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Efficacy of an Onsite Rotary and Fixed Bin Composting System for Food Waste Management

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Abstract

Food waste management is one of the most significant challenges worldwide, contributing to the unsustainable management of food waste resulting in the loss of food resources and environmental degradation. A decentralized composting facility with onsite food waste treatment is one of the solutions to improving food waste management. Composting is an aerobic process during which organic waste is biologically degraded by micro-organisms to humus-like material suitable for use as a soil amendment (Partanen et al., 2010). This study designed and evaluated the performance of a small-scale rotary drum composting vessel for onsite food waste management and compared it with the traditional fixed bin composting process within university premises. A rotary drum composting vessel of 50 kg capacity was designed and fabricated to evaluate food waste recycling and management. The composting recipe of 25 kg volume was made from a food waste layer consisting of eggshells, cucumber, carrot, potato, and bread and mixed with brown and green materials. The key compositing parameters, such as dry organic matter content, temperature, pH, electrical conductivity, moisture content, pathogen indicators, and heavy metals, were monitored over seven weeks to evaluate the composting process's effectiveness and compared with the fixed bin compositing system to assess good quality compost. Oxford nanopore-based 16S rRNA gene sequencing method was used to monitor bacterial community changes in the fixed bin and rotary composting system. The physicochemical parameters of the compost were found within the recommended range of good-quality compost. Metals such as Cu, Cd, Cr, Pb, Ni, As, Zn, and K were found within the maximum permissible levels in the rotary drum and a fixed compost bin. The last few stages (weeks 5-7) of the composting process indicated a significant reduction of *E. coli* and total coliform. Higher reads and diversity of bacterial classes were observed in the fixed bin compared to the rotary drum system throughout the composting process. However, good quality and ready-to-use compost was detected on day 17th in the rotary drum composting system. In conclusion, the newly designed rotatory composting vessel was more efficient for onsite treatment and food waste disposal than the fixed bin composting system in terms of quality and time of compost production.

Keywords: Rotary drum and fixed bin composting, food waste, Bacterial community, physicochemical parameters, heavy metals, pathogen indicators

References

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