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Research Article

Effect of distillery spent wash on macronutrients of vermicompost

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Abstract

Distillery industries are one of the important agro-based industries producing ethyl alcohol for industrial and potable purposes. They also assume importance due to growing requirement of alcohol in energy sector. However their environmental significance is assessed as pollution causing, as they generate large quantity of foul smelling coloured wastewater known as spent wash. The experiment involves vermicomposting on application of primary treated spent wash to press mud and soya bean waste in different dilutions using earthworms Eudrilus eugeniae. Initial characterization was done for primary treated spent wash, press mud & soya bean waste. The vermicompost samples made were collected and analyzed for their macro nutrients N, P, K .The bioconversion period of spent wash with soya bean waste was found to be 53 days; whereas for spent wash with press mud was 45 days. The N,P,K values increased from 1.26 to 1.96% , 0.45 to 0.97% & 0.6 to 0.99% for VC of SW+PM, similarly N,P,K values increased from 1.48 to 1.86% , 0.35 to 0.68% & 0.46 to 0.61% for VC of SW+SBW respectively.

Keywords*: Spent wash, Nitrogen, Phosphorus, Press mud, Organic waste, Organic carbon, C/N ratio.*

Abbreviations*: **SW**: Spent wash; **SBW**: Soya bean waste; **N**: Nitrogen; **P**: Phosphorus, **K**: Potassium, **OC**: Organic carbon; Press mud: PM; **C/N**: Carbon /Nitrogen ratio.*

Introduction

India is a major producer of sugar in the world and sugar industry offers employment potential and contributes substantially to economic development. There are about 579 sugar mills and 285 distilleries in India. The alcohol industry produces a huge amount of wastes every day, which is rich in organic material and characteristically less toxic and easily amenable for microorganisms. Alcohol is produced in India by the fermentation of molasses. The mother liquor left after the sugar production is spent wash (SW). It is dark brown in color, with high temperature, low pH and high ash content. The distillery SW does not contain any toxic compound, but rich in plant nutrients, organic carbon and proteinaceous substances [R Palaniswami et.al,2011]. Presently there are 285 distillery industries with an installed capacity of 2.7 billion liters of wastewater is generated as spent wash per annum. The disposal of such a large volume of wastewater is a serious concern to the environmentalist as well as agricultural scientists due to its high Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) [H. Kavitha et. Al,2]. Earthworms are the most important soil dwelling organisms involved in the process of soil formation and organic matter decomposition (R S Giraddi,2008). Vermicomposting is a mesophilic process and is the process of ingestion, digestion, and absorption of organic waste carried out by earthworms followed by excretion of castings through the worm's metabolic system, during which their biological activities enhance the levels of plant-nutrients of organic waste (S Pattnaik & M V Reddy, 2010). Vermiculture (derived from the Latin *vermi* meaning worm) involves the mass production of earthworms for waste degradation, and composting with 'vermicast' production. Earthworms are a major soil fauna on Earth, constituting 80 percent of the soil invertebrate population in many ecosystems, especially in the tropical ecosystems. The species used in India were Indian blue (*Perionyx excavatus),* African night crawler *(Eudrilus euginiae)* and the Tiger worm *(Elsinia foetida)* (R Sinha). Vermicompost is rich in NPK, micronutrients, beneficial soil microbes and also contain 'plant growth hormones & enzymes'. It is scientifically proving as 'miracle growth promoter & also plant protector' from pests and diseases. The nutritional quality of vermicompost is determined primarily by the type of the substrate (raw materials) and species of earthworms used for composting, along with microbial inoculants, humidity, pH and temperature (Am-Euras, 2009, P M Munnoli and Saroj Bhosle 2008, 2009). The current paper reveals the effect of distillery SW on quality of vermicompost of PM and SBW. The

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macronutrient content of SW and vermicompost are analyzed and the results are discussed.

Materials and Methods

Experimental set up

Vermicomposting was carried out in plastic boxes of size 36 x 26 x 30 cm. African night crawler, *Eudrilus eugeniae* was used in the experimentation (P M Munnoli and Saroj Bhosle 2008, 2009).

Collection and Characterization of distillery Spent wash

Distillery SW and sugar industry by-product PM for the study were collected from Sri Lakshmi Narasimha Distilleries, Garag village in Dharwad District, Karnataka, India. Organic waste i.e. soyabean waste was collected from Main Research Station (MRS) of University of Agricultural Sciences, Dharwad. The physico-chemical properties of spent wash were characterized by standard methods of APHA & AWWA [7] and results were shown in Table 1.

Experimental details

Experiment was conducted using PM and SBW as substrates with *Eudrilus eugeniae* earthworms to examine the effect of SW on quality of vermicompost at Main Research Station, Department of organic farming, University of Agricultural Sciences, Dharwad, Karnataka, India. Hard plastic troughs of size 36 cm x 26 cm x 30 cm were filled with waste materials. 2 kg of PM was filled in all of 18 plastic troughs. Total 7 treatments were imposed. Each treatment was replicated twice. 1 kg of SBW was filled in another 14 plastic troughs. Total 7 treatments were imposed. 20 *Eudrilus eugeniae* earthworms were put into all of 28 boxes. Different dilutions of SW and water were added to all troughs. A moisture level of 60–70% was maintained in the troughs throughout the experimentation. The plastic troughs were covered by thin muslin cloth pieces so that worms don't escape from boxes.

Treatment Details

Treatments with varied dilutions of spent wash and water were done such as T1-1:1, T2-1:2, T3-1:3, T4-1:5, T5-1:10, T6-1:20, T7-1:50. Each treatment was replicated twice.

Observations

Observations were made on number of earthworms survived at 1, 3, 7, 15, 30, 45 Days after release (DAR) of worms with press mud and soya bean waste as substrates.
Nutrient status of the wastes and recycled end products:
The substrates i.e. PM and SBW used for experimentation were tested before the start of vermicomposting study to know the initial characteristics before degradation. Vermicompost samples using both substrates were analyzed for nutrient status such as N, P, K, C: N ratio. The nutrient status of SW and vermicompost were characterized by standard methods of APHA & AWWA (1985).

Results and discussion

Initial chemical composition of PM and SBW waste

The initial nutrient values of substrates such as SW (Table 1), PM and SBW were analyzed before initiating VC. The results are tabulated in Table 2.

Table 1: Physico - Chemical Properties of primary treated SW Sample

Parameters	SW	Parameters	SW
		Total N (%)	0.23
Colour	Blackish brown	Total P (%)	0.035
Odour	Unpleasant burnt sugar	Total K (%)	0.85
pH	8.04	Total Fe (mg/L)	59
EC (mS/cm)	19.23	Total Cu (mg/L)	0.2
TS (mg/L)	32,500	Total Mn (mg/L)	10.8
TDS (mg/L)	27,720	Total Zn (mg/L)	0.5
TSS (mg/L)	4780	Ca (mg/L)	2108
COD (mg/L)	32,500	Mg (mg/L)	1856
BOD_3 (mg/L)	16,500	Na (mg/L)	480

Note: Above values are mean of triplicate samples.

Table 2: Initial Characteristics of PM and SBW before vermicomposting

Organic Carbon (%)	39.81	49.43
Total Nitrogen (%)	1.26	1.48
C:N	31:01:00	33:01:00
Total Phosphorus (%)	0.45	0.35
Total Potassium (%)	0.6	0.46

Total N in VC

The N value of vermicompost increased from lower treatment to higher treatment. This could be attributed to higher organic load of SW which on decomposition increases the nitrogen content of vermicompost. Total N of treatment T1 was found to be 1.48% & 1.24% for **VC** made of **PM** & **SBW**. Total N of treatment with only water was found to be 1.58% & 1.7%. This was due to survival of more worms in this treatment. Highest nitrogen 1.96% & 1.86% was recorded for treatment T7 1:50 dilutions for **VC** made of **PM** & **SBW.** This was mainly because of zero worms in the treatment. The results are presented in Table **3**.

Table 3: Changes in N, P, K, C:N values of vermicompost

	PM				SBW			
Treatment	N	P	K	C/N	N	P	K	C/N
T1 1:1	1.48	0.42	1.47	26.5	1.24	0.25	1.2	27.1
T2 1:2	1.55	0.55	1.41	24.75	1.37	0.35	1.1	23
T3 1:3	1.56	0.56	1.32	20.9	1.45	0.43	1.02	21.25
T4 1:5	1.65	0.62	1.25	19.5	1.59	0.52	0.96	19.25
T5 1:10	1.76	0.78	1.22	18.2	1.74	0.55	0.84	17.5
T6 1:20	1.79	0.85	1.14	16	1.79	0.57	0.68	16.65
T7 1:50	1.96	0.97	0.99	12.8	1.86	0.68	0.61	12.7

Total P in VC

The P value of vermicompost sample increased from lower treatment to higher treatment. Total P content of treatment T1 was found to be 0.42% & 0.25% for VC made of PM & SBW. Total P of treatment with only water was found to be 0.48% & 0.44%. This was due to survival of more worms in this treatment. Highest P 0.97% & 0.68% was recorded for treatment T7 1:50 dilutions. Lowest P content of VC of PM was recorded as 0.33%. This was mainly because of zero worms in the treatment. The total phosphorus content of treatment T1, 1:1 dilution was found to be 0.25% which is the lowest value. The results are tabulated in Table 3.

Total K in VC

The potassium content increased with increase in SW application. This increase in total potassium content is attributed to supply of K from lagoon SW which contained very high amount of K. The highest K content was recorded in treatment which was found to be 1.53% & 1.26% for VC made of PM & SBW. This was mainly because of only SW in the treatment. The K 0.99% & 0.61% was recorded in treatment T7 1:50 for VC made of PM & SBW. Total K of treatment T1 was found to be 1.47% & 1.2% for VC made of PM & SBW. This was due to high amount of SW in this treatment. The results are tabulated in Table 3.

Total C/N ratio in VC

The C: N ratio decreased with dilution. The C: N ratio recorded in treatment T1, 1:1 dilution was found to be 26.5:1 & 27.1:1 for VC made of PM & SBW. The C: N ratio of treatment T8 with only water was found to be 17.1:1 & 17.75:1 for VC made of PM & SBW. This may be due to survival of more worms in this treatment. Lowest C: N ratio 12.8:1 & 12.7:1 was recorded for treatment T7 1:50 dilutions for VC made of PM & SBW. Highest C: N ratio was recorded in treatment with undiluted samples was found to be 28.3:1 & 30.32:1 for VC made of PM & SBW. This was mainly because of partial degradation due to zero worms in the treatment. The results are tabulated in Table 3.

Conclusions

From the experimental observations it may be concluded that the survival of *Eudrilus eugeniae* worms was higher in treatment with only water and no SW concentration. 100 % death of worms due to direct application of SW was observed. Macro nutrients in VC made of PM & SBW were in the order of nitrogen, potassium and phosphorus. The C: N ratio in VC using PM was lesser than in VC using SBW indicating the extent of bio-degradation of PM was higher than the SBW.

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