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Evaluation of parameters for preparation of vermicompost from bagasse and press mud by using *Eudrilus eugeniae*

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Abstract
Sugar Industry and its ancillary units in India play a vital role in the economic development of rural areas. The increase in sugarcane and sugar production has resulted in increased quantity of wastes in the form of bagasse and press mud per day. Most of these wastes are usually burnt in the field, which creates severe environmental pollution and health hazard. Hence it was thought to use these wastes as raw material for vermicomposting. Vermicomposting is a composting process by using earthworms. In this study both wastes were pre-treated with cow dung and urine of cow for 15 days at room temperature and then it was used to fill up in 2Kg capacity pots and then *Eudrilus eugeniae* was used to convert this waste into Vermicompost. Then optimizations of parameters like temperature, pH, moisture, particle size of waste were carried out using *Eudrilus eugeniae* for six weeks. It was found that 25 ºC pH 7.0, 1-1.8 mm particle size and 80% moisture content were optimum parameters for vermicomposting of sugarcane waste.

Keywords: Vermicompost, environmental pollution, waste, *Eudrilus eugenia*

Introductions
Vermicompost (Vermicompost) is the product of the decomposition process using various species of worms, usually red wigglers, white worms, and other earthworms, to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. This process is called vermicomposting, while the rearing of worms for this purpose is called vermiculture.

Vermicast (Also called worm castings, [a] worm humus, worm manure, or worm faeces) is the end product of the breakdown of organic matter by earthworms. These excreta have been shown to contain reduced levels of contaminants and a higher saturation of nutrients than the organic materials before vermicomposting.

Vermicompost contains water-soluble nutrients and is an excellent, nutrient-rich organic fertilizer and soil conditioner. It is used in gardening and sustainable, organic farming.

Vermicomposting can also be applied for treatment of sewage. A variation of the process is vermifiltration (or vermi digestion) which is used to remove organic matter, pathogens, and oxygen demand from wastewater or directly from black water of flush toilets.

Vermicomposting is a decomposition process involving the combined action of earthworms and microorganisms. The temperature, pH, organic matter, moisture, and particle size, C: N ratio are the major factors which affects the growth and activities of earthworms under these conditions earthworm's growth, reproduction, respiration shows variation. Vermicomposting is faster when all the conditions are favorable for the growth of earth worm and microorganisms under unfavorable conditions they remain calm and show very negligible activity.

Press mud and bagasse are major wastes of sugar industry. Press mud is heavily polluting and also has harmful effects on the ambient environment. It generates intense heat (65 °C) and foul odor. Its natural decomposition takes a long time [1]. Bagasse is a matted cellulose fiber residue. It mainly consists of cellulose 45%, hemi cellulose 28% and lignin 19% [2]. Previously both these wastes were burnt as a means of solid waste disposal. However, as the cost of fuel oil, natural gas and electricity has increased, bagasse has come to be regarded as a fuel rather than refuse in the sugar mills [3, 4].

These organic wastes are converted to biofertilizer by earthworm's action over a certain period of time in a vermin reactor [5].

Press mud and bagasse serves as an ideal medium for vermicomposting and the earthworms grow luxuriously in it. By introducing earthworms into heaps of well-prepared press mud and bagasse, we can create a wealth of enriched organic manure in the form of Vermicompost. The earthworms feed on the organic waste and the earthworms gut acts as a bioreactor and vermin casts are produced [6]. Vermicompost maintains a steady mineral balance, improves nutrient availability and could act as complex biofertilizer rejuvenating the soil, in addition of reduction of pathogenic organisms too. It is also used for waste management in the urban environment. The present study deals with the study of optimization of different parameters affecting vermicomposting using sugar industry waste specially bagasse and press mud admixed with cow dung and urine of cow initially. After partial decomposition of waste it was excellent raw material for vermicomposting. Then it was used for optimization of vermicomposting parameters like temperature, pH, moisture content, particle size of waste. Earthworm species used in the present study was *Eudrilus eugeniae*.

Materials and Methods

Materials

1. Bagasse: Kisanveer Sahakari Sugar Factory Ltd. Bhuinj, Dist. Satara.)
2. Press mud: Kisan veer Sahakari Sugar Factory Ltd. Bhuinj, Dist. Satara.)
3. Cow dung: Cow dung sample was collected from the nearby cattle shade. iv)
4. Urine of cow: Urine of cow was collected from nearby cattle shade.
5. Earthworms: In the present study the well-known species of Earthworm *Eudrilus eugeniae* was obtained from a vermicomposting unit of Ajinkya Krushi seva Padali, Dist. Satara.
6. Vermi culturing pot: The pots of bamboo material having 2 Kg capacities were obtained from local market
7. Electronic balance –

Methods

1. **Precomposting of the sample:** Shade dried samples of bagasse and press mud were mixed with cow dung, urine of cow to increase carbon to nitrogen ratio. Moisture content was adjusted to 80% by sprinkling water. It was kept three weeks for precomposting.

2. **Earthworm culture:** Earthworms were collected from the a Vermicomposting unit and brought to the laboratory and mass cultured in the culture pot containing cow dung as growth medium at laboratory conditions. These earthworms were further used in the vermicomposting experiments.

3. **Preparation of vermiculturing pots:** For vermicomposting 2 kg capacity vermiculturing pots were used. The precomposted bagasse and press mud samples were added in the pots. Water was sprinkled over the bed to hold the moisture content 80% and then this admixture was used for vermicomposting process.

4. **General Vermicomposting process:** The 2 kg material was filled in the pots and kept for 6 weeks by adding 10 earthworms per pot. Every week the weight of earthworm biomass per pot was taken after 2 thorough washing and blotting of earthworms and then they were reinnoculated in the respective pots. The procedure was followed for every week till 6 weeks.

Evaluation of Vermicomposting Specifications

1. **Effect of particle size of material on the vermicomposting process:** The particle size of material selected for experiment was 0.5 to 1.2 mm, 1.0 to 1.8 mm, 2.36 mm and 4.75 mm. pH of material was adjusted to pH 7.0 2 Kg material of each particle size was filled in four pots and inoculated with ten earthworms per pot and incubated at room temperature (25 ºC) for six weeks. The average biomass of earthworms per pot was taken per week.

2. **Effect of moisture containt of material on the vermicomposting process:** The pH of material was adjusted to 7.0 and particle size 1 to 1.8 mm. The moisture content of vermicomposting material was adjusted to 60%, 70%, 80% and 90% with water and filled in 2 Kg amounts in four pots and inoculated with ten earthworms per pot and incubated at room temperature (2 ºC) for six weeks. The average biomass of earthworms per pot was taken per week.

3. **Effect of pH of material on the vermicomposting process:** The pH of vermicomposting material was adjusted with 1NHCl/1NNaOH to 5, 6, 7, 8 and 9. The pH values adjusted materials were filled in 2 Kg amounts in five pots and inoculated with ten earthworms per pot and incubated at 25 ºC for six weeks. The average biomass of earthworms per pot was taken per week.

4. **Effect of temperature on the vermicomposting process:** The temperature range selected for experiment was 20, 25, 30, 35 ºC taking into account average minimum and maximum temperature found in Satara district region and the seasonal variations in the year. The material was filled in 2 Kg amount in four pots and were inoculated with ten earthworms per pot and incubated for six weeks in BOD Incubator at temperature 20, 25 and 30 ºC. The average biomass of earthworms per pot was taken per week.

Result and Discussion

Particle size optimization: The particle size range selected was 0.5 to 1.2 mm, 1.0 to 1.8 mm, 2.3 mm and 4.75 mm. The maximum average biomass of 26.52 Gms was obtained at the end of six weeks at 1 to 1.8 mm particle size indicating it is the optimal particle size for vermicomposting studies using *Eudrilus eugeniae* at pH 7.0, 25 ºC and 80% moisture level (Table No 1). It was reported by Kadam, 2004 that maximum biomass of *Eudrilus eugeniae* was attained at 1 mm particle size using Tendu leaves as raw material and findings in the present investigation showed 1-1.8 mm particle size as optimum particle size. These findings supported present results indicating large particle size are not suitable to earthworms.

Table 1: Optimization of Particle Size

Size in mm	Initial Weight Dt. 28/01/15	First Week Dt.04/02/15	Second Week Dt.11/02/15	Third Week Dt.18/02/15	Fourth Week Dt.25/02/15	Fifth Week Dt.04/03/15	Sixth Week Dt.11 /03/ 15
0.5 – 1.2 mm	02.00 gm	03.04 gm	04.03 gm	05.12 gm	07.72 gm	10.32 gm	14.28 gm
1.0 – 1.8 mm	01.23 gm	02.58 gm	06.18 gm	18.12 gm	21.32 gm	24.12 gm	26.52 gm
2.36 mm	01.3 gm	02.5 gm	03.3 gm	04.8 gm	05.1 gm	08.62 gm	12.78 gm
4.75 mm	01.4 gm	02. 72 gm	03.54 gm	05.28 gm	05.86 gm	06.68 gm	09.52 gm

Moisture Percent Optimization

It is evident from (Table 2) that when vermicomposting was carried out at pH 7.0 and 25 ºC and 1-1.8 mm particle size of material and with selected moisture level 60% to 90%, there was gradual increase in the biomass of earthworms from 60 to 80% moisture levels every week till the end of sixth week but maximum biomass increase was obtained at 80% moisture level whereas at 90% moisture level comparatively less biomass production was obtained. It indicated that 80% moisture level was the optimum level for vermicomposting of sugarcane waste using *Eudrilus eugeniae*. The maximum Cocoon production at 70-80% moisture level reported by [7]. While 85% as optimal moisture level for Eudrilus andrei when grown on pig manure was reported by [8]. These reports thus support findings of present investigations.

Table 2: Optimization Moisture Percent

Moisture Percentage	Initial Weight Dt. 28/01/15	First Week Dt.04/02/15	Second Week Dt.11/02/15	Third Week Dt.18/02/15	Fourth Week Dt.25/02/15	Fifth Week Dt.04/03/15	Sixth Week Dt.11 /03/ 15
60%	01.4 gm	02.46 gm	03.28 gm	05.56 gm	06.34 gm	07.12 gm	10.72 gm
70%	02.34 gm	03.24 gm	04.06 gm	08.16 gm	10.42 gm	14.24 gm	16.32 gm
80%	02.4 gm	03.71 gm	06.23 gm	09.18 gm	12.42 gm	16.31 gm	19.72 gm
90%	02.1 gm	03.02 gm	04.32 gm	07.08 gm	09.44 gm	11.22 gm	15.12 gm

pH Optimization

The pH range of 5 to 9 was used for the studies. There was gradual increase in the average earthworm biomass production from pH 5 to 7 (Table 3). The maximum average biomass obtained at the end of 6th week was 28.66 gm at pH 7.0 indicating pH 7.0 being optimal for vermicomposting with *Eudrilus eugeniae* at 25 ºC temperature and 1-1.8 mm particle size of material. Earthworms are very sensitive to pH. Thus pH of soil or waste is a factor that limits the distribution, number and species of earthworms. Several researchers have stated that most species of earthworm prefer to pH of about 7.0 [9, 10, 11].

Table 3: Optimization of pH

pH	Initial Weight Dt. 28/01/15	First Week Dt.04/02/15	Second Week Dt.11/02/15	Third Week Dt.18/02/15	Fourth Week Dt.25/02/15	Fifth Week Dt.04/03/15	Sixth Week Dt.11 /03/ 15
05	02.4 gm	03.75 gm	04.12 gm	05.28 gm	06.81 gm	08.32 gm	18.12 gm
06	03.2 gm	04.18 gm	07.34 gm	10.11 gm	12.42 gm	15.12 gm	23.13 gm
07	02.4 gm	04.42 gm	06.34 gm	10.32 gm	14.42 gm	20.25 gm	28.66 gm
08	3.12 gm	04.92 gm	10.14 gm	12.32 gm	13.45 gm	19.12 gm	22.02 gm
09	02.17 gm	03.47 gm	04.82 gm	05.74 gm	06.66 gm	10.64 gm	15.34 gm

Incubation Temperature Optimization

The Table 4 shows that out of 20, 25, 30, 35 ºC temperature used for incubation, maximum average biomass of 23.12 gm were produced at 25 ºC. At the incubation temperatures beyond 30 ºC the earthworms could not survive, indicating 25 ºC being optimal when the 7.0 pH and 1-1.8 mm particle size material used. It was reported by [12, 13, 14, 7] that about 30 ºC high mortality of E. fetida was observed. The better biomass and cocoon production was reported by them at 25-30 ºC temperature. It was observed that the results of present studies regarding vermicomposting temperature using *Eudrilus eugeniae* are constant.

Table 4: Optimization of Incubation Temperature

Temperature (ºC)	Initial Weight Dt. 28/01/15	First Week Dt.04/02/15	Second Week Dt.11/02/15	Third Week Dt.18/02/15	Fourth Week Dt.25/02/15	Fifth Week Dt.04/03/15	Sixth Week Dt.11 /03/ 15
20 ºC	02.6 gm	03.12 gm	04.92 gm	06.03 gm	08.12 gm	14.34 gm	12.38 gm
25 ºC	03.65 gm	04.22 gm	07.32 gm	11.35 gm	16.12 gm	19.72 gm	23.12 gm
30 ºC	02.1 gm	03.34 gm	04.16 gm	06.92 gm	09.74 gm	12.82 gm	18.28 gm
35 ºC	03.5 gm	04.24 gm	05.02 gm	06.13 gm	08.96 gm	10.28 gm	14.24 gm

Conclusion

1. Sugar industry wastes like press mud and bagasse can be used for production of Vermicompost.
2. The partially decomposed press mud and bagasse serves as an excellent raw material for vermicomposting.
3. Earthworm species *Eudrilus Eugenia* have capacity to produce best quality Vermicompost.

4. The optimized conditions for vermicomposting were observed as-i) P_H 7.0-ii) Temperature 25 ºC-iii) Moisture 80%-iv) Particle size 1- 1.8 mm.

References

1. Sen B, Chandra TS. Chemplitic and solid state spectroscopic evaluation of organic matter transformation during vermicomposting of sugar industry waste. Bioresour. Technol. 2007;98(8):1680-1683.
2. Pehlivan E, Tran HT, Ouedraoga WKI, Schmidt C, Zachmann D, Bahadis M. Sugarcane bagasse treated with hydrous ferric oxide as a potential adsorbent for removal of AS (V) from aqueous solutions. Food chemistry. 2013 May 1;138(1):133-8.
3. Paya J, Monzo Borracharo MV, Diaz Pinzon L, Ordonez LM. Sugarcane bagasse ash (SCBA): Studies on its properties for reusing in concrete production. Journal of Chemical Technology and Biotechnology. 2007;77(3):21-32.
4. Aigbodion VS. Potential of using bagasse ash particle in metal matrix composite, Ph.D. work on going. Department of Metallergical and Materials Engineering, Ahmadu Bello University, Samaru, Zaria, Nigeria; c2011.
5. Gurav MV, Pathade GR. Production of vermicompost from tenle waste (Nirmalya): A case study. Universal Journal of Environmental Research and Technology. 2011;1(2):182-192.
6. Ansari AA, Sukhraj K. Effect of vermiwash and vermicompost on soil parameters and productivity of okra (*Abelmoschus esculentus*) in Guyana. African Journal of Agricultural research. 2004;5(14):1794-1798.
7. Kadam DG. Studies on vermicomposting of Tendu leaf (*Diospyros Melanoxylon* Roxb), Refuse with Emphasis on Microbiological and Biochemical aspects, Ph.D. Thesis, Shivaji University, Kolhapur; c2004.
8. Dominquez J, Edward CA, Subler S. A comparison of vermicomposting and composting. Biocycle. 1997;38:57-59.
9. Narayan J. Vermicomposting of biodegradable wastes collected from Kuvempu University campus using local and exotic species of earthworm. In: Proceedings of a National Conference on Industry and Environment, 20th to 21 st Dec. 1999, Karad, India; c2000, p. 417-419.
10. Pagaria P, Totwat KL. Effects of press mud and spent wash in integration with phosphogypsum on metallic cation build up in the calcareous sodic soils, Journal of the Indian Society of Soil Science. 2007;55(1):52-57.
11. Suthar S. Microbial and decomposition efficiencies of monoculture and polyculture vermireactors, based on epigeic and anecic earthworms. World Journal of Microbiology and Biotechnology.
    2008 Aug;24(8):1471-9.
12. Munnoli PM. Management of Industrial organic solid wastes through vermiculture biotechnology with special reference to microorganisms. PhD thesis, Goa University, India; c2007, p. 1-334.
13. Yadav KD, Tare V, Ahammed MM. Vermicomposting of source-separated human faeces for nutrient recycling. Waste Management. 2010 Jan 1;30(1):50-6.
14. Tripathi G, Bharadwaj P. Comparatives studied on Biomass production, Life cycles and composting efficiency of *Eisenia foetida* (Savigny) and *Lampito mauritii* (Kinberg). Bioresorce technology. 2004;94:275-283.