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Original Research Paper

Study on Management of Sugar Cane Industry Solid Waste Using the Technique of Composting

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ABSTRACT

Sugar industries play a pivotal role to improve the economy of our country. For the management of sugar industry solid waste (press mud and bagasse) an effort was taken. The press mud and bagasse mixed with garden waste and cow dung were subjected to the process of a composting (anaerobic decomposition) in 1:1:2 ratio. One set of component was moistened with water (A) and another one was moistened with spent wash (B). As spent wash is characterized with high BOD and COD along with high nitrate, phosphate, potassium and other minerals, it was selected for moistening the organic waste. After the experimental period (95 days) the reduction of organic matter and C:N ratio was considerable. The amount of N,P,K in compost A was found to be 2.4%, 0.71% and 2.14% respectively. The N.P.K value of compost B was found to be 2.8%, 0.85% and 3.59% respectively. All these nutrients have considerably increased in compost B than compost A. The C:N ratio of both the composts was around 11:1, which has been reduced from the initial of 25:1 ratio. The identified organisms *Pseudomonas* sp., *Streptococcus* sp., *Bacillus* sp. and *Klebsiella* sp. were involved in the composting process of A. Besides these organisms, compost B also has *Seratia* sp. Hence, from these observations, it is clear that the press mud and bagasse in combination with garden waste and cow dung may be utilized for the production of compost successfully. This technique further minimizes the environmental hazards that could have been caused by press mud and spent wash if they were disposed off as such in the environment.

INTRODUCTION

Solid wastes are generated right from the beginning of mining of raw materials and get on accumulated at every stage of manufacturing process until the raw materials get transformed into finished goods for consumption. Further, the use of product and the disposal of the used products again generate solid wastes. Sugar industry is one of the major agro-based industries in India. Bagasse and press mud are the solid residue by-products from the sugar industry during milling and clarification process respectively. Dirt and other impurities in the cane and suspended impurities in cane juice are separated as filter mud or press mud. It contains all non-sucrose impurities along with $CaCO_3$ and sulphate. Press mud from double sulphitation process contains valuable nutrients like N, P, K, etc., and, therefore, used as a fertilizer (Trivedy 1998). Bagasse is sugarcane fibre pulp left after the juice has been extracted from the sugarcane stable. It is estimated that bagasse contributes to 33.3% residue of the total cane crushed.

The wastewater disposed off from distilleries is called spent wash. The spent wash is characterized by the intense colour, higher TDS, TS, BOD, COD, nitrate, chloride and potassium, and hence, it can pollute the natural water and land severely. Vasanthy et al. (2004) have reported that suitably diluted spent wash could be used for fertigation, and it promotes the plant growth. Hence, the treatment of spent wash and utilization of solid waste is of prime concern. Recycling and reuse of the solid wastes help to reduce the problem of waste disposal. In order to make the solid waste useful as fertilizer, it is essential to subject the press mud for biocomposting.

MATERIALS AND METHODS

Selection and Collection of Organic Wastes

Cow dung: Urine and straw free cow dung was collected from a dairy yard.

Press mud and bagasse: Press mud and bagasse were collected from a sugar factory and were stored in troughs.

Garden waste: Garden waste was collected from the college campus.

Spent wash: It was collected from a distillery industry. The physico-chemical characteristics were estimated as per APHA (1989).

Preparation of Experimental Media for Composting

Two sets were put in the earthen basin trench for anaerobic degradation. The A and B sets (Table 1) of organic waste

Table 1: Composition of experimental media for composting.

Trench	Component	Wt(kg)	Total Wt. (kg)	Length & depth (ft)
1. (Set A)	Cowdung + bagasse + press mud + garden waste + water	2 + 1 + 1 + 1	5	2 × 2
2. (Set B)	Cow dung + bagasse + press mud + garden waste + spent wash	2 + 1 + 1 + 1	5	2 × 2

were moistened every day with water and spent wash respectively to maintain (60%) the required moisture content.

Physico-Chemical Characterization of the Compost

The pH was measured in a 1:5 suspension of biocompost. The suspension was prepared by adding 100 mL of distilled water to 20 g of biocompost in a beaker and then stirring the contents for about half an hour at regular intervals. The pH and EC were estimated using the pH meter (Elico model LI–127) and electrical conductivity meter (Elico model CM 180), respectively. The nutrients such as N, P, K were estimated (Tandon 1993). Organic carbon was estimated by the modified Walkley-Black method (Muthuvel & Udayasoorian 1998). Isolation and identification of microorganisms from the manure was done using the pour plate technique.

Identification of Organisms From the Sample

The microorganisms isolated from the sample were identified by the procedure of Atlas et al. (1995).

RESULTS AND DISCUSSION

Physico-chemical characterization of the spent wash: The physico-chemical characters of the spent wash used in the study are given in Table 2. The colour and odour of the spent wash were dark brown and objectionable. The pH of the sample was of acidic and the temperature was about 90°C. The DO of the spent wash was nil. The BOD and COD of spent wash were found to be 60000mg/L, 126000 mg/L respectively. The TDS of spent wash was 90000 mg/L. A similar result has been reported by Vasanthy et al. (2006) and Handa & Seth (1990). The higher BOD & COD could be attributed to 40-50% of total reducing sugars, organic acids, unfermented sugars, and proteins along with nitrogenous compounds and minerals too. Vasanthy et al. (2004) have reported that suitably diluted spent wash could promote the growth of *Trigonella foenum* due to the presence of higher salts such as sodium, potassium, nitrate and sulphate in spent wash used as a moistening agent for composting of press mud.

Physical characteristics of samples before and after composting (Table 3): The pH of the samples before and after composting was found to be near neutral. The EC of

Table 2: Physico-chemical characterization of spent wash.

S.NO	Parameters	Spent wash
1	Colour	Dark Brown
2	Odour	Objectionable
3	Temperature	90°C
4	pH	4.5
5	TS	100000
6	TDS	90000
7	TSS	100000
8	DO	Nil
9	BOD	600000
10	COD	126000
11	Chloride	7000
12	Nitrate	2500
13	Phosphate	2500
14	Potassium	12000
15	Sodium	200
16	Sulphate	7500

All the values are in mg/L, except pH and temperature.

Table 3: Physical characteristics of initial, and compost A and B.

S.No.	Parameters	Initial	A	B
1.	pH	6.76	7.82	7.95
2.	EC (mmhos)	0.98	1.54	1.27

before (initial) and after of compost A and B were 0.98, 1.54 and 1.27 mmhos respectively. The EC of the sample before and after composting has shown slight changes. During the composting process the microorganisms involved in the process of mineralization may have imparted higher EC. Similar result has been reported by Lakshmibai & Vijayalakshmi (2000).

Manurial value of compost: The manurial value of the compost is given in Table 4 and Figs. 1 and 2. The total organic carbon has got reduced in its content by 53% in the compost when compared with the raw waste; the reduction is due to the oxidation of organic matter. Similar result has been found by Mali (2002) and Gomathi et al. (2004).

The amount of N, P, K in compost A was found to be 2.4%, 0.71% and 2.14% and the same nutrient value of compost B was found to be 2.8%, 0.85% and 3.59% respectively.

The percentage of the nitrogen increased in the compost may be attributed to the increase in the microbial population

Table 4: Manurial value before and after composting.

S. No	Parameters	Initial	Compost A	Compost B
1	Organic carbon (%)	32.12	13.60	14.91
2	Organic matter (%)	40.27	25	29.28
3	Total Nitrogen (%)	2.1	2.4	2.8
4	Total Phosphorus (%)	0.52	0.71	0.85
5	Total Potassium (%)	2.1	2.14	3.59
6	Total Sodium (%)	0.92	0.22	0.96
7	Total Calcium (%)	1.27	1.28	3.58
8	Total Magnesium (%)	0.82	0.84	1.29
9	Total Sulphur (%)	0.14	0.16	0.55
10	Total Zinc (ppm)	0.92	0.96	2.46
11	Total Iron (ppm)	10.15	10.40	19.49
12	Total Manganese (ppm)	2.4	2.48	5.46
13	Total Boron (ppm)	0.05	0.06	0.12
14	Total molybdenum (ppm)	0.05	0.05	0.09
15	Total Copper (ppm)	0.35	0.39	1.59
16	C:N ratio	25:1	11:1	11:1

which could perform the process of nitrogen fixation. Similar result has been cited by Kale et al. (1992). The increase of phosphorus might be due to the humic substances, which would have increased phosphorus availability. Similar result has been produced by Mali (2002), Gomathi et al. (2004) and Vasanthy et al. (2005). The total organic carbon of compost A has reduced to 13.60% from the 32.12% of initial. Similarly, in compost B the organic matter has reduced to 25% from the 40.27% of initial. All these nutrients have considerably increased in compost B than A. The C:N ratio of both the composts was around 11, which has been reduced from the C:N ratio of 25 of initial.

The reduction of the C:N ratio is an indication of completion of the composting process. If C:N ratio is around 10, it denotes the completion of composting process and also the high manurial value. Similar results have been given by Mali (2002). Other micronutrients have shown slight increase

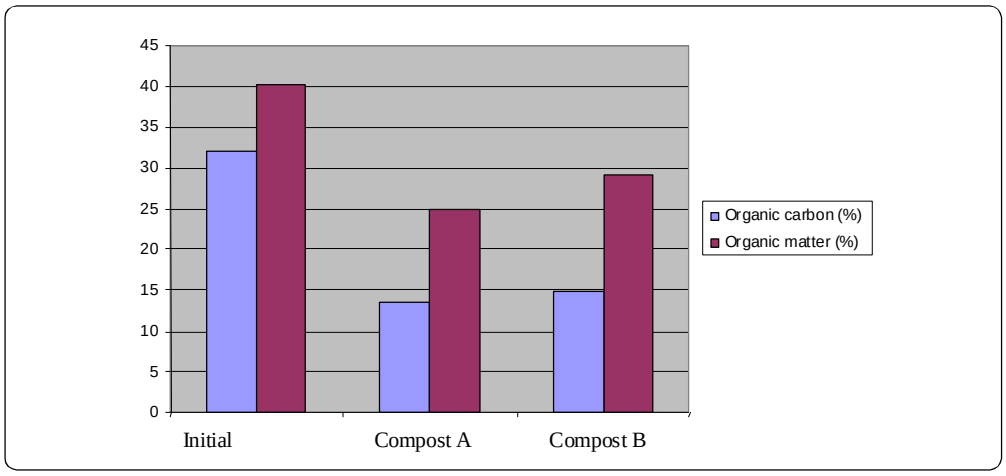

Fig. 1: Organic carbon and organic matter in compost.

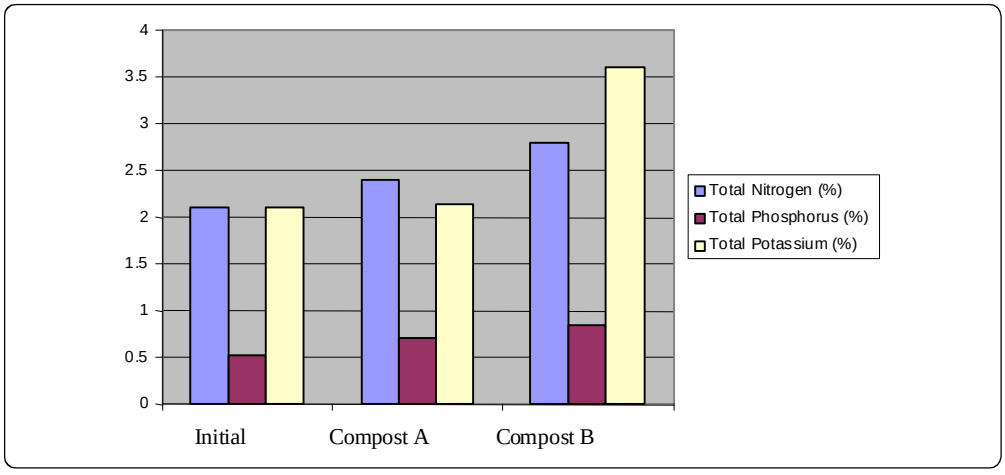

Fig. 2: Macronutrients in compost.

Table 5: Identified microorganisms from the compost:

S.No.	Compost A	Compost B
1	*Pseudomonas* sp.	*Pseudomonas* sp.
2	*Streptococcus* sp.	*Streptococcus* sp.
3	*Bacillus* sp.	*Bacillus* sp.
4	*Klebsiella* sp.	*Klebsiella* sp.
5	-	*Seratia* sp.

in the compost A and B than initial. The manurial value of compost B was higher than A. The remarkable increase of macro and micronutrients were due to the addition of spent wash in compost B. Because spent wash contain higher N, P, K, Na, SO_4, Ca, etc.

Identification of microorganisms from the compost (Table 5): The identified organisms were *Pseudomonas* sp., *Streptococcus* sp., *Bacillus* sp., and *Klebsiella* sp. from compost A. Besides these organisms, in compost B *Seratia* sp. has also been reported. These identified microorganisms were involved in the composting process. The metabolic activities of microorganisms that populated compost piles cause dramatic changes in the physical and chemical structure of the pile. In the final compost stage (maturation) most digestible organic matter gets consumed by the microbial population and the composted material is considered stable (Thakur 2006).

Thus, it is clear that utilization of spent wash for composting of the solid waste like press mud and bagasse could be boon for the solid waste management of sugar industry by improving the soil quality in an eco-friendly manner.

Hence, from these observations, we have concluded that the press mud and bagasse in combination with garden waste and cow dung can be utilized for the production of compost successfully.

REFERENCES

APHA 1989. Standard Methods for the Examinations of Water and Wastewater. 17th edition, American Public Health Association, Washington DC.

Atlas, R.M., Parks, L.C. and Brown, A.E. (Eds.) 1995. Laboratory Manual of Experimental Microbiology. Mosby-Chicago. pp. 65-110.

Gomathi, M., Anithasubash and Parvatham, R. 2004. Bioremediation of tannery solid waste by vermicomposting using *Eudrilus eugeniae*, *Lampito mauriti*. Journal of Industrial Pollution Control, 20(2): 331-338.

Handa, B. K. and Seth, R. 1990. Waste management in distillery industry. J. of IAEM, 17: 44-54.

Inthorn, D., Silapanuntakul, S. and Chanchitprecha, C. 2001. Improvement of colour and COD removal in molasses wastewater by using advanced oxidation processes. Poll. Res., 20(4): 691-696.

Kale, R.D., Mallesh, B.C., Banu, K. and Bagyaraj, D.J. 1992. Influence of vermicompost application on the available macronutrients and subsequent microbial populations in the paddy field. Soil Biology and Biochemistry, 24: 1307-1320.

Lakhsmibai, L. and Vijayalakshmi 2000. Vermicomposting of sugar factory filter press mud using an African earthworm species *Eudrilus eugeniae* with a note on its physico-chemical features. Poll. Res., 19(3): 481-483.

Muthuvel, P. and Udayasoorian, C. (Eds) 1998. Soil, Plant, Water and Agrochemical Analysis. TNAU. Coimbatore.

Mali, S.D. 2002. Aerobic composting of spent wash. Journal of Ecotoxicol. Environ. Monitoring, 12(2): 101-104.

Trivedy, R.K. 1998. A Text Book on Advances in Wastewater Treatment Technology, Global Science Publication, pp. 336-337.

Tandon, H.L.S. (ed). 1993. Methods of analysis of soils, plants, waters, fertilisers & organic manures. Fertiliser Development and Consultation Organisation, New Delhi, India.

Thakur, I.S. 2006. Environmental Chemistry. Goel publication, Meerut. pp. 151.

Vasanthy, M., Thamaraiselvi, C. and Sathya, R. 2004. Effect of untreated distillery effluent on growth and biochemical characters of *Trigonella foenum*. J. Eco. Env. & Cons., 10(3): 239-242.

Vasanthy, M., Thamaraiselvi, C. and Ramadoss, A. 2005. Utilization of garden waste for the production of vermicompost. J. Ecotoxicol. Environ. Monit., 15(3): 207-211.

Vasanthy, M. and Thamaraiselvi, C. 2006. Decolourisation of diluted spent wash using chemical and biological agents. Journal of Industrial Pollution Control, 22(2): 269-272.