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Research Article

Composting of Coir Pith Using Biopond Effluent from Effluent Treatment Plant of Petrochemical Division

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ABSTRACT

In the present study microorganisms were isolated from biopond effluent and their appearance and colony morphology were observed. Composting of coir pith using biopond effluent from water treatment plant and monitoring of pH and estimation of organic matter, carbon and total nitrogen in the compost were carried out. Further comparison of characteristics of compost with raw coir pith were also analysed. The results showed that coir pith can be composted using biopond effluent from effluent treatment plant. Composting period was found to be 60 days. Considering the reduction of carbon and increase in the percentage of nitrogen, it can be concluded that biopond effluent enriched in nutrient agar was more efficient.

Keywords: Biopond, Compost, Nitrogen, Carbon, pH, Effluent.

INTRODUCTION

Coconut palm (*Cocos nucifera*) is being cultivated in many parts of the world producing around 4 billion coconuts per year from an estimated area of 12.78 million hectare. India produces 22.3 percent of the total coconuts and is being considered as a premier coconut producer in the world. Coconut is known to play a role in the economy of marginal farmers in India. The coconuts are processed in industries to yield oil from dried kernels (copra). The above process generates huge quantities of husk (mesocarp) which was considered to be a waste. These husks are now being utilized as a raw material for the production of coir fiber. During the extraction of coir fiber from the husk, a light weight spongy material is released. This spongy material is known as coir pith which accounts to 50-60% of the total weight of the husk[1].

Coir industry is facing great difficulties in the disposal of coir pith. Very often coir pith is heaped as mounts on way side. Large quantities of coir pith thus stored causes contamination of portable ground water due to the percolation of leachates containing residual phenols from these dumps especially during rainy seasons. It also act as ideal breading ground for rodents and insect pests. Coir pith is easily blown by wind due to its light weight thereby creating air pollution. In comparison to other waste materials such as saw dust, rice husk and groundnut shell, coir pith is found to have a higher heat value. High levels of carbon dioxide and smoke are released from coir pith while burning due to its poor combustion properties.[2]

The coir pith thus produced decomposes very slowly in the soil as its pentosan-lignin ratio is below 0.5, and because of the chemical and structural complexity of its lignin-cellulose complex.[3] This structural feature has important implications for effective biodegradation by microorganisms[4].

Coir pith is an ideal soil reconditioner, soil structure improver with excellent water holding capacity. It is an invaluable soil vitalizer. Coir pith products consists of macronutrients such as nitrogen, phosphorous and potassium and micronutrients such as calcium and magnesium. It is a totally organic medium that maintains the soil in a natural way. It has large oxygen capacity and superior water holding capacity. It is also rich in root simulating hormones.[5]

The anti-fungal properties of coir pith protects plant from root diseases including fungal infestations. Coir pith consists of lignin and tannin with lignocellulose bonds which makes it resistant of microbial attack.

The soil coir pith enhances the nutrient carrying capacity of the plant. Coir pith improves water infiltration and nutrient availability to crops.[6] Composted coir pith is ideal for growing plants in pots. It doesn't require much soil as it can hold water for a long time. The humus content of compost is very high. Humus is very vital for the growth of plants.

Coir pith compost have been found to increase yield by improving soil pore space, water holding capacity, and nitrogen content. It helps to improve the texture of the soil. Composting divert coir pith from landfills, reduce some of the risk associated with land filling and produce a valuable by-product.[7]

If the soil is fertile and contain components like micro and macronutrients, many gardening problems can be nullified. Much attention must be paid to keeping it in good condition. The ideal vegetable garden soil is deep, friable, welldrained and has high organic matter content. Proper soil preparation provides the basis for good seed germination and subsequent growth of garden crops. Careful use of various soil amendments can improve the physical and biological condition of soil and provide the best possible starting ground for your crops. Coir pith not only revitalizes your plants, it induces uniformity in growth by enhancing water retention and microbial activity. Coir pith contains high quality of nutrients that keep the soil healthy in a natural way. It acts as a top dressing that helps maintain moisture and reconditions the soil. Coir pith enhances the nutrient carrying capacity of plants.[8]

Sustainable agriculture practices such as this creates a healthy perfect loop from table to earth. Pure and natural, this organic biodegradable matter is an economical and natural alternate for rock wool slabs, peat moss and perlite. This natural spongy coir industry by-product is a perfect organic growing medium for fruits such as strawberry, vegetables such as pepper, cucumber, tomatoes and flowers such as gerbera, gladiola, lily, anthurium and rose. Coir pith is a useful product to produce better yield in the field of agriculture and in home nurseries. This is a new technique proposed for maintaining the growth of plants in the potting medium. The technology proposed in this paper helps to develop the product with less consumption of electricity and labors. The fertile growth of plants during the summer season, in dry lands and also at the time of deficiency of minerals in the soil can be avoided using coir pith product[9].

Coir pith is richly used as soil less medium of glass houses. In this context, the particle size of the coir pith is very important. Media developed out of coir pith should provide adequate oxygen, water and nutrients for the proper function of root. It also should offer physical support to the plants [1].

MATERIALS AND METHODS

Isolation and Identification of microorganism in Biopond Effluent

20 ml nutrient agar was added to each sterile petri plates and solidified. The biopond sample was streaked and the plates were kept in incubator for 24 hrs. The individual colonies formed in the plates and their morphology and appearance was identified.

Composting of coirpith using biopond efflurnt from water treatment plant

Raw coir pith is obtained from central coir board, kallavor, Alappey, Kerala. The biopond effluent was obtained from the biotreatment section of FACT, Petrochemical Division.

Sample 1: 100 ml of biopond effluent was taken in a beaker. To this 200 ml of water was added into it and mixed.

Sample 2: prepared 300 ml nutrient broth by adding 3.9g nutrient broth in 300 ml water and autoclaved. Then 25 ml of biopond water was added to it and mixed.100 ml of culture was taken in a beaker to this 200 ml of water was added into it and mixed properly.

Sample 3: prepared 300 ml nutrient broth by adding 3.9g nutrient broth in 300 ml water and autoclaved. The colonies were transferred and mixed properly and keep it in shaker for 24 hrs to culture it.100 ml of culture was taken in a beaker and 200 ml of water was added into it and mixed properly.

Sample 4: 100 ml of biopond effluent was taken in a beaker. Dissolved 0.1 g of urea in 100 ml water and mixed it with the biopond effluent. 100 ml of water was added into it and mixed thoroughly.

The coir pith was sieved properly to remove any fiber present in it.100 g of coir pith was taken in 4 different containers.Sample 1, Sample 2, Sample 3 and Sample 4 was added to container 1, 2, 3 and 4 respectively.The mixture is mixed properly.If the moisture is not sufficient more water is added and mixed properly.The mixtures were left as a heap for composting.The contents in the containers should be mixed every day for proper aeration. Water should be added according to the demand.The setup should be kept for 60 days to form compost.

Monitoring controling and assesment of composting process

Estimation of pH

25 g of compost was made into suspension in 50 ml of distilled water and shake on a rotary shaker for 2 hrs.and this was Filtered through the Watt man No.1 filter paper under vacuum using a Buchner funnel

and pH was determined.

Determination of total nitrogen by Kjeldhal method

Sample (0.7-2.2 g) was taken in in digestion flask. 40ml H_2SO_4 containing 2 g salicylic acid was added and shaked until thoroughly mixed and let stand with occasional shaking for 30 min or more and 2 g Zn dust was added. The flask were shaked and let it stand for 5 min then heated over low flame until frothing ceases. The heat, was turned off and 0.7 g $CuSO_4$, 15 g powdered Na_2SO_4 were added and boiled briskly until solution was cleared and transferred to 500 ml volumetric flask after giving several washing with water to the digestion flask and this was cooled and made up the volume to the mark. 25 ml aliquot was taken in the distillation flask. Add 300 ml of water and a pinch of Zn dust. Taken 20 ml of standard acid solution in the receiving conical flask and added 4-5 drop of methyl red indicator. The lower end of condenser was fully immersed in acid solution. Added 30 ml of 45% NaOH to the distilling flask gently so that the contents don't mix. Immediately distillation flask was connected to the distillation assembly and swirled to mix the contents. Heated until all ammonia was distilled (at least 50 ml distillate). This was then tested with red litmus paper, if any ammonia was still coming out the receiving flask was removed. The outlet tube was rinsed in to receiving flask with a small amount of distilled water.

CALCULATION

$$\text{Nitrogen percentage} = \frac{1.401\ (V1N1-V2N2)}{W}$$

V_1 = Volume (in ml) of standard acid taken in receiving flask for sample
V_2 = Volume (in ml) of standard NaOH used in titrating standard acid in receiving flask after distilation
N1 = Normality (in N) of standard acid
N2 = Normality (in N) of standard NaOH
W = weight (in gm) of sample taken

Estimation of organic carbon

Accurately measured 10 g of sample dried in oven at 105 ^oC for 6 hrs in a pre-weighted crucible. The material was ignited in a muffle furnace at 650 ^oC to 700 ^oC for 6-8 hrs. This was cooled and weighed.

CALCULATION

Calculate the total organic carbon by the following formula.

$$\text{Total organic matter \%} = \frac{\text{initial weight – final weight}}{\text{Weight of sampl taken}}$$

$$\text{Total carbon \%} = \frac{\text{Total organic matter}}{1.724}$$

Comparision of characteristics of compost with raw coir pith

To compare the various characteristics of compost with coir pith such as:

a) carbon
b) nitrogen
c) C : N
d) pH

RESULTS AND DISCUSSIONS

Isolation and Identification Of Microorganism In Biopond Effluent

Three different types of colonies were isolated from the biopond effluent. The morphology and appearance of the isolated organisms were studied as

Table 1: Morphology and Appearance

Colony	Plate 1	Plate 2	Plate 3
Colour	White	White	Yellow
Shape	Round	Spread	Round
Nature	Slimy	Rough	Smooth

The white round colony was found to be more prominent in nutrient agar. As its growth was found to be more favorable, it was cultured in nutrient broth for aiding in composting.

Composting of coirpith using biopond efflurnt from water treatment plant

All the 4 experimental setup were given the same environmental conditions. The coir pith in container 4 had a darker shade compared to others due to

presence of urea. The color of the 4 composts started to change from brown to black eventually. As well as there was reduction in volume in all composts. The composts were powdered when compared to the initial condition.

Monitoring controling and assesment of composting process

Table 2: Assessment of composting process

S. No.	SAMPLE	DAY	pH	% OF CARBON CONTENT IN SAMPLE	% OF NITROGEN CONTENT IN SAMPLE
1	Raw CP	0	5.70	54.60	0.37
1 2 3	Expt : 1 Expt : 1 Expt : 1	21 42 63	6.13 6.02 5.75	54.17 53.83 53.54	0.48 0.85 0.86
1 2 3	Expt : 2 Expt : 2 Expt : 2	21 42 63	6.23 5.92 5.81	53.27 53.28 52.59	0.43 0.95 0.99
1 2 3	Expt : 3 Expt : 3 Expt : 3	21 42 63	6.22 6.15 5.9	53.84 53.53 52.36	0.74 0.87 0.96
1 2 3	Expt : 4 Expt : 4 Expt : 4	21 42 63	6.26 5.61 5.47	54.35 53.90 53.54	0.91 1.03 1.10

Monitoring of pH

Normal pH of coir pith was 5.70. Initially the pH of coir pith increased due to addition of samples for composting. But as composting process continued, the pH was coming down to its normal level. Initially the order of pH was :

exp 4 > exp 3 > exp 2 > exp 1

After composting the order was:

Exp 3 > exp 2 > exp 1 > exp 4

Assessment of carbon

The percentage of carbon in raw coirpith was very high (54.60). As the composting proceeds the percentage of carbon also reduced.

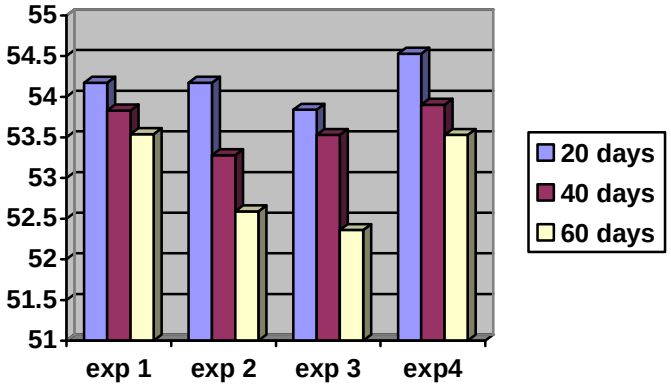

Fig. 1: Assessment of carbon

The reduction of carbon in exp 2 (enriched biopond effluent) is more prominent than the other experiments. So enriched biopond can be considered more efficient for carbon reduction.

Assessment of nitrogen

The percent of nitrogen in raw coir pith was about 0.34% which is very low. As the composting proceeds the percentage of nitrogen also increased.

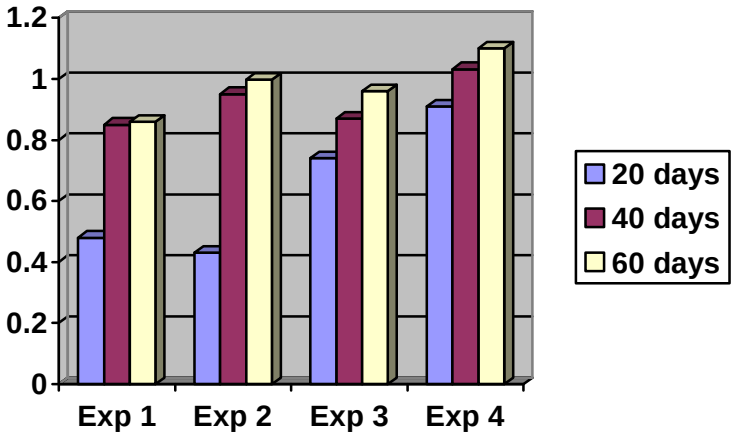

Fig. 2: Assessment of nitrogen

The maximum increase in nitrogen is found in exp 4. but due to the presence of urea , the nitrogen content in that sample was high compared to other sample. When we consider individually the increase in the amount of nitrogen is more in exp 2 (enriched biopond effluent) compared to exp 4 (urea with biopond effluent) there is an increase of .47 % in exp 2 where as there is only an increase of .19 % in case of exp 4. So enriched biopond effluent have more effect on increasing nitrogen content.

Table 3: Comparision of composts with raw coir pith

characteristics	Raw coir pith	Compost 1	Compost 2	Compost 3	Compost 4
pH	5.70	5.87	5.88	5.90	5.47
% Carbon	54.60	53.54	52.59	53.53	53.54
% Nitrogen	0.37	0.86	0.95	0.96	1.10
C : N ratio	147.57	62.25	55.37	55.76	48.67

Comparision of composts with respect to pH

The pH of the compost was in range of normal coir pith. After composting the order of pH was found to be compost 3 > compost 2 > compost 1 > raw coir pith > compost 4. The effect of compost with respect to pH was studied.[10]

Comparison of composts with respect to C : N ratio

The carbon: nitrogen ratio is an important factor for microbial growth as well as plant growth. The C : N ratio should be between 30 : 1 to 20 : 1 for an efficient compost. The C : N ratio of raw coir pith is 147.57. [11] reported the The C : N ratio of raw coir pith is to be 120.6

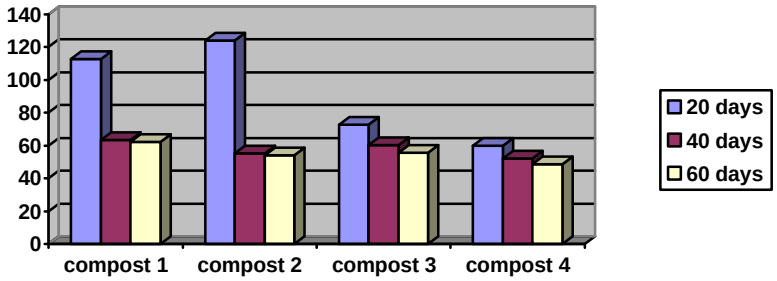

Fig. 3: Compaison with respect to C : N ratio

The reduction in C : N ratio shows that compost 4 is more efficient compared to other composts.The lignin content of compost 2 is lesser than all other composts. This proves that experiment 2 (enriched biopond effluent) is more efficient compared to other experiments.

CONCLUSION

From the present study it was found that coir pith can be composted using biopond effluent from effluent treatment plant, petrochemical division, FACT. Composting period was found to be 60 days.Considering the reduction of carbon and increase in the percentage of nitrogen, it can be concluded that biopond effluent enriched in nutrient agar was more efficient.

REFERENCES

1. Maragatham J and Raj, Physical characteristics of coirpith as a function of its particle size to be used as soil medium, American Eurasian J. Agri. Environ. Sci. 2010; 8 : 431-437.
2. Federico A, Borraz GM, Molina JAM, Vermicompost as a soil supplement to improve growth, yield and fruit quality of tomato, Biores. Technol. 2007; 98: 2781-2786.
3. Ramalingam A, Gangatharan M, KasturiBai R, 'Solid state bio-treatment of coir pith and paddy straw, Asian J. Microbiol. Biotechnol. and Environ. Sci., 2004; 6:141-142.
4. Manna MC, Jha S, Ghosh PK, Acharya CL, Comparative efficacy of three epigeic earthworms under different deciduous forest litters decomposition, Biores.Technol. 2003; 88:197-206.
5. Lowry DA, Bough NJ, Fair AZ, Rondall RJ, 'Protein measurement with the folin–ciocalteu reagent', J. Biological Chem. 1951; 193:265-275.
6. Mc Carthy AJ, Macdonald MJ, Paterson A, Paul B, Degradation of [14C] lignin-labeled wheat lignocellulose by white-rot fungi', J. Genl Microbiol. 1984; 130:1023-1030.
7. Anthony E, Fluid Power with Applications, Pearson Education Inc, 2001; 7: 552-558.
8. Krishnamurthy K, Design and Fabrication of Coir Pith Prequetting Machine, World Appl. Sci. J. 2009; 7: 552-558.
9. Nair J, Sekiozoic V, Anda M, Effect of pre-composting on vermicomposting of kitchen waste, Biores. Technol. 2006; 97: 2091-2095.
10. Kadirvelu K, Thamaraiselvi K, Namasivayam C, Removal of heavy metals from industrial waste waters by adsorption onto activated carbon prepared from an agricultural solid waste, Biores. Technol. 2001; 76:63-65.
11. Hashemimajd, Somarin, Effect of elemental sulphur and compost of pH, electrical conductivity and availablity of one clay soil, African j. Biotechnol. 2012; 11: 1425-1432.