	1.64	1.69	1.78	1.85
C/N	23.03	20.00	17.86	16.73	15.86	13.96	13.33	13.06	12.90

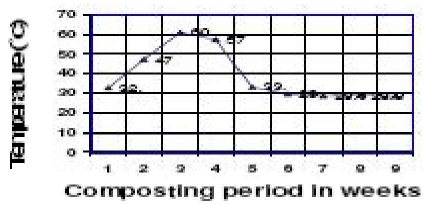

Figure 2 : Temperature change during composting

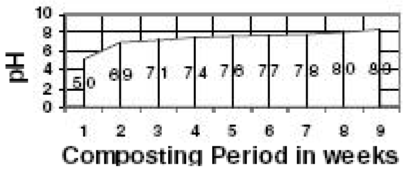

Figure 3: pH change during composting

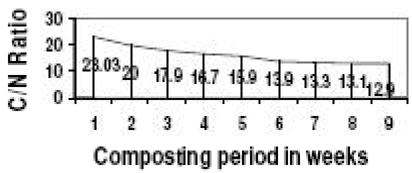

Figure 3: Changes in C/N ratio during composting

nitrogen ratio of the waste were 42.22 and 23.03 per cent respectively (TABLE 1)

Moisture and temperature changes

The moisture content of the compost during the entire period of composting ranged from 72.6 to 30.7 percent. When the process was progressed further, a significant reduction was observed. This reduction in moisture content might be due to the evaporation, as a consequence of microbial heat generation[5,8]. The overall picture of the temperature increase was rapid in the first four week, afterwards a gradual decrease till it reached the surrounding temperature (Figure 2). The use of poultry droppings and exothermic energy release might have contributed for the heat development[2,10].

Changes in pH and EC

Regarding the pH of the compost, a slight reduction was noticed after that, it was gradually increased (Figure 3) and at the maturity stage it was 8.36. The reduction in pH is due to production of organic acid and pH rise could be due to ammonia volatilization[4]. Electrical conductivity (TABLE 1), during composting was ranged between 0.50 and 0.87.dSm^{-1}.

Changes in organic carbon and carbon/nitrogen ratio

Significant reduction in total organic carbon was observed, in the first three weeks of decomposition period and was reduced from 42.65 to 35.03 percent (TABLE 1). At the end of the period it was 28.4 per cent. The carbon/nitrogen ratio reduction was significant during the second and third week of the composting period (Figure 4).And it could be due to the release of carbon-di-oxide, as a result of microbial oxidation of substrate materials[1,3].

Changes in the concentration of major nutrients

Initially the nitrogen, phosphorus and potassium content of the material were 1.45, 0.1 and 1.0 percent respectively but at the end, they were 2.2, 0.18 and 1.85 percent respectively. The increased level of nitrogen, phosphorus and potassium in the compost might be due to the oxidation of carbon as Co_2[11,6].

Changes in micronutrient concentration

The composted market waste had copper, iron, and manganese in the following order of concentrations viz., 38, 2720 and 316ppm. The increase in phosphorus and micronutrients might be due to added rock phosphate[7].

CONCLUSION

Ttemperature of the compost heap, during the third week was above the mesophilic range, and most of the mesophilic pathogenic organisms might have got killed during composting. The pH did not exceed 8.5, therefore the usage of compost may not alter the soil pH to alkaline range. As the carbon/ nitrogen ratio of the finished compost was narrow (12.9), its usage as manure for crop production, will not cause 'nitrogen robbing'. In addition to the micronutrients. the compost was also rich in nitrogen and potassium and hence the compost application will definitely improve the soil fertility and also the crop growth. The present study would give a solution for solid waste management especially, in Fruit and Vegetable markets, Uzhavar sandai (Farmers' Market) and Juice Shops. In future, efficient microbial strains and low cost nutrient substrates are to be identified, for reducing the composting period to one month.

REFERENCES

[1] D.K.Borkar, E.S.Deshmukh, V.S.Bhoyar; J.Soil and Crops, **1**, 117-119 **(1991)**.

[2] M.S.Finstein, M.L.Morris; Adv.Appl.Microbiol., **19**, 113-151 **(1975)**.

[3] A.C.Gaur; Manual of Rural Composting. FAO/UNDP, Regional Project.RAS/75/004, **(1982)**.

[4] H.Kubota, K.Nagasaki; Biocycle., **32**, 66-68 **(1991)**.

[5] S.T.Mac Gregor, F.C.Miller, K.M.Prarianos, M.S. Finstein; Applied Environmental Microbiology, **41**, 132-1330 **(1981)**.

[6] S.Mahimairaja, N.S.Bolan, M.J.Hedley, A.N.Mac Gregor; Biores. Technol., **47**, 265-273 **(1994)**.

[7] S.P.Mathur, N.K.Patni, M.P.Levesque; Biol. Wastes., **34**, 323-333 **(1994)**.

[8] F.C.Miller, M.S.Finstein; J.Wastes Pollut.Control Fed., **57**, 122-127 **(1985)**.

[9] S.Sathyamoorthy; Post harvest technology for Banana. Seventeenth Annual Convocation of the Tamil Nadu Agricultural University, 5th September, Coimbatore, 22-25 **(1995)**.

[10] P.F.Strom, M.S.Finstein; Abst.Annu.Meet.Amer. Soc.Microbiol., Q89 **(1979)**.

[11] G.B.Willson, J.F.Parr, E.Epstein, P.B.Marsh, R.C. Chaney, D.Colacicco, W.D. Burge, L.J.Sikora, C.E. Teste, S.Hornick; Manual for composting sewage sludge by the Beltsville aerated-pile method. Report, EPA-600/8-80-022, MERL/ORD Cincinnati, **(1980)**.