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Management of Kitchen Waste Material through Vermicomposting

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ABSTRACT

India produces around 3000 million tones of organic waste annually. This huge volume of waste(s) comes from agriculture, urban and industrial sources and also from domestic activities. Utilization of this waste material for productivity process is important for both economical and environmental reasons. In the present study an effort has been made to asses the efficacy of E. foetida (red tiger worm) in utilizing the kitchen waste material, to analyze the waste decomposition process assessed with earthworm activity. This chosen substrate was mixed with cow dung in the ratio of 4:1 (w/w) to initiate the waste conversion process into a useful product. Physical and biochemical activity, occurring during the 75 days of vermicomposting period were analyzed. During this process pH, organic carbon, organic matter and C:N ratio revealed negative trend, however total nitrogen, available phosphorus and exchangeable potassium content expressed positive trend of increment with vercomposting period. 15 days precomposting of substrate (kitchen waste + cow dung) and subsequent vermicomposting upto 75 days, clearly indicate the potential of earthworm biotechnology in reduction of biomass of the waste, addition of the nutrient pool (nutrient enrichment) and more availability of animal protein in the form of earthworm number and biomass.

KEY WORDS: *E. foetida, pH, organic carbon, organic matter, cow dung*

INTRODUCTION

Due to increasing in population, rapid industrialization and trend of urbanization, the problem of various types of men made waste products are gradually increasing. There are different types of wastes like solid, liquid and gas, which are needed to be handled and the solid waste management itself covers a vast field. Solid wastes are produced at different sources i.e. institutional, commercial, agricultural and industrial.

Utilization of these waste materials for productivity process is important for both economical and environmental reasons. Agricultural waste, city garbage and kitchen waste has been recycled with vermicomposting along with bio-conversion of organic waste material into nutrition rich vermicompost by earthworm activity [1]. Vermicomposting is an important aspect, as it converts waste to wealth by using cheap eco-friendly option with activity of earthworm [1].

The physical process include substrate aeration, mixing as well as grinding, while the biochemical process is influenced by microbial decomposition of substrate in the intestine of earthworm [2-3]. The present study chosen considering the fact that management of kitchen waste through vermicomposting is of paramount significant from the point of view of healthy quality of environment. Hence this work promote the utility of earthworm potential in waste management biotechnology, thus resulted in utilization of waste material into useful product on one side environment clean up another side.

MATERIALS AND METHODS

Collection of material

Kitchen waste material was collect from houses, then air dried and grinded into small pieces. This grinded waste material was mixed with cow dung in the ratio of 4:1 (w/w) and was subjected aerobic composting to initiate microbial activity. Moisture content of the was maintained to 60% to 70% and this mixture was then kept in plastic containers covered with paper having holes to facilitate aeration in order to get final composted material. This mixture was hand manipulated at regular time intervals and remoistened for sufficient microbial activity.

Collection of animals

When the temperature becomes constant and colour of the mixture turns brown to black, it was used as substrate for vermicomposting. For vermicomposting the earthworms (*Eisenia foetida*) were obtained from vermicompost unit of Dept. of Botany and Microbiology, B.S.A College, Mathura.

Physico-chemcial analysis

During the composting process the material was analysed for different physico-chemical attributes such as pH, organic carbon, total nitrogen, available phosphorus, exchangeable potassium, C: N ratio and organic matter as per the methods suggested by other workers [4-6], as well as for earthworm number, biomass, cocoon production and weight loss of organic substrate [7-8]. During the course of investigation, the samples were examined at periodic intervals after 15, 45 and 75 days of vermicomposting.

RESULT AND DISCUSSION

It is evident from the data presented in Table 1. that kitchen waste material (control) characterized with high values of pH (9.32), organic carbon (7.25%) and organic matter (12.49%). However, other nutrients such as total nitrogen (0.214%), available phosphorus (0.11%) and exchangeable potassium (0.086%) were found in very trace amounts. The vermicomposting activity significantly modified the physical and chemical properties of kitchen waste material that can be an important tool for organic farming.

It is indicated in Table-1 that during vermicomposting the pH declines (from 9.32 to 8.37) with the advancement of vermicomposting period (from 0 to 75 days). It might be on account of high mineralization of nitrogen and phosphorus into nitrates/nitrites and ortho-phosphate. Moreover, the organic carbon content, organic matter and C:N ratio of the kitchen waste material also showed the same pattern and decline gradually upto 75 days. The highest values of organic carbon, organic matter and C:N ratio were obtained in control (0 day) i.e. 7.25%, 12.49% and 30.08% respectively and lowest values were obtained after 75 days of vermicomposting i.e. 3.69%, 6.37% and 4.79% respectively. Moreover, after 75 days of vermicomposting, there is about 10.19% decline found in pH, 49.02% in organic carbon, 49.03% in organic matter and 84.08% in C: N ratio. These data are also supported by Elvira *et al*. [9], who observed 20 to 42% loss of carbon as CO_2 during vermicomposting of paper mill and dairy sludge. Moreover, the increase in earthworm population might also be attributed to the C: N ratio decreasing with time [10].

It is clearly evident from the result of Table 1. that the values of total nitrogen, available phosphorus and exchangeable potassium increased over 75 days of vermicomposting. Lowest values of total nitrogen (0.214%), available phosphorus (0.11%) and exchangeable potassium (0.086%) were found in control (0 day). Moreover, as the time period increases during vermicomposting, these parameters also increases and their maximum values i.e. total nitrogen (0.771%), available phosphorus (0.11%) and exchangeable potassium (0.386%) were obtained after 75 days of vermicomposting. Gunadi *et al*. [11] also demonstrate that after six months of vermicomposting, the nitrogen content in the end product was high. The perusal of data as revealed in Table-2, that no mortality of earthworm was observed in vermicomposting of precomposted kitchen waste. Garg *et al.* [12], while working growth and reproduction of *E. foetida* in animal wastes also opined that precomposting is very essential to avoid the mortality of worms. Increased worm number and cocoon production was found to be maximum after 75 days of vermicomposting. Suthar [13] also noted the changes in biomass and cocoon production and attributed the cause of difference in substrate composting quality. It is clearly evident from Table-3, that earthworm biotechnology greatly reduces the waste amount, besides improving the nutrient pool status of converted biomass for its utilization for one or the other purposes in agricultural production. During vermicomposting of kitchen waste, the weight loss percentage was found to be 61.94%.

From the present study, it can be concluded that earthworm biotechnology is the one more economic, eco-friendly waste management technology and resulting in the bioconversion from waste to wealth. Moreover, this waste management technology mediated by earthworm could also be utilized for self employment, resource generation in rural areas and a big income generation resource especially in urban cities.

Table-1 Effect of vermicompost on different phyco-chemical parameter of kitchen waste

S. No.	Parameters	Duration of vermicomposting			
		0 days	15 days	45 days	75 days
1	Ph	9.32	9.22	8.9	8.37
2	Organic carbon (%)	7.25	5.265	5.078	3.696
3	Total nitrogen (%)	0.241	0.301	0.361	0.771
4	Available phosphorus (%)	0.11	0.12	0.16	0.18
5	Exchangeable potassium (%)	0.0086	0.132	0.196	0.386
6	C:N ratio	30.08	17.49	14.06	4.79
7	Organic matter (%)	12.499	9.076	8.754	6.371

Table 2. Impact of composting period on earthworm number, biomass and cocoon production

Type of Waste	Earthworm Number			Body Weight (gm)			Cocoon Production		
	0 days	45 days	75 days	0 days	45 days	75 days	0 days	45 days	75 days
Kitchen Waste	50	59	65	16.45	35.50	41.40	Nil	20	38

Table 3 Impact of vermicomposting on weight loss of organic substrate

Type of Waste	Initial weight of substrate (gm)	Weight of precomposted waste (gm)	Final weight of vermicompost (gm)	Loss % during vermicompost
Kitchen Waste	1000	670	255	61.94

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