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Nutrient Enrichment of Silkworm Rearing Waste Through Microbial Decomposing

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ABSTRACT

The efficacy of the different microbes *Trichodermaviridae, Pleurotus* sp. and *Paecilomyces* sp. were evaluated for decomposing the silkworm rearing waste (SRW). The samples were collected from all the treatments at 90, 120, 150, 180 days of decomposition and analyzed for organic carbon (OC), N, P, K, Ca, micronutrients (Fe, Mn, Cu and Zn) and bio-chemical components viz., cellulose and lignin. The rate of decomposition was faster when SRW (75 %) was mixed with FYM (25 %) and inoculated with different microbial cultures.The OC content in the compost reduced significantly over 90 to 180 days of decomposition among all the treatments. The compost harvested after 180 days of microbial decomposition of SRW (75 %) + FYM (25%) was found to have enriched with higher N (1.42 %), P (0.54 %), K (0.94 %), Ca (2.39 %), Fe (4865.47 ppm), Mn (446.60 ppm), Cu (94.48 ppm) and Zn (255.93 ppm). Apart from nutrient enrichment, the microbes, *T. viride* and *Paecilomyces* sp. found to be most effective in hastening the degradation of lignin and cellulose in the SRW that reduced was to 13.46 and 14.53 %, respectively.

Keywords Silkworm rearing waste (SRW), Microbial decomposition, Seri compost, Plant nutrientsutrient enrichment.

INTRODUCTION

Sericulture is a commercially sustainable farm based economic enterprise favouring rural poor in the unorganized sector because of its relatively low requirement of fixed capital and higher returns. India produces four different varieties of silks viz., Mulberry, Tasar, Muga and Eri, employing around 7,00,000 farm families in about 54,000 villages and they are depending on sericulture industry for their livelihood (https://www.indianmirror.com/indian-industries/silk.html).

Advent of modern technologies like high yielding varieties, chemical fertilizers, crop protection chemicals though helped in improving productivity, have adversely affected the soil health and resulted in eco-imbalance. In order to sustain productivity of exhaustive high yielding varieties, conserving natural resources and reviving soil health, replacement of chemical fertilizers with safe organic inputs is imminent. The nutrients contained in organic manures

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are released more slowly and stored in the soil for a longer period of time ensuring a prolonged residual effect. The soil microbial population is also improved and maintained at maximum levels (Kalaiyarasan *et al*. 2015).

The high yielding mulberry variety, Victory 1 (V_1) requires high input of inorganic fertilizers i.e., 350:140:140 kg of NPK per hectare per year along with 20 MT of FYM to exhibit its complete potentiality in terms of quantitative and qualitative parameters (Dandin *et al.* 2003). But, the availability of such a huge quantity of good quality organic manure is a great challenge. Hence, effective recycling of on-farm crop residues and convert into quality compost would be an appropriate possibility to meet the nutrient demand of the crop plants.

Compost is a stable product of bio-degradable organic wastes converted into humus by indigenous micro-flora found in nature using a simple technique. The nature of compost vary widely and depends on the nature of feedstock and its nutrient content, composting process, time of composting, method of composting. Composting can be defined as the process where in controlled biological decomposition of organic residues is achieved under optimum conditions of temperature, moisture and aeration (Devika *et al*. 2019). The organic residues of any crop can be utilized for preparing quality compost. In sericulture, the silkworm rearing generates lot of wastes comprising of organic matter like larval excreta, waste twigs, leaf litter, dead larvae, pupae, and cocoons (Kamili and Mosoodi 2000), as they are quite easy to collect and utilize for composting.

Potentiality of recycling and utility of seri-wastes

All sericulture wastes can be converted into compost rich in nutritive value. The rearing of silkworms conducted by utilizing one hectare of mulberry generates approximately 25 MT of seri-farm residues per year, which could be recycled in the farm itself for converting into high quality compost with more plant required elements and it is found to be much superior compared to farmyard manure (Kalaiyarasan *et al.* 2015). An estimate of convergence cost of seri-farm residues possess with assured cost benefit ratio upto 1:3.5 based on various composting methods can be obtainable (Christiana *et al.* 2008). Thus, effective recycling of seri-farm residues can induce economic feasibility with better cost benefit ratio apart from improving the soil fertility status.

The seri-wastes though serve as potential feedstock for quality compost preparation, these waste materials mainly consist of mulberry shoots having about 50-60% cellulose, 10-20% lignin and conspicuous quantity of hemicelluloses that take more than a year for complete decomposition under natural condition. Hence, there is a need to find an ecofriendly and cost effective method of decomposition of these hard materials in a short span of time (Nishitha Naik *et al*. 2013).

The microbes like *Pleurotus, Trichoderma, Aspergillus, Azotobacter,* produce the enzymes like cellulases, hemicellulases, proteases and α-1, 3-glucanases which degrades complex substrates (Keswani *et al.* 2013) and also release growth hormones and antibiotics viz., gibberellic acid, indole 3-acetic acid and abscisic acid (Hassanein 2012) essential for plant growth and development. As the species of *Bacillus, Pseudomonas, Trichoderma* and *Verticillium* are also known to be the potential bio control agent of plant diseases, the compost enriched with these microbes are effective in managing the soil borne diseases of mulberry. With this background, a study was conducted at farmer's field to examine the efficacy of three different micro organisms viz., *Trichoderma viridae, Pleurotus* sp. and *Paecilomyces* sp. to decompose seri-waste and recovery of the plant nutrients and organic carbon to the soil.

MATERIALS AND METHODS

The experiment was conducted at farmer's field at Bommavara village, Devanahalli taluk, Bengaluru Rural District, which is situated at an altitude of 13° 13' 57" North, 77° 41' 57" East receiving an average annual rainfall of 732 mm.

Collection of materials for composting: A total of 300 DFLs were reared by the farmer at a time and the silkworm rearing wastes including litter, left over leaf, twigs and other bed wastes were collected from the farmer's rearing house. The organic wastes viz., FYM and cow dung were also collected at the same premises.

Microbial consortium: The microbial cultures of *Trichoderma viridae, Pleurotus* sp. and *Paecilomyces* sp. for decomposing the seri-waste were collected from the Department of Agricultural Microbiology, UAS, GKVK, Bangalore 560065.

Method of composting: Compost pits measuring 1 m × 1 m × 1 m were dug (Singh and Sharma 2003) and the seri-waste along with FYM and cow dung were weighed according to the treatment and filled in the pit layer by layer. Respective microbial cultures with the microbial population of 1×107CFU/g (Gupta *et al.* 2009) were inoculated as per the treatment. The pits were covered on the top by soil and watered at regular interval to maintain the moisture.

Treatment details**:**

Treat-ments	Treatment details
T_1	100% Silkworm Rearing Waste (SRW)
T_2	100 % SRW + *Trichoderma viridae*
T_3	100 % SRW + *Pleurotus* sp.
T_4	100 % SRW + *Paecilomyces* sp.
T_5	75 % SRW + 25 % FYM
T_6	75 % SRW + 25 % FYM + *T. viridae*
T_7	75 % SRW + 25 % FYM + *Pleurotus* sp.
T_8	75 % SRW + 25 % FYM + *Paecilomyces* sp.
T_9	50 % SRW + 50 % FYM
T_{10}	50 % SRW + 50 % FYM + *T. viridae*
T_{11}	50 % SRW + 50 % FYM + *Pleurotus* sp.
T_{12}	50 % SRW + 50 % FYM + *Paecilomyces* sp.
T_{13}	Regular FYM

Collection of the sample: The samples from all the treatments were collected at 90, 120, 150, 180 days of decomposition (Thompson *et al.* 2002). Each sample was a composite of three subsamples drawn from different depths along the pile and analyzed for chemical components like, organic carbon, N, P, K, Ca, micronutrients (Fe, Mn, Zn and Cu) and bio-chemical components viz., cellulose and lignin. The data were analyzed using RCBD.

Analysis of seri-waste compost: The collected samples of seri-waste compost were analyzed for various characters as per standard procedure.

Methods adopted for sample analysis.

Nutrient	Method
Organic carbon (OC)	Dry combustion method (Jackson 1973)
Nitrogen (N)	Kjeldahl method (Piper 1966)
Phosphorus (P)	Vanadomolybdic Yellow olor method (Piper 1966)
Potassium (K)	
Calcium (Ca)	Flame photometer (Piper 1966)
Manganese (Mn)	Atomic absorption spectrophotometry
Copper (Cu)	(Lindsey and Norwell 1978)
Zinc (Zn)	
Cellulose	
Lignin	(Sadasivam and Manickam 1996)

RESULTS AND DISCUSSION

Organic carbon (OC): The OC content of compost harvested from different treatments found to decrease over a period of time from 90 to 180 days in all the treatments (Table 1). The highest OC content (41.33%) was observed when used only silkworm rearing waste (SRW) (T_1) for composting at 90 days interval, while it reduced to 31.45 % after 180 days. Among the other treatments, the compost harvested from decomposition of SRW (75 %) + FYM (25 %) enriched with *Pleurotus* sp. (T_7) showed least OC content after 90 and 180 days (33.70 and 22.35 %,respectively) and that was on par with T_6 – 75 % SRW + 25 % FYM and inoculated with *T.viridae* (22.37

Table 1. Organic carbon (OC) content of silkworm rearing waste compost as influenced by various microbes at different intervals.

	Organic carbon content at different intervals (%)			
Treatments	90 days	120 days	150 days	180 days
T_1	41.33	37.90	33.54	31.45
T_2	40.27	36.41	31.23	30.09
T_3	39.70	34.66	30.59	29.56
T_4	39.57	36.18	29.29	26.47
T_5	37.67	32.32	30.12	27.30
T_6	38.40	31.42	27.85	22.37
T_7	33.70	30.54	25.62	22.35
T_8	37.20	33.75	25.30	22.97
T_9	35.77	32.98	28.59	25.25
T_{10}	35.60	34.05	29.17	26.52
T_{11}	36.13	33.40	30.94	28.43
T_{12}	34.17	30.54	27.46	24.56
T_{13}	34.50	31.22	26.53	23.67
SEm ±	0.222	0.181	0.209	0.203
CD at 5%	0.647	0.527	0.610	0.594

Table 2. NPK content of silkworm rearing waste compost as influenced by various microbes at different intervals.

Treatments	NPK content of the compost at different intervals (%)											
	90 days			120 days			150 days			180 days		
	N	P	K	N	P	K	N	P	K	N	P	K
T_1	0.08	0.02	0.09	0.40	0.10	0.10	0.73	0.14	0.11	1.00	0.22	0.12
T_2	0.24	0.05	0.21	0.55	0.12	0.27	0.87	0.16	0.29	1.18	0.30	0.32
T_3	0.25	0.11	0.26	0.70	0.18	0.28	1.07	0.21	0.28	1.26	0.35	0.29
T_4	0.28	0.03	0.16	0.52	0.07	0.25	1.09	0.16	0.29	1.29	0.25	0.32
T_5	0.72	0.27	0.32	0.82	0.32	0.41	1.01	0.35	0.47	1.31	0.42	0.49
T_6	0.61	0.36	0.44	0.86	0.42	0.53	1.16	0.45	0.73	1.38	0.52	0.94
T_7	0.47	0.16	0.41	0.76	0.22	0.45	0.79	0.23	0.49	1.26	0.29	0.67
T_8	0.74	0.37	0.19	0.97	0.44	0.25	1.19	0.48	0.29	1.42	0.54	0.46
T_9	0.55	0.22	0.20	0.78	0.26	0.25	1.16	0.39	0.31	1.27	0.41	0.43
T_{10}	0.35	0.09	0.18	0.67	0.15	0.19	1.03	0.18	0.21	1.21	0.28	0.30
T_{11}	0.40	0.15	0.32	0.75	0.24	0.37	1.03	0.33	0.40	1.27	0.40	0.42
T_{12}	0.55	0.22	0.25	0.93	0.24	0.26	1.19	0.39	0.29	1.37	0.45	0.30
T_{13}	0.28	0.15	0.34	0.48	0.19	0.39	0.78	0.25	0.45	1.05	0.28	0.52
SEm ±	0.011	0.012	0.013	0.013	0.013	0.011	0.092	0.016	0.014	0.011	0.015	0.010
CD at 5%	0.033	0.034	0.038	0.037	0.038	0.032	0.269	0.046	0.041	0.032	0.044	0.028

T: Treatments, N: Nitrogen, P: Phosphorus, K: Potassium.

%) after 180 days of inoculation.

Nitrogen (N): The highest N containing compost was estimated after 180 days by decomposing SRW (75 %) along with 25% FYM and inoculation of *Paecilomyces* sp.(1.42 %) (T_8) and *T.viridae* (1.38 %) (T_6). The compost sampled from the pit containing only seri-waste without any microbial inoculants showed least quantity of N (1.00%) (T_1). Among different inoculants used in the experiment the N content was higher when decomposed with *Paecilomyces* sp. at all the durations followed by *T. viridae* (Table 2).

Phosphorus (P): The phosphorus content increased gradually along with days of decomposition of SRW, which was evident among all the treatments (Table 2). Highest quantity of P was recovered when SRW (75%) and FYM (25%) was decomposed inoculating with *Paecilomyces* sp. (0.54 %) and *T. viridae* (0.52 %) after 180 days (T_8 and T_6, respectively).Irrespective of the organism used, the least P content was witnessed from decomposition of only SRW (100 %) (0.22 %) (T_1).

Potassium (K): The amount of K recovered from the samples found to increase as the days of decomposition increased (Table 2). A significantly higher was the K content in the treatment where seri-waste (75 %) was composted along with FYM (25%) enriching with *T.viridae* (0.44, 0.53, 0.73 and 0.94 %, respectively) and *Pleurotus* sp. (0.41, 0.45, 0.49 and 0.67 %, respectively), after 90, 120, 150 and 180 days, respectively. The quantity of K was least in the compost prepared using 100% SRW (0.09, 0.10, 0.11 and 0.12 %, after 90, 120, 150 and 180 days, respectively).

Calcium (Ca): The Ca content marked an increasing trend gradually from 90 to 180 days of decomposition among different treatments (Fig. 1). The compost harvested by composting SRW using 25% FYM inoculating with different microbes had highest Ca content after 180 days among all treatments and specifically inoculation with *Pleurotus* sp. (2.39 %) (T_7) and *T.*

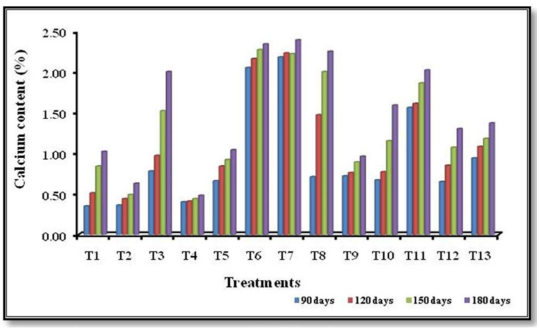

Fig. 1. Enrichment of calcium in the sericulture waste compost as influenced by various microbes at different intervals.

Table 3. Enrichment of different micro nutrients in the silkworm rearing waste compost as influenced by various microbes at different intervals.

Treatments	90 days				120 days			
	Fe	Mn	Cu	Zn	Fe	Mn	Cu	Zn
T_1	3444.17	106.13	10.50	48.54	3648.23	119.63	11.23	47.44
T_2	3702.60	194.90	25.47	32.61	3912.73	284.40	35.42	54.13
T_3	3758.13	214.07	17.10	40.59	3998.03	308.03	29.70	108.34
T_4	3552.93	272.00	25.10	45.84	3826.63	282.20	30.26	49.20
T_5	3747.27	320.50	39.97	119.95	3953.40	374.70	50.40	122.51
T_6	3839.17	421.93	51.52	176.33	4093.50	439.03	55.48	189.12
T_7	3706.67	384.40	41.68	172.20	3891.97	422.53	44.30	184.08
T_8	3782.33	250.57	40.33	98.22	3992.43	389.34	42.10	102.72
T_9	3474.40	284.57	38.22	51.99	3846.30	308.43	39.01	59.28
T_{10}	3514.60	121.17	15.59	51.59	3826.30	226.83	22.75	49.34
T_{11}	3912.67	350.77	32.96	68.32	4219.17	410.43	41.92	72.35
T_{12}	3806.83	224.33	27.92	64.97	4165.80	380.41	72.21	65.15
T_{13}	3700.80	283.70	32.39	60.63	4048.50	374.63	37.63	88.58
SEm ±	1.497	1.518	0.216	0.782	1.242	1.191	0.229	0.388
CD at 5%	4.369	4.431	0.629	2.284	3.624	3.476	0.668	1.133

Table 3. Continued.

Treatments	150 days				180 days			
	Fe	Mn	Cu	Zn	Fe	Mn	Cu	Zn
T_1	3926.46	119.63	11.23	48.17	4171.37	125.83	12.73	49.33
T_2	4245.70	284.40	35.42	79.81	4659.73	321.30	40.66	98.26
T_3	4252.80	308.03	29.70	192.56	4691.10	357.07	34.50	203.29
T_4	4146.37	282.20	30.26	52.70	4564.33	292.03	33.34	53.62
T_5	4482.50	374.70	50.40	158.58	4674.87	393.50	57.26	194.47
T_6	4511.80	439.03	55.48	196.48	4786.03	446.60	57.53	255.93
T_7	4371.37	422.53	44.30	188.46	4695.63	446.57	46.23	204.35
T_8	4419.33	389.34	42.10	109.45	4681.40	408.50	43.75	116.42
T_9	4189.57	308.43	39.01	67.47	4475.93	314.60	39.26	80.65
T_{10}	4241.67	226.83	22.75	52.67	4507.90	271.21	24.42	57.43
T_{11}	4624.93	410.43	41.92	79.57	4865.47	443.40	46.73	86.00
T_{12}	4587.97	380.41	72.21	67.96	4736.60	412.70	94.48	69.10
T_{13}	4490.33	374.63	37.63	101.29	4624.17	404.81	40.82	115.47
SEm ±	1.259	1.191	0.229	0.272	1.292	1.086	0.186	0.211
CD at 5%	3.675	3.476	0.668	0.794	3.771	3.171	0.544	0.615

viridae (2.34 %) (T_6) showed highest Ca content in the compost. The least was when SRW (100 %) was decomposed using the inoculants, *Paecilomyces* sp. (0.48 %) (T_4).

Micronutrients: The growth and development of a plant requires several elements. However, not all are required in the same quantities. Micronutrients viz., Iron (Fe), Manganese (Mn), Copper (Cu) and Zinc (Zn), though required in minute quantities, play a major role in productivity of quality biomass in crop plants as well as plant's defense mechanism. It is observed that these micronutrients can be made available to the plants through eco-friendly nutrient supplements like organic manures i.e., compost, vermin compost. Sericulture waste being an excellent source for obtaining several essential nutrients could be a potential feedstock for preparing quality compost.

Iron (Fe): The Fe content different significantly among different treatments of which the compost extracted from T_{11} yielded highest quantity during all the intervals. Highest Fe enrichment was observed in the compost harvested by decomposing 50 % SRW + 50 % FYM and inoculation of *Pleurotus* sp. (4865.47 ppm) after 180 days. The least quantity of FE was

Table 4. Cellulose and lignin content of silkworm rearing waste compost as influenced by various microbes at different intervals.

Treatments	Cellulose and lignin content at different intervals (%)							
	90 days		120 days		150 days		180 days	
	Cellulose	Lignin	Cellulose	Lignin	Cellulose	Lignin	Cellulose	Lignin
T_1	24.11	29.43	23.54	25.50	20.93	20.36	19.33	18.50
T_2	20.99	22.34	19.45	19.22	17.02	17.69	15.63	16.43
T_3	22.26	23.38	19.52	21.33	17.31	20.35	15.85	18.24
T_4	23.53	28.72	20.28	22.79	18.32	18.51	16.81	15.53
T_5	23.17	27.49	19.45	23.41	16.68	19.33	14.37	16.72
T_6	20.45	25.41	19.01	22.53	16.67	20.41	13.96	15.28
T_7	20.19	20.49	18.60	18.29	16.53	16.35	13.46	14.53
T_8	21.52	25.62	19.40	22.46	17.34	17.46	14.63	15.24
T_9	21.08	24.69	19.72	21.56	16.89	16.81	14.78	14.97
T_{10}	23.06	23.14	19.65	20.55	17.33	17.32	15.35	15.53
T_{11}	22.15	22.43	20.43	21.55	16.62	18.27	14.36	16.26
T_{12}	21.56	21.28	18.32	19.11	16.50	17.46	15.03	15.37
T_{13}	23.23	26.52	19.52	24.45	17.81	19.60	16.30	16.48
SEm ±	0.336	0.184	0.283	0.190	0.321	0.154	0.311	0.074
CD at 5%	0.982	0.536	0.825	0.554	0.938	0.449	0.908	0.217

observed in the compost where only SRW was used as feedstock for compost preparation at all durations (Table 3).

Manganese (Mn): The Mn content in the compost varied from 106.13 to 446.60 ppm at different durations of composting and among different treatments. Highest quantity of Mn was recorded when SRW (75 %) was composted along with FYM (25 %) and enriched with *T. viridae* (446.60 ppm) and *Pleurotus* sp. (446.57 ppm) after 180 days and it was least in T_1 when neither FYM nor microbes were added during decomposition (Table 3).

Copper (Cu): The Cu content in the compost harvested from different treatments exhibited a peculiar trend. The quantity of Cu recovered was least from composting with 100% SRW during all the intervals viz., 90 (9.51 ppm), 120 (10.50 ppm), 120 (11.23 ppm) and 150 (12.73 ppm) days of composting. But, the percent recovery of Cu increased when SRW was mixed with FYM and enriched with different microbes at all durations of decomposition. The decomposition of SRW with 25 % FYM recorded highest at all durations when inoculated with *T. viridae* (51.52 ppm on 90th day to 57.53 ppm on 150 days of composting). When the quantity of FYM was increased to 50 %, the decomposition with *Paecilomyces* sp. recorded highest Cu content in the compost that increased from 27.92 on 90th day to 94.48 ppm on 150 days of decomposition while it was least with inoculation of *T. viridae* on all the intervals (Table 3).

Zinc (Zn): A relative increase in the Zn content has been noticed whenever FYM was also used in decomposition of SRW. The zinc content recorded highest at 90, 120, 150 and 180 days of decomposition in the treatment T_6 (75% SRW + 25% FYM enriched with *T. viridae*) that was 176.33, 189.12, 196.48 and 255.93 ppm, respectively, followed by $T_7$where composting was carried out using 75 % SRW+ 25 % FYM inoculated with *Pleurotus* sp. (172.20, 184.08, 188.46 and 204.35 ppm, respectively on different intervals). The composted harvested from the decomposition of only SRW yielded minimal quantity of Zn compared to all other treatments (Table 3).

Cellulose: The cellulose is a polysaccharide difficult to degrade. However, the cellulose content in the organic waste decreased significantly upon decomposition using different microbes. Significantly lesser content of cellulose was observed at 90, 120,150 and 180 days after composting (Table 4). Among the three microbial inoculants, decomposition of 75% SRW with 25% FYM along with inoculation of *T. viride* (13.96%) (T_6) and *Pleurotus* sp. (13.46%) (T_7) yielded least amount of cellulose in compost after 180 days, while it was highest in the absence of microbes,viz., FYM (16.30 %) (T_{13}) and without microbe SRW (19.33 %) (T_1).

Lignin: The lignin content was least at all the intervals (90, 120, 150 and 180 days) of composting of SRW when decomposed along with FYM and microbes (Table 4). T_7 (75 % SRW + 25 % FYM + inoculation of *Pleurotus* sp. exhibited least quantity of lignin in the compost estimated on 90, 120, 150 and 180 days (20.49, 18.29, 16.35 and 14.53%, respectively) of composting while it was highest in T_1 with 100 % SRW without inoculation of any microbes, 20.36 and 18.50% when estimated after resulted in high lignin content of 29, 43, 25, 50, 20. 36 and 18.50% when estimated after 90, 120,150 and 180 days, respectively

The inoculation of microbes hastened the decomposition process and enriched the compost with plant nutrients such as N, P, K, Ca and micronutrients like Cu, Mn, Fe and Zn (Terman *et al.* 1973, Gupta *et al.* 2009 and Gaur *et al.* 1982). The application of cellulolytic fungal isolates viz., *Trichoderma* sp., *Penicillium* sp., *Aspergillus* sp., *Paecilomyces* sp., *Rhizopus* sp. and their consortia significantly accelerated the rate of decomposition of the compost showing a marked decrease in C:N ratio upto 16.3. The rate of decrease in the OC was highest at 90 days of decomposition that decreased gradually later upto 180 days; with a proportionate increase in N content of the compost that was also observed by Dhapate *et al.*(2018) in their study.

The increase in N content during composting might be a direct manifestation of loss in the mass and carbon of the organic wastes and the microbial protein (Goyal *et al.* 2005) that corroborates the present investigation. An integrated system of composting with bio-inoculants like *Pleurotus sajor-caju*, *Trichoderma harzianum* and *Azotobacter chroococcum* in different combinations and recorded P content of 0.20 % which increased significantly during pre-decomposition with inoculants because of mineralization of organic matter (Singh and Sharma 2003). The P solubilizing bacteria viz., *Azotobacter* and *Aspergillus* increase the available P content in the city compost (Shinde *et al*. 1985). The K content in the seri-compost was maximum (0.30-0.50%) when enriched with the fungal species of *Pleurotus florida* and *P. ostreatus* apart from hastening the decomposition process (Nishitha Naik *et al*. 2013 and Gupta *et al*. 2009). The studies on decomposition of SRW along with FYM and different micro organisms indicated that the micro biome aided decomposition of SRW not only increases major nutrients, but also the microelements required for plant growth and development. Nishitha Naik *et al.* (2013) and Gupta *et al.* (2009) also recorded high amount of micronutrients viz., Mn, Cu and Zn when composted SRW with *Pleurotus* sp.

The dry organic wastes that include crop residues take a very long time to decompose, which is mainly due to the presence of higher quantity of lingo-cellulose compounds. However, from the studies on decomposition of coir dust, olive pomace, waste mulberry twigs, showed drastic reduction of cellulose in coir dust (25.6 to 10.1%) and lignin (30 to 4.80 %) content when inoculated with *Pleurotus* sp. (Nagarajan *et al.* 1985, Cortez *et al.* 1996) and *Trichoderma harzianum* and *Phanerochaetechryso sporium* (Malik Haddadin *et al*. 2009) during composting, which is evident in the present investigation where cellulose (24.11 to 13.96 %) and lignin (29.43 to 14.53 %) exhibited similar hunt. The analytical reason is that microbes produce ligninolytic enzymes into composting material which enhances the degradation of lignin and cellulose materials (Feng *et al.* 2011).

CONCLUSION

The micro-organisms play a vital role in degradation of complex organic compounds like lignin, cellulose through enzymatic degradation. The major enzyme cascades includelaccases, peroxidases, that act on higher molecular weight compounds and convert them into available form of NPK. Further, the carbon consumption of microbes reduces the organic carbon thereby reducing the C:N ratio. It is evident from the experiment that major constituents of silkworm rearing waste viz., Nitrogen, Phosphorus, Potassium and Calcium increases significantly from 90 to 180 days of decomposition. As inoculation of microbes hastened it improves the decomposition process and enriches the compost by enhancing the nutrients with the conversion of organics.

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