

Efficacy of *Phanerochaete chrysosporium* (MTCC-787) on the biodegradation of coir waste

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SUMMARY

An investigation was carried out to convert coir waste, an environmental pollutant into organic manure by inoculating a white rot fungus, *Phanerochaete chrysosporium* for 60 days. The results of the study revealed that after 60 days of biodegradation, the lignin, cellulose and organic carbon, C:N ratio, total phenol, reducing and non-reducing sugars showed a decreasing trend. An increasing trend was observed in total nitrogen from 0.26 to 1.01 per cent after 60 days of *Phanerochaete chrysosporium* inoculation.

Key words : *Phanerochaete chrysosporium*, Biodegradation, Coir pith

The green revolution in India has led to an abundance of crop residues. The quantity of agricultural residues and by products produced in India is about 1396 metric tons, of which the quantum of crop residues is to the tune of 273.3 metric tons. In TamilNadu, a quantity of about 20 metric tons of crop residues are available every year. Various agricultural waste and by products of agrofarm waste industries are being used effectively as an organic manure (Selvi and Selvaseelan, 1992). Coir pith hillocks is a common sight in places like Kinathukadavu, Pollachi, Thenkasi and other coir fibre extraction centres. It is estimated that the total quantity of coir pith produced in India is about 5, 00, 000 tonnes and around 2000 tonnes are produced per working day. About 5 lakhs metric ton of the coir waste can be converted into 2-9 lakh tons of organic manure valued for over 20 crores (George, 1995).

Hence, the present investigation was carried out to convert the environmental pollutant, coir waste into nutrient enriched organic manure by inoculating *Phanerochaete chrysosporium*.

MATERIALS AND METHODS

Collection of materials :

Phanerochaete chrysosporium (MTCC-787) was bought from Institute of Microbial Technology, Chandigarh, India. Fresh coir pith samples were collected from Cheenapuram village in Kunnathur near Erode.

Biochemical analysis:

Biochemical analysis of raw and decomposed coir waste was undertaken at an interval of 15 days for 60 days following the method

- Estimation of cellulose (Updegraff, 1969).
- Estimation of lignin (Goering and Vansoest, 1975).
- Estimation of organic carbon (Walkeley and Black, 1934)
- Estimation of total nitrogen (Microkjeldhal method – Humphries, 1956).
- Estimation of total phenol by folin – Ciocalteu method (Bray and Thorpe, 1954).
- Estimation of reducing sugars by Dinitroslicylic acid method (Miller, 1972).

RESULTS AND DISCUSSION

The results obtained from the present investigation are presented in Table 1.

Cellulose and lignin content :

Investigation on cellulose and lignin content of coir waste revealed a steady reduction from 35.53 per cent (raw) to 20.80 per cent and from 35.79 (raw) to 9.12 per cent in *Phanerochaete chrysosporium* inoculated samples after 60 days of decomposition (Table 1).

The result is in accordance with the result of Marimuthu *et al.* (1999) who found that there was reduction in cellulose content from 26.50 per cent to 10.10 per cent in coir pith after 45 days due to *Pleurotus* spp. inoculation. Similar result was also obtained by Sridevi and Padmaja (1999) who also reported that the lignin content in fresh coir pith sample was 29.0 per cent and it was decreased to 8.6 per cent in the 10 year old coir pith sample (under natural environment).

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Table 1 : Chemical composition of raw and composted coir pith

Chemical composition	Raw coir pith	Days of observation				S.E. \pm	C.D. (P<0.01)
		15	30	45	60		
Cellulose (per cent)	35.53	31.65	28.63	26.05	20.80	0.40	1.26
Lignin (per cent)	35.79	26.43	17.50	14.96	9.12	0.34	1.09
Carbon (per cent)	44.27	36.43	34.10	31.27	28.73	0.26	0.81
Nitrogen (per cent)	0.26	0.58	0.82	0.94	1.01	0.02	0.05
C : N	171 : 1	63 : 1	42 : 1	33 : 1	28 : 1	-	-
Phenol (mg g ⁻¹)	5.52	3.60	2.48	0.79	0.29	0.29	0.85
Reducing sugar(mg g ⁻¹)	0.81	0.74	0.62	0.40	0.19	0.19	0.07

Organic carbon :

The organic carbon content of raw coir waste was 44.27 per cent. After inoculation with *Phanerochaete chrysosporium*, it was reduced gradually from 36.43 per cent (15 days) to 28.73 per cent after 60 days of decomposition.

The result coincides with that of Adlene sangeeth and Padmaja (2006) who investigated the efficacy of *Phanerochaete chrysosporium* and *Trichoderma viride* for composting bagasse. They reported that the dual inoculated (*P. chrysosporium* and *T. viride* basasse sample showed a drastic reduction in organic carbon content 21.13 per cent from 41.13 per cent (raw bagasse)with in 60 days of decomposition.

Nitrogen content :

It was observed from the present investigation that due to *Phanerochaete chrysosporium* inoculation into the coir waste, the total nitrogen content tended to increase from 0.26 per cent (raw coir waste) to 1.01 per cent after 60 days of decomposition.

The result is in accordance with the findings of Adlene sangeeth and Padmaja(2006).They reported that dual inoculated (*Phanerochaete chrysosporium* and *Trichoderma viride*) bagasse sample recorded maximum total nitrogen content of 1.03 per cent from 0.33 per cent over 60 days of decomposition.

C:N ratio:

The white rot fungus, *Phanerochaete chrysosporium* inoculation into the coir waste hastened the rate of

biodegradation as revealed in the drastic narrowing down of C:N ratio from 171 : 1 (raw) to 28 : 1 after 60 days. The decrease in C:N ratio indicates compost maturity and suitability as biomanure.

Sheeba *et al.*(1998) degraded coir pith along with urea after inoculating *Pleurotus sajor-caju*, a lignin degrading fungus. The fungus narrowed down the C:N ratio from 112 : 1 to 24 : 1 over a period of 30 days.

Total phenol and reducing sugar :

A drastic reduction in total phenolic content 0.29 mg g⁻¹ was registered in *Phanerochaete chrysosporium* inoculated coir waste sample after 60 days of decomposition over uninoculated raw coir waste (5.52 mg g⁻¹).

Similar result was reported Sridevi and Padmaja (1999). They found that the phenolic content in fresh coir pith sample was reduced from 12.5 mg g⁻¹ to 4.5mg g⁻¹(10 year old) decomposed coir pith sample during decomposition under natural environment.

Studies made on reducing sugar indicated that it got reduced from 0.81 mg g⁻¹ to 0.19 mg g⁻¹ after 60 days of decomposition in *Phanerochaete chrysosporium* inoculated coir waste.

Conclusion:

Coir pith, a waste which is accumulating in huge quantities causing pollution and disposal being a serious problem could be profitably utilized as organic manure after decomposing it with white rot fungus, *Phanerochaete chrysosporium*.

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