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PHYSICO- CHEMICAL PARAMETERS OF COMPOST AND VERMICOMPOST PRODUCED OUT OF DIFFERENT ORGANIC WASTES BY THE EPIGEIC EARTHWORM, EUDRILUS EUGENIAE

Soumya R. Patil and Pulikeshi M. Biradar*

Department of Zoology, Karnatak University, Dharwad-580003 (Karantaka), India

ABSTRACT

Epigeic earthworms have the ability to convert organic wastes into valuable vermicompost as biofertilizer for and worm biomass as animal feed. The present work was undertaken to find out the quality of produced compost (without worm) and vermicompost (with Eudrilus eugeniae) out of different organic wastes [Cattle manure (CM)-Control, Eupatorium odaratum (EO), Tectona grandis (TG), Lantina camera (LC), Mangifera indica (MI), Cassia fistula (CF)] through their physico-chemical analysis such as pH, EC, % Organic carbon, available macro(N,P,K,S,Ca,Mg) and micro nutrients(Fe,Cu,Mn,Zn) were estimated through standard methods. Results revealed that % Organic carbon (OC) was more in compost compared to vermicompost whereas remaining parameters such as pH, EC, macro and micro nutrients were almost more in vermicompost than that of compost in all organic wastes. Again the quality of compost and vermicompost mainly depends on the nature of waste, potentiality of the earthworm in vermicomposting process, the activities of saprophytic microorganisms present in the earthworm gut and prevailing environmental conditions. The vermicompost produced by the earthworm, Eudrilus eugeniae from different organic wastes have all the essential physico-chemical parameters as biofertlizer for sustainable agriculture practices.

Keywords: Physico-chemical parameters, Compost, Vermicompost, Earthworm-Eudrilus eugeniae

1. INTRODUCTION

Earthworms are considered as one of the most important “biotic components of soil” as they participate in the biodegradation of organic wastes helps in mineralization process and recycling of plant nutrients. It has long been known that earthworms play significant role in breakdown of organic matter and release of available plant nutrients from wastes (Darwin, 1881). The usage of several earthworm species from temperate and tropical regions in break- down of various organic wastes (such as brewery wastes, potato wastes, paper industry wastes, animal wastes and horticultural wastes) in vermicomposting process through biodegradation process have been documented (Fosgate and Babb, 1972; Tsukamato and Watanabe,1977; Graff,1981; Haimi and Hunta,1986; Edwards,1998). The extensive breakdown of different nutritionally valuable organic wastes have also been undertaken by using litter dwelling composting epigeic earthworms (Loehr *et al.*, 1985)

Vermicomposting is a non-thermophilic biological oxidation process in which organic material are converted into vermicompost, which contains major and minor plant nutrients in available forms along with enzymes, vitamins and plant growth hormones (Mahalingam and Maruthmalai Rasi, 2014). Vermicast produced after processing of organic wastes by the suitable earthworm species was proved to be a suitable organic fertilizer as it contains more available plant nutrients due to rapid breakdown of complex organic molecules. (Bano *et al.*, 1987)

Eudrilus eugeniae is one of the epigeic earthworm species known for its voracious feeding and breeding habit helps in breakdown of any kind of non-toxic organic wastes so as to produce vermicast and worm biomass in large scale (Reinecke *et al.*, 1992; Tripathi and Bhardwaj, 2004).Literature revealed that there is a paucity of work dealing with the compostability of different individual organic wastes by the earthworm, *Eudrilus eugeniae* and their influence on physico-chemical parameters of their produced vermicompost and their comparison with normal compost. Hence, the present work was undertaken to find out the quality of produced compost (without worm) and vermicompost (with *Eudrilus eugeniae*) out of different organic wastes through their physico-chemical analysis (such as pH, EC, % OC, macro(N,P,K,S,Ca,Mg) and micro (Fe, Zn, Mn,Cu) nutrients.

2. MATERIALS AND METHODS

The compost (without worms) and the vermicompost (with *Eudrilus eugeniae*) produced out of different organic wastes were collected individually after processing of 16 weeks. The organic wastes used in the experiment were *Eupatorium odoratum* (EO*), Tectona grandis* (TG), *Lantina camera* (LC), *Mangifera indica* (MI) and *Cassia fistula* (CF) along with Cattle manure (CM) in 10:1 ratio so as to maintain C:N ratio and cattle manure (CM) alone served as Control. The collected compost and vermicompost were analysed for physico-chemical parameters to know the quality and nutrient status.

The physico-chemical analysis of different parameters such as pH, EC, %OC, N, P, K, S, Ca, Mg and Fe, Zn, Mn and Cu were carried out through different standard methods. pH and Electric Conductivity(mS/cm) were estimated as per the procedure described by Chandrabose *et al.*, (1988). The % Organic carbon (OC) was estimated by Walkey and Black (1934) method. Available Nitrogen (N) was determined by Singh and Pradhan (1981). Available Phosphorus and Potassium were determined by Bray and Krutz (1945) and Flame Photometer method respectively. The available Sulphur (S) was determined through the procedure given by Yasushi and Shinjiro (2010). Determination of exchangeable Calcium and Magnesium was done by Jackson (1973). Micronutrients (Fe, Zn, Mn and Cu) have been analysed by Lindsay and Norvell (1978) through Atomic Absorption Spectrophotometer (ASS).

3. RESULTS AND DISCUSSION

Table-1 and 2 represents the physico-chemical parameters of compost and vermicompost of individual organic wastes were analysed with respect to pH and Electric Conductivity (EC), Percent Organic carbon, available macro-nutrients (N,P,K,S,Ca & Mg) and micro-nutrients

(Fe,Zn,Mn & Cu) respectively. Based on the analysis of the data the % OC was more (30.36- 33.30) in compost compared to vermicompost (26.32- 29.40) in all organic wastes. The observance of less % OC in vermicompost may be because of utilization of organic carbon by the earthworm for building up of their body biomass during their growth and development along with decomposition process. The OC is decreased with passage of time during composting and vermicomposting process as it lost in the form of Co_2 through microbial respiration and mineralization of organic matter leads to increase in total Nitrogen.The decrease in % OC in both compost and vermicompost may also be attributed to microorganisms might used the carbon as a source of energy in decomposing organic matter. The reduction in OC was higher in vermicompostiong compared to normal composting process was also witnessed by various researchers (Cabrera *et al.,* 2005; Garg and Kaushik, 2005; Tognetti *et al.,* 2005)

The physical parameters such as pH and EC were more in vermicompost than that of compost and were ranged between 7.70 to 8.12 and 7.30 to 7.90 and 4.10×10^2 to 5.60×10^2 and 3.25×10^2 to 3.75×10^2 in vermicompost and compost respectively (Table-1&2). The higher pH and EC in vermicompost may be due to increase in soluble salts through biodegradation and mineralization process. Gunadi and Edwards (2003) have also observed pH shift after processing of cattle manure and other vegetable wastes in vermicomposting. The increased EC during vermicomposting process, which was probably due to the degradation of OC by earthworms and releasing exchangeable minerals such as Ca, Mg, K and P in the available forms (Kaviraj and Sharma, 2003; Tognetti *et al.*, 2007; Jadia and Fulekar,2008)

The macro-nutrients (N, P, K, S, Ca and Mg) and micro-nutrients (Fe, Zn, Mn and Cu) were also recorded more in vermicompost produced by *Eudrilus eugeniae* rather than that of normal compost produced by saprophytic microorganisms in all organic wastes (Table 1&2). This increase may be due to accumulation of mucus, excretory substances and enzymes by the earthworms. Increase in available macro and micro nutrients during vermicomposting were also reported by Edwards and Lofty (1972). Some researchers have also reported higher content of NPK and other micronutrients in vermicompost than that of compost (Jambhekar, 1992; Delgado *et al.,* 1995; Tripathi and Bhardwaj,2004)

All the nutrients are more in control CM compared to other organic wastes in both compost and vermicompost may be due to less palatability and small particle size in CM than that of other wastes. % OC was less in CM than that of other wastes.

There is a slight variation in all the physico-chemical parameters among compost and vermicompost of individual organic wastes may be due to different chemical composition of respective parent organic materials. The variation in the vermicompost may also be attributed to the worm's preference in feeding towards particular organic wastes in biodegradation process. Crawford (1983) and Gaur and Singh (1995) have also reported that Nitrogen content in compost and vermicompost is dependent on the raw materials and the extent of biodegradation process by earthworms even by the saprophytic microorganisms. Kale and Krishnamoorthy (1981a and 1981b) have also reported that nature of food influences worm activity and even variation in the acceptability of organic wastes by the earthworms depending on the texture and chemical nature of particular wastes.

In the present study, it is revealed that comparatively more amount of both macro and micro nutrients excepr %OC more were recorded in vermicompost than that of compost in all organic wastes. This overall increase of plant nutrients in vermicompost may be due to feeding activities by the earthworm, *Eudrilus eugeniae* and in biodegradation activities by the earthworm *Eudrilus eugeniae* that might enhanced the microbial population and their activity, in turn increased mineralization process, ultimately enhanced plant nutrients.

All the nutrients are also more in control CM compaired to other organic wastes in bth compost and vermicompost may be due to less palatability and particle size in CM than that of other wastes. %OC was less in CM than that of other wastes.

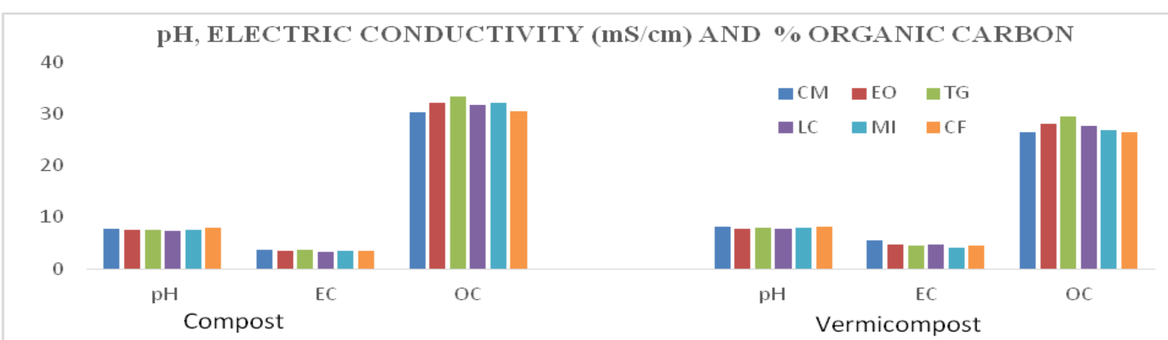
Table No. 1: Analysis of physico-chemical parameters of compost (without worms) produced out of different organic wastes.

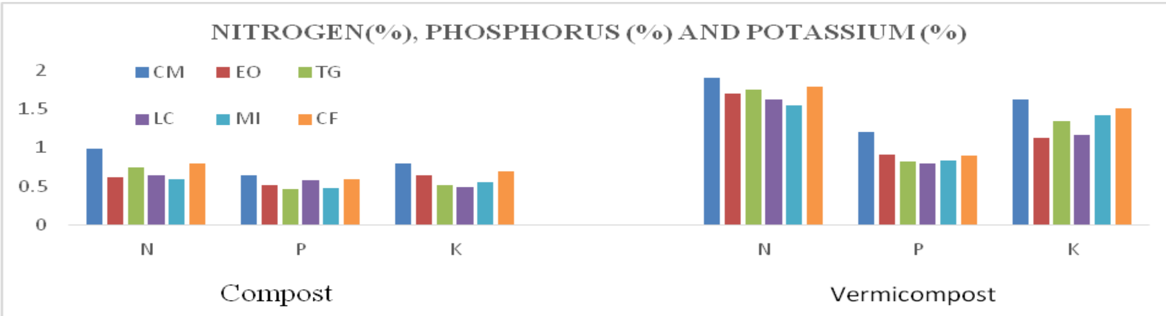
SL.No	Organic waste	pH	EC (mS/cm)	%OC	N %	P%	K %	S%	Ca%	Mg %	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
1	Cattle manure(CM) Control	7.70	3.60×10^2	30.36	0.99	0.65	0.80	0.29	1.60	0.170	606	415	230	160
2	*Eupatorium odaratum* (EO)	7.60	3.50×10^2	32.20	0.62	0.52	0.65	0.26	1.42	0.090	326	296	190	170
3	*Tectona grandis* (TG)	7.50	3.75×10^2	33.30	0.74	0.47	0.52	0.25	1.31	0.092	426	284	180	153
4	*Lantina camera* (LC)	7.30	3.25×10^2	31.60	0.65	0.58	0.49	0.22	1.52	0.082	392	302	172	160
5	*Mangifera indica* (MI)	7.50	3.40×10^2	32.20	0.59	0.48	0.56	0.19	1.48	0.084	412	273	162	132
6	*Cassia fistula* (CF)	7.90	3.56×10^2	30.50	0.80	0.59	0.69	0.28	1.69	0.096	376	290	156	144

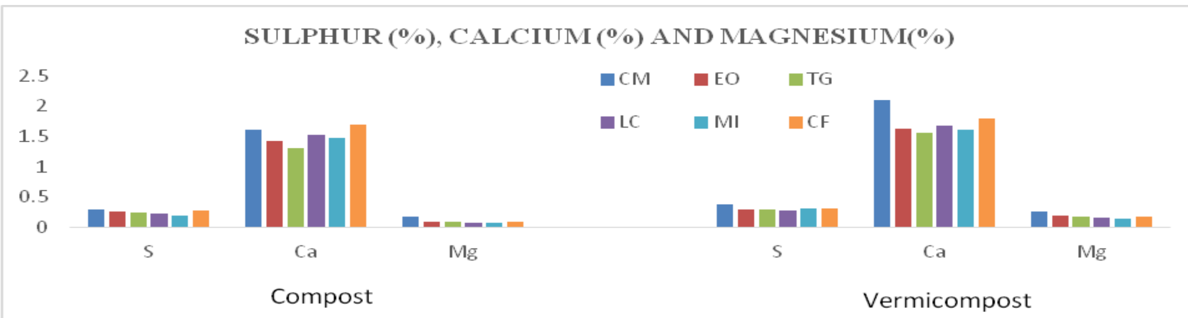
Table No.2: Analysis of physico-chemical parameters of vermicompost (with *Eudrilus eugeniae*) produced out of different organic wastes.

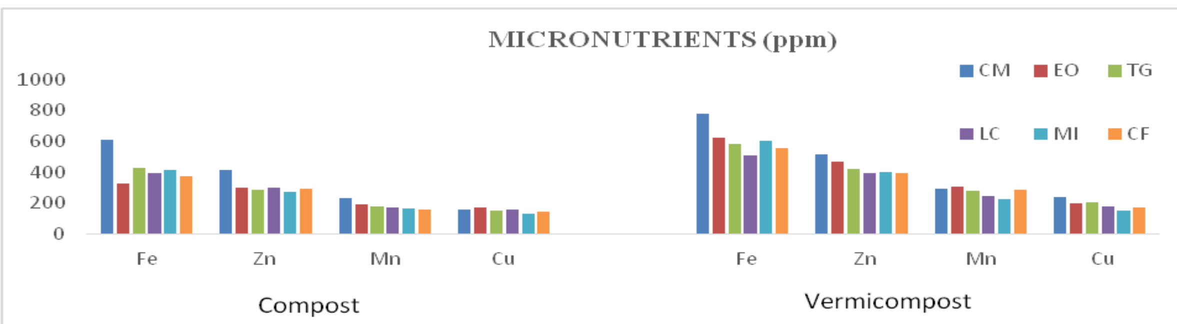
Sl. No.	Organic wastes	pH	EC (mS/cm)	%OC	N %	P %	K %	S %	Ca %	Mg %	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
1	Cattle manure(CM) Control	8.10	5.60×10^2	26.32	1.90	1.20	1.62	0.38	2.10	0.26	776	514	290	236
2	*Eupatorium odaratum* (EO)	7.80	4.60×10^2	28.00	1.70	0.91	1.12	0.30	1.62	0.20	621	469	304	196
3	*Tectona grandis* (TG)	8.00	4.50×10^2	29.40	1.75	0.82	1.34	0.29	1.56	0.18	582	423	282	208
4	*Lantina camera* (LC)	7.70	4.70×10^2	27.60	1.62	0.80	1.16	0.28	1.68	0.16	506	396	248	176
5	*Mangifera indica* (MI)	8.00	4.10×10^2	26.90	1.54	0.84	1.42	0.31	1.60	0.15	602	400	226	149
6	*Cassia fistula* (CF)	8.12	4.40×10^2	26.50	1.79	0.90	1.50	0.32	1.80	0.18	555	396	289	168

Figure1-4: Comparison of various physico-chemical parameters of compost and vermicompost produced out of different organic wastes.









4. CONCLUSION

The physico-chemical parameters such as macro and micro nutrients (pH,EC,N,P,K,S,Ca,Mg and Fe,Zn,Mn,Cu) were more in vermicompost produced by the earthworms, *Eudrilus eugeniae* as compared to normal compost produced by the saprophytic microorganisms. The % OC was decreased in vermicompost as that of compost in all organic wastes. Based on the nutrient status of compost and vermicompost, it can be concluded that the earthworm, *Eudrilus eugeniae* is a voracious feeder and breeder that have all the potentiality to convert any non-toxic organic wastes into valuable vermicompost as biofertlizer that in turn can be utilized for sustainable agricultural practice.

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