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STUDIES ON SUGARCANE PRESSMUD AND DISTILLERY WASTE AS A BIOFERTILIZER THROUGH COMPOSTING

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ABSTRACT

Composting is a biological process in which organic material is decomposed by a mixed microbial population in warm, moist and aerobic environment. During this process, the degradable organic substrate undergoes chemical and physical transformation to give a stable and humidified end product. The product is of value in agriculture both as an organic fertilizer and soil improver. The present study deals with the sources, treatment and strategies for future management of biomass. In this study, the quantification, characterization and leachate analysis of the biomass from Sakthi Sugars Limited has been done and developed a procedure for conversion of compost from biomass using simple and inexpensive equipment of the type commonly available in the urban and rural households. Further, a lab scale windrows of specified design is made by using the mixed feed stock and the performance analysis of the biomass is done. During this study, necessary convention techniques and analysis of the wastes had been undertaken.

Key words: Pressmud, Coir pith, Agricultural waste, Distillery effluent and Biocomposting.

INTRODUCTION

Pressmud and bagasse are commonly known as major wastes of the sugar industry. Sugarcane pressmud & bagasse are soft, spongy amorphous and dark brown to brownish white material containing lignin, cellulose, hemicellulose fibers. In India, it has been estimated that the annual production of sugarcane waste and pressmud is 24 to 28 million tonnes and 3.6 to 3.9 million tonnes respectively, while the production of coir pith is about 900 million tonnes. Lignin degradation takes more time because of its structural complexity. Lignin is a natural polymer having complex three dimensional structures, the phenolic compounds. While cellulose and starch contain glucose units. Pectins contain galacturonic

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acid monomers. Hemicelluloses contain mannans, xylans and galactans. Most of the part of these wastes is usually burnt in the field due to lack of proper management techniques, which creates severe environmental pollution and health hazards. Also when these organic wastes when applied without composting to the soil may lead to temporary lock up of nutrients as a result of impaired C:N ratio may not be beneficial to crop. Hence, composting of organic wastes is necessary to reduce the lignin and cellulose contents, there by the nutrient availability is improved.

Pressmud

Pressmud from the sugar industries is a very useful source of fertilizer as well as some substances. The major use that has recently been developed in India is in biocomposting (usually trade named as Bioearth) where it is treated with the spent wash from the distillery. The composition of pressmud is given in Table 1.

Table 1: Composition of pressmud

S. No.	Composition	(%)
1	Crude wax	5-14
2	Fiber	15-30
3	Crude protein	5-15
4	SiO	4-10
5	CaO	1-4
6	PO	1-3
7	MgO	0.5-1.5
8	Total ash	9-10

Its usefulness as fertilizer is based on the nutrient content of the pressmud and the spent wash as shown below.

Table 2: Nutrient content of pressmud & spent wash

Composition	Pressmud (%)	Spent wash (mg/L)
Nitrogen	1.15-3.0	2630
Phosphorus	0.60-3.50	201
Potassium	0.30-1.80	222

Molasses

During production of sugar, the by-product is molasses. It is a viscous liquid, which is separated from masecuite. An average of 23 Litre of molasses is produced per ton of sugarcane. In India around 2.5 million metric tons (MMT) of molasses is produced, which has multiple uses like production of ethanol, commercial purposes such as alcohols and automobile fuel. The composition of molasses has considerable variation depending on the same factors as discuses above in the press mud compositions. The composition of molasses used to produce bio-fertilizer is listed in Table 3.

Table 3: Percentage of nutrients present in molasses

S. No.	Nutrients	(%)
1.	Sucrose	30-35
2.	Glucose and Fructose	10-25
3.	Moisture	23-23.5
4.	Ash	16-16.5
5.	Calcium and Magnesium	4.8-5
6.	Non-sugar compounds	2-3
7.	Other mineral contents	1-2

Inoculums preparation

The bio-compost is produced by spraying spent wash on stacks of pressmud called windrows. The period required to produce usable fertilizer varies with the process used. A typical 40 day process includes the following steps:

- Formation of windrows and reduction of moisture content from 70% to 50% in five days.
- Inoculation of microbial culture.
- Spraying of spent wash and homogenization of windrows for 30 days.
- Maturation period of 10 days to reduce moisture to 30%.

Windrow process

The conventional windrow process involves initial mixing of dewatered sludge with a bulking agent such as finished compost, often supplemented with an external amendment, followed by formation of long windrows. Formation of the windrows is generally two types. Typically, front-end loaders are used to initially stack material in a rough windrow configuration, then a specially designed mobile composter is used to fine mix the material by turning the windrow in place. An active windrow composting period of 30 days is provided following initial mixing and formation. During this period, the windrows are periodically turned with a mobile composter (in some cases front-end loaders are used) to aerate and remix the material. A turning frequency of two or three times per week is typical. Temperature is monitored for process control. Following the active windrow composting period, the composted material is allowed to cure for at least 30 days, then, a portion of the finished compost is recycled and a portion is stockpiled for distribution.

EXPERIMENTAL

Materials and methods

Collection of raw materials

The pressmud was collected from Sakthi Sugars Limited, Erode, Tamilnadu and it was powdered and stored. The leaf waste was collected from Kongu Garden and it was partially degraded, moistened and used for further studies. The coir pith wastes was collected from Pollachi, Tamilnadu and it was partially degraded, moistened and used for further studies.

Glass wares and chemicals

Glass wares used in present study were thoroughly washed dried and then sterilized at 160°C for hr in a hot air oven. The chemicals and reagents used in experiments were AR grade supplied by S. D. Fine Chemicals Limited, Mumbai, India.

Media sterilization

The media used in the present investigation was prepared as per recommendation and sterilized in a pressure 15 lb for 15 mins in an autoclave.

Experiment work

In simple heap and windrow system is the most admired and economic of a non-reactor, agitated solid a bed system. Mixed feedstock are placed in rows and turned periodically. The length, width and height of the triangular heaps are 3 m, 0.5 m and 0.5 m, respectively. Oxygen is primarily supplied by natural ventilation, which results in the increase of buoyancy of hot gases in the windrows. This feedstock material is fed into four different pots. The composition of feed stock material is shown in Table 4.

Table 4: Chemical composition of the wastes (in %) on the initial day

Pot	Temp. (°C)	pH	Carbon	Nitrogen	Phosphorous	Potassium	Calcium	Magnesium
T1	44	6.94	32.18	0.98	1.18	0.64	3.98	0.98
T2	45	7.02	32.24	0.98	1.19	0.58	4.0	1.02
T3	46	7.08	34.58	1.14	1.24	0.61	4.38	1.12
T4	46	6.84	35.26	1.24	1.28	0.74	4.61	1.20

Water is sprayed in the mixed feedstock periodically and simultaneous mixing is done. The initial chemical composition of the materials in the four pots is given in the Table 4 and the chemical compositions are again evaluated after in 10, 20, 30 and 40 days is shown in Table 6.

Factors affecting the composting process

Moisture

Optimum moisture content is essential for the microbial proliferation during composting. Aerobic decomposition can proceed at moisture on pavilion between 30 to 100% if adequate aeration can be provided. Initially the moisture content may be between 45 to 75% optimum conditions is 50 to 65%.

pH

The pH of compostable material influences the type of organisms involved. In the composting process, fungi tolerate a wider pH rang 5.5 to 7.8 than bacteria. The optimum pH range for most bacteria is between 6.0 to 7.5 and proper temperature control is an essential for aerobic composting process.

Temperature

The high temperature (about 50°C) is essential for the destruction of pathogenic organisms and undesirable weeds. Optimum decomposition takes place between 55 to 60°C.

During compositing process the temperature increased to around 50°C and then decrease gradually it increased again after turning.

C : N ratio

The carbon and nitrogen ratio affects the speed of the composting process and the volume of material finished. In other words, the rate at which organic matter decomposes during composting is principally dependent upon the C:N ratio of the material. During composting, microorganisms utilize carbon as a source of energy and nitrogen for building cell structure. More carbon than nitrogen is needed. But if the carbon is excessive, decomposition decrease.

Aeration and culture addition

Bacterial culture, which enables quick bioconversion of organic is sprayed on the pressmud in the beginning and mixed thoroughly using aerotiller. This mixing makes the pressmud aerable and it encourages the decomposition process by added culture. About 1 Kg of bio culture is required for one tone of pressmud.

RESULTS AND DISCUSSION

Composting of sugarcane and distillery industrial waste with change and its impact on microbial population. In the present study, pressmud a sugarcane waste with change like coir pith waste and litter waste in compost preparation and its impact on microbial population were studied shown in Table 5.

Table 5: Combination of waste composting

No. of Trails	Mixed feedstock
Pot 1	Press mud + Distillery effluent
Pot 2	Press mud + Litter waste + Distillery effluent
Pot 3	Press mud + Coir pith waste + Distillery effluent
Pot 4	Press mud + Litter waste + Coir pith + Distillery effluent

Composting temperature increased to 60°C to 70°C and 20th day. However the temperature decreases gradually after 40th day of composting. The pH of the substrate increase gradually during composting due to the degradation of nitrogen containing materials in the raw materials to soluble organic nitrogen, the foundation of NH^{4+} ions and the release of hydroxide by hydrolysis. The same phenomenon was found in our study. Pot 4 press mud added with changes like litter waste and coir pith waste shows the increased microbial activity and also decreased carbon content. It also contains an increased N, P, K, Ca and Mg in the finished compost shown in Table 6. The variations in the amount of chemical substances in the four pots during the composting operation are shown graphically.

Table 6: Average results in different days/pot (in %)

Pot	Temp. (°C)	pH	Carbon	Nitrogen	Phosphorous	Potassium	Calcium	Magnesiun
Chemical composition of the wastes on the 10th day								
T1	61	7.14	31.12	1.02	1.24	0.64	4.02	1.02
T2	65	7.21	31.60	1.12	1.38	0.86	4.34	1.16
T3	67	7.28	32.12	1.21	1.48	0.94	4.42	1.22
T4	67	6.98	33.74	1.34	1.59	1.02	4.78	1.34
Chemical composition of the wastes on the 20th day								
T1	65	7.24	29.26	1.08	1.30	0.63	4.12	1.04
T2	67	7.46	30.54	1.28	1.52	1.34	4.46	1.22
T3	70	7.51	31.06	1.32	1.72	1.42	4.48	1.35
T4	70	7.18	32.58	1.40	1.81	1.58	4.84	1.48
Chemical composition of the wastes on the 30th day								
T1	59	7.33	28.04	1.14	1.38	0.68	4.12	1.02
T2	60	7.61	29.24	1.36	1.68	2.24	4.52	1.28
T3	62	7.66	29.84	1.46	1.76	2.34	4.64	1.46
T4	61	7.34	30.12	1.56	1.96	2.40	4.96	1.86
Chemical composition of the wastes on the 40th day								
T1	43	7.38	26.0	1.18	1.41	0.62	4.10	1.10
T2	44	7.79	27.36	1.44	1.72	2.86	4.56	1.34
T3	41	7.84	26.52	1.52	1.84	2.94	4.78	1.52
T4	45	7.84	28.46	1.74	1.98	3.04	5.02	1.67

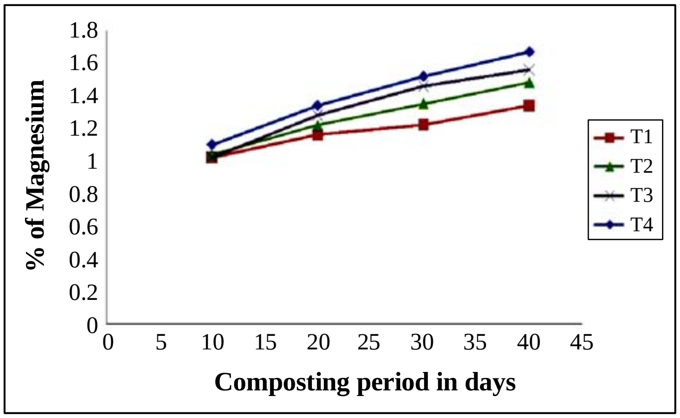

Fig. 1: Mg during the different period of composting

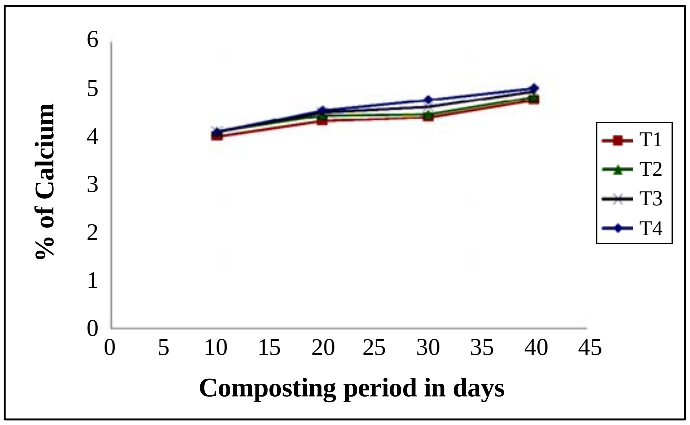

Fig. 2: Ca during the different period of composting

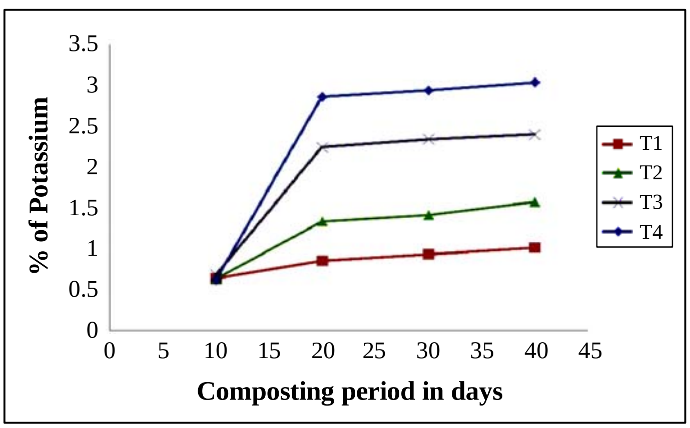

Fig. 3: K during the different period of composting

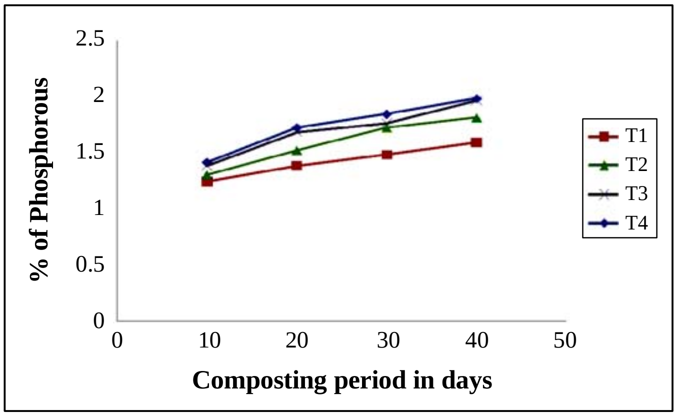

Fig. 4: P during the different period of composting

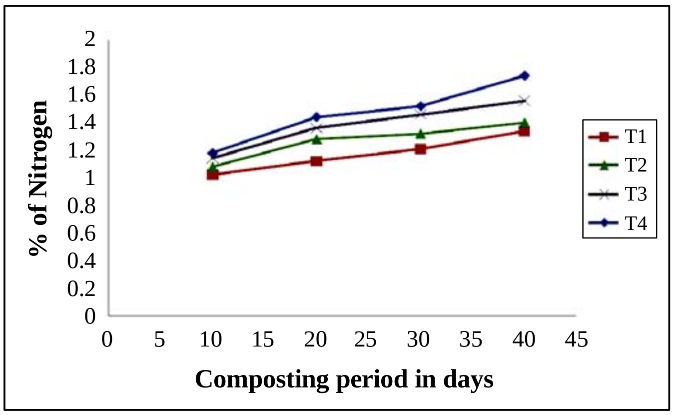

Fig. 5: N during the different period of composting

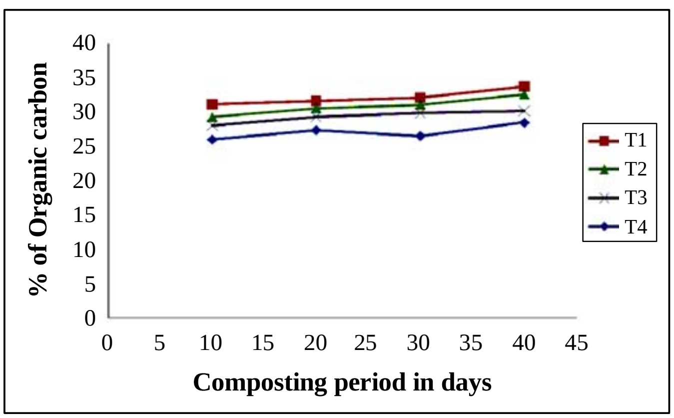

Fig. 6: O.C. during the different period of composting

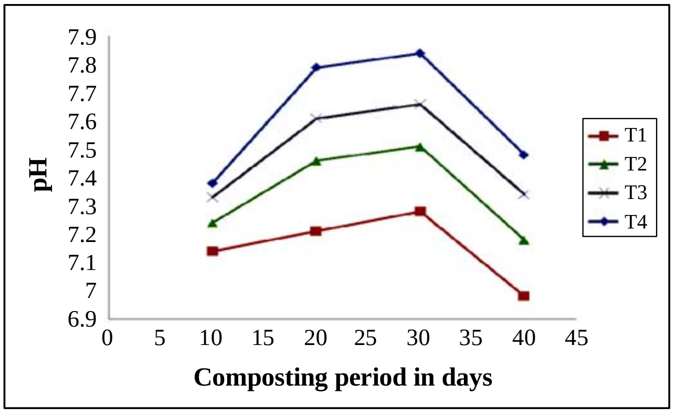

Fig. 7: pH during the different period of composting

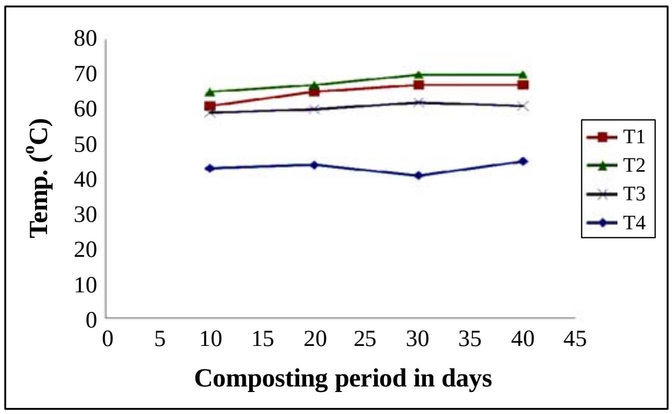

Fig. 8: Temperature during the different period of composting

CONCLUSION

Composting is a microbiological non-polluting and method of disposal and conversion of this organic waste. Compost temperature is increase 60°C to 70°C and day 10 to 20th day. However the temperature gradually decreases after 40th days. This is why the thermophilic temperature was reached when the wastes were loaded on dry basis due to the assimilatory and dissimilatory activities of micro organisms present in the mixed feedstock. The reduced C/N ratio material is suitable than the raw manure. The result in this laboratory scale study showed that, solid waste pollutants from sugar and distillery waste addition with coir pith and liter waste could be converted into organic fertilizer through the process of aerobic composting. Hence, good results are obtained during this process. Cost of bio-composting operation is comparatively is less and natural aeration is preferred for the economic benefit of this process.

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