BIODEGRADATION AND ANALYSIS OF COLLEGE CAMPUS SOLID WASTE INTO LIQUID VERMIWASH

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Abstract:
Solid waste management is a major issue in educational campuses in India. Tons of solid waste generated every year from office paper waste, canteen waste, garden waste, fallen leaves of various plants etc. Improper dumping, fire of this solid waste mainly causes water, soil and air pollution. In this study, campus waste has been recycled with the help of vermicomposting technologies. The species of earthworm used for vermicomposting was *Eisenia foetida*. Vermicompost was prepared from college campus waste. Initial feed mixture and final vermicompost was used for preparation of vermiwash. Physico-chemical properties of vermiwash were studied. There was significant decrease in pH, total carbon and electrical conductance and significant increase in plant nutrients was observed in vermiwash obtained from initial feed mixture to vermiwash obtained from final vermicompost.

Key words: Campus **solid wastes, Vermicomposting, *Eisenia foetida*, Vermiwash, Chemical analysis.**

I. INTRODUCTION:

Expanding urbanization and drastic growth of population have caused a severe increase of the solid waste around us and educational campuses. Waste generated in educational campuses may contain biodegradable material like paper pieces, garden waste, canteen waste, fallen leaves and non-biodegradable materials like plastics, glass, metals, and electronic waste. These wastes are either burnt or disposed off in the environment. The improper disposal of solid waste adversely affects the environment and human health (T. M. Shazwin et. al. 2010). It also causes land degradation, air and water pollution (ATSDR, 2007). Solid waste is dangerous to the environment or human health (Liu et.al. 1997). Several methods are available to recycle biodegradable wastes but these methods may be time consuming or may have adverse effects on the environment. There are three top ways in solid waste management; these are Reduce, Reuse and Recycle. Vermicomposting technology is an effective and time saving process for recycling college campus solid waste (Giramkar, 2019). The gut of earthworms in vermicomposting acts as bioreactor and releases vermicasts (Ansari, A. et. al. 2010). Vermiwash produced from vermicomposting is easily absorbed by plants (Manyuchi. M .M et.al. 2013). This paper emphasizes on the proper conversion and analysis of educational campus biodegradable solid waste into liquid vermiwash.

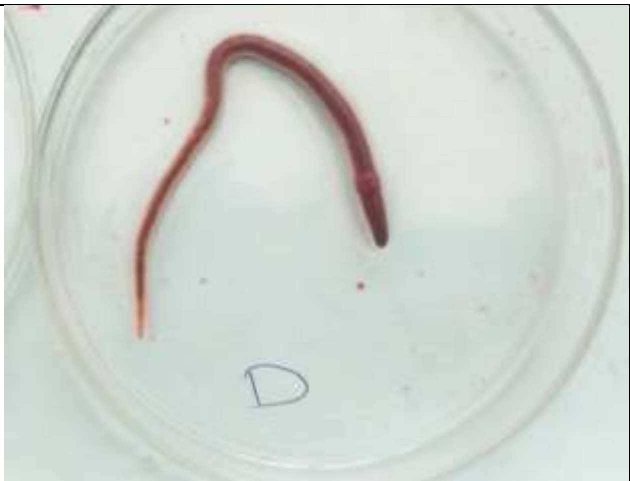
II.MATERIAL AND METHODS:

2.1 Collection and processing of waste:

College campus organic wastes (containing canteen waste, paper waste, garden waste) were collected. Collected wastes were exposed to sunlight for 4 to 7 days to remove the various harmful organisms and toxic gases from waste (Bhatnagar and Paitta, 1996).

2.2 Preparation of Vermicompost:

Sun dried waste was layered in a vermicomposting bed (Giramkar, 2019). Eartworm species *Eisenia foetida* (Image: A) was collected from Shriinath Mhaskoba Sugar Institute Manjari, Hadapsar, Pune and used for vermicomposting. Vermicomposting bed was prepared, vermibed was covered with jute pockets and moistened daily up to 40 to 50 days. Aerobic condition was maintained in the bed by providing 5 mm diameter holes at 100 mm c/c spacing all along the width and the length of walls of the bed (Giramkar, 2019). After 50 to 55 days watering was stopped and vermicompost was harvested when tea powered like granules of vermicompost appeared on the upper surface of vermibed (Image: B). The top layer of granular vermicompost was collected for further study.

	
A. Earthworm species *E. foetida* used in vermicomposting.	B. Vermicompost obtained during work

2.3 Extraction of Vermiwash:

Vermiwash was extracted through a vermiwash collecting device, which was a metal drum having five liter capacity. A tap was fitted at the bottom of the vermiwash collection device. The device is layered with 10-12 cm thick broken breaks, 2-3 cm fine sand followed by 30-35 cm layer of vermicompost containing a heavy population of adult and healthy *E. foetida* species of earthworm. On the top of the unit, a five liter capacity water container perforated at the base was fitted. Water was gradually sprinkled overnight on the vermiwash unit. This water gets percolated at the base of the container. The tap of the unit was opened the next morning and vermiwash was collected. The different concentrations of collected vermiwash were used for chemical analysis.

2.4 Chemical Analysis:

The chemical analysis of vermiwash obtained from initial feed mixture and final vermicomposts were observed. The pH and electrical conductivity (EC) were determined by the method of Garg et al. 2006. Total organic carbon (TOC) was measured by the method of Nelson and Sommers (1982). Total nitrogen was measured by the procedure followed by Bremmer and Mulvaney (1982). Total phosphorus was determined by colorimetric method while total potassium and calcium was determined by flame photometer (Bansal and Kapoor 2000). The data was statistically analyzed and expressed as mean ± SE of six replicates. ANOVA test was applied to determine any significant ($P<0.05$) difference among the parameters (Sokal and Rohlf, 1973) observed in vermiwash obtained from initial feed mixture and final vermicomposts.

III. RESULT AND DISCUSSION:

Table- 01: Physico-chemical properties of vermiwash obtained from initial feed mixture and final vermicompost:

Parameters	Initial feed	Final feed
pH	8.6 ± 0.03	7.1 ±0.04
EC (ds/m)	2. 65 ± 0.04	1.06 ± 0.05
TOC (g/kg)	615 . 87 ± 3.01	317.85 ± 3.12
N (g/kg)	10 .3 ± 0.67	27.2 ± 1.03
C:N ratio	49.3 ± 1.13	14.3 ± 0.04
P (g/kg)	5.4 ± 0.07	7.1 ± 0.04
K (g/kg)	7.2 ± 1.02	8.1 ± `0.11
Ca (g/kg)	1.5 ± 0.5	2.4 ± 0.4

Physico-chemical properties of vermiwash obtained from initial feed mixture and final vermicompost were tested and compared (Table-:01). It was observed that pH and electrical conductivity in vermiwash was more in vermiwash obtained from initial feed than in vermiwash obtained from final feed. Decrease in pH in vermiwash might be due to mineralization of nitrogen and phosphorus into nitrates/nitrites and orthro-phosphates and microbial activity during decomposition (Gorakh Nath et. al. 2009).

Total organic carbon (TOC) was measured and it was found to be decreased in vermiwash obtained from initial feed mixture to final vermicompost. It might be due to feed degredation by earthworms and microbial degradation of initial feed to vermicompost. It was reported that excreta of earthworm contain urea, high concentration of organic matter, mucus and ammonia which help in microbial growth (Suthar, 2007). During composting of feed, carbon loss takes place through microbial respiration and even through mineralization of organic matter (Garg and Kaushik, 2003).

Total nitrogen content was measured and it was more in vermiwash obtained from final vermicompost. Increase in nitrogen may be due to decrease in pH in final vermicompost. Decreased pH might allow loss of volatile ammonia from elements and retention of nitrogen. Earthworms increase nitrogen transformation through mineralization in the form of nitrates (Atiyeh et al.2000). During the process of composting, an alimentary canal of earthworms adds nitrogen in vermicompost by releasing nitrogen containing excreta, growth hormones, enzymes etc (Tripathi and Bhardwaj, 2004).

The C: N ratio was observed and this ratio was used as an organic waste maturation indicator. Vermicompost was harvested when C: N ratio was below 15. The declined C: N ratio below 20 indicates the degree of organic matter stabilization and formation of adequate organic wastes (Senesi, 1989). Microbial respiration removes carbon as CO_2 and addition of the excretory material retain nitrogen during vermicomposting. Thus C: N ratio is a commonly used indicator of vermicompost maturation.

Total phosphorus content was estimated and it was more in vermiwash obtained from final vermicompost. The phosphorus in vermicompost is increased partly by the gut activity of earthworms such as gut phosphates and partly by the P-solubility of microorganisms present in warm casts (Gorakh Nath et. al. 2009). As feed passes through the alimentary canal of earthworms, the alimentary canal releases gut phosphatase which releases phosphate from food. Further released phosphorus is contributed by phosphorus solubilizing microorganism present in vermicast (Lee, 1992).

Total potassium content was measured and it was slightly more in vermiwash obtained from final vermicompost. According to Suthar (2007), vermicast contains high concentration of exchangeable potassium, the enhanced microbial activity during the vermicomposting process increases rate of mineralization which adds minerals in worm cast.

Total calcium content was measured and it was more in vermiwash obtained from final vermicompost. Earthworm gut processes are associated with calcium metabolism to enhance the content of inorganic calcium content in worm cast (Gorakh Nath et. al. 2009).

IV. CONCLUSION:

It was evident that there was a significant decrease in pH, total carbon and electrical conductance in vermiwash obtained from final vermicompost. While significant increase in plant nutrients such as nitrogen, phosphorus, potassium and calcium in vermiwash obtained from initial feed mixture to vermiwash obtained from final vermicompost. Thus vermicompost and liquid vermiwash obtained after vermicomposting of biodegradable solid waste are productive bio-fertilizers.

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