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Conversion of Dye Soaked Dry Flower Industrial Waste into A Value Added Product Using Earthworm

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ABSTRACT

By adopting Vermi technology the dye soaked and chemically treated hard natured dry flower industrial waste, which became a major problem to the industrialists and one of the public nuisance to the people of Thoothukudi was converted into a value based bio-product, the vermin compost to some extent. This study was only a pioneer and hence a further improvement in the technology may improve this process a more successful one. In this experiment the hard mega sized dry flower industrial waste were pulverized into small pieces and mixed with cow dung in the ratio of 1:1 and 2:1 and earthworms were allowed to act on them. A separate control was maintained using cow dung and leaf litter. The process of vermi compost completed in the control on 80th day while in the treated, the process was preceded beyond 120days. The net compost obtained in control was 98.8% and in treated it was 85.7 and 62.08 in 1:1 and 2:1 ratio. The biochemical analysis also showed a remarkable alterations such as reduction of S, H and C/N ratio which are at the acceptable level by the plants.

Keywords: Vermitechnology, Dryflower Industrial Waste, Bio-conversation, Value added product, Earthworms.

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INTRODUCTION

Vermicomposting technology application helps in cost effective and efficient recycling of animal wastes, agricultural residues, industrial wastes[1] and also an appropriate technique for the safe treatment and reuse of non-toxic wastes by natural biodegradation[2, 3, 4]. As a process for handling organic residuals, it represents an alternative approach in waste management, in as much as the material is neither land filled nor burned but is considered a resource that maybe recycled. Vermicomposting is a simple biotechnological process of composting, in which certain species of earthworms are used to enhance the process of waste conversion and produce a better end product. Vermicomposting utilizes earthworms as bioreactors to biodegrade organic wastes to humus[5]. Substrates as solid wastes [6] derived from agro based and food processing industries and agricultural residues[7, 8, 9] have been tried for vermi composting. Cowdung[9, 10] has been employed as a medium substrate to initiate and acclimatize earthworms first to local conditions and then initiate vermicomposting of chosen industrial substrates. Earthworms are also known to contribute several kinds of nutrients in the form of nitrogenous wastes to the soil[11]. Researchers have enormous data supporting the viability of vermitechnology as a source of soil fertility [12,13,14] and as a means of waste management[15,16], disease suppression[17] and bio-remediation[18]. Vermiculture technology can be used for the management of wastes from agriculture, industries, kitchen and even aquatic weeds[19,20,21,22,23]. Various organic wastes tested in past as feed material for different species of earthworms include sewage sludges[24,25,26,27], water hyacinth[28,29,30,31], paper waste[32,33], crop residues[34], cattle manure[35,36,37], organic wastes[38,39,40,41], olive mill waste[36], rice stubbles, mango leaves[42] and textile mill sludge[43] and so on. The contribution of composting literature to each of these areas of interest is vast, but the scope for the literature review is limited to an industrial waste particularly dry flower industrial waste, and hence the present study was planned and in this work, the dry flower industrial wastes were mixed in different proportions with the cowdung and the vermicomposting was executed using earthworms.

MATERIALS AND METHODS

Preparation of vermibed

The earthworms (*Esieniafoetida*) were collected from Tamil Nadu Agricultural University, Killikulam and were maintained in the normal vermibed with required nutrient for multiplication and acclimatization. From this, the required number of worms were chosen and used for the experiment. The dry flower industrial waste materials used for this study include varieties of macro sized dye soaked materials which was pulverized roughly and then mixed with dried

cowdung powder in the ratio of 1:1 and 2:1 in a wide mouthed wooden container and was sprinkled with enough water and maintained for 7 days. Fresh cow dung was collected from a cattle yard near Thoothukudi, sun dried, powdered and used in this study. Then sufficient numbers of earthworms were introduced into the culture (one worm/100g). Each experimental container was maintained with 2 kg of bed material. The container was maintained in maintained inshady place. Water was sprinkled regularly to maintain required moisture. Triplicates were maintained for each composition of the study material. Separate Control was maintained using only cow dung and leaf litter (1:1). The earthworms introduced converted the industrial waste into the bio-fertilizer slowly but steadily.The results obtained from the two experimental set up was compared with the control numerically as well as statistically using the Excel software no 5.6. Student 't' test was employed to analyze the validity of the results obtained.

RESULTS AND DISCUSSIONS

The quantity of vermicompost obtained during the present study is well illustrated in Table 1. The earthworms converted the Control material very efficiently and the entire process was completed within 80 days and the total production of compost was 98.78%. When compared to the Control, the conversion efficiency of earthworms declined significantly to a greater extent in both the treated materials (1:1 and 2:1). In case of the studied experiments, the number of days utilized by the worms for the conversion process was extended upto 120 days and the total production of compost was also reduced significantly. The total composts obtained were 85.73 and 62.08% in 1:1 and 2:1 ratio respectively. By consuming the control materials as well as the treatment materials growth of the earthworm's also remarkably happened. Both length, weight and population of the earthworm were remarkably noted in all experimental set up. In the control group there was about 80% increase in 1:1 ratio bed and 45% increase in 2:1 ratio bed. Comparatively the 2:1 bed showed a poor performance in the growth and population of the earthworms (Table 2). The main emphasis of the present study was the conversion of the dry flower industrial waste, which is incorporated with high concentration of chemical dyes into useful, value added fertilizer and harvesting of cultured earthworms[44]. Normally the vermicomposting process is completed within 30-60 days, when using the organic wastes as the raw material[12,15,16,18]. But in the present study the time taken for the conversion was extended upto 120 days. This was mainly because of the hard nature of the materials used. The chemicals and dyes, which are incorporated with the materials, may further act as a hindrance to the worms. The macronutrients analysis (Table 3) of the vermicompost obtained in the present study showed

that the Hydrogen as well as the Sulphur content of the various trials significantly dropped to a greater extent than the H and S present in the raw material (Table 3). The drop in the H and S level in the present study may be an indication for the complete decomposition of the spent waste by the action of earthworms[45]. The Organic Carbon concentration of vermicompost obtained by direct treatment of dry flower industrial waste with earthworms was 24.417% in 1:1 treatment and 24.313% in 2:1 treatment. The reduction of Organic Carbon indicated that the earthworms rapidly multiplied in number and decomposing the organics. Similar type of results were observed by several authors in various study[3,21,46] in which various types of wastes were decomposed by earthworms. The direct vermicompost of raw material also showed an increased level of nitrogen and it was about 1.678% in 1:1, and it was about 1.417% in 2:1 material. The increase of total Nitrogen showed the good quality of the bio-compost obtained[21,46]. The earthworms used the carbon content present in the material as a source of energy and simultaneously, the Nitrogen present in them was recycled. During this process, the casting of earthworms in turn enriched the macronutrients such as N, P, K resulting in the conversion of the spent materials into a good organic fertilizer. All these activities stabilized the level of carbon and nitrogen in the compost. The C/N ratio of vermicompost treatment of waste was found as 13.955 in 1:1 ratio and 17.158 in 2:1 ratio (Table 3). As per the MSW standard, the C/N ratio of a fertilizer between 15 to 20:1 is considered as good compost. In the present study the compost obtained from raw material when treated with earthworm showed the expected percentage of C/N ratio. This indicated that the process of composting perfectly occurred in these two trials. Several previous workers executed vermicomposting using different types substrates also obtained more or less the same type of results [21,46].

Table 1: Quantity and percentage of Vermicompost obtained during different time intervals, using the raw dry flower industrial waste as substrate. The values indicated are the mean of three observations and ± SD.

Substrates	**0 day** (g)	**40thday**(g)	**60th day** (g)	**80thday** (g)	**100th day** (g)	**120th day** (g)	**Total% of compost obtained**	**Undigested material** (g)
Control	2000	682.33± 2.52 34.12%	994.33± 4.51 49.72%	294.33± 4.51 14.72%	-	-	1971± 11.54 98.78%	29.02±1.12 1.45%
1:1	2000	362.0± 7.55 18.1%	246.0± 12.00 12.3%	686.0± 6.56 34.3%	301.33± 12.22 15.07%	119.33± 9.02 5.97%	1714.67± 47.35 85.73%	280.67± 10.07 14.03%
2:1	2000	318.67± 6.51	205.67± 6.03	356.33± 8.50	276.33± 9.07	84.67± 8.39	1241.67 38.50	753.33± 5.51

	15.93%	10.28%	17.82%	13.82%	4.23%	62.08%	37.67%

All values are significant at 0.05% level.

1:1 – 1 Kg material: 1 Kg cow dung; 2:1 – 1.340 kg material : 660 g cow dung

Table 2: Growth performance observed among the Earthworms reared in various ratios of dry flower industrial waste. The values indicated are the mean of three observations and ± SD.

Substrates	Weight of bag(g)	Initial No.	Length (cm)			Weight (g)			Final number and% increased
			Initial	Final	Length gain(%)	Initial	Final	Weight gain(%)	
Control	2000	20	4.62± 0.24	6.14± 0.23	**32.90**	0.53± 0.02	0.74± 0.02	**39.62**	**36 80%**
1:1	2000	20	4.44± 0.24	5.46± 0.19	**22.97**	0.56± 0.02	0.72± 0.02	**28.57**	**36 80%**
2:1	2000	20	4.43± 0.20	5.34± 0.25	**20.54**	0.53± 0.03	0.62± 0.03	**16.98**	**29 45%**

All values are significant at 0.05% level.

Table 3: CHNS Analysis of direct vermicompost. The values indicated are the mean of three observations and ± SD. The values indicated in parenthesis are the percent decrease/increase of elements than in the raw material.

SUBSTRATES	S (%)	H (%)	C (%)	N (%)	C/N Ratio
Raw material	1.583±0.03	3.656±0.03	35.753±0.05	0.645±0.01	55.432±0.24
Control	0.130±0.005	0.716±0.01	23.022±0.01	0.798±0.01	28.853±0.40
2:1 of R.M. and C.D	0.855±0.01 (45.99)	1.254±0.02 (65.70)	24.313±0.08 (32.00)	1.417±0.006 (-478.76)	17.158±0.02 (69.05)
1:1 of R.M. and C.D	0.607±0.004 (61.66)	2.130±0.002 (41.74)	24.417±0.04 (31.71)	1.678±0.008 (-160.16)	13.955±0.09 (74.83)

All values are singnificant at 0.05% level. R.M. – Raw Material; C.D. – Cow Dung

CONCLUSIONS

In the present study, the researcher by using earthworms had converted the chemical and dye soaked dry flower industrial waste, which created an unhealthy environment in the production site and as a public nuisance into a valuable nutritious resource for the plants. When the study improved further, then it would be an easy and cost effective waste management for treating various kind of organic industrial waste.

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