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Use of Microbial Consortium for Biodegradation of Coir Pith

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Microbes such as bacteria and fungi were isolated from aged coir pith and identified. One Bacterial and three fungal isolates which showed predominant growth were mass multiplied and a microbial consortium was formulated by mixing the bacteriae and fungal mixture in 1:1 ratio. The soft part of fresh coir pith was separated and treated using bacteria, fungal mixture and their consortium for 42 days. The physiochemical parameters such as pH, EC, C, N, P, K, and C: N ratio was analyzed in the treated coir pith compost.

Key words: Coir pith, Microbial consortium, Composting, Humus.

Coir pith or coir dust, is a by - product obtained from coir industry where fibre is extracted from coconut husk .It is the binding material of the fibres in the husk. In India, an estimated 7.5 million tones of coir pith are produced per annum. The coir pith decomposes very slowly in the soil, because of the complexity in the structure of ligno celluloses(Ramalingam *et a*l., 2005). However there is possibility of composting coir pith using microbes(Savithri, 1994). Composting is defined as degradation of organic wastes into compost by using microbes or by earthworms (vermicomposting). In the present study attempt has been made to convert coir pith into manure using bacterial and fungal species.

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MATERIAL AND METHODS

Old Coir pith sample was collected form Ambathurai Village, Dindigul District, Tamilnadu, India and transported to the laboratory for microbial analysis.Coir pith sample was serially diluted and plated on Nutrient agar and Rose Bengal agar for the isolation of bacteria and fungi respectively. The predominant colonies from Nutrient agar and Rose Bengal agar were selected and indentified based on the colony morphology and biochemical tests, such as Gram's staining,motility,indole production test,methyl red test,Voges Proskauer test ,citrate utilization test,catalase test,lipid test,starch hydrolysis test and gelatin hydrolysis test for bacteria and lactophenol cotton blue (staining) and gelatin liquefaction test for fungi.The predominant bacterium identified was mass multiplied in Nutrient broth for 24 hours at 37^0C and the three predominant fungal isolates were individually mass multiplied in sorghum grain medium. 200gms of sorghum grain was washed with distilled water and the water was drained and transferred to 500ml conical flask and boiled for 15min. After boiling the water was drained and the boiled sorghum

was sterilized using $CaCO_3$ powder and then the three fungal isolates were inoculated separately and kept in room temperature for 7 days. At the 7 day spore count was done using normal plate count. The three fungal strains were mixed in 1:1:1: ratio to get a fungal mixture. A consortium was prepared by mixing the selected bacterium with fungal mixture in 1:1 ratio and used for composting the coir pith. Compost was prepared using tray method. The coir pith sample was sieved and the soft parts were selected for preparing compost. 2kg of the coirpith was placed in plastic trays and three treatments were kept with three replicates

Treatment 1:

coir pith + bacteria ($5.67X10^8$ bacteria/ml)

Treatment 2:

coir pith + fungal mixture ($4.64x10^5$ fungi/ml)

Treatment 3:

coir pith + microbial consortium ($2.84x10^8$ bacteria/ml and $2.32x10^5$ fungal mixture /ml)

These treatments were maintained for a period of 42 days and analyzed for pH, EC, C, N, P and K.

RESULTS AND DISCUSSION

Composting is a low tech process in which the organic matter is biologically decomposed by microorganisms. Along with humus-like end product, the microorganisms convert organic material into carbon dioxide, biomass and thermal energy (Tuomela *et al*., 2000). Microbial biodegradation of coir pith waste is generally considered to be a safe, effective and environmentally friendly process (Crawford and Crawford, 1976). The results of the biochemical characteristics of the bacteria isolated from aged coir pith is given in Table 1 and the bacteria is identified as a *Bacillus sp.*

The three fungal isolates were identified based on their culture characteristics and microscopic observations and the results are recorded in Table 2.

Table 1. Biochemical characteristics of the bacterial isolate

Biochemical tests forthe bacterial isolate.	Results Observed
Gram's staining	Positive rods
Motility	Motile
Indole production test	Negative
Methyl red test	Positive
Voges Proskauer test	Negative
Citrate utilization test	Negative
Catalase test	Positive
Lipid test	Negative
Starch hydrolysis test	Positive
Gelatin hydrolysis test	Negative

Table 2. Culture characteristics and microscopic observations of the fungal isolates

Macroscopic appearance	Microscopic appearance	Cultures
White cottony growth on Rose Bengal agar plates	Sporangiospores arise from spherical shaped	*Rhizopus spp*
Round shaped colonies with black colour spores	sporangiophore Conidiospores	*Aspergillus spp*
Green colour colonies	Conidiospores and streak with conidial broom	*Penicillium spp*

Table 3. Physicochemical analysis of the coir pith substrate on the initial day

Physicochemical parameters analysed	Observed value
pH	7.60 ± 0.14
EC (dsmol-1)	0.70 ± 0.14
C (%)	29.87 ± 0.03
N (%)	0.90±0.01
P (%)	0.43± 0.01
K (%)	0.54 ± 0.01
C/N ratio	33

The physicochemical parameters such as pH, EC, C, N, P and K were analyzed in coir pith compost and the results on the initial and final days are recorded in Table 3 and 4 respectively.

Table 4. Physicochemical analysis of the coir pith compost on 42 day

Treatment	Physiochemical analysis on 42 day						
	pH	EC(dsm^{-1})	C	N	P	K	C/Nratio
Control	7.15±0.35	0.83±0.04	27.70±0.14	1.01±0.01	0.56±0.15	0.66±0.08	27
Treatment -1	6.60±0.14	1.03±0.11	25.25±0.35	1.10±0.01	0.64±0.09	0.75±0.04	23
Treatment- 2	6.60±0.28	1.45±0.21	24.25±0.49	1.15±0.01	0.67±0.08	0.77±0.10	21
Treatment-3	5.90±0.14	1.80±0.14	22.70±0.28	1.22±0.02	0.72±0.03	0.88±0.02	19

T-1: Bacterial Treatment T-2 :Fungal Treatment T-3 : Consortial Treatment

The results of the 42 days of composting of the coirpith showed a reduction in pH in all the three treatments and in the control. The decrease in T1, T2 and T3 were higher than in the control. Taiwo and Osa (2002) also observed a decrease in pH from 9.5 to 6.3 in the coirpith compost. Such type of decrease in pH could be due to the increase of humic acid in the compost. The Electrical conductivity showed an increase in all the three treatments and also in the control, after 42 days of coirpith composting. Such increase EC is due to the conversion of minerals into forms that are available for plant absorption ,by the activity of microorganisms present in the compost. Increase in the EC was in the order of Bacterial treatment > Fungal treatment > Consortial treatment. This observation shows that the consortium of bacteria and fungi are able to dissolve the minerals more efficiently and enhance the manurial property of the compost. The Carbon content showed a reduction, the N,P,K, showed an increase and the C:N ratio was drastically brought down by the consortium treatment than by the exclusive bacterial or fungal treatment. This study showed that their is a possibility of using microbial consortium to degrade coirpith. These observations are on par with the observations made by other researchers such as Pramanik *et.al* (2007) who observed an enhancement of potassium and reduction in C:N ratio in the coirpith that received microbial treatment . Theradimani and Marimuthu (1993) observed that *Aspergillus spp., Streptomyces spp., Bacillus spp., and Trichoderma spp*. were predominant in coir pith at different stages of composting and these organisms successfully narrowed down the C:N ratio. The present 42 days composting of coirpith using microorganisms give a scope for producing a good quality compost from coirpith, which is otherwise wasted. However, further studies are needed in this area.

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