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COMPARATIVE ANALYSIS OF MIXED VEGETABLE WASTES AND LEAF LITTER VERMICOMPOST USING THE EARTHWORM *PERIONYX EXCAVATUS*

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ABSTRACT

Vermicomposting is an efficient process by which the solid wastes generated using human activities such as domestic, commercial, and hospital, industrial, agricultural and mining activities.Vermicompost is a finely powdered material, peat like material containing high porosity, good aeration, drainage facility, water holding capacity, microbial activity, and excellent nutrient status and buffering capacity thereby resulting the required physicochemical characters congenial for soil fertility and plant growth. Vermicompost enhances the better quality of composts as compared with those prepared through traditional marks. Hence this present study focuses on the vermicomposting of kitchen wastes usingearthworm *Perionyxexcavates* and their effect on the growth on *Coriander sativum*.Due to its physical and chemical characters, Micro and Macro- nutrients vermicompost may be used to promote sustainable agriculture and also for the safe management of agricultural, industrial, domestic wastes which usually possesses serious threat to life and environment.

KEY WORDS:*Vermicompost, Perionyxexcavatus, Bio- degradable wastes, manures, Vermiculture and Organic matter.*

INTRODUCTION

Most of the countries including India are suffering from the problem due to urbanisation, which is a rapid process and worldwide phenomenon. One of the important impacts is the deteriorating quality of environment. In recent years due to high cost of fertilizers and low availability of organic manures, the recycling of Organic wastes for increasing soil fertility has gained importance. Vermicomposting is an efficient process by which the solid wastes generated using human activities such as domestic, commercial, hospital, industrial, agricultural and mining activities. If the disposal of these solid wastes is not done properly, it causes insanitation conditions and hazard to human being. Hence the importance of accomplished "Solid waste management" is highly recognized.

Earthworms play an important role in soil. The Greek philosopher, Aristotle, named them the'Intestine of Earth '. In India, so far, 509 species, referable to 607 genera and 10 families have been reported (Kale, 1991). Many different species of Earthworms are found in our Environment such as *Eiseniafoetida* (red earthworm), *Eudriluseugenae* (night crawler), *Perionyxexcavatus*, etc.

The earth worms are used for the bio-conversion of organic waste into dark brown nutrient-rich humus. Earthworms leave behind while reducing the biodegradable material such as household wastes by vermicomposting turn into a good source of manure for plants and other uses. In some specific cases, the worms could degrade specific pollutants and might allow the community formation of useful microorganisms. Due to low cost nature of inputs is good point butthe price of vermicompost in market is usually low in South Asian countries just like in which could potentially substitute to thermophilic composting is becoming increasingly common and numerous studies have shown that increased plant growth rate and high yield could be achieved when plants grown in the

presence of vermicompost (Atiyeh*et al.,* 2000, Aracon*et al.,* 2004 and Lee *et al.,* 2004).Shanthi*et al.,* (1993), in India, evaluated the potential of three species of earthworms namely *Metaphireposthuma*, *Eisenia* species and *Perionyxexcavatus* in degradation of vegetable waste. Among all three, *P. excavatus* was able to withstand greater ranges of moisture and temperature than other species and thus most suited for use in vermicomposting and thus we used *P. excavatus* in our project for the production of Vermicompost by using the organic material as vegetable wastes. To see the plant growth by comparison with the fertilizer and also used the compost for calculating their physico-chemical characters.

OBJECTIVES

- To develop an integrated and environmentally sound waste management system.
- To produce vermicompost from mixed vegetable wastes- (banana skin, onion peel, cabbage, cauliflower and potato skin) and leaf litter from the college garden.
- To analyse the physico-chemical characteristics of the vermicompost.
- To analyse the plant growth (*Coriander sativum*) of the leaf litter and vegetable wastes of the vermicompost.

MATERIALS AND METHODS

An experimental study was conducted using the Earthworm *Perionyx excavates* which will be procured from the vermicomposting unit of PG and Research Department of Zoology, NirmalaCollege for Women, Coimbatore, Tamilnadu, to obtain the vermicompost using mixed vegetable wastes and leaf litter wastes with cow dung. They were maintained in the normal environmental conditions. The worms used in the experiment will be almost of same body weight and body length.

The compost samples were collected in polythene bags and were brought to the laboratory for investigation. Approximately 500g compost samples were kept in clean polythene bags with proper labelling for analysis of different chemical parameters like sodium, potassium, calcium, magnesium and iron. pH, TDS (Total Dissolved Solids) and Electrical conductivity were monitored. Iron estimation by spectroscopy method. Total Potassium and Sodium were determined by flame photometry method. Calcium and Magnesium estimation by EDTA(Ethylene Diamine Tetra Acetic Acid) titration method.The pH and electrical conductivity were measured by Hanna Instrument. The pH was determined by measuring 5g of the vermicompost which was then mixed with 10ml deionized water and allowed to settle for ten minutes for determination for the pH. For the electrical conductivity, 5g of the vermicompost was mixed with 10ml of deionized water and allowed to settle for 10 minutes before measurement.

PREPARATION OF SOIL BEDS

Pots will be used for the preparation of soil beds. Dried soil (from nearby compost pit land) was crushed and filtered through a fine mesh sieve. One kg of fine soil was then poured in each pot and then water was added to moistened the soil then 250g dried powdered (3 week old) cow dung was also added to each pot to avoid starvation**.**

ADDITION OF ORGANIC WASTES

The vegetable wastes collected from the Nirmalacollege hostel will be processed for a week and then will be added to the soil.Mixed vegetable wastes (Onion peel, Banana skin, Cabbage, Cauliflower, Potato skin) and leaf litter from the college garden will be added in separate beds.Daily watering and the pots will be maintained for 30- 45 days. Then the compost will be ready for observation.

STATISTICAL ANALYSIS

All the reported data were statistically analysed by 'SPSS'- version 17.0 and 'STATISTICA' – VERSION' 98 statistical analyses. Comparison of the means, standard deviations and Correlation co-efficient were calculated.

RESULT AND DISCUSSION

Vermicompositing appears to be a high value bio fertilizer which promotes the plant growth and productivity by nutrient supply but is cost effective andpollution free. The use of vermicompostimproves the soil aggregation and stabilizes soil stratification. The mineralization of nutrients isobserved to be enhanced, therefore results into boosting up of crop productivity. Thevermicomposts have a higher Base Exchange capacity and more exchangeable calcium,magnesium, potassium than the soil in which worms live.

The results showed **(Table-1)**that the physico-chemical characteristics of mixed vegetable wastes vermicompostshas a rich source of nutrient content than the leaf litter vermicompostswith the cow dung. The pH was measured in leaf litter vermicompost as 5.5 whereas in mixed vegetable waste it was 6.5 and the temperature were measured as 27.3°C. In leaf litter it showed little higher in temperature (30.2°C).

The observations carried out for 45 days of vermicomposting revealed that earthworms play a significant role in the processing of substrates having different initial pH, as almost complete decomposition was observed in the experiments with earthworms, while decomposition process was continued in the respective controls. Effect of initial substrate pH on vermicomposting using *P. excavatus.*The initial increase in the substrate pH can be attributed to the fact that initially microbes participate in the degradation representing aerobic metabolism. As a result, basic hydroxides are formed in the presence of sufficient moisture which increases the substrate pH in the initial phase of decompositionRynk, *etal.*,(1992). Compared to temperate species tropical species can withstand higher temperature (Edwards and Lofty 1977, Lee 1985). The species *Drawidakanarensis, S.travancorensis,* and *Octochaetusthurstoni* appears to be tolerant to the higher temperature upto 30°C. Similarly, Ismail and Murthy (1985) observed tolerance of *Lampitomauritii* (kinberg) to higher temperature range (30± 2° C) at Madras.

The Electrical conductivity showed higher values that is 0.05 µs in mixed vegetable waste, but is lesser in leaf litter 0.02µs units.The total dissolved solids in leaf litter vermicompost were 0.17 and higher in the mixed vegetable waste i.e.0.35µs. The results of physico-chemical characteristics of mixed vegetable waste with cow dung vermicompostsand Leaf litter vermicompostwere also analysed.

Electrical conductivity is a very important indicator of concentrations of soluble salts. The results revealed that organic manures (vermicompost, FYM) contain more soluble salts (EC) than soil. The more electric conductivity in the vermicompost as compared to farmyard manure and soil (control) might be due to the presence of more exchangeable calcium, magnesium and potassium in worm casts than the soil (Bhatnagar and Palta, 1996). Moreover the results are in agreement with the findings of Balamurugan*et al.,* (1999), Bhatnagar and Palta (1996) and Balamurugan (2002) who reported that high concentration of dissolved salts in the vermicompost than the soil and farmyard manure. Moreover the well rotten farmyard manure acts as a nutrient reservoir and produces organic acids, thereby absorbed ions are released slowly during entire crop growth period.

The results of Micro and Macro nutrients of mixed vegetable wastes with the cow dung vermicompost**Table-2** showed higher values than the leaf litter vermicomposts. The highest nutrient values of Potassium and Sodium were recorded in themixed vegetable wastes vermicomposts as 1.20mg/lit and 52.4mg/lit respectively whereas in the leaf litter waste it was only about 0.85 mg/lit

and 45.5 mg/lit. The Calcium content of mixed vegetable wastes vermicompost was 40.0 mg/lit, Magnesium was 44.0 mg/lit and Iron was about 2.6 mg/lit. But magnesium content was lower i.e. 38.2 mg/lit in leaf litter waste vermicompost. Calcium showed 25.4 mg/lit and Iron 1.36 mg/lit. The protein content was higher 22.0mg/lit in the mixed vegetable wastes but lowers in leaf litter wastes i.e.20.0 mg/lit.

Table 1: Physical and Chemical characters of mixed vegetable wastesVermicompost and Leaf litter Vermicompost

S. No	Physico- Chemical Characters	Mixed Vegetable Wastes	Leaf Litter
1	**pH**	5.5	6.5
2	**Temperature**	27.3°C	30.2°C
3	**Electrical conductivity**	0.02µs	0.05µs
4	**Total Dissolved Solids**	0.17mg/l	0.35mg/l

Table 2: Micro and macro nutrients of Mixed vegetable wastes andLeaflitterVermicompost

S.No.	Parameters	Mixed Vegetable Wastes	Leaf Litter
1	**Potassium**	1.20 mg/litre	0.85 mg/litre
2	**Sodium**	52.4 mg/litre	45.5 mg/litre
3	**Calcium**	40.0 mg/litre	25.4 mg/litre
4	**Magnesium**	44.0 mg/litre	38.2 mg/litre
5	**Iron**	2.6 mg/litre	1.36 mg/litre
6	**Protein**	22mg/litre	20mg/litre

Table-3: Mean and Standard deviation for mixed vegetable wastes and leaf litter wastes

Variables	Mean	Std Deviation
Mixed Vegetable Wastes	27.03	21.85
Leaf Litter	21.88	18.45

Source: Computed.

Table-4: Correlation co-efficient for mixed vegetable wastesand leaf litter wastes

Variables	Correlation co-efficient	Correlation co-efficient
Leaf Litter	1.00	.97
Mixed Vegetable Wastes	.97	1.00

Source: Computed.

Table 5: Plant growth by Vermicompost in *Coriandersativum*

S.No.	Control	Leaf litter	Mixed vegetable wastes
1	**7 cm**	**10.5 cm**	**15 cm**

The earthworm cast contains excess amount of various micro-nutrients as compared to the other organic materials (termite mould, gallery, cow-dung etc.) (Reddy and Dutta, 1984) reported that the presence of ionic regulatory mechanism in the earthworms is responsible for the uptake of Fe, Mnand other metals from ingest and its excretion through the calciferous glands. Similar observations were also reported by Ash and Lee (1985) and Mba (1983). Balamurugan (2002) observed the excretion of Zn, Mn, Cu and Fe through the calciferous glands of the earthworms.

Earthworm emits sufficient oxygen to oxidize foul smell producing, compounds like H2S, mercaptans, skatol, etc. (Nagavallemma*et al.,* 2000) The study showed high bulk density because the porosity was increased which further improved the availability of nutrients to crop growth. Because during this process the important plant nutrients that the wastes contain, particularly nitrogen, phosphorus, potassium, magnesium, sulphur and calcium are released and converted through microbial action into forms that are much more soluble and available to plants than those in the parent compounds (Pramanik*et al.,* 2007). The moisture content was fluctuating which was maintained at 60%-70% by sprinkling water. Similarly the temperature was maintained below 35°C because exposure of the earthworms to temperatures above this, even for short periods can kill them and to avoid such overheating careful management of the wastes was done. (Taiwo and Oso, 2004).

The comparative analysis of the chemical parameters of mixed vegetable wastes and leaf and leaf litter wastes were also highlighted. The influence of the composts were tested with the growth**(Table-5)** using the plant *Coriander sativum*, in which the mixed vegetable wastes showed maximum growth in the plant (15 cm), in leaf litter waste composts showed (10.5 cm) and in the control showed (7cm).

From the statistical point of view **(Table-3),** the mean value of mixed vegetable waste composts shows (27.03) higher than the leaf litter waste compost (21.88) and the standard deviation also higher in mixed vegetable waste compost i.e. 21.85 and lower in leaf litter waste 18.45.**(Table-4)**The Correlation Co-efficient of Micro and Macro nutrients of mixed vegetable wastes with cow dung vermicomposts and Leaf litter vermicomposts showed 1.00 and 0.97 respectively.The graphical representation of correlation coefficient of mixed vegetable wastes and leaf litter wastes showed highly positive correlation.

SUMMARY AND CONCLUSION

Vermicomposting is a technology which involves trackling of Earthworms as versatile natural bio-reactors that plays a major role in the decomposition of Organic matter, maintaining soil fertility and to bring out nutrient recycling efficiently and also to enhance the plant growth. There are varieties of Organic solid wastes which are generated by our environment continuously in many forms such as animal wastes, Agro-industrial wastes, human wastes, etc., can be converted into vermicompost.

Further Improvement in the value of vermicompost is due to its other benefits simultaneously: Most of the earthworms can be used in the medicine field and also can be used as protein rich animal feed and Anti-soil pollutant if they are not grown on the polluted wastes.

Following are the summary of the present study:

- An experimental study was conducted in the Department of Zoology laboratory, Nirmala College for women, Coimbatore, to obtain the vermicompost using mixed vegetable wastes and leaf litter wastes with cow dung. The earthworm species used for this process was *Perionyxexcavatus.*
- The fully dried vegetable wastes like Onion peel, Banana skin, Cabbage, Cauliflower and potato skin with the help of cow dung was converted into castings by earthworms.
- Approximately 500g compost samples were kept in clean polythene bags with proper labelling for analysis of different chemical parameters like sodium, potassium, calcium, magnesium and iron. pH,temperature,TDS(TotalDissolvedSolids)and Electrical conductivity were monitored. Total

Iron was dissolved by nitric per chloric acid digestion and determined by spectrophotometry method.

- Total potassium and sodium were determined by flame photometry. Calcium and Magnesium estimation by EDTA titration method.
- All the reported data were statistically analysed by 'SPSS'- version 17.0 and 'STATISTICA'-VERSION'98 statistical analysis. Comparison of the means and standard deviations and Correlation co-efficient were calculated.
- To conclude, from the present study it can be noted that Earthworms are used to convert the solid organic waste of the environment into soil rich nutrients that would enhance the plant growth and also for the urban waste management that could be converted into vermicompost by using the earthworm *P. excavatus*. Like regular compost, vermicompost also benefits our environment as it may reduce the demand of chemical fertilizers and decline the amount of solid waste entering into the environment causing landfills. Thus, it contributes environmental sustainability by converting the solid wastes into a valuable product that enrich our environment and develops a unified and environmentally sound waste management system.

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