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Research Paper

Investigating the Properties of Granulated Compost Fertilizer Produced From Organic Waste with the National Compost Standard

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Extended Abstract

Introduction In the face of growing environmental challenges and climate change, effective waste management and the optimal use of natural resources have become critical imperatives. Urbanization and population growth have significantly increased the volume of waste produced in cities, which not only contributes to environmental pollution but also strains municipal waste management systems. A sustainable solution to this issue is the production of compost from organic waste. Composting can recycle nutrients, improve soil quality, and reduce the environmental impact of urban waste. This study investigates the production of granular compost fertilizer from organic waste and compares its properties with the national compost standards, focusing on physical, chemical, and microbial characteristics.

Methods The research was conducted at a composting site in Tehran, where organic waste from the city's fruit and vegetable markets was processed. The composting process used aerobic bioreactor technology, which involves the mechanical and biological breakdown of organic material over a period of 4 to 6 months. Samples were collected from three different depths of the compost pile (surface, middle, and deep) to ensure representative analysis. A variety of tests were conducted to determine the physical and chemical properties of the compost, including organic matter, total nitrogen, phosphorus, potassium, pH, electrical conductivity, and heavy metals. The microbial quality was assessed by testing for the presence of Salmonella and fecal coliforms. The results were compared with the national compost standards to assess the quality of the produced compost.

Results and Discussion The results indicated that the granular compost produced at site 19 of Tehran Municipality met several key criteria outlined in the national compost standards. The average organic matter content in the compost was 12.76%, and the organic carbon concentration was 30.44%. Other key macronutrient concentrations included total nitrogen (1.34%), phosphorus (1.01%), and potassium (0.57%). The compost exhibited a favorable pH of 7.54, which is suitable for plant growth, and an electrical conductivity of 4.55, indicating appropriate salt content. The ammonium-to-nitrate ratio was found to be 1.27, which is within the acceptable range for quality compost. Heavy metals, such as lead (18.94 mg/kg), zinc (73.12 mg/kg), and nickel (1.45 mg/kg), were measured at concentrations that fall within national standards. Microbial analysis showed no contamination by *Salmonella* or fecal coliforms, confirming the compost's safety for agricultural use. The germination index, a measure of compost's effect on plant seed growth, was 80%, which is considered a strong indicator of compost maturity and quality. The findings of this study underscore the viability of producing high-quality compost from urban organic waste. The results of the chemical and physical analyses demonstrate that the compost produced in this study meets or exceeds the national compost standards for organic matter, carbon content, and essential nutrients such as nitrogen, phosphorus, and potassium. This is in line with global research that highlights the importance of composting as a sustainable waste management strategy and a way to improve soil fertility. The absence of harmful microbial contamination and the favorable germination index further validate the compost's suitability for use in urban agricultural applications, where it can contribute to soil enrichment and the reduction of synthetic fertilizer dependence. The concentrations of heavy metals, while present in trace amounts, were within the permissible limits, suggesting that the compost is safe for use in soil without posing significant environmental or health risks. However, the study also identifies challenges related to the quality of input materials, which must be carefully managed to prevent contamination from hazardous substances. The composting process's efficiency, particularly in urban environments with limited space, and the time required for compost maturation, remain as key considerations for scaling up this practice.

Conclusion This research highlights the potential for using urban organic waste to produce granular compost that meets national standards and serves as an effective and sustainable solution for waste management. The compost produced from organic waste in Tehran demonstrated high-quality characteristics in terms of nutrient content, microbial safety, and suitability for soil enhancement. This study not only provides a model for sustainable waste management practices in urban settings but also emphasizes the importance of adhering to compost quality standards to ensure environmental and agricultural benefits. The findings advocate for the broader adoption of composting in cities as a means to reduce waste, improve soil health, and foster sustainable urban ecosystems. In conclusion, the production of granular compost from urban organic waste offers a promising approach to waste reduction, soil fertility enhancement, and sustainable urban management. With proper management and adherence to quality standards, this practice can contribute significantly to mitigating the challenges of urban waste and soil degradation, fostering a more sustainable future.

Keywords: Granular compost, Organic waste, National compost standard

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