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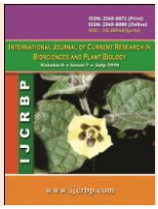

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Aerobic composting of fruits and vegetable wastes from Madiwala market, Bengaluru, Karnataka, India

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ABSTRACT

Composting is one of the cheap and best methods for the disposal of organic waste and its conversion into valuable products. Composting is a spontaneous, biological decomposition process of organic materials in a predominantly aerobic environment. Composting is one of the important and economical methods of the manipulation of a biological process, decomposition; raw organic materials such as manure, leaves, grass clippings, food wastes, and municipal bio solids are converted to stable soil-like humic substances. Composting is an ancient technology undertaken on a variety of levels, from home to industrial which involves a number of microbes. Composting have several benefits, it improves manure handling, possible saleable product, improves land application, minimum risk of different pollution problems, perfect soil conditioner. Composting is a process in which biological breakdown of organic waste under different controlled conditions takes place. The objective of this paper is to study the performance of the aerobic composting of vegetable and fruit wastes in different proportions which may prove to control the environmental pollution and the end product will be useful to the peoples.

Introduction

One of the major environmental concerns in urban areas today is the issue of Solid Waste Management. In India, the collection, transportation and disposal of solid waste is normally done in an unscientific and chaotic manner. Uncontrolled dumping of wastes on outskirts of towns and cities has created overflowing landfills, which are not only impossible to reclaim because of the haphazard manner of dumping, but also have serious environmental implications in terms of ground water pollution and contribution to global warming. An effective system of solid waste management is the need of the hour and should be environmentally and economically sustainable. Composting is the simplest yet best process for solid waste management for our condition. It is basically a special form of Waste Stabilization that requires special conditions of moisture and aeration to produce stable compost which can be used as a low grade manure and soil conditioner.

Composting is the biological decomposition and stabilization of organic substrates under conditions

that allow development of thermophilic temperatures as a result of biologically produced heat, to produce a final product that is stable, free of pathogens and plant seeds, and can be beneficially applied to land. A composting process seeks to connect the natural forces of decomposition to safe the conversion of organic waste into organic fertilizer. There are two main groups of organisms which decompose organic matter. a. Anaerobic bacteria which perform their work in the absence of oxygen. b. Aerobic bacteria which perform their work in the presence of oxygen. Plant nutrients are very important for the development of crops and hygienic food for the increasing population of world. Plant nutrients are major and important component of sustainable agriculture (Ryckeboer et al., 2003).

Biofertilizer made by composting process has been identified as an alternative to chemical fertilizer to enhance soil fertility and crop production (Michael et al., 1995). There is large number of genetic heterogeneity in microbes. Studying the microbial variety in the environment is the inability to get many of microbes in culture (Sait et al., 2002). The main characteristics of anaerobic composting are the process is a lengthy one extending over a period of 4 to 12 months. It is a low temperature process and the destruction of pathogens is not fully accomplished. The gaseous products of reduction like methane, hydrogen sulphide produce offensive odors. Nutrients are lost (Sait et al., 2001).

Nutrients are lost. Aerobic composting is characterized by rapid decomposition normally completed within 8-10 weeks. During this period high temperatures are attained leading to speedy destruction of pathogens, insect eggs and weed seeds. These materials also produce an unpleasant smell during degradation (Golabi et al., 2003).

Production of foul smelling gases like methane, hydrogen sulphide is minimized. Nutrients are fairly preserved. In order to accelerate and control the aerobic composting a specially formulated biological inoculum is used to treat the organic waste, which is the key element in aerobic composting. Time of composting process depends on C: N, aeration, particle size, moisture content and temperature (Dees and Ghiorse, 2001).

Materials and methods

Collection of fruits and vegetable waste

The Madiwala market waste (i.e., fruits and vegetable waste), has been selected as composting material along with the use of fallen tree leaves and dry grass as bulking material, for carrying out the study work of aerobic composting. Besides vegetable waste, fallen tree leaves and dry grass was also collected from the streets, yards and gullies. The ratio of vegetable waste and fallen tree leaves and dry grass was taken as 5:2 in order to adjust C/N ratio (Table 1).The following criteria were selected for an appropriate method for efficient disposal of vegetable waste and fallen tree leaves.

1. Nuisance and environmental friendly atmosphere.
2. No extra financial burden in collection and transportation of waste.
3. Minimum installation and operation cost.
4. Easy process to operate and maintain.
5. Effective disposal of vegetable waste generated from the kitchen.
6. Producing a final product which may be used as a good manure.

Experimental set up

Green colour aerobic plastic compost bin used for making compost from fruits and vegetable waste. The experiment was performed at an ambient temperature of 25 ± 7°C under the shed for 60 days in the Garden area of Department of Botany, Jyoti Nivas college Autonomous, Bengaluru. The quantity of waste material used for composting was 10 kg. On each layer is spread slurry made with 2.5 kg cow dung, 2.5 kg of soil. Sufficient quantity of water is sprinkled over the material in the pit to maintain the moisture content and monitored at regular intervals. The experiment was examined at an interval of one week for one month. At the end of experiment, changes in pH, moisture content, Carbon, Nitrogen, Phosphorous, Potassium and C: N ratio was monitored.

Results and discussion

The results obtained from the analysis are shown in Tables 1 to 5. The color of the finished product is

dark brown. It is having an early scent and crumbly in nature. The temperature of the product is almost equal to ambient temperature. The pH of the final compost is 8.00. Final C/N ratio is 25.23. The material was reduced to final size in granular form except very small percentage of some soil lumps, which were formed due to some partially decomposed tiny grass cutting of cellulite nature. The moisture content of vegetable market waste was higher which accounted 86% followed by combined waste (67.50%) and tree leaves + grass cuttings (34%) on dry weight basis (Table 1). The compost temperature increased up to 22 days and started to decline and finally reached 32.2°C on 60th day (Table 2). The total organic carbon content showed reduction from the initial values. The potassium content on dry weight was 0.53, 0.569, 0.583, 0.54 and 0.565 on 1, 15, 30, 45 and 60days of composting respectively (Table 3). As indicated in Table 4 the C/N ratio started to decline as a function of decomposition of organic wastes during composting. The values of final compost obtained showed on par with standard compost (Table 5). Earlier studies on paddy straw + maize stalk (1:1, w/w) compost was the best formulation which could be further exploited for large scale production of mushrooms for small and marginal farmers also showed similar results (Kaur et al., 2019). The results obtained in the present study coincide with the result obtained by Gurumurthy et al. (2018) where the study focused composting with microbial consortia.

It is concluded that the recycling of the vegetable waste through aerobic composting is a simple method to process and operate which is nuisance free, environmental friendly, aesthetically good looking, economical in long term and socially acceptable as the final product has good fertilizer value. Composting is an environmentally friendly method rather than directly dumped into earth and it method is useful to convert organic waste to useful products and that would otherwise have been land filled. Compost has a lot of benefits like: reduce landfill space, reduce surface and groundwater contamination, reduce methane emissions, reduce transportation costs, reduce air pollution from burning waste, provide more flexible overall waste management, enhance recycling of materials and can be carried out with little capital and operating costs. At the end of the decomposition process, a stabilized organic matter which can be used as fertilizer supplement for horticulturists, landscapers, orchardists, farmers etc was obtained. This stabilized organic matter can also be used to control soil erosion. Composting process by selected method seems to be an economical; it will not require any extra cost of collection and transportation of the waste. The existing system has already the facilities of collection and transportation and need not appoint any additional establishment for this job. Hence introduction of this system will prove to be economical for long term.

Table 1. Characteristics of composting material and bulking material.

Waste sample	Moisture content (%)	pH	Total organic carbon (%)	Total nitrogen (%)	C/N ratio
Madiwala Vegetable market waste	86.00	6.69	34.00	1.55	22.00
Tree leaves and grass cutting (Dry)	34.00	7.50	47.90	0.70	81.60
Combined waste (5 parts of vegetable waste)	67.50	6.90	37.50	1.167	31.92

Table 2. Observed values of temperature during composting.

Time (in Days)	Temperature °C	
	Ambient temperature	Compost temperature
1	26.50	29.00
8	28.30	41.00
15	29.00	48.50
22	33.00	52.50
30	35.00	49.00
37	34.50	43.00
45	36.00	41.00
52	33.50	36.00
60	30.20	32.20

Table 3. Change of physico-chemical parameters during composting.

Parameters Time (in days)→	1	15	30	45	60
Moisture content (%)	68.50	59.50	54.70	48.50	53.00
pH	6.80	5.50	7.00	7.80	8.00
Organic matter content (% dry weight)	68.00	49.50	43.00	38.20	29.00
Organic carbon content (% dry weight)	38.77	31.00	25.4	22.95	18.82
Total nitrogen content (% dry weight)	1.167	0.94	0.83	0.678	0.734
Phosphorus content (% dry weight)	0.614	0.589	0.577	0.569	0.589
Potassium content (% dry weight)	0.53	0.569	0.583	0.544	0.565

Table 4. Observed values of organic matter content, total organic carbon, total nitrogen and C/N ratio during composting.

Time (in Days)	Organic matter content (%)	Total organic carbon (%)	Total nitrogen (%)	C/N ratio
1	68.00	38.77	1.167	33.82
15	49.50	31.00	0.94	31.43
30	43.00	25.40	0.83	30.25
45	3.820	22.95	0.678	32.01
60	29.00	18.82	0.734	25.23

Table 5. Comparison of chemical characteristics of fresh waste, finished compost and standard compost.

Parameters	Fresh vegetable waste	Finished compost	Standard compost
Organic matter content	60.00	24.89	25 - 50
Total organic carbon	37.77	14.43	8 – 40
Total nitrogen	1.187	0.841	0.50 – 3.40
Total phosphorous	0.611	0.598	0.50 – 3.50
Total potassium	0.52	0.551	0.50 – 2.00
pH 6.80	8.02	7 – 8	

Note: All the values are in % except pH.

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Conflict of interest statement

Authors declare that they have no conflict of interest.

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