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Management of food industry waste employing vermicomposting technology

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ABSTRACT

This paper reports the vermicomposting of food industry sludges (FIS) mixed with different organic wastes employing *Eisenia fetida*. A total of 10 vermicomposting units containing different wastes combinations were established. After 15 weeks significant increase in total nitrogen (N_{total}) (60–214%), total available phosphorous (P_{avail}) (35.8–69.6%), total sodium (Na_{total}) (39–95%), and total potassium (K_{total}) (43.7–74.1%), while decrease in pH (8.45–19.7%), total organic carbon (OC_{total}) (28.4–36.1%) and C:N ratio (61.2–77.8%) was recorded. The results indicated that FIS may be converted into good quality manure by vermicomposting if spiked with other organic wastes in appropriate quantities.

1. Introduction

Food processing industries, livestock and poultry farms generate huge quantities of liquid and semi-solid wastes. Treatment, disposal and management of these wastes is a scientific challenge for industries, urban local bodies, scientists and engineers. Conventionally these wastes are disposed by non-scientific methods which invite public attention due to health and civic reasons. These organic wastes contain valuable plant nutrients and organic matter which are essential for soil fertility and crop production. So land application may be a recycling option for these wastes. But their direct land application may be harmful due to heavy metals, toxic organic compounds, pathogenic microorganisms, etc. Zucconi et al. (1981) have reported that application of immature organic materials in agricultural fields inhabit plant growth due to nitrogen starvation and production of toxic metabolites. Whereas Mishra et al. (1989) have reported that application of stabilized organics can supply essential nutrients to plants and improve soil fertility.

In vermicomposting process worms convert and stabilize organic wastes into nutrient rich humus-like material called vermicompost. In this process the action of earthworms on organic wastes is physical as well as biochemical. The physical action includes the aeration, mixing and grinding of organic waste, while the microbes are responsible for biochemical degradation of organic waste (Aira et al., 2008). During the transit of material through worms' gut, some important plant metabolites like NPK present in the organic waste are converted into such chemical forms which are more available to plants. Several studies have been made on the use of epigeic earthworms in vermicomposting processes using various organic materials (Elvira et al., 1998; Benítez et al., 2000; Gajalakshmi et al., 2002; Khwairakpam and Bhargava, 2009). The ability of *E. fetida* for agricultural, animal, poultry and wastes management has reported by several researchers (Loh et al., 2005; Garg and Kaushik, 2005; Yadav and Garg, 2011; Suthar, 2008). But utilization of heterogeneous wastes combinations in vermicomposting process is yet to be proven. Keeping this in view experiments were conducted on the vermicomposting of wastewater treatment plant sludge of a food industry mixed with cow dung, biogas plant slurry and poultry droppings in different combinations employing epigeic earthworm, *E. fetida*.

2. Methods

2.1. Waste materials and earthworms (Eisenia fetida)

Cow dung (CD) was collected from a livestock farm located at Hisar, India. The main physico-chemical parameters of CD were: pH: 8.0 ± 0.2; total organic carbon (OC_{total}): 495 ± 23 g/kg; total nitrogen (N_{total}): 8.2 ± 0.4 g/kg, total available phosphorous (P_{avail}): 5.7 ± 0.3 g/kg; total potassium (K_{total}): 7.8 ± 1.1 g/kg; total sodium (Na_{total}): 4.0 ± 0.25 g/kg total C:N ratio: 60.3 ± 5.5. Fresh anaerobically digested biogas plant slurry (BPS) was collected from post-methanation storage tank of an on-farm biogas plant situated at Hisar. The raw material used in the biogas plant was cow dung. The main physico-chemical parameters of BPS were: pH: 7.8 ± 0.2, OC_{total}: 471 ± 31 g/kg; N_{total}: 6.2 ± 0.3 g/kg, P_{avail}: 5.6 ± 0.15 g/kg; K_{total}: 4.2 ± 0.1 g/kg; Na_{total} 1.9 ± 0.05 g/kg; C:N ratio: 75.9 ± 4.5. The poultry droppings (PD) were collected from a poultry farm located near Hisar, India. The main physico-chemical parameters of

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