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Nutrient enrichment of vermicompost by probiotics supplementation

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ABSTRACT

Vermicompost has unfolded quicker and cheaper solutions to social, economic and environmental problems challenging the human society from waste management to land and soil remediation, safe and sustainable food production. In the present study an attempt has been made to find out if supplementation with probiotics such as Lactobacillus sporogenes, essential microbes and Saccharomyces cerevisiae, could enhance the vermicomposting process and improve nutrient levels in compost. Different waste such as cowdung, leaf litter, flower waste and onion garlic waste were used. In each waste four experiments with the probiotics, L. sporogenes, Essential microbes and S. cerevisiae were added and the nitrogen, phosphorus, potassium levels were analyzed using standard procedures. The result is discussed in the light of enhancement of NPK level by supplementation with probiotics.

Key words: Soil remediation, Waste management, Probiotics, Vermicomposting, *Eudriluseugeniae*.

INTRODUCTION

The ever growing human population places high demand on agricultural production which calls for the use of chemical fertilizers. Increased use of these chemicals may affect non - target organisms in soil and water [14].Vermitechnology comprises vermiculture, vermicomposting and vermiconservation. These provide multiple benefits in the form of waste biomass management, animal protein production, pollution abatement, waste and conservation, land reclamation, production of worm worked manure, soil fertility, maintenance and enhancement of plant production. As a result of human activity several wastes, such as market waste, garden waste, paperpulp, lignin rich sewage sludge and solids waste [7] are generated, which causes severe disposal problems.

MATERIALS AND METHODS

Collection and acclimatization of earthworms

A bulk sample of the epigeic earthworms, *Eudriluseugeniae* (Kinberg) was obtained from M/S. Santhosh farms near Pollachi (Coimbatore district), Tamilnadu. Four different wastes were used in the present study. The wastes used include cowdung, leaf litter, flower waste and onion garlic waste. In each of the above wastes four groups of worms were maintained.1. Control group (cowdung only), 2. Cowdung + leaf litter, 3. Cowdung + flower waste and 4. Cowdung + onion garlic waste.Each group had four sub groups as follows. Cowdung, cowdung + *Lacto bacillus sporogenes*cowdung + Essential microbes, cowdung + *Saccharomyces cerevisiae.* Earthworms were mainta ined under laboratory conditions in large plastic PVC containers (60cm X 40cm X 40cm) along with various predigestion mixtures. Cowdung was obtained from nearby cattle yard and mixed with leaf litter in the ratio of 1:1 w/w for 30 days for acclimatization before they were used in the experiment. Similarly for the above wastes also 4 experimental groups were set up. Thus 16 experiments were maintained. Everyday dechlorinated tap water was sprinkled to maintain the moisture content

Collection of earthworm

Eudrilluseugeniae were obtained from M/S Santhosh farms near Pollachi. It is an epigicexotic earthworm used in vermicomposting.

Collection of different wastes

Wastes such as cow dung, leaf litter, flower waste and onion garlic waste were collected from the college campus, flowers were collected from local market and onion garlic waste was collected from the hostel respectively. Four sets of experiments were set up containing cowdung + *L. sporogenes,* cowdung + *Essential microbes,* cowdung + *S. cerevisiae.* Similarly amendment with probiotics was done for other waste materials also. The NPK level was recorded after 30, 60 and 90 days of composting.

RESULTS

Nitrogen

In leaf litter from a control value of 2.10 ± 0.18% showed a decrease at 30, 60 and 90 days ranging from 0.62 ± 0.01% to 1.90 ± 0.56%. This coincides with increase in the number of cocoons at 60 days and 90 days. In flower waste from a control value of 1.56 ± 0.41% a slight decrease was noted at 30 days, 60 days which increased at 90 days. In flower waste and a flower waste + *L. sporogenes* slight decrease was noted at 30, 60 and 90 days while in Flower waste + Essential microbes and Flower waste + *S. cerevisiae* a slight increase was noted at 90 days. In onion garlic waste a slight decrease was seen at 30 and 60 days followed by an increase was observed at 90 days in onion garlic waste + *L. sporogenes*.

Phosphorus

The phosphorus content was 2.4 ± 0.37%, 2.50 ± 0.37%, 2.62 ± 0.34% and 2.54 ± 0.36% in cowdung, leaflitter, flower waste and onion garlic waste. At 30 days of vermicomposting an increase was observed in all the experiments while at 60 and 90 days.

Potassium

The potassium level was 4.06 ± 0.13% in cowdung, 4.14 ± 0.23% in leaflitter, 4.32 ± 0.76% in flower waste and 3.78 ± 0.54% in onion garlic waste. In all the experimental groups, a decrease was observed at 30, 60 and 90 days except in onion garlic waste + *S. cerevisiae* where a slight increase was observed at 90 days.

After 30, 60 and 90 days an increase was noted in cowdung while in leaf litter, flower waste and onion garlic waste – a decrease was noted. Phosphorus was reduced in onion garlic waste at 30 days followed by a decrease at 60 and 90 days of vermicomposting. Potassium level was decreased at 30 days.

DISSCUSSION

From the results it is evident that there was a decrease in nitrogen level from the initial predigestion mixture, followed by a decrease at 30 and 60 days, while at 90 days there was an increase in cowdung. In leaf litter also a decrease was noted at 90 days. In onion garlic waste decrease was observed at 30 and 60 days followed by a slight increase at 90 days. Phosphorus level showed a decreasing trend in cowdung, flower waste and onion garlic waste, while leaf litter showed an increase at 60 and 90 days. Potassium level showed a decreasing trend in all experiments at a exposure periods.

An increase in nitrogen, phosphorus and potassium has been reported in distillery sludge and agricultural, municipal solid waste and poultry waste mixed in 1:1, 1:3 and 3:1 proportion. The increase was 90.79% in nitrogen, 115.47% in phosphorus and 113.63% in potassium [17] at 60 days of composting using *Eiseniafetida*. The NPK content have been reported to be higher in vermicasts in vermibed then in sugar mill effluent treated worms [6]. 2.0 – 3.2 fold increase in total Kjeldahl nitrogen in textile mill sludge vermicomposting has been reported by [4] in addition releasing nitrogen from compost materials, earthworms also increase nitrogen level by adding their excretory products, mucous, body fluids, enzymes, growth stimulating hormones etc., to the substrate. 2.0 – 2.4 fold increase in nitrogen content has been reported by [15]. Earthworms enhance nitrogen mineralization in the substrate, so that mineral nitrogen is retained in the form [2].

Potassium level of 5.0 ± 0.46 – 9.7 ±0.26 k^{-1} has been reported by [1]. Earthworm processed waste material contains higher concentration of exchangeable potassium due to enhance microbial activity during the vermicomposting process, which enhances rate of mineralization. Higher levels of potassium have been reported in sewage sludge compost [4] and lower levels in coffee pulp waste after vermicomposting [9]. The difference may perhaps due to the initial chemical nature of the feed mixture.

Available nitrogen content in vermicompost was reported to be 450.26kg/ha as compared with ordinary compost with 234.30kg/ha. The phosphorus content was 96.63kg/ha and in ordinary compost it was 88kg/ha. The potassium level 560kg/ha in vermicompost and 326kg/ha in ordinary compost [11].1. 5-2 fold increase in total phosphorus of the final worm compost has been reported Anoop Yadav and Garg, (2009). An increase of 25% in total phosphorus of paper waste sludge occurs after worm activity. Availability of phosphorus to plants is mediated by phosphatase procedure within the earthworms and further release of phosphorus may be introduced by micro organisms in their casts, after excretion. Unavailable phosphorus is converted by available form for the plants. 1.4 – 1.8 food increase in total phosphorus has been reported after 91 days of vermicomposting as compared to initial feed mixture.NPK in organic household waste was 1.9%, 0.95% and 1.2% [8].

NPK levels in vermicompost prepared using *Polyalthialongifolia* leaf litter after 90 days were 70%, 30% and 55% respectively. In rose petal vermicompost the NPK were 85%, 28% and 60% respectively after 90 days. The percent change was (+) 21.42, (-) 20.00% and (+) 9.09% for nitrogen, phosphorus and potassium in *E. eugeniae* [3].NPK levels showed a decrease of (-) 2.15%, (-) 9.30% and (+) 3.57% after seven exposure. Addition of *L. sporogenes*along with seven showed a percent change of (-) 5.23%, (+) 2.33% and (+) 6.25% while in *L. sporogenes* alone amended vermicompost an increase of (+) 6.15%, (+) 23.26% and (+) 10.71% in NPK has been reported by [16]. Increase in NPK levels by vermicomposting by different species of earthworms has been reported [10];[19]. Significant increase in NPK has been reported by [12] in sugarcane trash, Coir waste and tapioca peel [13].

Fig-1. Comparison of Nitrogen (%) in cowdung, leaf litter, flower waste and onion garlic waste after supplementation with the probiotics *L. sporogenes*, Essential microbes and *S. cerevisiae* at 30,60 and 90 days of vermicomposting by *E. eugeniae*

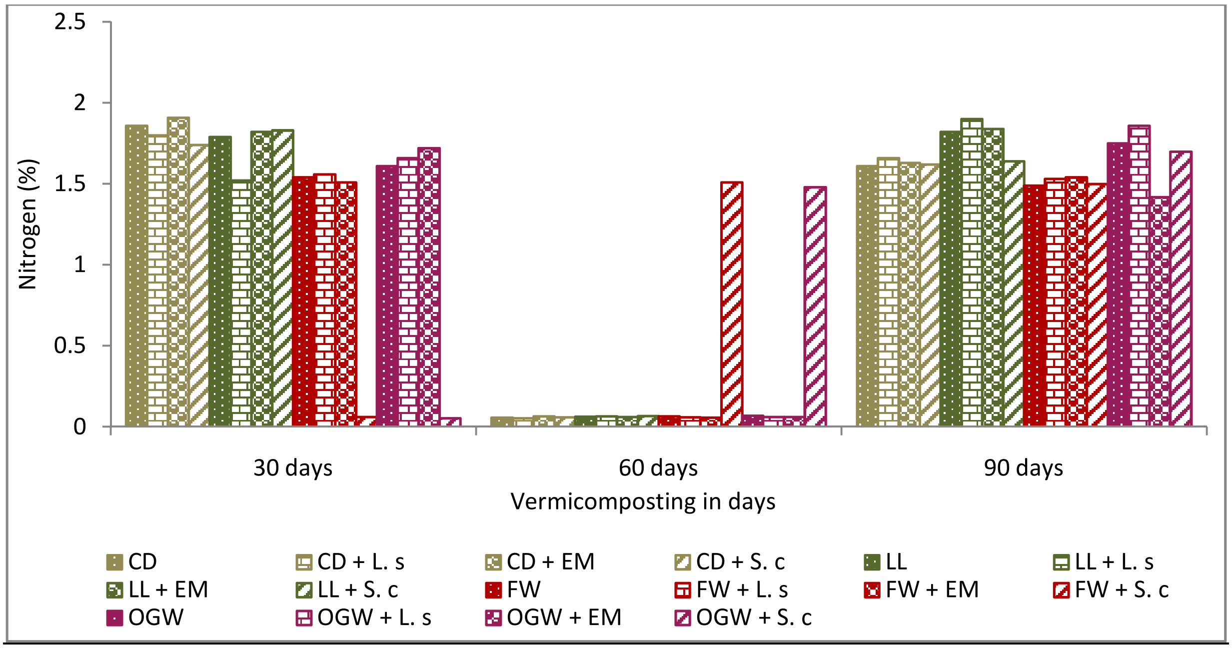


Fig-2. Comparison of Phosphorus (%) in cowdung, leaf litter, flower waste and onion garlic waste after supplementation with the probiotics *L. sporogenes*, Essential microbes and *S. cerevisiae* at 30,60 and 90 days of vermicomposting by *E. eugeniae*

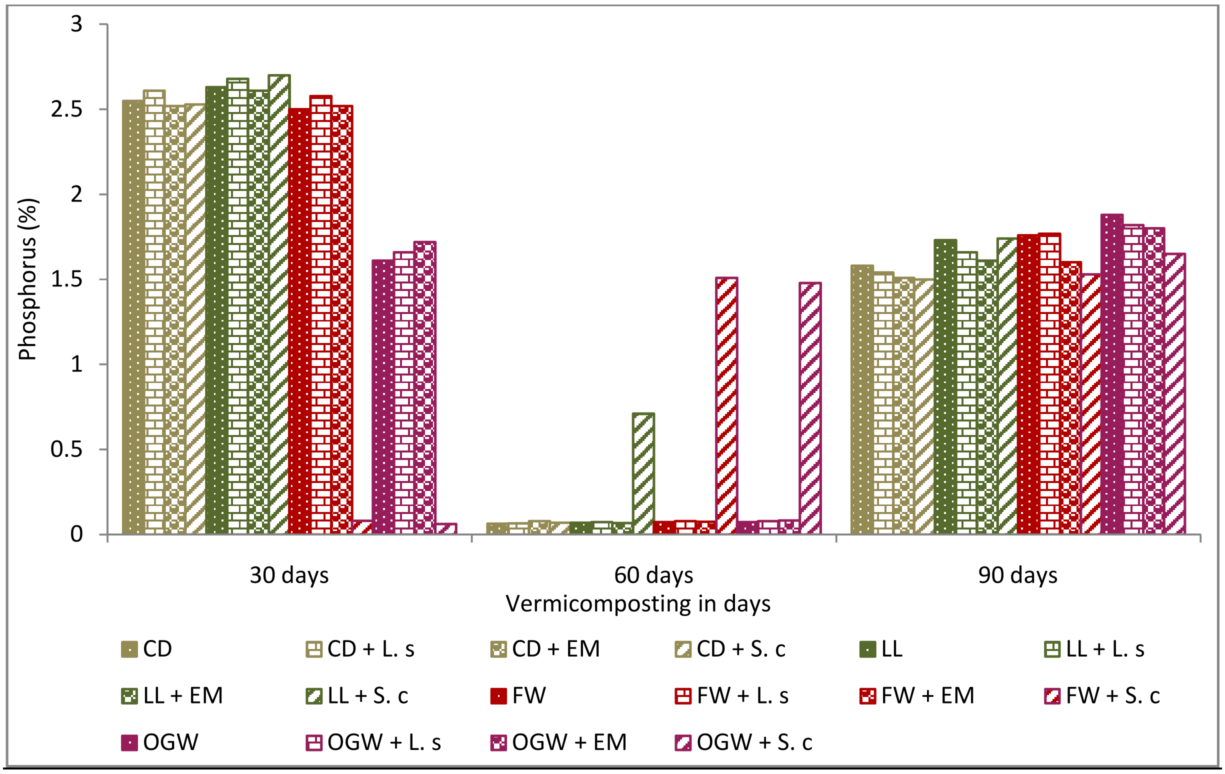
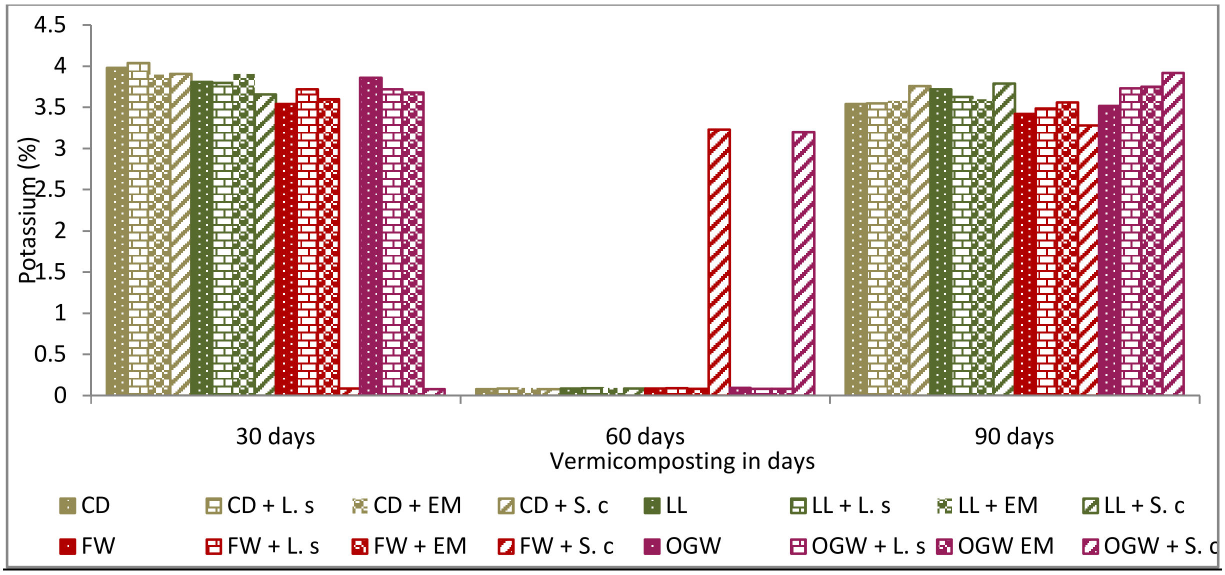


Fig-3.Comparsion of Potassium (%) in cowdung, leaf litter, flower waste and onion garlic waste after supplementation with the probiotics *L. sporogenes*,Essential microbes and *S. cerevisiae* at 30, 60 and 90 days of vermicomposting by *E. eugeniae*



CONCLUSION

Thus, from the present study it is clear that the vermicomposting process as a method of sustainable solid waste management, which if disposed off indiscriminately in open dumps, landfills poses significant hazards to the environment. Further supplementation with the probiotics may serve to enrich the vermicompost thereby improving the soil fertility.

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