

Enhancing Bioconversion Efficiency of the Earthworm *Eudrilus Eugeniae* (Kingberg) by Fortifying the Filtermud Vermibed using an Organic Nutrient

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Abstract: Problem statement: Rapid urbanization and population growth are largely responsible for very high increasing rate of solid waste in the urban areas, its proper management and recycling is major problems of Municipal Corporation. Conversion of industrial wastes in to beneficial vermicompost not only solves solid waste accumulation but also yield highly nutritive organic manure. **Approach:** Enhancing the efficiency of earthworm that is involved in process of converting sugar mill filter press mud in to vermicompost, will be highly economical. An African earthworm *Eudrilus eugeniae* was used to convert the sugar mill filter press mud into nutritive vermicompost. To enhance vermicomposting efficiency, an organic nutrient preparation Jeevamiratham, an effective microbial suspension was supplemented. **Results:** The vermicompost yielded in Jeevamiratham supplemented vermibed had a significantly high nitrogen, phosphorus and micronutrient value. In the Jeevamiratham supplemented vermicompost C/N ratio was 55.5% higher than that was present in the cowdung added vermicompost. In filtermud-Jeevamiratham, vermibed the mean egg production by a single worm at 45 days of growth was 12 ± 2.6 (33.33%). Jeevamiratham had influenced the egg production. When compared to filtermud-cowdung vermibed reared worm, (77.4%) the hatchability of eggs in filtermud jeevamiratham vermibed was high (85.8%). This indicates that the jeevamiratham supplementation strengthens viability of the eggs. **Conclusion:** The present study recommends utilization of effective microorganism suspension, Jeevamiratham for vermicomposting to enhance the functioning of the earthworm and to increase fertilizer value of vermicompost. In the present study also macronutrient and micronutrient content increased significantly in vermicompost prepared from pressmud waste due to the supplementation of Jeevamiratham. This is practical significance if adopted by urban farmers as a result of soil health and in turn the productivity of soil can be maintained for further agriculture.

Key words: Filterpressmud wastes, eudrilus eugeniae, jeevamiratham vermibed, micronutrient value, present study, recommends utilization, microorganism suspension, organic nutrient, vermicomposting process

INTRODUCTION

The vermicomposting process is a result of the combined action of the earthworms and microflora living in earthworm intestines and in the growth medium. Vermicompost improve the soil structure, increasing the water holding capacity and porosity which facilitate the root respiration and growth (Lee, 1992). The beneficial effects of vermicompost on crops like maize (Gutierrez-Miceli *et al.*, 2008), wheat (Sharma and Madan, 1988), strawberry (Singh *et al.*,

2008), petunias (Arancon *et al.*, 2004), marigold, pepper, cornflower, tomato (Bachman and Metzger, 2008), blackgram and pepper (Arancon *et al.*, 2004). Recycling of wastes through vermicomposting reduces problems of disposal of agricultural as well as industrial wastes without adversely impacting the environment (Prakash and Karmegam, 2010)

Filter cake or Pressmud as it is commonly known is one of the important by-products of the sugar industry. Filterpressmud is a soft, spongyamorphous and dark brown to brownish white material containing sugar,

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fibre coagulated colloids including cane wax, albuminoids, inorganic salts and soil particles. It is readily converted to a repository of macro and micro nutrients besides being a very effective soil ameliorant thorough vermicomposting. Pressmud mounts as it is accumulated at a stocking point, it undergoes self combustion and adds to pollution of the environment besides causing an eyes sore (Lakshmi and Vijayalakshmi, 2000). According to curing of Pressmud for 4-6 weeks is necessary before application to the soils. Hence, the present work was undertaken to convert fresh filter Pressmud into nutrient rich manure by using African Earthworm *Eudrilus eugeniae* (Kinberg)

According to proximately 12 million tones of press mud is produced in India annually. Due to the prohibitive cost of sludge disposal, it is either dumped in open or along roadsides or railway tracks or stored in the sugar mill premises where it causes adverse impacts on the ambient environment (Parthasarathi, 2008).

Conventional composting of press mud takes about 6 months and also does not remove the foul odor completely. Vermicompost so obtained has less nutritive value and more compactness. Therefore, appropriate press mud management technology is desired which not only protect and conserve the environment and land resources but also to recover the nutrients present in it. The present study deals with the vermiconversion of filterpressmud waste using a natural nutrient preparation, Jeevamirtham into nutrient rich manure by using the earthworm *Eudrilus eugeniae*.

MATERIALS AND METHODS

Jeevamirtham preparation: Two hundred litres of water was taken as a stock solution. To which, the following ingredients were mixed:

- Ten Kg desi cowdung (Cow dung of the native Indian breed cow, collected fresh)
- Five to Ten litres of desi cow's urine. (Urine can be collected and stored for any number of days, does not lose quality)
- Two Kg of Palmyra jaggery and 2-4 L of sugar cane juice
- Flour of black gram - best if hand ground; not as effective if ground in a power grinders the particle size varies
- Handful of chemical free soil

First the cow dung and urine were added to water, then jaggery, flour and soil were added together to that solution content was stirred clockwise for couple of

minutes and this was done 3 times a day. The solution fermented, within 48-72 h. The solution was stored in protective sterile containers.

Earthworm's cultures: *E.eugeniae* was obtained from a vermicomposting unit of Kalapavirusam in Tenkasi, Tamilnadu (India). The stock culture of the earthworm was maintained in plastic containers using partially decomposed bio-waste and cowdung as growth medium in laboratory condition. This was further used in the vermicomposting experiment.

Filtermud: The filter mud was collected from the Dharani Sugar Factory near Vasudevanallur, during June 2010. Fresh filter mud was kept in shade for 2-3 weeks before using for the vermicomposting process (Sangwan *et al.*, 2008). The shade dried filterpressmud was then blended with organic growth promoter Jeevamirtham rich in microbes and used as a bulking agent to increase the C/N ratio. The mixture was prepared by mixing 200 mL of 200g cow dung and 1000kg filter mud, the raw material for the vermicomposting process. Before starting of the experiment, Filterpressmud wastes (FM) and the filterpressmud wastes with Jeevamirtham (FM+JM) and Filterpressmud with cowdung mixture (FM+CD) were pre-composted for 15 days so that it becomes palatable to the earthworms.

Experimental design: The vermibeds were prepared using filterpressmud in plastic containers and watering was done regularly to moist the medium. Three treatments were taken for vermicomposting of FM materials; one with cowdung alone; while the other two with a mixture of Filterpressmud and Jeevamirtham and Filterpressmud and cow dung. The plastic containers were filled with 1.5 cm thick sterilized soil layer at the bottom as soil is considered as an important supporting material for vermicomposting (Yadav *et al.*, 2010), Control and treatments were triplicate.

To each plastic container, 10 adult 40 days old earthworms *Eudrilus eugeniae* were introduced from the stock culture after pre-composting of the raw materials. The experiment was conducted in dark room in ambient temperature. The moisture levels in the experimental containers were maintained at 70±10% (Yadav and Garg, 2009).

The vermicompost was harvested after the appearance of black granular structure on the surface of the composting medium. Watering of the composting medium was discontinued four days before the harvesting. Vermicompost output from each treatment was calculated on dry weight basis. Population of earthworm and their biomass as well as cocoons were

measured at the end of the experiment as per the method given by Gupta and Garg (2008).

Growth and reproduction of worm: After an undisturbed 7 days of composting period, the content in the triplicates was mixed and moisture content was checked together with earth worm's activity. Every 15 days over a period of 45 days the worms were hand sorted and weighed. The weight of 10 worms were taken together (mg) and calculated to percent of single worm weight. The Cocoons production by earthworm was measured in each worm worked compost containers. Separated cocoons were counted and introduced into separate bedding containing the same material in which their parents were reared. On the basis of the obtained data about the biomass and cocoon numbers, other parameters of earthworm such as biomass increase rate (mg day^{-1}), maximum weight achieved and reproduction rate (cocoon/worm/day) were calculated with the help of the recorded data for different worm.

Characteristics of the composts: After 45 days, worms were removed from the Worm-worked compost (WC). Samples of Worm-worked compost (WC) and control compost were sun dried and analyzed for pH (1:2.5 soil water suspension), electrical conductivity (EC) (1:2.5 soil water suspension filtrate), organic carbon (OC).

Statistical analysis: Paired sample t-test was used to analyze the differences in vermicompost production in different treatments. The same test was used to compare the mean values of different chemical parameters of the compost (control) and vermicompost generated in the two treatments. Finally, one-way ANOVA was employed to compare the effects of the different amendments effects within the control and experimental compost.

RESULTS

Filtermud is a sugar factory wastes which can't be directly applied to farms. Filter is converted into a nutrient rich vermicompost by employing the earthworm *Eudrilus eugeniae*. To enhance the bioconversion efficiencies of the earthworm an organic nutrient enriched with effective microbial suspension, jeevamiratham and cow dung were used.

Growth of earthworms: In the present experiments the African earthworm *Eudrilus eugeniae* was used to convert filtermud into vermicompost. To rear the worm's two types of vermibeds were used. In the both the vermibeds filtermud was used but nutrient

supplementation was different. In the filtermud-cowdung and filtermud-Jeevamiratham vermibeds the growth of earthworm different. After 45 days the mean weight increase of the earthworm in the filtermud-cowdung vermibed was 704.22 ± 59.62 mg (94.26% but in filtermud-Jeevamiratham vermibed the mean weight increase was 803.32 ± 91.40 (145.18%) (Table 1).

Significant difference was noticed in the weight of the earthworm reared in filtermud jeevamiratham vermibed when compared to filtermud-cow dung vermibed. The influence of jeevamiratham to enhance the growth of worm is evident.

Hatching and cocoon production: Cocoon production and their hatchability are influenced by the type of vermibed in which the worms are reared. In the filtermud-cowdung vermibed the mean number of eggs produced by a worm after 45 days of growth was 9 ± 3 . However in filtermud-Jeevamiratham, vermibed the mean egg production by a single worm at 45 days of growth was 12 ± 2.6 (33.33%). Jeevamiratham had influenced the egg production. When compared to filtermud-cowdung vermibed reared worm, (77.4%) the hatchability of eggs in the filtermud jeevamiratham vermibed was high (85.8%). This indicates that the jeevamiratham supplementation strengthens the viability of the eggs (Table 2).

Jeevamiratham mixed vermibed both the cocoons production and hatchling numbers were significantly higher than the vermibed in which cowdung was applied (Table 2).

In the present experiment, the influence of organic nutrient supplement, Jeevamiratham to convert sugar factory filtermud into high quality vermicompost was studied. Further, whether the Jeevamiratham addition with filtermud can influence the economic characteristics of the earthworm was also studied. The efficacy of Jeevamiratham on the vermicomposting efficiency of the earthworm *Eudrilus eugeniae* was compared with filtermud that was converted into vermicompost by mixing cowdung.

The influence of Jeevamiratham on the physico-chemical characteristics of vermicompost was analyzed and compared with vermin bed where cowdung was alone used. The characteristics like pH, EC, N, P, K, Ca, Mg, S and C/N ratio in raw filter pressmud, vermicompost made from filter pressmud by supplementing Jeevamiratham and cowdung showed that the various physico-chemical characteristics, in the Jeevamiratham used vermicompost was significantly greater when compared cowdung used vermibed and raw filter pressmud. N, P, K and micronutrients like Ca, Mg and S were found at an elevated level in Jeevamiratham mixed vermicompost (Table 3).

Table 1: Influence of Jeevamirtham on the growth of the earthworm *Eudrilus eugeniae* in different vermibeds

Types of vermibeds	Initial weight (mg) of the earth worm (Mean \pm SD of 10 worms)	Weight of the earthworm (mg) after of 10 worms (Mean \pm SD of 10 worms)
Filterpressmud + jeevamirtham	311.04 \pm 0.34	704.22 \pm 59.62 (94.26%)
Filterpressmud + cowdung	327.64 \pm 44.59	803.32 \pm 91.40 (145.18%)

Table 2: Influence of Jeevamirutham on cocoon, hatchability and Natality of the earthworm *Eudrilus eugeniae* employed in the vermicomposting process of Filterpressmud

Types of vermibeds	Total number of eggs(n = 30)	Number of eggs produced per worm	Total number of eggs hatched	Hatching percentage (%)
Filterpressmud +cowdung	270	9 \pm 3.0	209	77.4
Filterpressmud + jeevamirtham	360	12 \pm 2.6	302	85.8

Table 3: Physio-chemical changes in filtermud mixed with jeevamirtham and cowdung treated with earthworm *eudrilus eugeniae* (Mean \pm SD-Tukey's test, p<0.05

Treatments	pH	EC ds/m	N (%)	P (%)	K (%)	Micronutrients			
						Ca (%)	Mg (%)	S (%)	C/N ratio
Pressmud [©]	7.4200 \pm 0.00577	2.5000 \pm 0.05774	2.4533 \pm 0.01202	1.9733 \pm 0.00882	0.5300 \pm 0.00577	4.2600 \pm 0.01528	1.0433 \pm 0.00333	0.8400 \pm 0.00577	8.5800 \pm 0.00577
Pressmud+cowdung	7.5233 \pm	1.9167 \pm	3.4767 \pm	2.3467 \pm	0.8767 \pm	4.9267 \pm	1.8233 \pm	1.0567 \pm	9.1367 \pm
Vermicompost (wc-c1)	0.00333*	0.00882*	0.00667*	0.00882*	0.00333*	0.00333*	0.00333*	0.04333*	0.00882*
Pressmud+Jeevamirtham	7.4967 \pm	2.5500 \pm	4.0733 \pm	2.6600 \pm	0.9867 \pm	5.1333 \pm	1.8767 \pm	1.3433 \pm	14.0400 \pm 0
Vermicompost (wc-j1)	0.01667*	0.02887 ^{NA}	0.00333*	0.01528*	0.00333*	0.00333*	0.00333*	0.00333*	0.01000*

p = 0.05; *: 0.04 < 0.05 -Significant; ^{NA}: 0.423>0.05 - Non Significant

Also the pH of the vermicompost prepared using Jeevamirtham increased from its original value towards neutral. The vermicastes are more neutral in which the worms live and this may be due to the fact that the earthworms neutralize soil as it passes through them by secretions of the calciferous glands secretions from the intestine and also due to ammonia which is excreted. Suthar (2008) reported that there is significant increase in conductivity and K content in bed soil by the end of vermicomposting process, which might be due to leaching of K during vermicomposting process, Macronutrients such as nitrogen, phosphorus and also increased significantly in pressmud vermicompost.

In the present study also macronutrient and micronutrient content increased significantly in the vermicompost prepared from pressmud waste due to the supplementation of Jeevamirtham. In the Jeevamirtham supplemented vermicompost C/N ratio was 55.5% higher than that was present in the cowdung added vermicompost.

DISCUSSION

Comparatively the higher level of organic content in non worm-worked composts may be due to the increase in their microbial load, which is expected to be less in worm-worked composts (Garg and Kaushik, 2005; Parvaresh *et al.*, 2004; Suthar, 2009).

As far as interaction effects concerned, in compost and vermicompost highest nitrogen content was recorded in T5 which was on par with rest of the treatments. This is because may be due to higher

amount of nitrogen in parthenium and cassia (Sharma *et al.*, 2004).

The observed increase in the EC, N, P, K and micronutrients (Cu, Zn, Mg and Fe) in all worm worked composts (except in the case of N in neem leaves compost) showed that the activity of earthworm *E. eugeniae* along with microorganisms promoted mineralization process and brought the nutrients to ready to use form for plant growth.

Filter mud has significant fertilizer value but due to prohibitive cost of sludge disposal, it is dumped in open, where it adversely affects the ambient environment. Apart from this, such practices entail wastage of organic and inorganic nutrients present in the filter mud that might be put to good use. The management and nutrient recovery from filter mud carried out in the present work by mixing with Jeevamirtham was very effective. The results showed that during the supplementation of jeevamirtham the nutrient load viz; nitrogen, phosphorus and content was enhanced. The product so obtained can be used in agricultural fields as manure. This study provides a platform for the utilization of Filter mud amended with Jeevamirtham for the process of productive and value added vermicompost manufacture.

CONCLUSION

Filter pressmud with Jeevamirtham composted using employing *Eudrilus eugeniae*, showed high manurial value. Hence vermicomposting can be a potential

ecological engineering process to convert noxious industrial wastes into value-added materials for sustainable agriculture.

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