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**Vermicomposting of Organic Solid Waste with the *E. Fetida* in  
Different Bedding Materials**

(Case study: Jalal-E-Aleahmad vegetable and fruit market of Tehran at summer 2009)

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### **Introduction**

Population growth and increase in the rate of consumption in the recent years, has lead the solid waste management issue to a serious challenge especially in the large cities. One of the effective, environmental friendly and economical methods for solid waste management is Vermicomposting technology. In Vermicomposting, earthworms especially Epigeic species cooperate with other microorganisms for biotransformation and bio stabilization of organic waste converting into high valuable humus like substance or Vermicomposting. Vermicomposting has variety of applications such as bio adsorbent to removal heavy metal ions, enhancement of microbial community and enzyme activity, plant growth and germination index improvement, reduction of recalcitrant hydrocarbon in soil, wastewater treatment's sludge handling and reduction in the concentration of some pesticides in soil. Therefore Vermicomposting has two important advantages, first to reduce amount of organic wastes and the second to generate high valuable products.

Tehran produces 8000 tons of solid waste per day in which about 60 percent is organic waste. Although waste recycling and windrow composting are under gradual progress recently, but land filling is the first choice for solid waste management. One of the most important organic waste resources in Tehran is vegetable and fruit market (VFM). The number of stores in each VFM is variable which is depended to some parameters like population density and people's culture. Widespread goods diversity, centralization of services and low price are the main reasons of VFM popularity. The lack of suitable fruit packaging and distribution system produce more than 500 tons of organic waste materials daily. The object of the present work was to investigate the possibility of Vermicomposting as the prominent method for VFM organic waste management and to bio stabilize these waste materials into valuable products.

### **Materials and methods**

An important species is *Eisenia Fetida* which has high efficiency performance in some concerned parameters such as Vermicomposting duration, Vermicomposting quality, rapid reproduction ability and high adaptability to the different environment. In the present study *E. Fetida* was obtained from Tommy Topsoil firm in UK.

In the present research three different bedding materials were used; garden soils mixed with matured cow dung (SC), leaf litter from Sharif University campus (LL) and machine shredded paper from Department Office (MSP).

Biodegradable organic wastes were collected from Jalal Ale'ahmad VFM which is the biggest VFM in Tehran. The main waste composition was carrot, potato, lettuce and watermelon. In the next stage, these organic wastes were grinded for bed uniformity.

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Wooden cubic boxes of appropriate size (30 cm height, 40 cm width and 50 cm length) with perforated walls and bottoms for aeration were used as worms' bins. All worm bins were placed in dark and humid room with the set temperature of about 25°C. The moisture content of beddings was fixed to 65-70 percent throughout the study by periodic watering. At the start of the experiment, 300 g mixed juvenile and matured rinsed earthworms were added in different wooden bins including experimental beddings and VFC organic waste.

PH and electrical conductivity (EC) was analyzed using a double distilled water suspension in the ratio of 1:10 (w/v) that agitated mechanically for 30 min and filtered through what man No. 1 filter paper. Total organic carbon (TOC) of the Vermicomposting was estimated using the standard dichromate oxidation method and subsequent determination of the un-reduced dichromate by titration with ferrous ammonium sulfate. Total phosphorus (TP) was analyzed after sample dry digesting with concentrated HCl then followed by addition of ammonium molybdate solution and using the spectrophotometer. Total potassium (TK) was analyzed after sample dry digesting with concentrated HCl and followed by flame photometer.

Total Kjeldhal nitrogen (TKN) was determined after digesting the sample with concentrated H<sub>2</sub>SO<sub>4</sub> producing NH<sub>4</sub><sup>+</sup> then is followed by adding NaOH and steam distillation (Bremner and Mulvaney method).

### Results and discussion

All initial beddings pH was in neutral range. After Vermicomposting period all pH value were increased slightly irrespective of the initial pH of the organic substrates (Table 1). Maximum pH increase was occurred in the LL bedding (Table 2). The most probable theory of pH increasing throughout Vermicomposting is the activity of earthworm calciferous glands and secreting NH<sub>4</sub><sup>+</sup> ions which reduces H<sup>+</sup> ions.

The EC was increased in all beddings and the most changes were occurred in MSP beddings. EC increase might have been due to loss of organic matter and production of different minerals in available forms such as phosphate, ammonium, potassium, etc.

**Table 1: Physicochemical properties for worms' beddings**

Parameter	SC		LL		MSP	
	Initial	After 75 days	Initial	After 75 days	Initial	After 75 days
TOC (%)*	32.2	20.5	48.1	37.6	51.1	16.8
TKN (%)*	0.43	0.89	1.07	1.85	0.20	1.28
TP (%)*	0.32	0.42	0.07	0.38	0.46	0.47
TK (%)*	0.65	1.23	1.00	2.02	0.37	1.75
pH	7.1	7.4	6.7	8.0	7.6	8.6
EC (dS/m)	2.2	3.1	2.8	3.4	0.5	3.1

\*on dry basis

**Table 2: Changes in bedding properties during Vermicomposting**

Parameter	SC (%)	LL (%)	MSP (%)
TOC	-36.5	-21.8	<b>-67.1</b>
TKN	+106.9	+72.9	<b>+540.0</b>
TP	+31.2	+442.8	+2.1
TK	+89.2	+102.0	<b>+373.0</b>
pH	+4.2	<b>+15.9</b>	+13.2
EC	+40.9	+21.4	<b>+520</b>

An important index for determining compost maturity is C: N ratio. In all experiments, the nitrogen content was increased and organic carbon was decreased (Table 2). Thus C: N ratios in all beddings were improved. The most reduction was occurred in MSP beddings (Table 2).

The ~~reduction of~~ *Archive of SID* C:N ratio might be due to an increase of TKN content by the fixation of nitrogen from the air and the mineralization of organic C to CO<sub>2</sub> during the worm's metabolic activity.

In all experiments, the TP and TK contents were increased. The most changes of TP and TK were observed in LL and MSP bedding respectively. These might be interpreted while the substrate passes through the earthworm gut, various plant nutrients like TP and TK are transformed from unavailable forms to more soluble forms by large number of micro flora in earthworm gut. Therefore, these nutrient concentrations may increase in Vermicomposting.

### **Conclusion**

The present study was revealed that Vermicomposting is an alternate technology for the management of biodegradable organic wastes. During the course of Vermicomposting, while the TOC content can decrease considerably, the fertilizing capacity (NPK content) will increase sharply. The results obtained during this study indicate that Vermicomposting of VFM organic waste mixed with different types of bedding materials can convert this waste to valuable product suitable for different applications. Vermicomposting analysis was also shown that the type of the initial substrates has little effect on the product properties.

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### **Key words**

Organic Waste, Vermicomposting, Bedding Materials, C: N Ratio, *E. Fetida*