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Domestic Waste Exploitation in the Course of Composting under Changeable Sets of Biotic Mingle

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Abstract: Domestic waste that comprise of food waste and kitchen waste has high moisture and organic matter content, which is easily decomposed by microbes. An attempt was made to investigate the feasibility of microbial conversion of such waste to multiple function biofertilizer. Moisture content was maintained at over 46%. Most easily degradable organic matter i.e. hemi-cellulose and cellulose were degraded first and final product had low value. Lipids, total sugar, cellulose were degraded by 96%, 81% and 66% respectively. NPK content was fairly rich in prepared compost as compared to ordinary dung compost. Physical/chemical parameters (moisture, OM, pH and NPK), stability indicator and biological indicators were analyzed for assessment of product quality.

Key words: Domestic waste · Microbial conversion · Biofertilizer, churning · Compost · Biological indicators

INTRODUCTION

Domestic waste or garbage is any form of waste derived from food materials, Kitchen waste and yard (Garden waste). It Typically consist of vegetable and fruit peelings, egg shells, Tea bags, coffee grounds, spoiled or left over prepared food, packing paper, paper napkins etc and other discard from domestic and commercial kitchens, Besides this yard waste also form a major portion of domestic waste that comprise of vegetative matter resulting from landscape management, it includes tree and shrub trimmings, hedge clippings, gross, palm fronds, leaves, stumps etc.

The four principal methods of decomposing food waste are dumping, burning, minimizing and recycling. Dumping is most common but it not only causes environmental damage. Burning also impacts environmental and community health and avail no scope for recourse recovery. However recycling and composting of domestic waste has been established as a way of reducing biodegradable waste and encouraging recycling as a way of recourse recovery and to made out best out of waste. Composting is the biological degradation of organic martial such as kitchen and garden waste by organism that feed on waste in the presence of oxygen and result in a humic like end product. A part from its role in waste management composting provides an opportunity of producing a very valuable end product which can be used in market sector such as agriculture and horticulture to improve physical and biological properties of soil by acting as a soil conditioner, as a supplier of nutrients and as a disease suppressant. Thus composting is a cost effective method of overcoming problems of domestic waste management, landfill space conservation and an imperative answer to resource recovery from bio degradable food waste.

MATERIALS AND METHODS

Selected sites had been marked for pits and bins arrangement. The rectangular pit's size was 3 x 3 x 2 ft

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(18 ft) and bin's size was 25 liters closed lid. Transportation of feed stocks up to pit sites was managed for periodic filling. Feed stocks were segregated for unwanted imparities, segmented and fed. Green waste was taken base of feed stocks added with bulking agents to ensure sufficient porosity and moisture content. Biotic sets were prepared for all possible configurations of microbes selected, bulking agents and in terms of additional N supplied. Over all 12 combinations were made and all combinations were subjected to both aerobic and anaerobic conditions in pits and closed lid bins. Feed stocks were mixed with bulking material in various amalgamation and biotic sets for each combination was prepared. Such biotic sets were inoculated with thermophillic and lipolytic microbes and incubated in pits and bins. Microbial inoculation enhances the degradation of food waste, increase the total N, aid in hydrolyzing and shorten the maturity period and finally improve the quality of biofertillizer. Composting proceeds in predictable stages of mesophillic (50-105°F) and thermophillic range (106-170°C) which was the most productive stage of composting. Periodic mixing and churning of the compost pile was maintain in an ambient temperature range of 45-65°C, C:N ratio for various feed stocks were taken as food waste 15:1, grass trimmings 15:1, fruit waste 50:1 and an overall C:N ratio was maintained in the range of 30-45 which was most conducive. Additional N input was made by adding manure and urea. Inorganic N content of matured compost was very low rendering the compost as a good soil conditioner. Composting proceeds in predictable stages in terms of temperature and moisture content. The process initiating with warming up of pile through mesophillic range (50-105°F) and temperature rises up to thermophillic range (106-170°F) followed by curing and maturation. The harvesting of compost was done by separation of matured and cured compost from the parts and things that were not decomposed or still unfinished. Prepared and matured compost became dark, loose and crumbly.

RESULTS AND DISCUSSION

The compost so obtained was assessed for nutrient availability and other physical and chemical parameters such as C: N ratio, pH, moisture content (MC), organic matter content, bulk density and micro-macro nutrient analysis. The parameters are listed in Table 1.

Physical Parameters: All material was dark brown in color. Parent material was no longer visible. Structure was fine mixture of small and medium sized particle and humus crumbs. The smell was like rich humus from forest floor, No ammonia odor was found. The moisture content was found low <30-40%. Moisture content is a measure of amount of moisture present in a compost sample and expressed as a percentage. The range falls between <35%-<65%.

Chemical Parameters: The pH value of prepared compost was found in range of 6.5-8.5. It is important since applying compost to soil may alter the soil pH and had an effect on availability of nutrients to plants. C: N ratio is a ratio of organically bound carbon for total N which provides an indicator of rate of decomposition of the feed stocks and to determine when ripeness has been reached. Most prevalent range for C: N falls from 21 - 25.

Organic Matter: OM is am important ingredient of all soil, has an important role to play in maintaining soil structure nutrient, availability and water holding capacity. It is usually expressed as % age of dry Wt. range from 30-55%.

Table 1: Parameters Assessed for Various Biotic Sets

Sets/ Parameter	C.N. Ratio	pH	Moisture Content % fresh wt.	Organic Matter % dry wt.	Bulk Density g/l fresh wt.
AEROBIC					
A	26.5	7.5	44.45	37.5	228.6
B	20.2	8.0	52.1	40.8	320.6
C	17.8	6.9	57.1	50.9	404.3
D	24.2	8.5	42.8	48.9	253.8
E	19.0	8.2	48.0	36.5	309.1
F	27.2	7.1	55.8	45.6	317.8
G	17.5	6.8	57.8	35.5	327.3
H	26.8	8.4	40.6	45.2	268.6
ANAEROBIC					
I	28.0	6.5	60.8	44.8	356.0
J	28.4	6.9	60.4	39.6	269.1
K	30.1	7.0	58.7	41.0	415.9
L	28.4	7.2	59.4	37.5	387.6

Table 2: Nutrient Availability in Biotic Sets.

Sets/ Parameter	Organic C %	Total N%	P%	K%	Ca %	Mg %	Cu	Zn
A	7.8	1.2	0.48	0.96	1.55	0.5	18.8	-
B	7.47	1.7	1.0	1.4%	1.73	0.4	14.9	-
C	7.8	2.1	1.15	1.23	3.58	0.23	17.3	90.7
D	6.4	1.86-1.96	0.73	1.67	2.26	0.31	18.6	92.1
E	7.2	1.77	0.42	0.84-1.04	3.9	0.34	15.7	83.0
F	7.5	1.4	0.97	0.87	3.34	0.41	-	81.0
G	8.0	1.52	0.86	0.88-1.4	1.99	0.37	-	-
H	8.6	1.72-1.80	0.73	1.64	2.8	0.38	-	-
I	7.0	1.80-1.88	0.579	1.56	2.97	0.40	15.1	-
J	7.8	1.5	0.88	-	1.6	0.40	17.2	84.5
K	8.9	1.24	0.84	-	2.1	0.37	13.8	-
L	7.6	1.8	0.70	1.68	2.90	0.36	-	91.4

Abbreviations: MC=Moisture content, TN=Total Nitrogen, TP= Total Phosphorus, TKN= Total Kjendahl Nitrogen, NPK=Nitrogen, Phosphorus and Potassium, OM=Organic matter, Wt= Weight

Bulk Density: Bulk density is deferred as Wt. per unit volume. It can be measured after drying the sample at 105°C for 12 hr and recommends a range of 120-369 g/L.

Nutrient Content of Compost (NPK): Compost contains macro and micro nutrient, which are required for plant growth. N, P and K are nutrients which are utilized in the greatest quantities by plant knowledge of nutrient content of compost is important because it allow the facility user to determine an appropriate end use of the compost. In general, nutrients are organically bound within compost and are slowly released over a period of time as a result of microbial activity. Usually 90% of N in compost is organically bound and the most available form is only when it is converted into an inorganic form and exists as- NO_3N. It falls in a range of 1.0-2.0%. Total phosphorus (TP) is usually expressed in terms of % concentration per dry weight. The range of TP is usually between 0.4-1.1%. Potassium in its available form exists as K_2O in compost. Range of potassium is 0.6-1.7%.

Similar result for total C and N, C : N ratio and water soluble No_3-N and NH_4-N had been found by [1] in saw dust composting. Most favorable range was found between 30 - 40% and TN falls in arrange of > 8 mg NO_3-N/mg. A range of organic matter content from 30 - 58% dry wt. and C : N ratio between 25 - 30% was obtained by composting process of Biowaste and green waste [2] other parameters were also found relative as pH, MC and bulk density. Bulk density was measured after drying the sample at 105°C for 12 hrs and range most prevalent was found to be 120-140 g/L. Organic matter evolution during the decomposition of labile organic compounds and simultaneously synthesis of humic like substances were carried out by [3, 4]. A range of organic matter 32-56% and organic carbon<6> 1 was found. Result showed a promising evolution of total carbon employed in both ways of composting viz. piles and windrow methods. The pH, moisture content (MC), TKN (Total Kjeldahl nitrogen) and C: N ratio was taken as parameters of compost quality assessment in different sources of compost prepared [5]. The pH ranged of 6.8- 8.5, MC was slightly higher in range of 55 - 85% and C: N ratio was in similar range of 20 - 35%. Similar results in case of TP (Total phosphorus) were also found, falling in range of 0.4-1.5%.

Microbial conversion of food waste for biofertilizer production has been studied by [6] and a similar range of pH (5.5-8.0) and C: N ratio (20-25) and total Nitrogen (1.0-2.0%) was found. However the optimum range of total MC was a little high as the food stock was processed food. The comparison of composting experiment reveals that a significant reduction of total organic C, C: N ratio took place after the inoculation of microbes, which enhanced the degradation of OM and reduction in bulk density also.

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