



## Combined effect of *Pleurotus sajor-caju* and earthworm in reduction of physical characteristics, cellulose, hemicellulose and lignin content in coir pith compost

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### Abstract

Coir pith wastes were collected and analyzed for their physico-chemical properties. The result clearly revealed that the collected Coir pith waste was high potential for using as an organic manure. The reduction of Cellulose, Hemicellulose and Lignin contents were rich in the treatment T<sub>4</sub> (Coir pith waste + Cow dung + *Pleurotus sajor-caju* + Earthworm) followed by the treatment T<sub>3</sub> (Coir pith waste + Cow dung + *Pleurotus sajor-caju*) and T<sub>2</sub> (Coir pith waste + Cow dung). Less reduction was recorded in the treatment T<sub>1</sub> (Coir pith waste alone). The treatment T<sub>4</sub> showed maximum efficiency on 90 days of incubation rather than 120 days of incubation due to the maturity of compost, there are no carbonic compounds to be break down and used for inoculated metabolism.

**Keywords:** coir pith waste, earthworm, *Pleurotus sajor-caju*, cellulose, hemicellulose and lignin

### Introduction

Coir pith, a by-product of the coir fiber manufacturing industry is generated during coir fiber extraction from coconut husk. Coconut coir pith has found applications in brick and particle board production (Vadiraj *et al.*, 1998) [7], animal husbandry as bedding materials. Coir pith has been widely utilized in agriculture due to its physical properties such as high porosity and water holding capacity rendering it suitable for employing as planting materials (Ramalingam *et al.*, 2004) [5]. The coir pith contains high Carbon to Nitrogen (C/N) ratio, 75 to 186, together with 35 % to 54 % Lignin content. Therefore, coir pith is highly resistant to biological degradation (Aira and Dominguez, 2008) [1]. Earthworms play an important role in the recycling of Nitrogen in different agroecosystems, especially under jhum (shifting cultivation) where the use of agrochemicals is minimal. Desai *et al.* (2019) [2] reported that during the fallow period intervening between two crops at the same site in 5 to 15 years jhum system, earthworms participated in Nitrogen cycle through cast egestion, mucus production and dead tissue decomposition. Soil Nitrogen losses were more pronounced over a period of 15 years jhum system. The total soil Nitrogen made available for plant uptake was higher than the total input of Nitrogen to the soil through the addition of slashed vegetation, inorganic and organic manure, recycled crop residues and weeds.

### Materials and Methods

#### 1. Collection and Treatment of Vermiculture and Cow dung manure

Materials employed for composting in this study are earthworms (*Lambido maurtii* and *Eisenia foetida*), Coir

pith and Cow manure were collected from Tirupattur district, Tamil Nadu, India and used as the substrate, preliminary treatment was carried out for the Coir pith for 2 weeks.

#### 2. Preparation and Treatment for Composting

After the partial degradation for 2 weeks, the Composting material was mixed rationally and then allowed for 120 days of Composting. The *Lambido maurtii* and *Eisenia foetida* were applied over the treatment by 100/10 kg. The Coir pith was composted by adding different pretreatment sources including Cow dung, *Pleurotus sajor-caju*, and Earthworms. The Treatment schedule includes: T<sub>1</sub> - Coir pith waste alone; T<sub>2</sub> - Coir pith waste + Cow dung; T<sub>3</sub> - Coir pith waste + Cow dung + *Pleurotus sajor-caju* and T<sub>4</sub> - Coir pith waste + Cow dung + *Pleurotus-sajor-caju* + Earthworm. During this inoculation period the treatment materials were maintained with 65 – 75 % of moisture and heaped to maintain the temperature by turning the compost weekly twice.

#### 3. Estimation of Hemicellulose, Cellulose and Lignin

The hemicellulose, cellulose and lignin content for the collected organic materials were estimated by following the methods proposed by Van and Wine (1967) [8]. The pH, electrical conductivity and organic matter were also analysed for all the treatment mixtures.

### Results and Discussion

The results of the experiments, conducted on the degradation of Coir pith wastes by microbial composting and vermicomposting was statistically analyzed and presented in following tables. Table - 1 shows the Physico-chemical properties of coir pith wastes before composting.

**Table 1:** Physio-chemical properties of Coir pith wastes

Physio-chemical characteristics	Coir pith waste Initial analysis	Nutrients	Coir pith waste
pH	5.9	N (%)	0.26
EC	0.6	P (%)	0.01
Organic matter (%)	90	K (%)	0.78
Carbon (%)	48.13	Mn (ppm)	0.36
Lignin (%)	30.00	Zn (ppm)	7.50
Cellulose (%)	26.50	Cu (ppm)	1.9
Hemicelluloses	15-16	C:N ratio	46.00

**1. Effect of pretreatment on the pH value during Coir pith waste Composting**

The pH value was studied for Coir pith waste composting and their results were presented in Table - 2. The pH value of the coir pith waste was observed during the period of composting at 15 days, 30 days, 45 days, 60 days and 75 days. All the treatments Coir pith waste alone (T<sub>1</sub>), Coir pith waste + Cow dung (T<sub>2</sub>), Coir pith waste + Cow dung + *Pleurotus sajor-caju* (T<sub>3</sub>), and Coir pith waste + Cow dung + *Pleurotus sajor-caju* + Earthworm (T<sub>4</sub>) were almost in neutral condition and the pH was ranged from 3.0 to 5.9.

**Table 2:** Effect of pretreatment on the pH value during Coir pith waste Composting

Treatments	Sampling time in days					
	0	15	30	60	90	120
T <sub>1</sub>	5.9	5.2	4.2	4.0	3.8	3.8
T <sub>2</sub>	5.9	5.1	4.9	4.8	3.9	3.9
T <sub>3</sub>	5.9	5.1	4.2	4.0	3.1	3.0
T <sub>4</sub>	5.9	5.8	4.7	4.6	3.5	3.5

**2. Effect of pretreatment on the EC content during Coir pith waste Composting**

The Electrical conductivity (EC) of coir pith waste composting during composting period was observed and their results were presented in Table - 3. There was not much difference was observed in the EC of coir pith waste compost during the period of composting. There was only slight modification achieved during composting process. The treatments T<sub>4</sub>, T<sub>3</sub>, T<sub>2</sub> showed more or less same in EC i.e., 0.69 dsm<sup>-1</sup>. On maturity, the EC content of original substrate was around 0.23 and it was reduced about 45 % on maturity of compost.

**Table 3:** Effect of pretreatment on the EC content during Coir pith waste composting

Treatments	Sampling time in days C1:100 dsm <sup>-1</sup>					
	0	15	30	60	90	120
T <sub>1</sub>	0.23	0.18	0.15	0.12	0.09	0.07
T <sub>2</sub>	0.21	0.16	0.13	0.11	0.08	0.05
T <sub>3</sub>	0.17	0.14	0.10	0.08	0.05	0.03
T <sub>4</sub>	0.12	0.11	0.07	0.05	0.03	0.01

**3. Effect of pretreatment on the Cellulose content during Coir pith waste Composting**

The cellulose content of coir pith waste composting was presented in Table - 4. The cellulose content of coir pith waste treatment T<sub>1</sub> reported that 17.24, it was decreased with period of incubation. The treatment of T<sub>4</sub> showed maximum reduction per cent of 0.18 per cent which was almost 24.32 per cent decreased, it was followed by the treatments of T<sub>3</sub> and T<sub>2</sub>.

**Table 4:** Effect of pretreatment on the Cellulose content during Coir pith waste Composting

S. No	Treatments	Sampling time in days						Percentage decrease after composting (%)
		0	15	30	60	90	120	
1	T <sub>1</sub>	17.24	14.18	14.14	13.32	12.10	11.12	33.32
2	T <sub>2</sub>	17.58	14.17	10.18	6.64	1.48	1.16	30.68
3	T <sub>3</sub>	17.56	14.08	9.68	4.64	0.68	0.44	26.48
4	T <sub>4</sub>	17.64	14.04	8.10	3.32	0.40	0.18	24.32

**4. Effect of pretreatment on the Hemicelluloses content during Coir pith waste Composting**

The Hemicelluloses content of the Coir pith waste taken on the study was 14.14 (T<sub>1</sub>), 8.16 (T<sub>2</sub>), 8.1 (T<sub>3</sub>) and 8.18 (T<sub>4</sub>) (Table - 5). Among the treatments, the percentage decreases in Hemicelluloses were more in T<sub>4</sub> and recorded value of 41.86, it was followed by the treatments of T<sub>3</sub> and T<sub>2</sub>.

**Table 5:** Effect of pretreatment on the hemicelluloses content (%) during coir pith waste composting

Treatments	Sampling time in days						Percentage decrease after composting (%)
	0	15	30	60	90	120	
T <sub>1</sub>	14.14	8.18	6.18	5.68	4.36	2.12	30.32
T <sub>2</sub>	8.16	7.16	5.46	5.12	0.46	4.18	28.48
T <sub>3</sub>	8.12	7.12	5.18	4.18	4.12	3.46	33.99
T <sub>4</sub>	8.18	6.18	4.32	2.12	7.86	2.74	41.86

**5. Effect of pretreatment on the Lignin content during Coir pith waste composting**

The lignin content of coir pith waste composting was presented in Table - 6. The initial content of coir pith waste was 1.42 and it was decreased with period of incubation. The treatment T<sub>4</sub> showed maximum decreased percent of 0.66 which was almost 18.32 percentages decreased. The treatment T<sub>4</sub> was followed by the treatment T<sub>3</sub> and T<sub>2</sub>.

**Table 6:** Effect of pretreatment on the lignin content (%) during coir pith waste composting

Treatments	Sampling time in days						Percentage decrease after composting (%)
	0	15	30	60	90	120	
T <sub>1</sub>	1.42	1.40	1.39	1.36	1.34	1.28	24.56
T <sub>2</sub>	1.41	1.28	1.16	1.06	0.26	0.48	22.36
T <sub>3</sub>	1.42	0.49	0.26	0.02	0.98	0.68	20.86
T <sub>4</sub>	1.42	0.12	0.02	0.96	0.16	0.66	18.32

In the present study, during decomposition of coir pith wastes, the initial pH 7.7 was brought down to 6.5 during 45 days period of earthworms. The results are in time with the findings of Garg *et al.* (2006) [4] who observed change in pH from alkaline to neutral condition. The Electrical conductivity (EC) also decreased during composting process. The electrical conductivity was come down from 0.23 to 0.01 using cow dung micro flora and earthworm. The change in EC by the treatments could have been contributed by the microbial action on the composting material (Taiwo and Oso, 2004) [6]. Frederickson *et al.* (2007) [3] states during matter decomposition process, macro and micro nutrients were increase and organic matter and organic carbon was reduced. In the present study, similar results were obtained in organic matter. Organic carbon, cellulose content, hemicellulose content and lignin content were decreased tremendously. The maximum reductions were obtained in conversion. The treatment T<sub>4</sub> during coir

pith wastes compost. Similarly, there was increase in N, P and K content was observed and the treatment T<sub>4</sub> recorded maximum value.

### Conclusion

From the results of the present study composting of coir pith with cow manure, and *Pleurotus sajor-caju* decompose the organic matter rapidly and the physical changes in color, odour, texture, pH and electrical conductivity of the material was reduced during the entire period. the nutritive value of the coir pith is high and its recycling process effectively converts the waste into useful composting process.

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