RAPID AND QUALITY COMPOST PRODUCTION USING EFFICIENT MICROFLORA AND EARTH WORMS

by

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to my
dear mummy and papa

CERTIFICATE

This is to certify that the thesis entitled "Rapid and quality compost production using efficient microflora and earthworms", submitted by Ms. Anshu Singh has been prepared under my guidance in conformity with the rules and regulations of Indian Institute of Technology, Delhi, India. The research report and results presented in this thesis have not been submitted for any degree or diploma in any other University or Institute.

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Anshu Singh

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ABSTRACT

The composting process is currently viewed primarily as a waste management method to stabilize organic waste. The stabilized end product can be used as a soil amendment that can help to improve and maintain the deteriorating chemical, physical and biological properties of soils. This in turn would reduce the usage of chemical fertilizers and incessant accumulation of municipal solid waste which are posing a threat to our environment in regard to clean air, pure water and fertile soil Even though composting has been known for recycling organic waste since biblical times but there are many aspects that should be improved. One of these areas includes reduction in overall time period required for composting especially during winter season. Basidiomycetes viz. Mushroom fungi play vital role in lignocellulosic waste degradation under mesophilic condition. Vermicomposting is one form of composting which is known to accelerate the degradation process. But since some epigeic earthworm species require pre-decomposed waste it would be desirable to decrease the pre-decomposition time period of the waste to be vermicomposted by these efficient selected earthworm species. This can be done by treating the waste initially with certain efficient microflora having positive interactions with earthworms and actively degrading the cellulose, hemicellulose and lignin components of the waste. Inoculation with these microorganisms might thus accelerate the process of degradation by degrading the lignin portion of the waste that has been known to be inaccessible to microbes taking part in the decomposition process. Also, inoculation with nitrogen fixing bacteria like Azotobacter may increase the nutrient value of the compost.

Keeping the above in view, present study was focussed on testing the viability of the integrated approach i.e., combining both microbial pre-decomposition and subsequent vermicomposting, initially utilizing wheat straw, and later to be employed to other substrates specifically municipal solid waste.

The major objectives were;

1. *To study the interactions among different microflora (Basidiomycete, Deuteromycetes, Ascomycetes, Bacteria) and between microflora and earthworms under lab conditions.*
2. *To study the interactions between microflora and AM (Arbuscular Mycorrhiza) fungi under invivo conditions.*
3. *To accelerate the composting process and improve the quality of compost with the use of efficient microbial strains and subsequent vermicomposting.*
4. *To analyze and evaluate the quality of compost, prepared using different bioinoculants, on plants' growth.*
5. *To standardize the method for rapid and quality compost production.*

The thesis entitled "Rapid and quality compost production using efficient microflora and earthworms" (organized in 5 chapters) starting with a brief introduction on the theme, presents literature review on relevant aspects and focuses attention on efficiency of microorganisms namely, Pleurotus sajor-caju, Trichoderma harzianum and Aspergillus niger in enhancing the degradation process and role of Azotobacter chroococcum in improving the compost quality. Initially vermiculturing experiments were conducted on different substrates and in different seasons. Preliminary studies on waste degradation were conducted on wheat straw with different combination of bioinoculants and

subsequent vermicomposting. Thereafter, municipal solid waste in combination with horticultural waste was used as feedstock. The pre-decomposition time period varied to 1, 2, 3, 4, 8 and 12 weeks while vermicomposting time period was fixed for a period of one month. Different doses of fly ash were also studied as co-composting material. In order to ensure the quality of the compost produced the same was evaluated for nutrient levels and effects on Vigna radiata and Populus deltoides. growth. All the data were statistically analyzed and discussed.

Vermiculturing was found to be the best in partially decomposed forestry waste in combination with farmyard manure. Rainy season proved to be the best for vermiculturing. The interaction between earthworms and all the microorganisms was positive. A significant difference was observed in the quality of compost produced with the help of bioinoculants over the one where no bioinoculant was used. Co-composting of the waste with different doses of fly ash also resulted in similar results. Chemical analysis of the samples showed a significant decrease in cellulose, hemicellulose and lignin content both during pre-decomposition and vermicomposting. The nitrogen and potassium content increased significantly in the final product. On the other hand, non-significant increase was observed in the phosphorus content. Co-composting of the waste with 20% fly ash resulted in best compost. The best quality compost in the present study, based on the chemical and microbial analysis, was prepared where the substrate was treated with all the four bioinoculants P. sajor-caju, T. harzianum, A. niger and A. chrocooccum together for one week followed by vermicomposting for one month. The results of combinations were in the order of:

P. sajor-caju + T. harzianum + A. chroococcum + A. niger > P. sajor-caju + T. harzianum + A. chroococcum > P. sajor-caju + T. harzianum> P. sajor-caju >Control

Finally, the soil treated with the compost prepared by inoculating the waste with all four bioinoculants together enhanced growth of V. radiata and Populus sp. 20% fly ash compost enhanced the growth of both V. radiata and Populus sp. while higher concentrations declined their growth. The growth of Populus sp. was more affected with increase in fly ash concentration in the compost. Overall the results indicate that the combination of both the systems reduced the overall time period required for composting to 37 days and accelerated the composting of ligno-cellulosic waste during winter season besides producing nutrient enriched compost product.

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