ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Physico-chemical examination of market wastes – An aerobic composting study

T Janakiram* and K Sridevi

Kurinji College of Arts and Science, Tiruchirappalli - 620002,Tamil Nadu, India.

ABSTRACT

Solid waste disposal is an acute problem faced by big towns, municipalities and corporations in various parts of India and around the world. Solid waste manifests in different forms. The markets in various places dump vegetable and fruit wastes. It has been the desire of the authors to collect such solid wastes and convert them into useful organic manure by means of composting. The physical and chemical characteristics of the compost are determined so as to enable the farmers to effectively apply the organic manure. Such studies revealed that excepting pH and organic carbon all other parameters like percentage of nitrogen, phosphorous, potassium, magnesium, sodium, calcium, moisture content, and C/N ratio water holding capacity have been found to increase as days of composting prolonged suggesting that an effective manure can be obtained by extending the time of composting.

Key words: Aerobic composting, fruit waste, vegetable waste, increased period of composting, organic manure

**corresponding author*

ISSN: 0975-8585

INTRODUCTION

Composting is the controlled biological decomposition and conversion of solid organic material into a humus like substance called compost. Composting of agricultural and domestic waste is increasingly used to reduce its weight and volume and to improve the properties for its use as soil amendment [1].Incineration, aerobic composting vermi composting and landfill method are some of the methods of disposing solid wastes. Previous studies reveal that aerobic composting gives better results [2].

Hence the present study has been attempted,

(1) To compost the fruit and vegetable wastes
(2) To determine the physical and chemical parameters of the compost prepared after a period of thirty and sixty days
(3) To interpret the results

MATERIALS AND METHODS

Cauliflower waste, cabbage waste, orange waste and pineapple waste had been collected from one of the city markets located at chinthamani, Tiruchirappalli city, Tamil Nadu. Individual and mixture of vegetable as well as fruit wastes had been subjected to composting by mixing with cowdung in the ratio 1:1 (weights being in kg). Physical and chemical parameters of the samples were measured prior to composting and after a period of 30 and 60 days of composting.

Composting was carried out in plastic tubs (20x40 cm). Slurries of cowdung mixed with wastes were taken in the tube and allowed to compost. The contents were moistened once in a week to maintain optimum moisture content.

pH and electrical conductivity of the composted materials were measured using pH meter and conductivity meter respectively by preparing a suspension of 20 g of the material in 100 ml of deionised water. Flame photometer was used for the determination of the total sodium and potassium. The percentage of phosphorous was determined with the help of a photoelectric colorimeter.

Estimation of nitrogen, calcium, magnesium and organic carbon was carried out by standard methods. In addition, the parameters like bulk density (BD), moisture content (MC) and water holding capacity (WHC) were evaluated by the usual methods.

RESULTS

Individual vegetable wastes, mixed vegetable waste, individual fruit wastes and mixed fruit waste were taken for the study. Each one of the wastes was mixed with cowdung in the

ratio 1:1 by weight. The description of the samples used for investigation had been indicated below. Cauliflower waste and cowdung constitute sample 1, cabbage waste and cowdung constitute sample 2, mixed cauliflower and cabbage waste with cowdung constitute sample 3, orange waste and cowdung constitute sample 4, pineapple waste and cowdung constitute sample 5, and mixed orange and pineapple waste with cowdung constitute sample 6.

In each case physical and chemical parameters were determined prior to composting and after a period 30 and 60 days of composting. In table 1, the values of physical parameters of the samples 1 and 3 were given. The corresponding chemical parameters were tabulated in 4 and 6.

The values of physical parameters for samples 4,5 and 6 were presented in table 3. The corresponding chemical parameters were given in table 4.

An examination of the physical parameters of all the samples studied had indicated an increase in their values as the period of composting increased.

As for as chemical parameters were concerned, increase in the values had been observed for all except for pH and organic carbon and C/N ratio. The interpretation of the results had been discussed.

DISCUSSION

Bulk Density and Moisture Content

Bulk density has been found to increase in the case of all samples as the days of composting increased (Tables 1 and 3). This indicates that during the composting process microbial activities broke down the loosely combined raw materials into smaller pieces of degraded material resulting in an increase of bulk density [3]. Moisture content of the composting blend is an important environment al variable as it provides a medium for the transport of dissolved nutrients required for the metabolic and physiological activities of microorganisms [4] . Moisture content has been found to increase as the time of composting prolonged. This may help enzyme activities and microbial respiration of the composting process [5].

Water holding capacity

Water holding capacity is the amount of water held into pores after gravitation loss for a specified time. This test is assessed to find the utilization of compost for growing media. In the study carried out water holding capacity has been observed to increase. This reveals that the amount of water held in pores increases with days of composting.

pH

pH gives a measure of acidic or basic nature of the compost as composting progresses. There is a decrease in pH as composting is lengthened in all the samples. With the advancement of composting process the decrease in pH of the compost has been observed, which can be attributed to the production of CO_2, simple organic acids and loss of nitrogen [6].

Electrical Conductivity

The electrical conductivity in matured aerobic compost increased as the days progressed. These high values could be due to the effect of the concentration of salts as a consequence of degradation of organic matter[7].

Nitrogen, Phosphorous, Sodium and Potassium

The essential elements for the growth of any plant are nitrogen phosphorous, sodium and potassium. All these elements play a significant role if used in the form of a manure (or) fertilizer.

The rise in total nitrogen level during maturation phase could possibly be due to concentration effect caused by strong degradation of labile organic carbon compounds which reduces the weight of composting materials [8].

Phosphorous content gradually increases during composting process. The water solubility of phosphorous decreases with humification so that phosphorous solubility during the decomposition was subjected to further immobilization factor [9].

Potassium increases during the period of composting. Effective use of some fibrous material like straw or wood chips which can absorb relatively large quantities of water and still maintain structural integrity and porosity could prevent the loss of potassium from the compost formed [10].

Calcium and magnesium

$Ca+^2$ and $Mg+^2$ enhance the chelation ability in soil solution effectively. The enrichment of the exchange complex in Ca^{2+} and $Mg+^2$ can be particularly relevant in the reclamation of saline sodic soils, since it could decrease the proportion of Na+ in the exchange complex improving soil physical properties [11].

C/N Ratio

The C/N ratio of plant biomass is a determining factor for its degradation and a low C:N ratio during the initial decomposition phase causes mainifold increase in the decomposition

rate. During composting C/N ratio decreased further due to microbial activity and overall weight loss of substrate [12].

The following points are evident if we examine the values of various parameters in all the six samples. With regard to values at initial, after 30 and 60 days of composting, bulk density ranges from 0.1175 to 0.3470kgm$^{-3.}$ As far as moisture content is concerned the percentage increases form 11.58 to 18.42. With regard to water holding capacity the range is in between 11.39 to 44.74 %. The pH has been found to vary between 4.61 to 8.32, while the electrical conductivity varies between 4.82 to 9.82 dSm^{-1} . With respect to organic carbon there is an increase form 7.9 to 16.5. In the case of nitrogen the value changes from 0.54 to 0.98 % For phosphorous the range is between 0.213 to 0.495 while for potassium it is in the range 0.212 to 0.724 % .As far as sodium, calcium and magnesium are concerned the values range from 0.272 to 0.527, 0.273 to 0.602 and 0.272 to 0.49 respectively. The C/N ratio is in the range 11:1 to 30:1. In the case of nitrogen, phosphorous, potassium, sodium, calcium, and magnesium the increase in the values as the days of composting increased suggest that the compost prepared can act as a manure.

This is evident also from C/N ratio. The values of the various parameters have been compared for the composted samples after 60 days. It has been observed that among the six samples the maximum percentage of nitrogen potassium and sodium is found for sample 1 and the maximum percentage of phosphorus is found in sample 2. The least C/N ratio has been observed in the case of sample 3. These results indicate that sample 1 can function as the best manure among the six in terms of nitrogen phosphorous potassium and sodium while C/N ratio suggest that sample 3 can function as a effective manure.

In order to find out how effectively the composts prepared can function as organic manures, the growth parameters have been studied after a period of 30 days by utilizing each of the samples as manures in the growth of tomato plant. The results obtained are tabulated (Table). The six samples used are denoted as T1, T2, T3, T4, T5 and T6. respectively, where T refers to treatment.

On account of the increased cost of mineral fertilizers, it has been a desire of the writers to see the effectiveness of the compost prepared from fruit waste and vegetable waste as an organic manure. Hence the compost obtained as a test measure have been applied to matoplant to study the growth parameters. A control experiment is also performed. It has been found that the values of growth parameters such as number of leaves per plant, plant height, number of side branches, length of the root and stem dream meters are the highest in the case of the composts prepared from vegetable waste when compared to fruit waste compost and control.

Mixed vegetable waste compost also shows greater growth parameter when compared to others.

ISSN: 0975-8585

Anova has been performed between days and between treatments for physical and chemical parameters. It has been observed from Tables 6,7,8 & 9. That the results differ significantly with respect to physical parameters in terms of days and in terms of treatments. In each parameter 60^{th} day mean is maximum.

In the case of chemical parameters the results differ significantly with respect to days. However significant differences with respect to treatments have been observed for all except total phosphorous, total potassium and total sodium.

Duncan test reveals that treatment I has maximum value for bulk density, potassium, sodium and organic carbon. For electrical conductivity, phosphorous and calcium.

Treatment 2 has maximum value. Treatment 3 has maximum value for Mg. nitrogen has maximum value in treatment 4. moisture content, water holding capacity and PH have maximum value in treatment 6.

TABLE-1 PHYSICAL PARAMETERS FOR THE SAMPLES STUDIED

S.No	Parameters	Sample 1 (days)			Samples 2 (days)			Sample 3 (days)		
		0	30	60	0	30	60	0	30	60
1	Bulk density x 10-3(kgm-3)	0.3027	0.3126	0.3470	0.2317	0.2418	0.2878	0.2252	0.2311	0.2572
2	Moisture content (%)	15.32	16.73	17.59	11.58	12.76	14.32	12.73	13.78	15.03
3	Water holding capacity(%)	11.37	12.07	15.30	15.50	16.72	18.23	10.94	11.73	13.52

TABLE – 2 CHEMICAL PARAMETERS FOR THE SAMPLES STUDIED

S.No	Parameters	Sample 1 (days)			Samples 2			Sample 3		
		0	30	60	0	30	60	0	30	60
1	pH	5.72	5.21	5.01	6.75	5.98	5.52	6.61	5.97	5.64
2	Electrical conductivity (dsm^{-1})	7.31	7.92	8.27	9.37	9.52	9.82	8.79	7.82	8.47
3	Total organic carbon (%)	16.3	15.8	14.5	11.5	10.9	10.2	9.8	8.5	7.9
4	Total Nitrogen (%)	0.54	0.71	0.98	0.41	0.62	0.82	0.42	0.51	0.75
5	Totalphosphorous (%)	0.212	0.382	0.495	0.272	0.382	0.510	0.217	0.378	0.489
6	Total Potassium (%)	0.271	0.432	0.823	0.272	0.387	0.724	0.284	0.397	0.704
7	Total sodium (%)	0.272	0.402	0.527	0.217	0.322	0.487	0.272	0.386	0.408
8	Total calcium (%)	0.438	0.489	0.572	0.482	0.574	0.602	0.272	0.408	0.527
9	Total Magnesium (%)	0.272	0.394	0.452	0.284	0.324	0.397	0.372	0.428	0.497
10	C/N Ratio	30:1	22:1	14:1	28:1	18:1	13:1	23:1	17:1	11:1

ISSN: 0975-8585

TABLE-3
PHYSICAL PARAMETERS FOR THE SAMPLES STUDIED

S.No	Parameters	Sample 1 (days)			Samples 2			Sample 3		
		0 days	30	60	0	30	60	0	30	60
1	Bulk density x 10-3(kgm-3)	0.1275	0.3192	0.1475	0.1175	0.1287	0.1398	0.1365	0.1427	0.1538
2	Moisture content (%)	13.75	15.13	16.84	14.32	15.12	16.32	16.13	17.53	18.42
3	Water holding capacity(%)	32.58	34.37	35.92	40.26	41.78	43.73	42.56	43.57	44.74

TABLE – 4 CHEMICAL PARAMETERS FOR THE SAMPLES STUDIED

S.No	Parameters	Sample 4 (days)			Samples 5			Sample 6		
		0	30	60	0	30	60	0	30	60
1	PH	5.21	4.81	4.61	6.69	6.03	5.85	8.32	8.08	7.82
2	Electrical conductivity (dsm^{-1})	4.82	5.32	5.91	6.72	7.29	7.94	7.89	8.53	8.77
3	Total organic carbon (%)	15.8	14.2	13.9	16.5	15.2	14.2	15.4	14.5	13.8
4	Total Nitrogen (%)	0.62	6.82	0.96	0.62	0.73	0.91	0.58	0.76	0.94
5	Total phosphorous (%)	0.213	0.273	0.410	0.225	0.297	0.425	0.235	0.297	0.397
6	Total Potassium (%)	0.212	0.295	0.379	0.382	0.427	0.523	0.438	0.497	0.532
7	Total sodium (%)	0.272	0.282	0.301	0.217	0.273	0.343	0.215	0.318	0.372
8	Total calcium (%)	0.372	0.412	0.423	0.287	0.323	0.357	0.253	0.317	0.379
9	Total Magnesium (%)	0.298	0.317	0.364	0.273	0.312	0.384	0.353	0.397	0.424
10	C/N Ratio	24:1	17:1	15:1	26:1	20:1	16:1	25:1	19:1	15:1

TABLE -5 MORPHOLOGICAL PARAMETERS

Treatments	Number of leaves / plant	Plant height (cm)	Number of side branches / plant	Length of root (cm)
T_C	16	20	3	8
T_F	18	21	4	9
T1	19	22	5	10
T2	18	21	4	9
T3	19	23	6	11
T4	17	22	5	8
T5	18	21	4	9
T6	17	21	4	7

ISSN: 0975-8585

TABLE -6 ANOVA FOR PHYSICAL PARAMETERS (BETWEEN DAYS)

S.No	Parameters	Mean			F	Significance
		0	30	60		
1.	Bulk Density	.190	.199	.222	20.492	.000
2.	Moisture content	13.972	15.175	16.420	161.756	.000
3.	Water holding capacity	25.535	26.707	28.573	75.490	.000

TABLE -7 ANOVA FOR CHEMICAL PARAMETERS (BETWEEN DAYS)

S.No	Parameters	Mean			F	Significance
		0	30	60		
1.	PH	6.550	6.013	5.742	50.888	.000
2.	Electrial conductivity	7.150	7.733	8.197	35.423	.000
3.	Total organic carbon	14.217	13.183	12.417	69.715	.000
4.	Total nitrogen	0.532	0.692	0.893	155.720	.000
5.	Total Phosphorous	.229	.335	.454	93.720	.000
6.	Total Potassium	.308	.406	.614	13.919	.001
7.	Total sodium	.244	.331	.406	17.674	.001
8.	Total Calcium	.351	.421	.477	17.570	.001
9.	Total magnesium	.309	.362	.421	35.387	.000

Table -8 ANOVA for physical parameters (Between Treatments)

S.No	Parameters	Mean						F	Significance
		T1	T2	T3	T4	T5	T6		
1.	Bulk Density	.321	.254	.238	.138	.129	.144	232.700	.000
2.	Moisture content	16.547	12.887	13.847	15.240	15.253	17.360	147.494	.000
3.	Water holding capacity	12.913	16.817	12.063	34.290	41.923	43.623	3463	.000

TABLE -9 ANOVA FOR CHEMICAL PARAMETERS (BETWEEN TREATMENTS)

S.No	Parameters	Mean						F	Significance
		T1	T2	T3	T4	T5	T6		
1.	PH	5.313	6.083	6.073	4.877	6.190	8.073	181.008	.000
2.	Electrical conductivity	7.333	9.570	7.693	5.350	7.317	8.397	124.515	.000
3.	Total organic carbon	15.553	10.867	8.733	14.633	15.300	14.567	334.432	.000
4.	Total nitrogen	.743	.617	.560	.800	.753	.760	21.183	.000
5.	Total Phosphorous	.363	.388	.361	.299	.316	.310	4.798	.017
6.	Total Potassium	.509	.461	.458	.295	.444	.489	1.641	.236
7.	Total sodium	.400	.342	.355	.285	.278	.302	3.019	.065
8.	Total Calcium	.500	.553	.402	.402	.322	.316	19.736	.000
9.	Total magnesium	.373	.335	.432	.326	.323	.393	10.773	.001

ISSN: 0975-8585

CONCLUSION

Composting is one of the techniques used for solid waste disposal. In the present study aerobic composting of vegetable and fruit wastes have been taken for investigation. The physical and chemical parameters evaluated indicate an increase in these parameters as days of composting increased except in the case of pH and C/N ratio. The composted samples are tested for their manorial efficiency by studying the morphological parameters.

REFERENCES

[1] Jeevan Rao K, Proceed int conf sustaibnable solid waste mgmt 2007: 244-249
[2] Parr J.F and Hornick S.B In: Metting FB (ed) soil microbial ecology, Marcel Dekiker, New York 1993; 5:544-545.
[3] Jayapriya SP and Saseetharan MK. Nature Environment and Pollution technology 2006; 5(2): 24-252.
[4] Ist entiford E. composting 'control: Principles and practice' the science of composting parts chapmann and hall publisher Inc, London 1996: 49-59.
[5] Margesin et al. International Biodeterioration and biodegradation 2006; 88-932.
[6] Ravikumar P.etal, clean techn Environ policy 2009, 11: 473-484.
[7] Campbell et al. Compost Sci Vtil 1997; 5: 62-73.
[8] Bermal et al, Bioresource Technol 1998; 63: 91-99.
[9] Elango D. et al, applied energy 2009; 86(5): 663-668.
[10] Srimathu R. Iyengar, Prashant Bhave P. Waste management 2006; 20 (10): 1070 – 1080.
[11] Abdebasset lakhar et al. J of Hazardous materials 2009; 171 (1-3): 29-37
[12] Alok Kumar Pandy et al. Biodegradation 2009; 20: 293-306.