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Vermicomposting of milk processing industry sludge spiked with plant wastes

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ABSTRACT

This work illustrates the vermistabilization of wastewater sludge from a milk processing industry (MPIS) unit spiked with cow dung (CD), sugarcane trash (ST) and wheat straw (WS) employing earthworms *Eisenia fetida*. A total of nine experimental vermibeds were established and changes in chemical parameters of waste material have been observed for 90 days. Vermistabilization caused significant reduction in pH, organic carbon and C:N ratio and substantial increase in total N, available P and exchangeable K. The waste mixture containing MPIS (60%) + CD (10%) + ST (30%) and MPIS (60%) + CD (10%) + WS (30%) had better waste mineralization rate among waste mixtures studied. The earthworm showed better biomass and cocoon numbers in all vermibeds during vermicomposting operation. Results, thus suggest the suitability of *E. fetida* for conversion of noxious industrial waste into value-added product for land restoration programme.

1. Introduction

Agriculture, food processing, pulp and paper, or any agriculture-based industry produces massive quantity of liquid, gaseous or solid wastes. Such agro-industrial sludge/wastes not only spoil aesthetics sense of local habitats but at the same time also create issues of all types of environmental pollution, if proper disposal and management policy is not adopted. The dairy processing industry is the major component of food processing industry in the India. It is considered to be the largest source of food processing wastewater in many countries. Although the dairy industry is not commonly associated with sever environmental problem, it must continually consider its environmental impact – particularly as dairy pollutants are mostly of organic origin (protein, carbohydrate, lipids, suspended oils and/or grease) with high concentration of suspended solids, biochemical oxygen demand (BOD), chemical oxygen demand (COD) and nitrate contents (Britz et al., 2006). The wastewater and solids generated from dairy processing industry pose issues of safe management and disposal of treated and/or untreated wastewater solids. The traditional disposal methods such as open dumping and/or land filling practices of these materials are not only increasingly expensive, but impractical as open space becomes limited (Slater and Frederickson, 2001). Contamination of ground water, soils, as well as, food resources are some of the problems which have resulted from land filling practices of dumped waste materials (Ilgen et al., 2008). The emission of GHGs from waste dumping site is an issue of prime concern (IPCC, 2006; Lou and Nair, 2009). However, the stabilization of such sludge prior to use of disposal should reduce the environmental problems associated with its open dumping (Gomez-Brandon et al., 2011). In general, stabilization involves the decomposition of an organic waste into the extent of eliminating the hazards and is normally reflected by decreases in microbial activity and concentration of labile compounds (Benito et al., 2003).

Composting has been appeared as important tool to stabilize the organic waste generated from different sector of the society. Composting is the most sustainable option for onsite organic waste management as it is easy to operate and can be conducted in contained space provided (Lou and Nair, 2009; Hong et al., 2010). In recent years vermicomposting has been explored extensively to recycle the nutrient stuff from organic wastes from different community sources (Suthar, 2009). Vermicomposting, utilizing earthworms, is an ecobiotechnological process that transforms energy-rich and complex organic substances into a stabilized humus-like product vermicompost (Sinha et al., 2010). According to Dominguez (2004) it is a complex process involving the joint action of earthworms and microorganisms. Although microbes are responsible for biochemical degradation of organic matter, earthworms are the important drivers of the process, conditioning the substrate and altering the biological activity.

Vermistabilization is stabilization of organic material, such as sludge, involving the joint action of earthworms and microorganisms. The sludge can be stabilized effectively through vermistabilization process because of many beneficial impacts of inoculated earthworms upon aerobic decomposition process. Loehr et al. (1985) concluded that in vermicomposting system the earthworms

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