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Effect of Different Substrates and Effluent on Vermicomposting by Surface Feeder Species

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Abstract: ***Management of industrial waste has become one of the biggest problems world is facing today. The rapid increase in the volume of waste is one aspect of the environmental crisis, accompanying recent global development. The conventional methods of waste management including incineration and uncontrolled dumping proved to cause environmental pollution. Use of earthworm species to biodegrade various substrates (industrial wastes, agricultural residues etc) for composting has proven to be successful after initial stabilization of vermin beds. Present work is vermicomposting by essentially the consumption of organic material, the textile industry effluent by surface feeder earthworm species Eiseniafetida. The worms upon the consumption of effluent components brought about its treatment and subsequently the formation of compost. Effect of two different agricultural residues like saw dust and rice husk on vermicompost was also compared. Vermicomposting was better with sawdust as substrate.***

Keywords: Vermicompost, effluent, earthworm, sawdust, rice husk

1. Introduction

Most common practices of waste processing are uncontrolled dumping which causes mainly water and soil pollution. Besides dumping or sanitary land filling, the final disposal of solid waste can be carried out by other methods like incineration and composting. Although various physical, chemical and microbial methods of disposal of organic solid waste are currently in use, these methods have some disadvantages and involve high cost. In this regard 'Vermicomposting' has been reported to be a viable, cost effective technique for the efficient management of the organic soil waste (Longsdon, G., 1994; Hand *et al*., 1998). Several researches have demonstrated the ability of earthworms to obtain the biodegradable part of the municipal solid waste as well as industrial wastes (Ghosh*et al*., 1999; Sabrina *et al*., 2009).

Vermicomposting utilizes earthworms as bioreactors to biodegrade organic wastes to humus. Substrates as solid wastes derived from agro based and food processing industries and agricultural residues have been tried for vermicomposting. These wastes are recalcitrant to biodegradation (Munnoli and Bhosle , 2009). Cowdung has been employed as a medium substrate to initiate and acclimatize earthworms first to local conditions and then initiate vermicomposting of chosen industrial substrates (Arora and Sharma, 2002). By using variety of earthworms number of wastes can be converted into compost like, vegetable waste, domestic waste, paper, food refuses, agro - industrial waste, biogas digester effluent, sewage sludge and other industrial waste. Vermicomposting can be also employed for plant based residues those containing high quantity of cellulose, hemi cellulose, lignin, starch etc.

Epigeics like *Eiseniafetida* and *Eudriluseuginiae* have been used in converting organic wastes into vermicompost. Though these surface dwellers are capable of working hard on the litter layer and can convert all the organic waste into manure they are of no significant value in modifying the structure of the soil. In addition, it can take a lot of handling and rough treatment. Perhaps most importantly, like most if not all litter-dwelling worms, the compost worm has the capacity for very rapid reproduction.

Through vermicomposting process physical, chemical and biological reactions take place, resulting changes in the organic matter. The resultant product (vermicast) is much more fragmented, porous and microbially active (Rupani*et al*., 2010). In contrast to traditional microbial waste treatment, vermicomposting process results in bioconversion of the organic wastes into two useful products: the earthworm biomass and the vermicompost. Earthworm biomass can further be processed into proteins as a source of animal feeds (Hartenstein and Hartenstein, 1981). The latter product (vermicompost/casting) is considered as homogenous, has reduced levels of contaminants and tends to hold more nutrients. During the vermicomposting process, important plant nutrients such as nitrogen, phosphorus, potassium, etc. present in the waste are converted into much soluble and available to plants (Ndegwa and Thompson, 2001).

2. Materials and Methods

The effluent sample was collected from the outlet of polyfibers industry, Harihar. The sample was subjected to the analysis of a total of fifteen parameters mentioned below, before and after the treatment using *Eiseniafetida*.

Parameters analyzed: pH, COD, BOD, total dissolved solids, total suspended solids, sulfate, sulfide, fluoride, ammonia, total kjeldhal nitrogen, phosphate, residual chloride oil and grease by standard methods (APHA standard methods, 1995). Earthworm inoculum of surface feeder species (*E.fetida)* was procured form TaralabaluKendriyaKrushiVidyalaya, Davangere (fig 1).

Figure1: Eiseniafetida

Figure 2: Vermicomposting set up

Figure 3: maintenance of vermicomposting set up

Worm bins (fig.2, 3) made of plastic material of size 1.5*2*0.5 were taken. The first worm bin was fed with 20 liters of effluent and mixed with approximately 2-3 kg of saw dust. The second worm bin was fed with 20 liters of effluent and mixed with approximately 1-2 kg of rice husk. Both the effluent samples were allowed to decompose in the natural environment, so that the effluent was made ready to be worked upon by the earth worms. After 20 days of decomposition, each bin was added with about 25-30 grams of worms. The whole set up was nourished with 500-750 ml of cow-dung. This set up was incubated for 45 days with consistent wetting of the substrate with the effluent sample at periodic intervals. The set up was maintained under shade for the process to proceed under optimal condition (Munnoli andBhosle, 2009).

The sample wash was obtained by taking 500 grams of the product to which 1 liter of pure water was added and thoroughly mixed. This mixture was squeezed thoroughly to extract the wash. The wash was subjected to analysis of the parameters mentioned above to determine the effect of earth worms' activity on effluent. The values obtained were compared against standard controls. The controls usually consisted of: Control 1: Included only effluent. No substrate was added. Control 2: Included only saw dust and water. Control 3: Included only rice husk and water.

3. Results and Discussion

Formation of compost was observed within the expected time. The compost formation in saw dust was observed (fig. 4) and it was observed that the earth worms couldn't feed on rice husk (fig.5) and hence compost formation was not seen in the set up with rice husk as the substrate. This observation reveals the fact that the physical property of the rice husk was not feasible for consumption by earth worms.

Figure 4: Formation of compost in saw dust substrate

Figure 5: Rice husk not decomposed

There was significant change in certain parameters of the effluent namely: Sulfates, Ammonical nitrogen, Total kjheldal nitrogen, Phosphates and Dissolved solids (Table 1). This decrease in the value of the parameters can be attributed to reasons like saw dust was an edible substrate for earth worms. The enzymes oxidoreductase and peroxidase produced by the gastro intestinal tract of the earth worms acted upon the substrate and converted them into desired products, according to studies done by Pierre Valemboise*t al.*,1991.Biosorption (the process of adsorption of certain constituents in to the body of worms) might be another reason for the reduction in the value of constituents. The adsorption of the constituents on to the compost formed might also be the reason for the reduction in the value of some parameters in the effluent making the compost much rich in such nutrients. Vermicompost is humus like, finely granulated and friable material which can be used as a fertilizer to reintegrate the organic matter to the agricultural soils. Nagavallemma*et al.*, 2004 have reported that the nutrient composition of vermicompost may increase the plant nutrients as compared to the simple composting.

Table 1: Comparison of different parameters

Sl no	*Parameters (in mg/l)*	*Sawdust with effluent*	*Final values after treatment*
1	pH	7.46	6.65
2	BOD	2460	870
3	COD	6000	2171
4	Oil and grease	Not detected	Not detected
5	Sulfates	2080	680
6	Ammonicalnitrogen	3.6	1.60
7	Total kjheldal nitrogen	6.8	1.70
8	Dissolved phosphates	1.1	0.25

4. Conclusions

With the present work, the effluent is treated as well as used for compost preparation which further can be efficiently used as compost in agriculture. Further the vermiwash can be diluted with water (10%) and sprayed on plants to function as an effecting foliar spray and pesticide.

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