CONVERSION OF SOLID WASTE INTO BIO FERTILIZER BY VERMICOMPOSTING METHOD

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Abstract

The present study was under taken for the management of kitchen wastage, neem wastage, agricultural wastage and fruit wastage. Physical and chemical parameters were analyzed during this period of 40 days. Pre decomposition of 10 days and subsequent vermicomposting of 40 days indicate the role of this species in vermicomposting. Increase was found in all the parameters like pH, Electrical density, Nitrogen, Phosphorus, potassium, Manganese, Iron and Zinc are the timing of vermicomposting increased from 10 days to 40 days. In 40 days time good quality compost of kitchen waste was prepared by earth worm.

Keywords: Kitchen waste, agriculture waste, neem waste, fruit waste, vermicomposting.

1. Introduction

India and many other countries are suffering from the entire problem due to urbanization, which are a very rapid process and a worldwide phenomenon. Deteriorating quality of urban environment is one of its important impacts. SOLID WASTE is its major contribution the complexity in character of solid waste and its volume is greatly increasing due to increase of living standards and population density. Hence the importance of efficient "SOLID WASTE MANAGEMENT" is increasingly recognized.

The solid waste is complex in character and its volume is greatly increased due to increase of living standards and population density. Hence the importance of efficient solid waste management is increasingly recognized. Solid waste is the term now used internationally to describe non – liquid waste material arising from kitchen, Agriculture, Neem, Fruit and mining activities. Solid waste comprises countless different material kitchen waste, agriculture waste, neem waste, fruit waste. Solid waste includes both combustible and non-combustible waste. Disposal of solid waste should be properly managed. They cause insanitation conditions and hazard to human being. (Hemalatha, 2012).

In-situ management of earthworms for soil fertility is always beneficial (Borowski, 1995). To maintain earthworms in the soil, moisture and organic matter requirements are essential. Many such traditional and ecofriendly technologies, which are innovative, must be implemented to produce food free from chemicals, toxic substances and residues. One among the many such technologies, which can be used in all spheres, is "VERMITECH" (Ismail, 1994, 1995) using native or indigenous earthworms for converting organic waste into valuable vermicompost and in soil management. Growing concerns relating to land degradation, the inappropriate use of inorganic fertilizers, atmospheric pollution, soil health, overgrazing, soil biodiversity and sanitation have rekindled global interest in organic recycling practices such as vermicomposting.

2. Materials and Methods

Collection of Materials

The fruit wastage was collected from the Padma palamuthirsolai nilayam located at Mayiladuthurai, Nagappattinam (Dt) Tamilnadu. The Kitchen wastage, Neem wastage, Agriculture wastage was collected from Thittacherry,Nagappattinam (Dt) Tamilnadu.

Methods

Plan of vermicomposting (Sharma., 2003), Determination of pH (Blake more., 1972), Estimation of Electrical conductivity (Jones, 2001),Estimation of Total Nitrogen (Mathivanan*et al.,* 2013),Estimation of Phosphorus (Mathivanan *et al.,* 2013),Estimation of Potassium (Mathivanan *et al.,* 2013),Estimation of Manganese

(Krishnamurthy*et al.,* 2010),Estimation of Iron (Abolfazl and Ebrahim *et al*., 2013),Estimation of Zinc (Kitturmath *et al.,* 2007).

3. Results and Discussion

Analysis of various physicochemical parameters play a key role in determining the quality of vermicompost obtained from wastage decomposed by earth worm. The result of the present study are discussed under the following headings.

TABLE: 1 Comparative study of Nutrient levels of vermicompost

S.NO	Parameter	Kitchen wastage				Neem wastage				Fruit wastage				Agriculture wastage			
DAYS		10^{th} day	20^{th} day	30^{th} day	40^{th} day	10^{th} day	20^{th} day	30^{th} day	40^{th} day	10^{th} day	20^{th} day	30^{th} day	40^{th} day	10^{th} day	20^{th} day	30^{th} day	40^{th} day
1	pH	4.0±1.51	4.5±1.61	4.7±0.91	5.0±1.25	6.0±0.16	6.5±1.63	6.8±3.26	7.0±0.40	5.0±1.63	5.5±1.75	5.8±3.26	6.±0.41	7.0±1.63	7.5±1.73	7.8±1.73	8.0±1.32
2	EC	0.2±2.20	0.6±0.97	1.25±1.28	2.0±1.61	2.1±0.91	2.5±1.10	2.8±0.75	3.0±1.76	1.6±1.24	1.79±1.10	1.91±1.69	2±1.76	3.0±0.5	3.5±0.6	3.8±0.18	4±2.16
3	N	19.6±1.29	28.0±0.81	31.5±1.61	43.4±20.72	17.5±4.08	20.0±1.63	22.1±2.49	28.0±1.24	18.56±0.10	23.0±1.63	22.4±3.26	32.0±2.94	14.5±1.63	23.1±2.49	23.8±1.63	26.0±9.92
4	P	5±0.163	10.9±3.10	20.9±3.15	37.5±1.44	4.56±0.74	5.5±1.63	5.8±2.63	7.8±4.08	8.16±2.49	6±2.59	5.7±1.2	17.8±3.08	1.76±1.31	2.76±2.31	3.89±2.31	4.8±2.08
5	K	57.5±4.08	60.0±8.16	66.2±2.45	75.0±1.63	16.5±1.63	19.2±1.63	25.5±2.04	28.6±1.29	50.0±4.06	55±1.78	58±1.98	72.0±12.47	5.0±19.80	16.5±2.1	17.8±1.29	19.0±1.07
6	Mn	8.20±1.63	8.34±1.63	8.50±2.68	8.92±1.63	3.45±0.24	3.63±1.24	3.87±0.9	4.0±0.16	6.65±0.20	6.67±0.30	6.90±045	7.63±0.16	3.34±0.62	3.63±1.24	3.65±0.46	2.34±0.62
7	Fe	15.44±1.22	16.49±1.22	18.90±1.68	44.84±2.49	10.02±1.78	10.25±20.56	14.67±5.81	25±2.29	14.40±2.05	15.90±1.68	16.90±1.68	29.24±3.29	8.3±0.22	9.5±0.24	10.8±1.05	12±1.37
8	Zn	2.83±0.32	5.47±1.23	7.76±1.69	8.56±1.64	3.4±1.25	3.5±1.65	3.8±1.75	4.5±1.95	2.72±1.65	3.3±1.68	4.12±1.64	5.45±0.94.	0.83±0.32	1.47±1.23	2.8±1.75	3.0±1.29

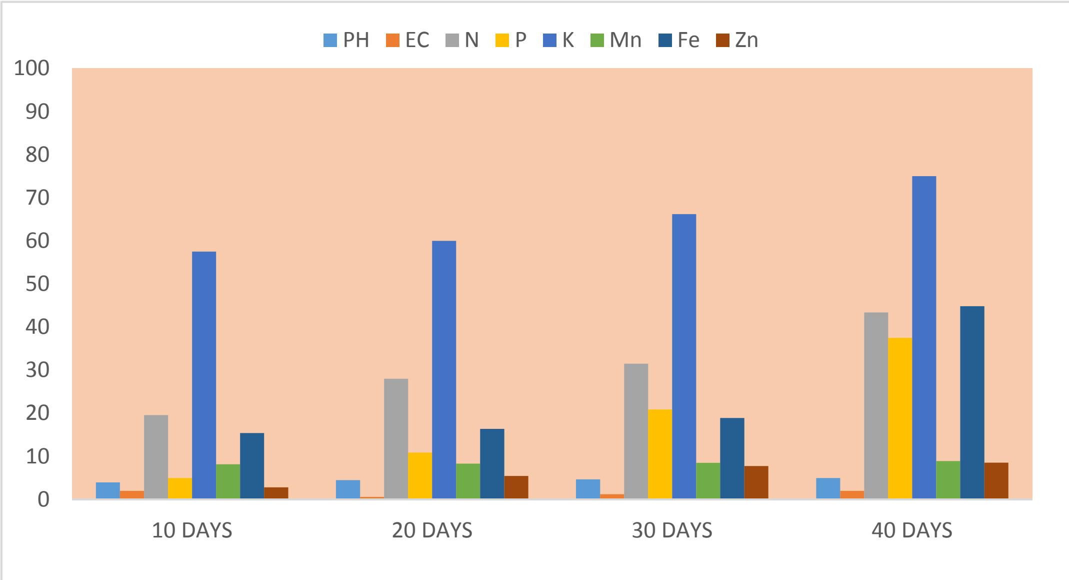

Figure 1.Influence of vermicompost on physico-chemical parameters with Kitchen wastage.

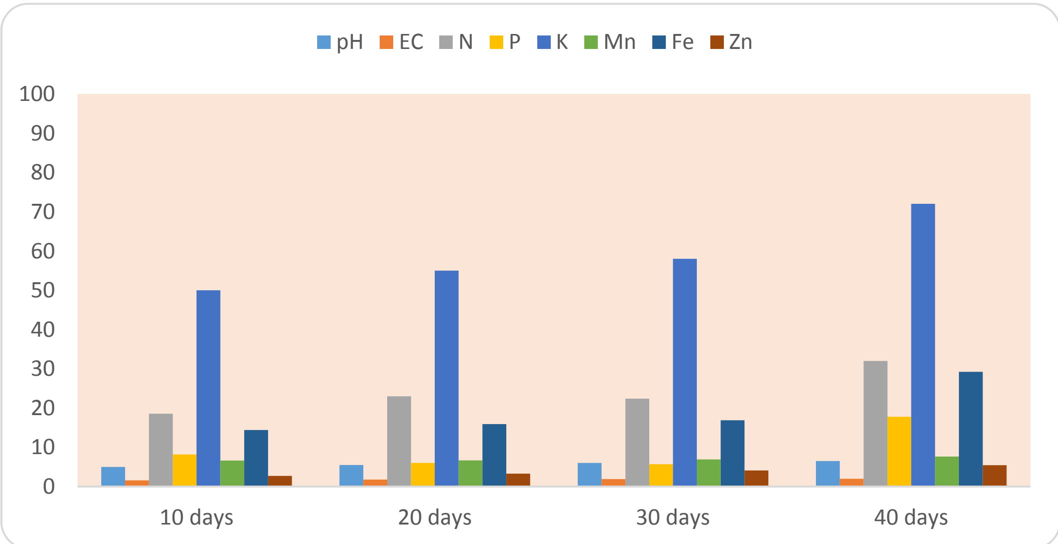

Figure 2.Influence of vermicompost on physico-chemical parameters with Fruit wastage.

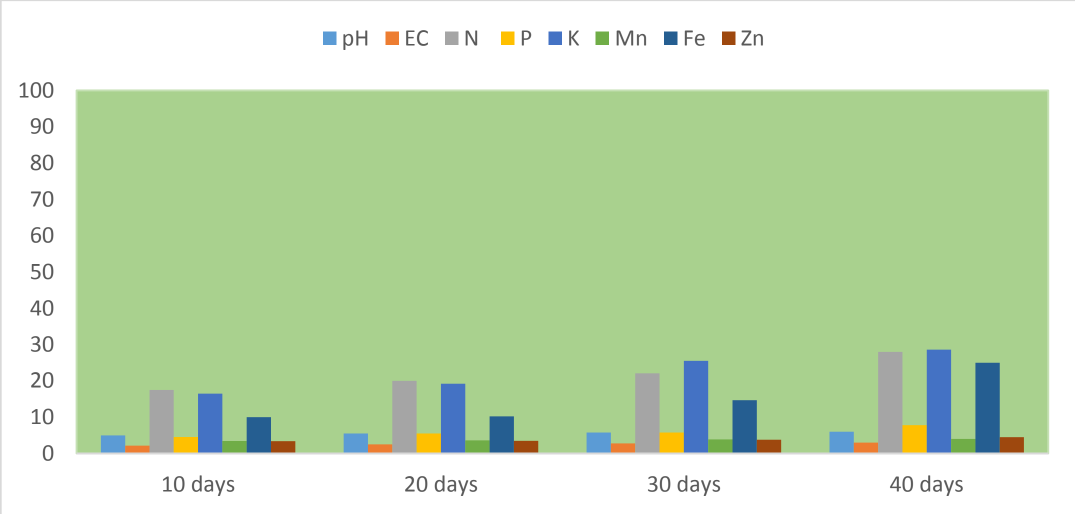

Figure3. Influence of vermicompost on physico chemical parameters with Neem wastage.

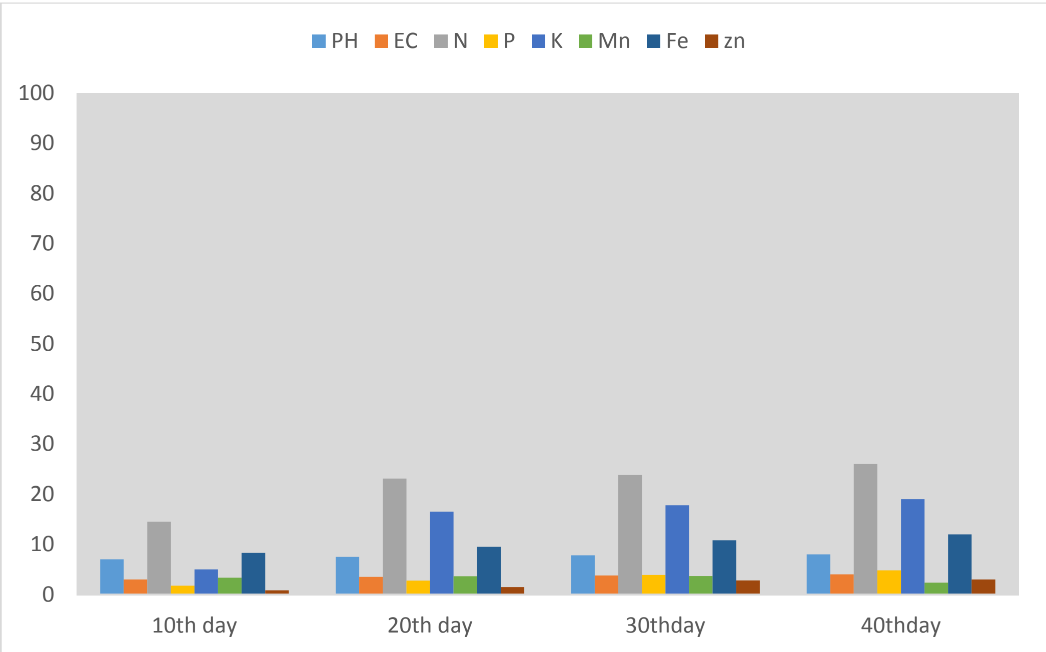

Figure 4.Influence of vermicompost on physico chemical parameters with Agriculture Wastage.

Picture:1 Influence of vermicompost on physico-chemical parameters with Kitchen wastage.

10th day

20th day

30th day

40th day

Picture:2 Influence of vermicompost on physico-chemical parameters with Fruit wastage.

10th day

20th day

30th day

40th day

Picture: 3 Influence of vermicompost on physico-chemical parameters with Neem wastage.

10th day

20th day

30thday

40thday

Picture:4 Influence of vermicompost on physico -chemical parameters with Agriculture Wastage.

10thday

20thday

30th day

40th day

pH

The pH in the vermicompost was reduced in all the wastage from 10th day to 40th day and they are presented in (Table 1).Among the vermicompost made by the kitchen wastage(5.0±1.25) was found to have minimum pH, followed by Neem wastage(7.0±0.40) fruit wastage(6±0.41) and agricultural wastage (8.0±1.32) on 40th day (Table 1).

The overall decrease of pH from the initial near alkaline towards slightly acidic conditions might be due to the decomposition of organic substrates by microbial activity resulting in the production of CO_2 and other intermediate species of organic acids in vermicompost (Elvira et al., 1998) Earthworms are directly affected by low pH. Each species showed a specific tolerance to acidity that influenced the distribution of that species in soils (Laverack, 1963) The distribution of the earthworm species get determined by the native soil pH (Piearce,1972) Stated that the decrease of pH towards neutral is an important factor to be considered influencing retention of nitrogen. The lower pH recorded in the final products might have been due to the production of $CO_2$and organic acids by microbial activity during the process of bioconversion of the different substrates in the beds (Haimi and Huhta, 1987).

Electrical conductivity

The electrical conductivity of wastage composted by earthworm is illustrated in table 1.The fine electrical conductivity recorded was (2.0±1.61) in kitchen wastage, (2±1.76) in fruit (3.0±1.76) in Neem wastage and (4±2.16) in Agriculture wastage on earthworm treated compost at 40th day. The increase of electrical conductivity in kitchen wastage when compared to the other wastage might be due to the presence of exchangeable calcium, magnesium and potassium in worm cast than the soil have also obtained similar result with press mud composted by Earthworm. The increase in electrical conductivity was mainly due to the loss of organic matter and the release of different soluble salts in available form (such as phosphate, ammonium and potassium) from the activity of earthworms and microorganism (Karmegam and Daniel 2009; Khwairakpam and Bhargava 2009).

Nitrogen

In all the four different type of compost, increase in the nitrogen content was observed in kitchen wastage compost. The nitrogen content was followed by kitchen wastage compost (43.4±20.72), Agriculture wastage (26.0±9.92), Neem wastage (28.0±1.24), and fruit wastage compost (32.0±2.94). The nitrogen enrichment pattern and mineralization activities mainly depend upon the total amount of N in the initial waste material and on the earthworm activity in the waste decomposition sub- system.

Besides releasing N from compost material, earthworm also enhance nitrogen levels by adding their excretory products, mucus, body fluid and enzymes to the substrate. (Suthar, et al., 2008) Suggested that the decaying tissues of dead worms also add a significant amount of N to vermicomposting subsystem.

Phosphorus

The phosphorus content was recorded maximum in all the four different compost under this study. Increased phosphorus content was observed in the kitchen wastage (5±0.163, 10.9±3.10, 20.9±3.15and 37.5± 1.44) during initial, 10th to 40th day. This was found to be maximum when compared to all other compost. The initial and final phosphorus contents in the four different composting system show that composting has increased phosphorus concentration over control in all the experiments. The uptake of bacteria and fungi followed by grazing microorganisms by the earthworms, excretion and decomposition might result in release of phosphorus compounds. Increased phosphorus content in the vermicomposts is due to the mineralization and mobilization of phosphorus by bacterial and faecal phosphatase activity of earthworm (Krishnamurthy, 1990).

Potassium

Significant increase was noted in all the four different compost at the end of the experiment. The maximum value increased (75.0±1.63) in kitchen compost, and minimum value was recorded in (19.0±1.07) agriculture compost. An increased in potassium level during vermicomposting may be due to the microbes present in the gut of earthworms which might have played an important role in this process. (Premuzic et al., 1998) claimed that acid production by the microorganisms is the major mechanism for solubilizing insoluble potassium in the organic waste (Garg et al., 2006).

Similarly, there was a consecutive increment in total potassium during the vermicomposting process**.** (Suthar, 2007) have reported that earthworm processed waste material contains higher concentration of exchangeable K due to enhanced microbial activity during the vermicomposting process, which consequently enhances the rate of mineralization. Solubilization of inorganic potassium in organic wastes by microorganisms through acid production was claimed by (Premuzic et al., 1998).The previous study indicated enhanced potassium content in vermicompost by the end of the experiment (Manna et al., 2003).

Manganese

Significant increased manganese level was observed in the present study for four different type of compost. After composting the manganese values increased in all the compost over initial and final. Increase of manganese content in vermicompost is due to mineralization of this element by the earthworm activity. Manganese is a catalyst for many enzymes and also facilitates the photosynthesis and chlorophyll production and release of the excess amount of manganese rand heavy metals from the earthworm body into the environment through the calciferous glands**.** (Ireland, 1975) suggested that the chemical changes that occur in the alimentary tract of earthworms might enable various metals more readily available to plants and mineralization of dead earthworms would release accumulated heavy metals into the environment.

The availability of metals such as Zn, Mn in the tissue of earthworm was reported by (Ireland, 1979). Ionic regulatory mechanism in earthworms involves uptake of Fe, Mn from ingesta and its excretion via calciferous glands (Bouche, 1983).

Iron

Table 1 and figure (1- 4) depicts the content of iron in vermicompost. Higher levels of iron were noticed in vermicompost on 40th day compared to 10thday compost. The range of iron in kitchen wastage compost (44.84±2.49), Fruit wastage compost (29.24±3.29), Neem wastage compost (25±2.29) and Agriculture wastage compost (12±1.37) respectively on 40th day. The presence of enzymes and co-factors in the earthworm gut increased the iron content in the vermicompost. Our results are in accordance with the presence of iron content in vermicompost (Suthar, 2007).

The initial and final values of the Iron revealed that the main reason for the increase in their on in the vermicomposts in the present might be due to the release of the excess amount of iron rand heavy metals from the earthworm body into the environment through the calciferous glands**.** (Ireland, 1975) suggested that the chemical changes that occur in the alimentary tract of earthworms might enable various metals more readily available to plants and mineralization of dead earthworms would release accumulated heavy metals into the environment. The chemical properties of earthworm cast, termite mould and ant gallery were compared by (Reddy and Dutta, 1984) who found that the earthworm casts had increased nutrients than the others.

Zinc

The zinc content in vermicompost is represented in Table 1.The effect of worm action on vermicompost was found to be more on 40th day of kitchen wastage (8.56±1.64) composting when compared to 10th day of (2.83±0.32) compost. Zn is essential for the transformation of carbohydrates and it regulates the consumption of sugars.

The soil pH is the most important factor controlling the Zn availability. The findings of the present study are in accordance with the study who found that zinc content was increased in the vermicompost (Sainz et al., 1998).

4. Summary and conclusion

In the present study, the physiochemical parameters of the vermicast from different organic waste were analyzed. There was a slight change in pH of all vermicompost and it showed high pH in agricultural wastage. The electrical conductivity of each vermicompost was determined and it revealed more or less similar value in all the samples. Nitrogen is the most important nutrient for plant growth and its content was observed to be higher in kitchen wastage. In kitchen wastage compost is highest amount of nutrients content P, K, Fe, Zn and Mn were observed. In addition to this it may be recommended that the vermicompost from solid waste management can be utilized for organic farming. The study area is totally based on natural process; it is quite economical in construction and maintenance. This is an ecofriendly and cost effective methods. It is an ideal method for the management of solid waste.

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