Synthesis of Organic Fertilizer from Biodegradable Wastes

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ABSTRACT

Changing life style and increase in population has increased the quantity of organic waste in the environment. Nearly 700 million tons of Biodegradable wastes are generated in India. To mitigate this problem all the waste can be converted into highly valuable nutrient-rich compost in an environment friendly manner. Vermicomposting is better option to tackle all these problems. Present study examines the potential of the Red Wriggler (Eisenia Foetida) in the vermicomposting of Kitchen (Biodegradable) waste through tank method. In this process, the digestive tracts of certain earthworm species (e.g., Red Wriggler) are used to stabilize organic wastes. A mixture of Kitchen waste and cow dung in the ratio of 1:2 was found to be the addition of best substrates. The final product is an odorless peat like substance, which is produces from the guts of earthworm, known as Vermicast (BLACK GOLD) that has good structure, moisture-holding capacity, relatively large amounts of available nutrients, and microbial metabolites that may act as plant growth regulators. Vermicomposting is becoming popular as a major component of organic farming system, as it offers immense scope to small and marginal farmers in creating their own organic manorial resources and ways to generate alternative income.

Keywords: Cow dung, Eudrilus eugeniae, Kitchen Waste, Organic Farming, vermicomposting

1.0 Introduction

Organic agriculture is the only way which promotes and enhances agro ecosystem health, including biodiversity, biological cycles and soil biological activity. In the recent years, it is no doubt that in India, where on one side pollution is increasing day by day due to accumulation of organic waste and on the other side there is a great shortage of organic manure. Management of solid waste has become one of the biggest problems we are facing today.

Substantial increase in population has leaded the solid waste management issue to a serious challenge especially in the metropolitan cities. It has been estimated that India, as a whole, generates as much as 25 million tonnes of urban solid waste of diverse composition per year [1]. Solid waste comprises of both organic and inorganic matter. Of these, household kitchen waste (Biodegradable wastes) is one of the major sources of municipal solid waste. About 50-70% of kitchen and canteen wastes are generated every day. Under the present condition of environmental degradation vermicomposting technology offers recovery of valuable resources like manure from such biodegradable waste.

Green revolution can only be attained by adopting the Vermicomposting technology. It is one of the most effective, eco-friendly ,and economical method for composting any kind of organic matter, which would provide a „win-win" solutions to tackle the problem of safe disposal of waste and also provide most needed plant nutrients for sustainable productivity. Vermicomposting has variety of applications such as bio adsorbent to removal heavy metal ions, enhancement of microbial community, plant growth, reduction of recalcitrant hydrocarbon in soil, and reduction in the concentration of some pesticides in soil.

Vermicomposting is an inexpensive, modern biotechnology provided for the biodegradation of solid wastes, in which earthworms are employed as natural bioreactors in the process of decomposition of organic matter. It is a mesophilic process, in which earthworms especially Epigeic species (Eisenia foetida) cooperate with other microorganisms for bio-transformation and bio- stabilization of organic waste converting into high valuable end product known as vermin compost. Vermin-compost provides major nutrients to the soil for plant growth and also consists of important vitamins and growth hormones. Advanced systems for vermicomposting are based on top feeding and bottom discharge of a raised reactor, thus providing stability and control over key areas of temperature, moisture, and aeration.

2.0 METHODOLOGY

MATERIAL REQUIREMENTS:

COLLECTION OF VEGETABLE AND FRUIT WASTES:

Degradable wastes such as vegetable peels and other fruit skins are collected from College Mess and Canteen. The collected organic wastes are dried under shady areas in order to avoid direct exposure of sunlight, as it will consume all the bio contents of the peels. No citric acid fruits should be included as it kills the entire life of the earthworms.

COLLECTION OF BEDDING STOCKS AND DRY COW DUNG:

Bedding materials such as Pebbles, Sand, Soil, Neem leaves, Cartons, Coconut Fibers, Rice husk, Straw, Egg shells, Litters, Vegetable peels, Fruit skins (Banana peels) etc., Pebbles are purchased from India Mart, with a quantity of 25Kg. Sand is collected from the constructional area of our college premises. Soil is taken from the garden. Neem leaves, Litters, Grasses, Rice husks, Straw are collected from the lawn. Vegetable peels and Fruit skin such as Banana peels, Egg shells, Cartons, Coconut Fibers are collected from the Canteen and Hostel Mess. Dry Cow Dung is collected [2].

COLLECTION OF RED WORMS:

The Red Wriggler Worms are collected from the nursery. These are the only worms which will intake the biodegradable waste as their food. These worms will not make burrows in the soil, as it feeds exclusively on decomposing Organic matter. These worms will not stay permanently as it cannot bear more tropic or temperate environment.

TYPES OF COMPOSTING:

There are two fundamental types of composting: They are, Aerobic and Anaerobic

Aerobic composting

Composting is the decomposition of organic waste in the presence of oxygen (air); the process includes CO_2, NH_3, water and heat. This can be used to treat any type of organic waste but, effective Composting requires the right combination of ingredients and conditions. These include the moisture contents around 60-70% and Carbon to Nitrogen (C / N) ratios of 30/1. Any significant variation inhibits degradation process. In general, wood and paper provide an important source of carbon, while sewage sludge and food waste provides nitrogen to ensure an adequate supply of oxygen at all times. Ventilation of waste, either forced or passive is essential [3].

Anaerobic composting

Anaerobic Composting is the decomposition of organic wastes in the absence of O_2, the products being methane (CH_4), CO_2, NH_3 and trace amounts of other gases and organic acids. Anaerobic composting was traditionally used to compost animal manure and human sewage sludge, but recently it is become more common for some municipal solid waste (MSW) and green waste to be treated in this way [4].

COMPOSTING METHODS:

Pit below the Ground:

Pits made for vermicomposting are 1m length and 1.5m wide. The lengh and depth may vary as required.

Heap above the Ground:

The organic wastes are spread on a polythene sheet placed on the ground and then covered with cattle dung. Considering the biodegradation of wastes as the criterion, the heap method of preparing vermicompost was better than the pit method. Earthworm population was high in the heap method, with a 21-fold increase in Eudrilus eugenae as compared to 17-fold increase in the pit method. Consequent production of vermicompost was also higher in the heap method (51Kg) than in pit method (40Kg) [5-7].

Tanks above the Ground: (Preferred Method for the Project)

Tanks made up of different materials such as normal bricks, hollow bricks, and locally available rocks were evaluated for vermicompost preparation. Tanks can be constructed with the dimensions suitable for operation. The commercial bio-digester contains a partition wall with small holes to facilitate easy movement of earthworms from one tank to another.

Cement Rings:

Vermicompost can also be prepared above the ground by using cement rings. The size of the cement ring should be 90 cm in diameter and 30 cm in height.

3.0 RESULTS AND DISCUSSION

PARAMETERS:

1. pH:

The pH of the compost was lower in all the experimental set ups than their initial values. The decrease in pH value at the final stage of compost formation may be due to the production of CO_2 and organic acids by microbial metabolism during decomposition of different substrates in the vegetable waste.

2. Nitrogen:

Decrease in pH may be an important factor in Nitrogen retention as this element is lost as volatile ammonia at highest pH, loss in organic carbon might be responsible for nitrogen enhancement. Pseudomonas bacteria also have great impact on nitrogen transformation in manure, by enhancing nitrogen mineralization, so that mineral nitrogen may be retained in the nitrate form. However in general the final nitrogen content of compost is dependent on the initial nitrogen present in the waste and the extent of decomposition. In the present study, the vegetable wastes were effectively decomposed by the applied microbes. It is due to increased microbial activity continues in the casts and results in an increased rate of mineralization of organic nitrogen [6].

3. Phosphorous:

The total phosphorus increased significantly in the experimental setup than the control Increase in TP during compost formation by bacterial action is probably due to mineralization and mobilization of phosphorus and enzymatic activity of bacteria.

4. Potassium:

Acid production by the microorganisms seems to be prime mechanism for solubilizing the insoluble potassium.

5. C:N Ratio:

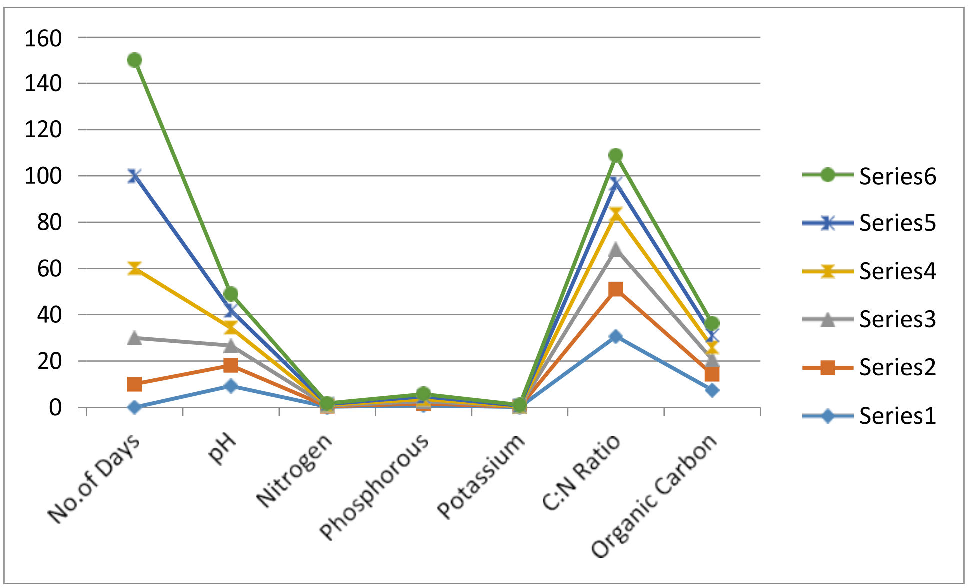
The CN ratio traditionally considered as a parameter to determine the degree of maturity of compost. C N ratio below 20 is an indication of acceptable maturity. While a ratio of 15 or below being preferable [7,8].

Table 1. Nutrient Analysis of Vermicompost

S.No.	No.of Days	pH	Nitrogen	Phosphorous	Potassium	C:N Ratio	Organic Carbon

1.	0	9.2	0.18	0.76	0.07	30.6	7.4
2.	10	8.9	0.24	0.83	0.1	20.42	6.8
3.	20	8.5	0.28	0.92	0.125	17.3	6.4
4.	30	7.8	0.32	1.02	0.134	15.28	5.3
5.	40	7.4	0.35	1.1	0.26	13.12	5.24
6.	50	7.2	0.37	1.19	0.32	12.08	5.04

Figure 1: Nutrient Composition



4.0 CONCLUSION

The present study was revealed that Vermicomposting is an alternate technology for the management of biodegradable organic wastes. During the course of Vermicomposting, while the TOC content can decrease' considerably, the fertilizing capacity (NPK content) will increase sharply. The results obtained during this study indicate that Vermicomposting of VFM organic waste mixed with different types of bedding materials can convert this waste to valuable product suitable for different applications. Vermicomposting analysis was also shown that the type of the initial substrates has little effect on the product properties.

Our review identified that vermicomposting may be the viable and a very low cost option to handle solid waste in an eco – friendly way. Based on the above discussion, it can be concluded that vermicomposting is a waste management technology that involves decomposition of organic fraction of solid waste in an ecofriendly way to a level in which it can be easily stored, handled, and applied to agricultural fields without any adverse effects. Integration approach of composting and vermicomposting processes provides better results by combining both processes and choosing one of the two forms as (i) Pre vermicomposting followed by composting or (ii) Pre composting followed by vermicomposting.

Further, to optimize the process of vermicomposting, codigestion of organic wastes provides better opportunity for both microorganisms and earthworms to convert the organic fraction of solid waste under controlled environmental conditions. Feeding, stocking density, pH, C/N ratio, temperature, and moisture, by inference, seem to be the critical factors that influence the vermicomposting process. Furthermore, the end product of vermicomposting, the nutrient-rich compost, could be used for biogas production. Hence, the management of solid waste and energy production can be achieved at the same time with no further costs. Thus, vermicomposting technology can be used for economical recycling of solid organic waste in developing countries. It is strongly recommended that this technology can be used to manage the waste placed in landfill or in open dumps, sewage sludge, incineration waste, and dumps in the agricultural fields to avoid/reduce groundwater contamination and toxicity of soils and plants through different contaminants.

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