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Research Article

PHYSICOCHEMICAL CHARACTERIZATION OF VERMICOMPOST FROM FISH WASTE USING *EUDRILUS EUGENIAE*

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A B S T R A C T

Solid waste management is essential to maintain a healthy environment. Earthworms are capable of transforming garbage into 'gold'. In the present study, an effort had been made to degrade fish waste through vermicompost by *Eudrilus eugeniae* with cowdung. The composts were analyzed for various physical and chemical parameters and the results showed significant difference in the gradual increase of nitrogen, phosphorous and potash value, thereby revealing that treatment of fish waste for production of vermicompost would be an effective method for maximum utilization of organic waste.

INTRODUCTION

All human activities generate by-products or wastes, which are apparently of no use and needs to be discarded. Rapid industrialization, urbanization and unplanned population growth have led to an increased accumulation of solid waste materials[1]. In India, 60% of the solid wastes are organic in nature[2]. These wastes possess a serious threat and problems because it creates conditions that are favourable to the survival and growth of the microbial pathogens. Fish production in India has increased more than tenfold since its independence in 1947. According to the Food and Agriculture Organization (FAO) of the United Nations, fish output in India doubled between 1990 and 2010. As the production is more, waste production also increases. Fish processing activities generate potentially large quantities of organic waste and by-products from inedible fish parts and endoskeleton shell parts from the crustacean peeling process. Fish waste is a rich source of essential amino acids, and all inedible fish waste should be converted into by-products. Vermitechnology involves the use of earthworms for processing various types of organic waste into valuable resources. It helps in giving bio-fertilizers in terms of vermicompost, for agricultural uses and a high quality protein (earthworm biomass) for supplementing the nutritional energy needs of animals, at a faster rate.

Earthworms are well known natural machineries. They can transform organic waste materials into vermicompost for agricultural applications[3]. During vermicomposting important organic nutrients are released by earthworms[4]. To manage fish waste accumulation and to maintain the cleaner environment an attempt was made to study the influence of *Eudrilus eugeniae* in fish waste with combination of cowdung in different ratios. The survey of literature indicated the efficiency of earthworm and nutritional value of compost in various fields but information about the growth of earthworms in fish waste is scanty. The greatest challenge to the environmentalist is the eco friendly management of this waste and application of microorganisms in this context[5]. Hence, in the present study an attempt has been made to influence of earthworm in fish waste management in combination with microbial digestion and cow dung.

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MATERIALS AND METHODS

Collection of raw materials

Fish waste used for the experimental study was collected from the local fish market, Tambaram, Chennai, Tamil Nadu, India. *Eudrilus eugeniae* were collected from the stock culture maintained in Madras Christian College Farm, Tambaram, Chennai, Tamil Nadu, India and cowdung from local farm in Tambaram, Chennai, Tamil Nadu, India.

Experimental setup

Collected fish waste was shade dried for fifteen days and powdered. For the experiment, three plastic trays were used (size 45cm x 35cm x 24cm). A mixture of fish waste and cowdung were loaded onto each tray followed by release of forty healthy adult *Eudrilus eugeniae* to experiment 1, 2 and 3. Experiment 1 consisted of processed fish waste + cowdung (1:1) + earthworms; experiment 2 was processed fish waste +

cowdung (1:2) + earthworms and experiment 3 with processed fish waste + cowdung, (1:3) + earthworms. Processed fish waster and cowdung devoid of earthworms served as control. Proper shading, temperature and pH were provided to ensure survival of earthworms. The moisture level was maintained about 20-30% throughout the study by sprinkling adequate quantity of water. Experimental setups were allowed to degrade the waste for thirty days. Samples were analyzed for physical and chemical parameters, *viz*., pH, Electrical Conductivity (EC), moisture, Nitrogen (N), Phosphorous (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Iron (Fe), Copper (Cu), Organic Carbon (OC) and Carbon:Nitrogen(C:N) ratio.

RESULTS AND DISCUSSION

pH, nitrogen, phosphorous, potassium and all the micronutrients increased in all the experiments; Nutrient contents were found comparatively higher in experiment 1, followed by experiment 2 and control, emphasizing the efficiency of microbial treated fish waste decomposition (Table 1).

Table 1 Physicochemical parameters and pattern of nutrient change in vermicompost

Parameters	Units	Control		Experiment 1		Experiment 2		Experiment 3	
		Days							
		0	30	0	30	0	30	0	30
pH	---	4.56	4.17	4.56	5.21	4.56	5.32	4.56	5.56
EC	mS/cm	4.91	5.75	4.91	5.29	4.91	5.11	4.91	5.71
Moisture		50.56	51.32	50.56	49.41	50.56	49.60	50.56	47.39
OC		47.34	30.03	47.34	38.86	47.34	40.17	47.34	39.23
N		1.28	1.30	1.28	1.42	1.28	1.61	1.28	1.88
P	%	0.29	1.44	0.29	1.52	0.29	1.64	0.29	1.90
K		0.19	0.26	0.19	0.35	0.19	0.39	0.19	0.28
Ca		0.21	0.43	0.21	0.26	0.21	0.91	0.21	1.08
Mg		0.18	0.61	0.18	0.54	0.18	0.51	0.18	0.57
Zn		105.09	107.69	105.09	112.99	105.09	101.22	105.09	105.05
Mn	mg/Kg	138.38	215.99	138.38	227.15	138.38	212.87	138.38	217.98
Fe		493.78	2158.66	493.78	2229.20	493.78	2293.64	493.78	2204.69
Cu		26.05	27.86	26.05	22.03	26.05	25.64	26.05	27.30

The difference in growth rate among different treatments seems to be closely related to substrate quality[6]. Increase of pH, nitrogen, phosphorous, potassium and all the micronutrients are due to the following reasons. pH is an important factor that limits the distribution and number of species[7]. Several researchers have also stated that most species of earthworm prefer a pH of about 7.0[8,9]. The level of pH increased slowly from acidic towards neutral in experiment 1 and 2. Increase of pH in treatments might be due to the participation of microbes in decomposition during vermicomposting. Increase in pH may be attributed due to mineralization of nitrogen and phosphorous into nitrites/ nitrates and orthophosphates and bioconversion of organic material into intermediate species of organic acids[10]. Decrease in pH of vermicompost in control may be due to the presence of anaerobic bacteria present in the sample. Increase in nitrogen content in the experiments was due to the presence of nitrogen fixing bacteria. The decomposition of organic material by earthworms accelerates the nitrogen mineralization process and changes nitrogen profile of the substrate[11]. Phosphorous level increased progressively due to the mineralization of phosphorous during vermicomposting. The release of phosphorous in the available form is performed partly by earthworms gut phosphatases and further release of phosphorous might be attributed to the phosphorous solubilizing microorganisms present in the compost[12]. Potassium increase in content might be due to changes in the distribution of potassium between non exchangeable and exchangeable ion forms; Earthworms process waste material containing high concentration of exchangeable potassium which consequently enhances the rate of mineralization[13]. Micronutrients like iron, copper, calcium, zinc, manganese also increased in traces. Earthworms convert calcium oxalate crystals in ingested fungal hyphae to calcium bicarbonate which is then egested in cast materials. This increases calcium availability in the compost[14]. The increase of iron in the compost proves the presence of enzymes and co-factor in the earthworm gut and the increase of copper content was due to the presence of several copper containing oxidizing enzymes. Further, the C:N ratio exhibited a decreased level (Figure 1) which indicated biodegradation. All the above mentioned results demonstrated vermicomposting as an alternative technology for the management of chicken waste with cowdung and also increased efficiency of the vermicompost by increasing the cowdung ratio and the days of microbial treatment. It can be concluded that degradation of chicken waste by earthworm can be a promising method.

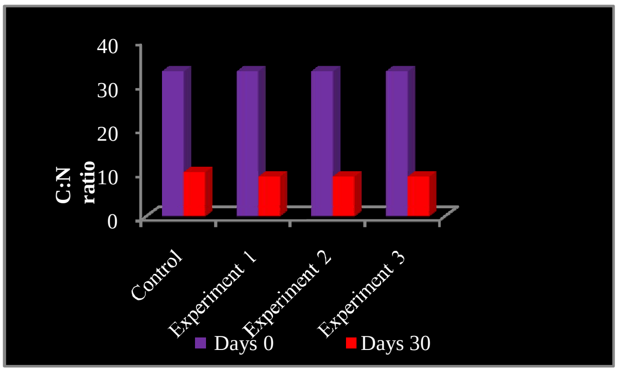

Figure 1 C: N ratio of vermicompost

Efficient quality rich compost can be obtained by increasing the cowdung ratio and days of microbial treatment. Application of vermiculture in the degradation of chicken waste allows maximum utilization of organic waste and promotes eco-friendly environment.

It was found that vermicomposting units containing earthworms are efficient in compost formation when compared to the unit without earthworms and vermicomposting units containing commercial microbes in the mixture was efficient in compost formation when compared to units containing normal soil microflora. Thus employing earthworms for degradation and recycling of fish wastes and production of valuable compost to enrich and enhance soil fertility, is being proposed as a suitable alternative to fish waste management. It was also found that increase in cowdung ratio increased the nutrient value of the vermicompost. From this study, it has been found that direct dumping of fish waste leads to increase in solid waste which may be hazardous to the environment and by vermicomposting the fish waste could be converted into valuable manure.

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