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Estimation of Physico-Chemical Changes of Different Combinations of Buffalo Dung with Distillery Effluents by Vermic Activity of Earthworm *Lampito mauritii*

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Abstract: The discharge of organic waste from distilleries poses a significant hazard to the environment. The dumping of organic wastes results in offensive odours, soil contamination, the spread of viral infections that are extremely contagious and harm a variety of species, as well as vector transmitted diseases that impact humans. Vermi-bioconversion is an ideal technique for employing worms to convert organic waste into nutrient-rich fertilizer, healthy soil, and remediation of soil from pollution. Distillery effluents have a negative impact on the ecosystem and its constituents. These effluents contain more dangerous compounds, such as chloride, sulphate, and nitrate. A viable method for converting waste into rich organic bio-fertilizers is vermicomposting, utilizing earthworms like *Lampito mauritii*. The pH, organic carbon, organic matter, and the C:N ratio of the different organic waste combinations all tended to decrease throughout this process, whereas the nitrogen content, accessible phosphorous, and exchangeable potassium all tended to increase as the vermicomposting period went on. Consequently, it can be said that using the vermicomposting procedure to handle distillery effluents is simple. Vermicomposting has been shown to be an alternative approach for recycling and environmentally acceptable waste management. In the present study vermicomposting of distillery effluents with various combinations of buffalo dung by using *Lampito mauritii* was done. The purpose of this study was to use the environmental friendly technology of vermiconversion to solve the waste disposal issue of biological wastes.

Keywords: Distillery effluents, *Lampito mauritii,* Organic waste, Vermicomposting

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Introduction

Rapid industrialization and overuse of natural resources have indeed contributed to the rise of pollution. India uses a lot of water because more water-intensive industries like distilleries, textiles, dye, dairy, sugar, tanneries, paper, soap, and breweries are located throughout the country's cities and dump sludge and wastewater into rivers. These industrial waste should be recycled to prevent pollution problems. Typical methods of managing solid waste, such as landfilling, open dumping, and open burning, are inadmissible because they produce toxic materials and gases that have a detrimental effect on the environment, human health, and biodiversity (Lee *et al*., 2012; Perez-Godinez *et al*., 2017). In both developed and developing nations today, solid waste is recycled (Abdel-Shafy and Mansour, 2018). The management of industrial waste is one of the most significant environmental issues facing by the globe today. For the survival and functioning of societies, proper solid waste management is essential and requires immediate action (Bui *et al*., 2020). In the form of spent wash, which is the leftover liquid produced after alcohol manufacturing, the distillery industry produces large amounts of trash. As a result, in a developing nation like India, distillery industries have emerged as a significant source of pollution, as 88% of their raw materials are turned into waste and dumped into water bodies (Suthar and Singh, 2008). According to the Ministry of Environment and Forests (MoEF), distilleries are the most polluting industries and are recognized as the top Red Category industry. According to CPCB (2018), the amount of biomethananted spentwash of 8-9° brix produced by the sector is concentrated from approximately 320 M^2 per day to 51 M^3 per day. Distilleries using molasses produce a particular kind of industrial waste called distillery effluent. An industrial waste product created in distilleries using molasses is known as distillery effluent. It is a complex organic compound that is dark brown in color, has a low pH, and has extremely high COD and BOD (chemical and biological oxygen demands) (Shin *et al*., 1992; Saha *et al*., 2005; Srivastava *et al*., 2012). It has reduced sugars, carbohydrates, proteins, waxes, alcohol, minerals, sulphurous chemicals, melanoidins, etc. The production of alcohol from the fermentation and subsequent distillation of sugar cane molasses is considered one of the major sources of pollution in those nations. Chowdhary *et al.* (2017) report an increase in the number of distillery units in India to 319, with their annual production of alcohol and waste water posing a severe pollution issue. Distilleries must take the necessary precautions to monitor wastewater discharge. Therefore, effective management of this spent wash is essential for the future of the planet and of civilization. Recent research has demonstrated the potential for using decomposing organisms, primarily earthworms, to process used wash through cleaner technology like vermiculture, hence reducing environmental pollution.

Vermicomposting is a low-cost, socially acceptable, and environmental friendly method for managing organic waste (Lim *et al*., 2016). Various researchers have been successful in converting wastes produced by the industries into vermicompost with the use of earthworm (Kumari *et al*., 2011; Singh and Suthar, 2012; Basheer and Agrawal, 2013). Vermicomposting is currently being used to turn organic waste into a useful organic fertilizer (Bellitürk, 2018; Joseph *et al*., 2020). Utilizing industrial waste as feed material for earthworms offers the potential for sustainable waste management, resource recovery, and soil improvement (Singh and Singh, 2023). Organic waste materials go through the gizzard of earthworms during this process, producing vermicast, which is rich in essential plant nutrients and unidentified chemicals that stimulate plant development (Sharma and Garg, 2019). Earthworms feed on organic waste voraciously, and while they only use a small fraction of it for body synthesis, they expel a substantial quantity of it in a partially digested state. These partially digested foods breakdown quickly and change into a type of vermicompost within a short period of time due to the large variety of bacteria, enzymes, hormones, etc. that are present in the intestines of earthworms (Moorthi *et al*., 2017). During the vermicomposting process, earthworms are known to make compost by ingesting complex organics and excreting simpler forms (Van Groenigen *et al*., 2019). Anecic earthworms migrate to soil levels with better environmental conditions to avoid the cold. According to Gergs *et al.* (2022) anecic species are perfect for conditioning organic waste from canteens, homes, towns, farms, etc. The ecology and efficiency of decomposition of *Lampito mauritii* have been studied in earlier research. The organism *Lampito mauritii* is capable of vermicomposting a wide range of organic wastes (Suthar and Singh, 2008).

Keeping in view of the above facts, the aim of this study was to evaluate the changes in physico-chemical composition of waste mixtures i.e. buffalo dung with distillery effluent in different ratios after the processing of the earthworm *Lampito mauritii*.

Materials and Methods

Collection and rearing of the earthworm Lampito mauritii:

The cultured earthworm, *Lampito mauritii* from the Vermiculture Laboratory of the Department of Zoology, D.D.U. Gorakhpur University, Gorakhpur were used for the experiment. In the laboratory, vermibed were prepared by using garden litter with buffalo dung on a cemented surface for the experiment. Young cultured earthworms were used for the experiments.

Collection of buffalo dung and distillery effluents:

Buffalo dung was collected from the farm houses located at different places in Gorakhpur. Distillery effluents were collected from Pipraich Sugar Mill, Gorakhpur, U.P. Distillery effluents were used for vermicomposting as well as feeding material for earthworms. For up to 10 days, these organic wastes are spread out in a layer and exposed to sunlight to get rid of the various harmful organisms and noxious gases (Garg *et al*., 2005; Nath and Singh, 2009).

Experimental setup:

A cemented earth surface was used for the experiment. Two kilograms of each five combinations of buffalo dung (BD) and distillery effluents (DE), i.e. DE+BD 1:1; DE+BD 1:2; DE+BD 2:1; DE+BD 1:3; DE+BD 3:1; as well as BD and DE alone were prepared in beds of (30cm x 30cm x 10cm) at room temperature in the dark. The vermicomposting beds were turned over manually every 24 h for 10 days in order to eliminate volatile substances. After this, 20 newly hatched *Lampito mauritii* were introduced into each bed. In order to provide optimal environmental conditions for worms, the moisture of all the treatments was maintained at 60-70% by sprinkling water during the experiment. After vermicomposting of 90 days, samples from each vermibed were collected again and composting was terminated because the residuals of bedding materials in the treatments had been eaten up by *Lampito mauritii*. For further analysis, the collected dried and homogenized samples were grinded into fine particles. Each experiment was replicated six times.

Chemical analysis:

pH and electrical conductivity were evaluated of each sample by using a 1:10 (w/v) double distilled water suspension that had been mechanically stirred for 30 min and filtered through Whatman No. 1 filter paper. Total organic carbon was measured using the Nelson and Sommers (1982) method. The sample was digested using conc. H_2SO_4 and conc. $HClO_4$, (9:1 v/v), in accordance with Bremmer and Mulvaney's procedure (1982), total Kjeldahl nitrogen (TKN) was measured. Using molybdenum and sulfuric acid in a colorimetric analysis, total phosphorus was determined (Garg *et al*., 2005). By using a flame photometer, the total potassium was calculated.

Statistical Analysis:

All the experiments were replicated at least six times to ensure consistency in the results. Analysis of variance was used to determine the significant difference between the combinations; Student's t-test ($P < 0.05$) was used to determine which bedding type was more homogeneous in terms of reproduction and growth from the control (Sokal and Rohlf, 1973).

Results and Discussion

There was significant decrease in levels of pH, EC (Electrical conductivity), TOC (Total organic carbon) and C/N ratio, whereas significant increases in the levels of TKN (Total Kjeldahl nitrogen), TAP (Total available phosphorus), TK (Total potassium) and TCa (Total calcium) (Tables 1-4). Singh and Singh (2023) observed that combinations of feed material of sugarcane bagasse and buffalo dung have significant decrease in pH, EC, TOC and C/N ratio as well as significant increase in TKN, TAP, TK and TCa. With respect to the initial feed mixture, the pH of all the vermibeds was significantly decreased after the processing of *Lampito mauritii* (Table 1, Fig. 1). The maximum decrease was observed in buffalo dung alone i.e. 20.23% (8.4±0.06 to 6.7±0.02) and minimum decrease was observed in distillery effluents i.e. 4.22% (7.1±0.02 to 6.8±0.02). Komilis and Ham (2006) and Sharma *et al.* (2011), reported that the earthworm's activity and the microorganism in its gut produce CO_2, ammonia and organic acid, which contribute to pH levels fall during vermicomposting. Similar findings have been observed by various researchers during the processing of wastes by earthworms (Elvira *et al*., 1998; Garg and Gupta, 2011). The breakdown of organic solid wastes may be responsible for these pH fluctuations in the various feed materials. Due to the mineralization of nitrogen and phosphorus into nitrites/nitrates and phosphates, the pH of various feed material mixes decreased (Short *et al*., 1999; Ndegwa *et al*., 2000). Due to the production of fulvic acid and humic acid during the processing of earthworms, low pH in the final product may also occur (Chauhan and Singh, 2012).

After the processing of *Lampito mauritii*, the EC of all the vermibed significantly decreased in comparison to the initial feed mixture (Table 1, Fig. 1). Among all the combinations of buffalo dung and distillery effluents, a maximum decrease of 57.14% (2.8±0.01 to 1.2±0.07) and minimum decrease of 10% (2.0±0.02 to 1.8±0.03) were observed in DE+BD (1:3) and DE alone, respectively. Researchers in the past have noted 28% to 46% EC in the final vermicompost (Garg *et al*., 2006). Singh *et al*., (2010) observed that EC substantially decreased (28.69%) in the final vermicompost during the management of biosludge in the beverage sector. Ansari and Rajpersaud (2012) report that while the vermicomposting process progressed, the starting materials' EC progressively fell till a lower EC was obtained. The electrical conductivity of several agro-industrial wastes ranged from 0.76 dsm^{-1} (coir waste) to 1.15 dsm^{-1} (press mud) (Kitturmath *et al*., 2007).

As compared to their initial level, the total organic carbon (TOC) in all vermibed substantially decreased (Table 2, Fig. 2). Among all the combinations of buffalo dung and distillery effluents, the maximum decrease of TOC was observed in the combination of DE+BD (2:1) i.e. 61.17% (445.8±0.12 to 173.1±0.28) and the minimum decrease of TOC was observed in the combination of DE+BD (1:3) i.e. 47.83% (454.3±0.25 to 237.0±0.25). Earthworms also have an impact on changing the nitrogen cycle in manure (Umar and Sharif, 2013). They also suggested that organic carbon loss might change as nitrogen levels increase. Prakash and Karmegam (2010) and Bhat *et al*. (2014) also found a decrease in TOC in worm composting of sugar factory sludge. Earthworm activity resulted in a reduction in TOC due to CO_2 (Kaushik and Garg, 2003; Suthar and Singh, 2008). According to various researches, the reduction in organic carbon was greater when vermicomposting was used instead of a traditional composting technique (Cabrera *et al*., 2005; Garg and Kaushik, 2005; Tognetti *et al*., 2005).

During the processing of *Lampito mauritii*, the TKN concentration in every combination of feed mixture increased considerably (Table 2, Fig. 2). A maximum increase of 111.90% (4.2±0.01 to 8.9±0.10) and a minimum increase of 22.72% (2.2±0.01 to 2.7±0.02) were observed in DE+BD (1:1) and DE alone, respectively. Cynthia and Rajeshkumar (2012) also noted an increase in TKN of sugar mill effluent, which they attributed to worms accelerating the nitrogen mineralization process through waste decomposition. Through the decomposing tissues of dead earthworms,

Table 1: Concentration of pH and EC in initial feed mixtures and final vermicompost of buffalo dung mixed with distillery effluents in different combination

Combinations	pH			EC		
	IFM	VC	% decrease	IFM	VC	% decrease
BD	8.4 ± 0.06	6.7 ± 0.02*	20.23	2.4 ± 0.04	1.1 ± 0.02*	54.17
DE	7.1 ± 0.02	6.8 ± 0.02*	4.22	2.0 ± 0.02	1.8 ± 0.03*	10.00
DE+BD (1:1)	7.7 ± 0.05	6.9 ± 0.03*	10.39	2.3 ± 0.05	1.6 ± 0.03*	30.43
DE+BD (1:2)	7.4 ± 0.04	6.7 ± 0.04*	9.46	2.6 ± 0.03	1.4 ± 0.05*	46.15
DE+BD (2:1)	7.6 ± 0.13	6.5 ± 0.02*	14.47	2.5 ± 0.02	1.7 ± 0.04*	32.00
DE+BD (1:3)	7.3 ± 0.05	6.7 ± 0.03*	8.22	2.8 ± 0.01	1.2 ± 0.07*	57.14
DE+BD (3:1)	7.9 ± 0.04	6.5 ± 0.04*	17.72	2.1 ± 0.03	1.5 ± 0.06*	28.57

Each value is the mean ± SE of six replicates. IFM = Initial Feed Material, VC = Vermicompost, BD = Buffalo Dung, DE= Distillery effluent. *Significant ($P < 0.05$) 't' test between before and after vermicomposting in 30.0x30.0x10.0 cm^3 area of vermicompost bed.

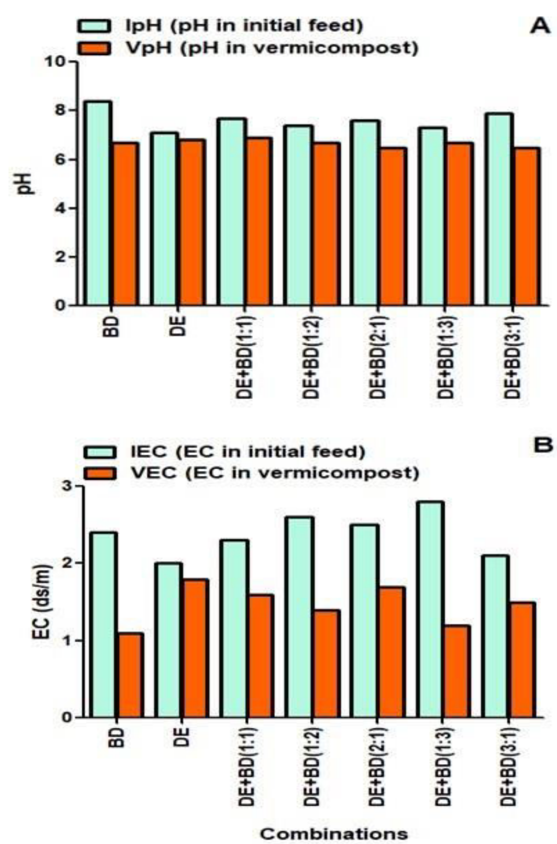

Fig. 1: Concentration of pH (A) and EC (B) in initial feed material and the vermicompost of different combinations of buffalo dung with distillery effluents by *Lampito mauritii*. IpH= pH in initial feed material, VpH= pH in vermicompost, IEC= electrical conductivity in initial feed material, VEC= electrical conductivity in vermicompost, BD= buffalo dung, DE= distillery effluents.

Table 2: Concentration of TOC and TKN in initial feed mixtures and final vermicompost of buffalo dung mixed with distillery effluents in different combination

Combinations	TOC (G/Kg)			TKN (G/Kg)		
	IFM	VC	% decrease	IFM	VC	% increase
BD	510.9± 0.26	230.8± 0.23*	54.82	6.1± 0.03	8.0± 0.03*	31.14
DE	430.7± 0.48	176.0± 0.22*	59.13	2.2± 0.01	2.7± 0.02*	22.72
DE+BD (1:1)	434.2± 0.25	176.4± 0.18*	59.37	4.2± 0.01	8.9± 0.10*	111.90
DE+BD (1:2)	457.6± 0.26	225.4± 0.25*	50.74	4.9± 0.02	8.1± 0.03*	65.30
DE+BD (2:1)	445.8± 0.12	173.1± 0.28*	61.17	4.4± 0.02	9.1± 0.04*	106.82
DE+BD (1:3)	454.3±0.25	237.0± 0.25*	47.83	5.4± 0.03	7.9± 0.04*	46.29
DE+BD (3:1)	440.4± 0.23	171.5±0.33*	61.04	4.6± 0.02	9.7± 0.04*	110.87

Each value is the mean ± SE of six replicates. IFM = Initial Feed Material, VC = Vermicompost, BD = Buffalo Dung, DE = Distillery effluents. *Significant ($P < 0.05$) 't' test between before and after vermicomposting in 30.0x30.0x10.0 cm^3 area of vermicompost bed.

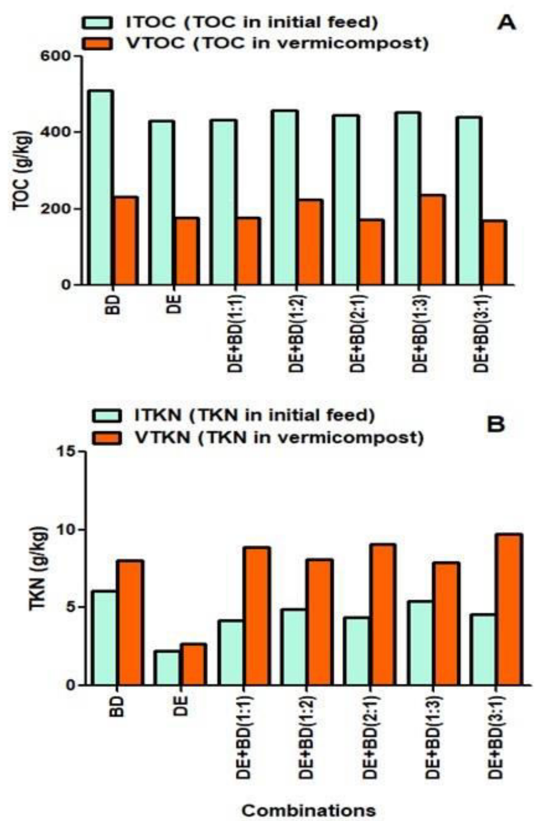

Fig. 2: Concentration of TOC (A) and TKN (B) in initial feed material and the vermicompost of different combinations of buffalo dung with distillery effluents by *Lampito mauritii*. ITOC= total organic carbon in initial feed material, VTOC= total organic carbon in vermicompost, ITKN= total kjeldahl nitrogen in initial feed material, VTKN= total kjeldahl nitrogen in vermicompost, BD= buffalo dung, DE= distillery effluents.

earthworms improve the nitrogen content of vermicompost, and microbially mediated nitrogen transformation in vermicomposting systems leads to additional increases in nitrogen (Atiyeh *et al*., 2000; Suthar, 2007). Mineralization and the addition of different byproducts or assimilatory products by the earthworm during the processing of earthworms may be accountable for the increase in TKN in the finished product (Chauhan and Singh, 2012). Losses of organic carbon may result in the addition of nitrogen in the form of mucus nitrogen secretory material, growth-stimulating hormones, and enzymes from the gut of earthworms (Tripathi and Bhardwaj, 2004). The mineralization of C-rich materials and the activity of N-fixing bacteria found in the feed combinations may be reasons for the rise in nitrogen content (Plaza *et al*., 2008). Organic carbon often declines while total nitrogen coverage rises during vermicomposting (Kizilkaya and Hepsen, 2007; Fatehi and Seaygan, 2010).

The stability and mineralization of waste during the vermicomposting process is shown by the C/N ratio. Increased carbon loss via microbial respiration in the form of CO_2, as well as a rise in nitrogen and stabilization of waste by worm activity, were the causes of the drop in the C/N ratio (Hait and Tare, 2011; Vig *et al*., 2011; Hanc and Chandimova, 2014). Table 3 and Figure 3 show the C/N ratio in all the feed mixtures of buffalo dung with distillery effluents. A significant decrease in the C/N ratio was observed in all the feed mixtures of buffalo dung with distillery effluents. Among all the combinations of buffalo dung with distillery effluents, the maximum decrease of C/N ratio was observed in the combination of DE+BD (3:1) which is 81.60% (95.7±0.41 to 17.6±0.11) and the minimum decrease of C/N ratio was observed in the combination of DE+BD (1:3) which is 64.32% (84.1± 0.41 to 30.0±0.19). A declining C/N ratio (less than 20) indicates an advanced level of organic matter stabilization and reflects a good level of organic waste (Senesi, 1989). Cow dung is added as palatable waste and reduces the C/N ratio while raising certain macronutrients in the vermicompost, which influences the rate of vermicomposting (Muthukumaravel et al., 2008). Earthworms speed up humification during vermicomposting, which lowers the C:N ratio (Suthar, 2006; Dores Silva *et al*., 2011).

During the processing of *Lampito mauritii*, the total potassium concentration in every combination of feed mixture increased considerably. Among all the combinations of buffalo dung and distillery effluents, the maximum increase of TK was observed in the distillery effluent i.e 173.68% (1.9±0.04 to 5.2± 0.08) and the minimum increase of TK was observed in the buffalo dung i.e 29.41% (5.1±0.04 to 6.6±0.04) (Table 3, Fig. 3). *Lampito mauritii* and *Eisenia fetida* both increased the quantity of TK by 10% and 5%, respectively, during vermicomposting (Kaviraj and Sharma, 2003). Additionally, vermicomposting waste significantly increased the potassium content, according to Suthar (2008) and Yadav *et al.* (2010). Potassium is one of the micronutrients which is increased by earthworm action on organic matter (Kale, 1998; Ansari and Ismail, 2001).

TAP content in all the feed mixtures of buffalo dung with distillery effluent has been shown in Table 4 and Figure 4. Significant increase of TAP content was observed in all the combinations of feed mixtures after the processing of *Lampito mauritii*. Among all the combinations of buffalo dung with distillery effluents, the maximum increase of TAP was observed in the combination of DE+BD (1:3) i.e. 84.90% (5.3± 0.09 to 9.8±0.03) and minimum increase of TAP was observed in the of BD i.e. 33.33% (5.1±0.01 to 6.8± 0.04). Vig *et al*. (2011) found that after vermicomposting tannery sludge mixed with cattle dung, TP increased from the original range of 8.57%-44.8%, which is consistent with the current study. In addition, Satchell and Martein (1984) discovered that worm activity increased the phosphorus content of paper waste sludge by 25%. The phosphorus content of the composted mixture was later enhanced by earthworms as a result of the acid that was produced by microorganisms during the

Table 3: Concentration of C:N ratio and TK in initial feed mixtures and final vermicompost of buffalo dung mixed with distillery effluents in different combination

Combinations	C:N ratio			TK(G/Kg)		
	IFM	VC	% decrease	IFM	VC	% increase
BD	83.7 ± 0.46	28.8 ± 0.09*	65.59	5.1 ± 0.04	6.6 ± 0.04*	29.41
DE	195.7 ± 1.56	65.19 ± 0.59*	66.69	1.9 ± 0.04	5.2 ± 0.08*	173.68
DE+BD (1:1)	103.8 ± 0.45	19.8 ± 0.26*	80.92	3.2 ± 0.02	5.6 ± 0.06*	75.00
DE+BD (1:2)	93.4 ± 0.50	27.8 ± 0.22*	70.23	3.6 ± 0.02	6.4 ± 0.03*	77.78
DE+BD (2:1)	101.3 ± 0.65	19.0 ± 0.20*	81.24	2.9 ± 0.06	5.1± 0.02*	75.86
DE+BD (1:3)	84.1 ± 0.41	30.0 ± 0.19*	64.32	3.9 ± 0.04	6.7 ± 0.07*	71.80
DE+BD (3:1)	95.7 ± 0.41	17.6 ± 0.11	81.60	2.5± 0.02	3.8 ± 0.05*	52.00

Each value is the mean ± SE of six replicates. IFM = Initial Feed Material, VC = Vermicompost, BD = Buffalo Dung, DE = Distillery effluents. *Significant ($P < 0.05$) 't' test between before and after vermicomposting in 30.0x30.0x10.0 cm^3 area of vermicompost bed.

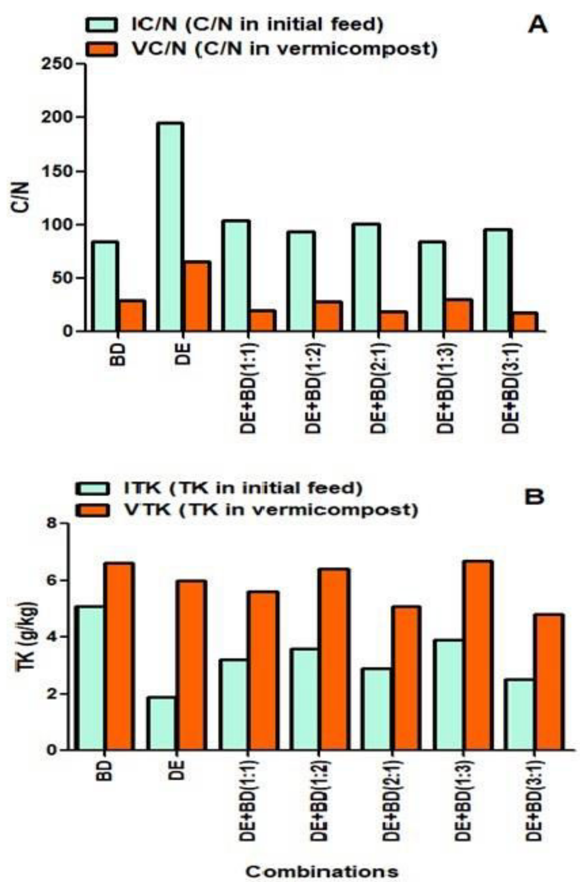

Fig. 3: Concentration of C/N ratio (A) and TK (B) in initial feed material and the vermicompost of different combinations of buffalo dung with distillery effluents by *Lampito mauritii*. IC/N= carbon to nitrogen ratio in initial feed material, VC/N= carbon to nitrogen ratio in vermicompost, ITK= total potassium in initial feed material, VTK= total potassium in vermicompost, BD= buffalo dung, DE= distillery effluents.

Table 4: Concentration of TAP and TCa in initial feed mixtures and final vermicompost of buffalo dung mixed with distillery effluents in different combination

Combinations	TAP (G/K			TCa (G/Kg)		
	IFM	VC	% Increase	IFM	VC	% Increase
BD	5.1 ± 0.01	6.8 ± 0.04*	33.33	1.8 ± 0.02	2.5 ± 0.03*	38.89
DE	6.2 ± 0.02	8.5 ± 0.03*	37.09	1.9 ± 0.03	2.6 ± 0.04*	36.84
DE+BD (1:1)	5.7 ± 0.03	9.2 ± 0.05*	61.40	1.5 ± 0.05	2.0 ± 0.03*	33.33
DE+BD (1:2)	5.2 ± 0.05	8.8 ± 0.05*	69.23	1.3 ± 0.01	1.9 ± 0.02*	46.15
DE+BD (2:1)	5.9 ± 0.02	10.0 ± 0.04*	69.49	1.7 ± 0.02	2.3 ± 0.03*	35.29
DE+BD (1:3)	5.3 ± 0.09	9.8 ± 0.03*	84.90	1.1 ± 0.03	1.7 ± 0.03*	54.54
DE+BD (3:1)	6.2 ± 0.04	10.7 ± 0.06*	72.58	2.1 ± 0.03	2.6 ± 0.04*	23.80

Each value is the mean ± SE of six replicates. IFM = Initial Feed Material, VC = Vermicompost, BD = Buffalo Dung, DE = Distillery effluents. *Significant ($P < 0.05$) 't' test between before and after vermicomposting in 30.0x30.0x10.0 cm^3 area of vermicompost bed.

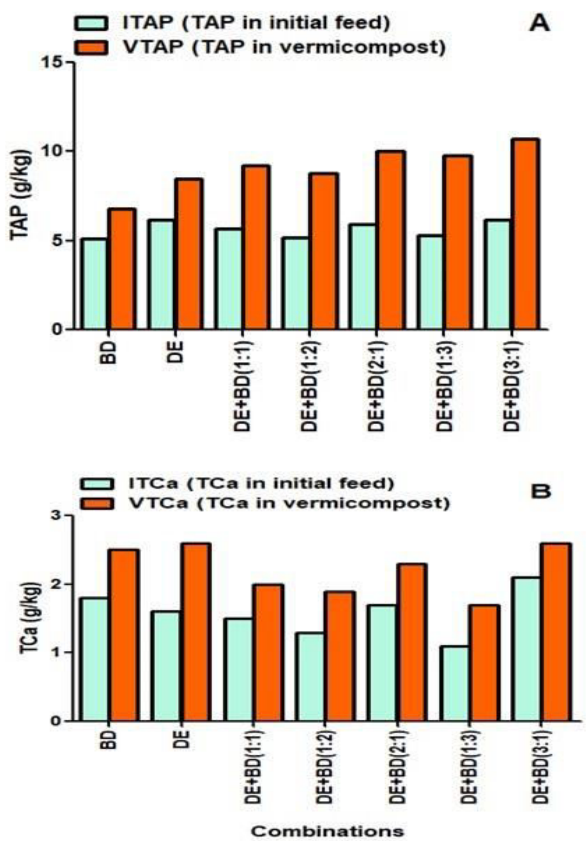

Fig. 4: Concentration of TAP (A) and TCa (B) in initial feed material and the vermicompost of different combinations of buffalo dung with distillery effluents by *Lampito mauritii*. ITAP= total available phosphorus in initial feed material, VTAP= total available phosphorus in vermicompost, ITCa= total calcium in initial feed material, VTCa= total calcium in vermicompost, BD= buffalo dung, DE= distillery effluents.

decomposition of organic waste (Pramanik *et al*., 2007). Ndegwa *et al*. (2000) found a correlation between an increase in TAP and worms, processing time, and feed material quality.

Total calcium is significantly higher in all the final vermicompost compared to the initial feed mixtures of buffalo dung with distillery effluents (Table 4, Fig. 4). The maximum increase of calcium was observed in combination of DE+BD (1:3) i.e. 54.54% (1.1±0.03 to 1.7±0.03) and the minimum increase of calcium was observed in DE+BD (3:1) i.e. 23.80% (2.1±0.03 to 2.6±0.04). The increased concentration of inorganic calcium in worms cast is thought to be predominantly caused by gut processes connected with calcium metabolism (Garg *et al*., 2006). Sangawan *et al.* (2010) observed an increase in N, P, and Ca concentration in pressmud vermicompost using *Eisenia fetida* and hypothesized that vermicomposting, when combined with cow dung to a maximum of 50%, could be a substitute technology for the management of pH into useful fertilizer material.

Conclusion

Environmental concerns are further heightened by the buildup of industrial waste. This study's primary goal was to use earthworms as biological reactors to transform industrial waste into vermicompost for agricultural use. The study comes to the conclusion that the physico-chemical texture of mixtures of distillery effluents and buffalo dung is favourably influenced by the vermic activity of the earthworm *Lampito mauritii*. It improves soil structure, increases nutrient availability, speeds up decomposition, lowers toxic levels, and controls soil pH. Important plant nutrients included in feed materials, such as nitrogen, phosphorus, potassium, calcium, etc., are changed throughout these processes into forms that plants can more readily absorb. It causes a significant decrease in the population of hazardous pathogenic microorganisms and is environmentally beneficial. In conclusion, these results emphasize the usefulness of earthworms in waste management and soil enhancement techniques, particularly in the context of utilizing organic distillery waste.

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