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Combined Effect of *Trichoderma resii* and earthworm in reduction of physical characteristics, cellulose, hemicellulose and lignin content in market wastes

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Abstract

Market wastes were collected and analyzed for their physico-chemical properties. The result clearly revealed that this waste was high potential for using as organic manure. The physical parameters such as pH and EC was studied. The results showed that pH was bought down to neutral state by vermicomposting and electrical conductivity was also reduced effectively. The organic matter and organic carbon were almost reduced to 60% by vermicomposting. The treatment T_4 (Market waste + cow dung + *Trichoderma resii* + Earthworm) showed maximum reduction when compare with (Market waste + cow dung + *Trichoderma resii* (T_3) and (Market waste + cow dung (T_2). Likewise, the cellulose, hemicelluloses and lignin content were also reduced during composting and vermicomposting. The maximum reduction was observed in the treatment T_4 (75 % NPK + VC) about 60 % in cellulose content, 55 % in hemicelluloses content and 40 % in lignin content. The macro nutrients like nitrogen, phosphorous and potassium content was increased in all the treatment T_2, T_3, and T_4. The treatment T_4 recorded maximum of 56 % N, 46 % P and 22 % K. The microbial flora also showed increased initially during composting there after reduction in their activity due to depletion of carbon source.

Keywords: vermicomposting, market waste, earthworm, cow dung and *Trichoderma ressi*

Introduction

Tremendous increase in population, Industrialization and agricultural production results in accumulation of large quantities of solid wastes, resulted in serious causes in environmental pollution. Accordingly, the municipal wastes has also been increased and disposal of these segregated market wastes from the centralized wholesale markets to the dumpsites and landfills leads' also to the underutilization of these organic wastes (Velusamy Mozhiarasi, 2022) [8]. Agricultural and industrial waste include bran, rice husk, rice straw, wheat and other cereal straw, sugarcane trash, baggase, molasses, pressmud, cotton, mill waste, city refuse, sewage sludge, fruit and vegetable processing waste, dairy waste etc., can be used for bioconversion as organic manure. In India the estimated organic waste per annum was about 750 million tonnes which can supply about 7.1, 3.0 and 7.6 million tonnes of N, P_2O_5, and K_2O respectively (Giroddi, 2000) [3]. Interestingly these organic wastes can be recycled through vermicomposting and productively utilised. It can be produced by employing vermicultures such as *Eudrilus eugeniae*, *Eisenia fetida* and *Perionyx excavates* (Suryateja *et al*., 2022) [5]. The resultant compost is an organic fertilizer that contains carbon, nitrogen, phosphorus and sulphur, improves soil fertility and nutritional content, in addition to aiding detoxification of polluted soil (Kokila *et al*., 2022) [4].

Materials and Methods

1. Collection of Market wastes and Cow dung

Market waste (Vegetable market waste) was collected from Tirupattur district, Tamil Nadu, India and used as the substrate for developing vermicomposting process. Cow dung collected from a cattle farm from Tirupattur district, Tamil Nadu, India.

2. Collection of Earthworms

The earthworms belonging *Lambido maurtii* and *Eisenia foetida* collected from Department of Zoology, College of Basic Science and Humanities, Bangalore has been used for the study.

3. Treatment schedule for Composting

Market waste was composted following the slightly modified method and the materials were chopped with knife for about 5 to 10 cm. Initially the cow dung with 1 percent of the total volume of the substrate and at the rate of 5 bottles *Trichoderma resii* and 5 kg of urea for every tone of substance *viz*., Market wastes were added and allowed to decompose for two weeks. The water level was maintained around 50 %. Market waste alone (T_1); Market waste + Cow dung (T_2); Market waste + Cow dung + *Trichoderma resii* (T_3) and Market waste + Cow dung +*Trichoderma resii* + Earthworm (T_4). After partial degradation of wastes for about 2 weeks, vermicultures were inoculated (100/10 kg) and maintained for 60 days to complete the process. Moisture content (65 - 75 %) was maintained by turning twice a week to regulate the temperature.

4. 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) [7]. The pH,

electrical conductivity and organic matter were also analysed for all the treatment mixtures.

Results and Discussion

1. Physico- chemical properties of the Market wastes

The physico – chemical parameters of the organic waste were analysed before treatment with vermiculture and the results were presented in Table - 1.

Table 1: Physico-chemical properties of the Market wastes

Physico-chemical characteristics	Market waste	Nutrients	Initial percentage (%)
pH	7.3	N (%)	0.64
EC (C1:100 dsm^{-1})	0.84	P (%)	0.16
Organic matter (%)	50.20	K (%)	0.18
Carbon (%)	34.32	Fe (ppm)	61.00
Lignin (%)	5.40	Mn (ppm)	56.00
Cellulose (%)	29.64	Zn (ppm)	52.00
Hemicelluloses (%)	20.18	Cu (ppm)	6.00

2. Effect of Pretreatment on the pH of Composting

The pH value was studied for market waste composting and their results were presented in Table - 2. The pH value of the market waste was observed during the period of composting at 15 days, 30 days, 45 days, 60 days and 75 days. All the treatments Market waste alone (T_1), Market waste + Cow dung (T_2), Market waste + Cow dung + *Trichoderma resii* (T_3), and Market waste + Cow dung + *Trichoderma resii* + Earthworm (T_4) were almost in neutral condition and the pH was ranged from 6.8 to 7.2.

Table 2: Effect of pretreatment on the pH value during Market waste composting

Treatments	Sampling time in days					
	0	15	30	45	60	75
T_1	7.3	7.2	7.2	7.0	6.8	6.8
T_2	7.2	7.1	6.9	6.8	6.9	6.9
T_3	7.3	7.1	7.2	7.0	7.1	7.0
T_4	7.3	7.2	7.2	7.1	7.0	7.0

3. Effect of Pretreatment on the EC content during composting

The Electrical conductivities of market 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 market waste compost during the period of composting. There was only slight modification achieved during composting process. The treatments T_4, T_3, T_2 showed more or less same in EC i.e., 0.69 dsm^{-1}. On maturity, the EC content of original substrate was around 1, 21 and it was reduced about 45 % on maturity of compost.

Table 3: Effect of pretreatment on the EC content during Market waste composting

Treatments	Sampling time in days C1:100 dsm^{-1}					
	0	15	30	45	60	75
T_1	1.26	0.98	0.92	0.84	0.74	0.74
T_2	1.12	0.86	0.72	0.66	0.62	0.75
T_3	1.13	0.66	0.65	0.66	0.67	0.70
T_4	1.16	0.75	0.76	0.78	0.77	0.69

4. Effect of pretreatment on the Hemicelluloses content (%) during composting

The hemicelluloses content of the Market wasted taken on the study was 24.14 (T_1), 18.16 (T_2), 18.1 (T_3), and 18.18 (T_4) (Table - 4). Among the treatments, the percentage decreases in hemicelluloses were more in T_4 and recorded value of 51.86 it was followed by the treatments of T_3 and T_2.

Table 4: Effect of pretreatment on the Hemicelluloses content (%) during Market waste composting

Treatments	Sampling time in days						Percentage decrease after composting (%)
	0	15	30	45	60	75	
T_1	24.14	18.18	16.18	15.68	14.36	12.12	60.32
T_2	18.16	17.16	15.46	15.12	10.46	8.18	58.48
T_3	18.12	17.12	15.18	14.18	8.36	7.46	43.99
T_4	18.18	16.18	14.32	12.12	17.86	6.74	51.86

5. Effect of pretreatment on the Cellulose content during composting

The cellulose content of market waste treatment T_1 reported that 27.24, it was decreased with period of incubation. The treatment T_4 showed maximum reduction percent of 8.18 percent which was almost 44.32 percentages decreased. The treatments T_4 followed by T_3 and T_2 and the results were presented in Table - 5.

Table 5: Effect of pretreatment on the Cellulose content during Market waste composting

Treatments	Sampling time in days						Percentage decrease after composting (%)
	0	15	30	45	60	75	
T_1	27.24	24.18	24.14	23.32	22.10	21.12	53.32
T_2	27.58	24.17	20.18	16.64	11.48	10.16	50.68
T_3	27.56	24.08	19.68	14.64	10.68	9.64	46.48
T_4	27.64	24.04	18.10	13.32	8.40	8.18	44.32

6. Effect of pretreatment on the Lignin content during Market waste composting

The lignin content of market waste composting was presented in Table - 6. The initial content of market waste was 3.42 and it was decreased with period of incubation. The treatment T_4 showed maximum decreased percent of 0.96 which was almost 38.32 percentages decreased. The treatment T_4 was followed by T_3 and T_2.

Table 6: Effect of pretreatment on the Lignin content during Market waste composting

S. No	Treatments	Sampling time in days						% Decrease after composting
		0	15	30	45	60	75	
1	T_1	3.42	3.40	3.39	3.36	3.34	3.28	44.56
2	T_2	3.41	3.28	3.16	3.06	2.26	2.48	42.36
3	T_3	3.42	2.49	2.26	2.02	1.98	1.68	40.86
4	T_4	3.42	2.12	2.02	1.96	1.16	0.96	38.32

Initial pH 7.3 was brought down to 7.0 during 45 days period of earthworms. The results are in time with the findings of Garg *et al*. (2006) [2] 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 1.26 to 0.69 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) [1] 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_4 during market wastes compost. Similarly, there was increase in Nitrogen, Phosphorous and Potassium content was observed and the treatment T_4 recorded maximum value.

Conclusion

Results of the present study showed that the Vermicomposting process helps in the gradual decrease in the pH, Electrical conductivity, Cellulose, Hemicellulose and Lignin contents of the Market wastes. The effective recycling of the Market wastes through Vermicomposting plays a major role in the development of growth and yield of various agricultural crops. The nutritive value of Vermicompost material is high and the Vermicomposting process effectively converts the waste product into useful by-product.

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