تأثيرات المخلفات العضوية المختلفة على نمو دودة الأرض (إيودريليوس إيوجينيه Eudrilus eugeniae)

د. محمد عمر الباشا

تمت دراسة نمو دودة الأرض (إيودريلوس *إيوجينيه* ***E. eugeniae***) في مجموعة من المخلفات العضوية المختلفة في المختبر. كانت الأوراق الجافة، والنفايات البلاستيكية ومخلفات المطبخ ومخلفات الورق ذات نسبة الرطوبة (53.3، 41.1، 81.8، 71.2)، ودرجة الحموضة (7.9، 7.6، 7.5، 7.8)، والقدرة على التوصيل(3.4، 3.1، 3.2، 4.2) بالترتيب على التوالي للديدان الأرض بمثابة أوساط غذائية. تم رصد النمو في دودة الأرض (إيودريلوس *إيوجينيه*) لمدة 25 أسبوع حتى توقفت ديدان الأرض عن إنتاج الشرانق . لا تستطيع دودة الأرض (إيودريلوس *إيوجينيه*) البقاء على قيد الحياة في النفايات البلاستيكية و المخلفات الورقية. لقد استمر نمو دودة الأرض (إيودريلوس *إيوجينيه*) في مخلفات المطبخ حتى النهاية، وكان النمو أسرع في الأوراق الجافة عن النمو في النفايات البلاستيكية والمخلفات الورقية.

Abstract:

The growth of the epigeic earthworm *Eudrilus eugeniae*, in a range of different wastes were studied in the laboratory. Dry leaves, plastic waste, kitchen waste and waste paper with Moisture content (53.3, 41.1, 81.8, & 71.2), pH (7.9, 7.6, 7.5 & 7.8) and Conductivity(3.4, 3.1, 3.2 & 4.2), respectively were earthworms as substrates. The growth, of *E. eugeniae* were monitored for 25 weeks until the earthworms stopped producing cocoons.. *E. eugeniae* could not survive in plastic waste, and waste paper. The growth of *E. eugeniae* in growing-finish kitchen waste and dry leaves was faster than in plastic waste and waste paper.

Key words: *Eudrilus eugeniae*, Dry leaves, plastic waste, kitchen waste and waste paper

Introduction

Earthworms, the main characters of this process, are described briefly, showing

how these animals can be important organic waste decomposers and converters. The different earthworm species that are suitable for vermicomposting have quite different requirements for their optimal development, growth and productivity in organic wastes and we review the life cycles of these species and the general requirements of ideal vermicomposting earthworm species (**Dominguez *et al*., 2001 and Dominguez and Edwards, 2004**).There are

four types waste material for vermicomposting i.e. animal wastes, plant wastes, agricultural waste and urban wastes. The growth patterns of the earthworm *Eudrilus eugeniae* (Savigny) in different types of wastes have been investigated by various authors in laboratory studies. Animal manures have been used as a main substrate for *E. fetida* e.g. cattle **(Edwards et al. 1985; Reinecke&Viljoen 1990a, b; Gunadi et al. 2002)**, ducks **(Edwards et al. 1985)**, horses **(Kaplan et al. 1980)**, pigs **(Reeh 1992)**, poultry (Edwards et al. 1985), vegetable wastes **(Shanthi et al. 1993),** coffee grounds **(Aranda et al. 1999)** and tea leaf wastes **(Gunadi et al. 1998)** and pongamia leaf (**Jesikha and Lekeshmanaswamy 2013)**. Urban wastes are very diverse, ranging from sewage bio-solids to food wastes from restaurants and waste management units.

During vermicomposting, the final pH of all the vermibed reactors was significantly decreased with respect to the initial feed mixture. These changes in pH may be due to the degradation of organic solid wastes, and during this process, formation of fulvic acid humic acid and ammonium ions occurred (**Chauhan and Singh, 2012).**

During the vermicomposting processes the earthworms should be monitored for rates of growth in continuous systems to identify their optimal needs. Continuous cultures of earth-worms have a close relationship with multiple

substrate additions of wastes commonly used as waste management systems. The presence of abundant agrowastes and animal dung causes serious problems to animals as well as to human beings, due to the improper management of these wastes. Due to the presence of different physicochemical parameters, these agrowastes and animal dung as food source influence not only the earthworm population but also affect their growth and reproduction during vermicomposting **(Chauhan and Singh 2013).**

There were aims in this investigation to assess the growth of *Eudrilus eugeniae* in a range of different wastes.

Materials and Methods

Culture of earthworms

First experiment. Batches of 500 g wet weight of each waste were used as an initial substrate with a moisture content of 80–85 %. They were placed in plastic boxes (20 x 20 x10 cm) covered with pierced lids for aeration. Eight juvenile *Eudrilus eugeniae*, each in the range 10–12 mg fresh weight, were placed in each plastic box together with one of the different wastes. There were four replicate containers for each type of waste. The 16 plastic boxes with a total of 128 earth-worms were incubated at a room temperature of 28 ± 1°C.

All the earthworms were counted and weighed weekly for 25 weeks until they stopped producing co-coons. The

total numbers of cocoons produced in the different substrates were counted every week and the dates of individual cocoon production recorded. Co-coons were collected and put in cavities in micro-plates in a plastic container filled with distilled water for observation of the numbers of their hatchlings.

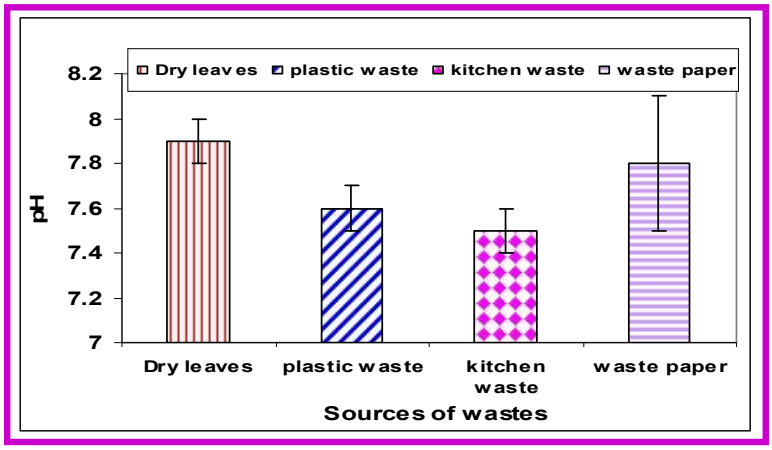
Results

Individual growth, mortality, cocoon and hatchling production in the first experiment. The rates of growth of *Eudrilus eugeniae* in the kitchen waste solids (growing-finish and sow) were about twice as fast as in the dry leaves. *E. eugeniae* survived only to the second week and third week in the fresh kitchen waste .The fastest growth of individuals in the first three months, or during the period of active growth, was 8.9 mg day^{-1} in growing-finish kitchen waste in this substrate there was an overall mortality of 75 % after 25 weeks. This growth rate was significantly different from those in the other substrates such as separated.

After 25 weeks, the highest individual earthworm growth reached in the adult kitchen waste and the lowest individual growth in plastic waste **[Table 1, Fig.1(A, B) & Fig.2(A, B)].**

Table 1:- The physio-chemical characteristics of different organic wastes

Sources of wastes	Moisture content (% dry wt.)	pH	Conductivity (dS m^{-1})	C/N ratio
Dry leaves	53. 3	7.9 ± 0.1	3.4	32.4
plastic waste	41.1	7.6 ± 0.1	3.1	35.43
kitchen waste	81.8	7.5 ± 0.1	3.2	36.1
waste paper	71.2	7.8 ± 0.3	4.2	29.3



A

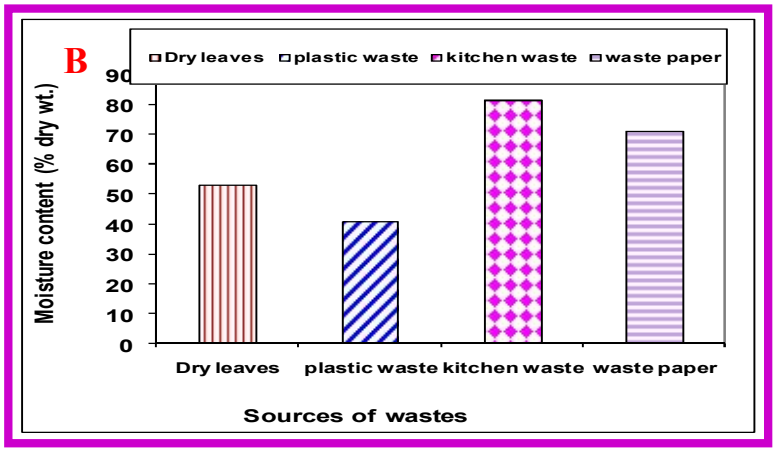
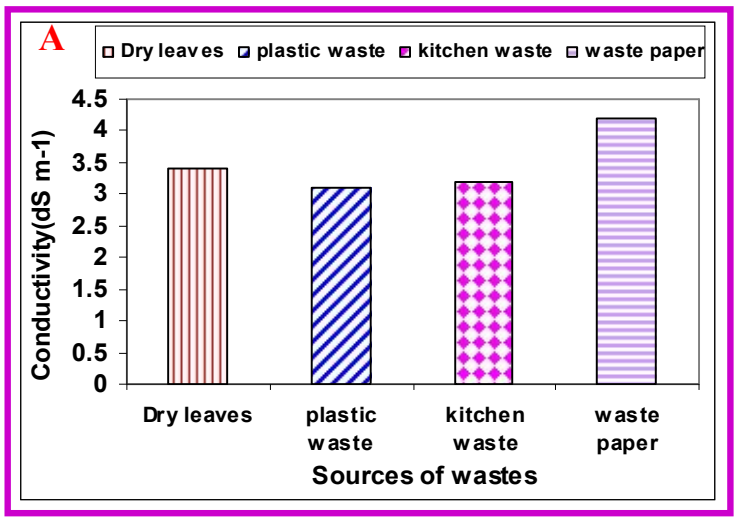


Fig. 1: The physio-chemical characteristics of different organic wastes
(A: Moisture content (% dry wt.), B: pH).



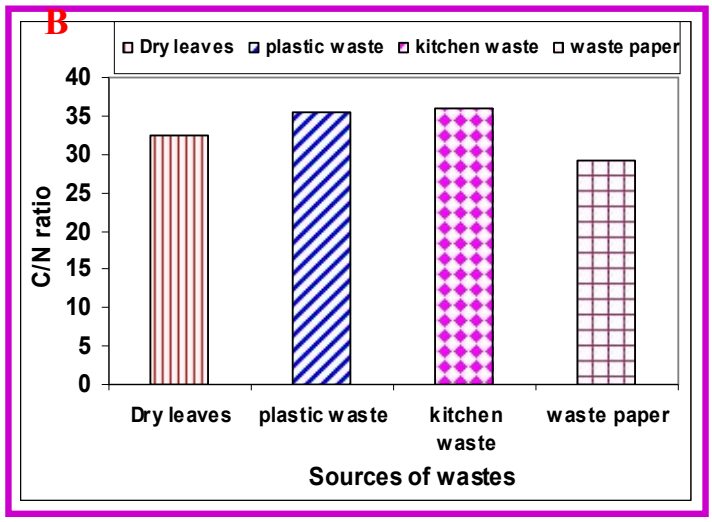


Fig. 2: The physio-chemical characteristics of different organic wastes

(A: Conductivity(dS m^{-1}), B: C/N ratio)

Discussion

The other difference was the aim of this investigation to quantify the mortality of *Eudrilus eugeniae* in different organic waste substrates. As a consequence, some *Eudrilus eugeniae* did not survive in plastic waste or survived only until the second week or third week in fresh paper waste.

In the experiment the earthworms died after 2 weeks in the plastic waste although the moisture content, pH, electrical conductivity, C/N ratio, contents were suitable for the growth of *E. eugeniae* (Table 1). Probably after two weeks the fresh plastic waste became anaerobic.

Aerobically-digested wastes are essential for the growth of earthworms (**Neuhauser et al. 1988).** The organic content was lost in the form of CO2 by the earthworm activity, thus, also a decline from initial feed mixture as well as increase the stabilization process of wastes. The TOC reduction during vermicomposting was observed 24% to 60% in the different combinations of vermibed in an earlier research **(Yadav and Garg 2010).**

The growth rate of worms also continuously increased up to 8th and 9th week in cow dung medium and Pongamia medium respectively and after that the growth rate decreased. This fluctuation was because of the energy utilized by reproduction purpose. The worm increased in weight and again decreased because of the energy was utilized by cocoon formation as well as in that time the worm laying eggs **(Chauhan and Singh 2013)**. The growth of earthworms in plant derived materials could be retarded due to presence of some chemical substances e.g. polyphenols **(Suthar, 2007).** Comparatively, in the present study the earthworm showed least biological potential on leaf residues, and it could be due to presence of some polyphenols and related substances. Besides to high concentrations of nutrient in plant origin wastes, some secondary metabolites are also important, which directly or indirectly influence the composting potential as well as

growth patterns of earthworm species during vermicomposting practices.

Conclusions

The vermicomposting of different biological wastes by the E. *eugeniae* showed significant changes in the physicochemical properties of wastes into a potent vermicompost. It can be concluded that the continuous culture of earthworms in the laboratory is important since the role of vermicomposting, as a part of waste management systems, is mostly in continuous condition.

References

1- **Aranda, E., Barois**, I., Arellano, P., Irisson, S., Salazar, T., Rodriguez, J., Patron, J. C. (1999) Vermicomposting in the tropics. In: Lavelle, P., Brussaard, L., Hendrix, P. (eds) Earthworm Management in Tropical Agroecosystems. CAB International Publishing, New York, pp. 285–287.

2- **Chauhan, H. K.,** and Singh K.(2013) Effect of tertiary combinations of animal dung with agrowastes on the growth and development of earthworm *Eisenia fetida* during organic waste management. Inter J Recycl Organic Waste Agri.;2(11): 1-7

3- **Chauhan, H. K.,** and Singh K.(2012) Effect of binary combinations of buffalo, cow and goat dung with different agro wastes on reproduction and development of earthworm Eisenia fetida (Haplotoxida: Lumbricidae). World J Zool 7:23–29 .

4- **Dominguez J**, Edwards CA (2004) Vermicomposting organic wastes: A review. Soil Zoology for Sustainable Development in the 21st Century. Shakir Hanna S.H. and MikhaTl W.Z.A., eds, Cairo .

5- **Dominguez J**, Edwards CA, and Ashby J (2001) The biology and ecology of Eudrilus eugeniae (Kinberg) (Oligochaeta) bred in cattle waste. Pedobiologia45: 341-353.

6- Gunadi, B.,Susanto, S. J. A., Sosrodjojo, P. S. (1998) Laboratory and large-scale indoor conditions for culturing two species of redworms (*Eisenia andrei* and *Eisenia fetida*) using tea leaf waste as a food. Report Sosro Research and Development Department, Jakarta, 14 pp.

7- Gunadi, B., Blount, C., Edwards, C. A. (2002) The growth and fecundity of *Eisenia fetida* (Savigny) in cattle solids pre-composted for different periods. Pedobiologia 46, 15–23.

8- Jesikha, M. and Lekeshmanaswamy, M. (2013) Effect of pongamia leaf medium on
growth of earthworm (*Eudrilus eugeniae*). International Journal of Scientific and Research Publications, 3(1): 1- 4.

9- Kaplan, D. L., Hartenstein, R., Neuhauser, E. F., Malecki, M. R. (1980) Physicochemical requirements in the environment of the earthworm *Eisenia foetida*. Soil Biology and Biochemistry 12, 347–352.

10- Neuhauser, E. F.,Loehr, R. C., Malecki, M. R. (1988) The potential of earthworms for managing sewage sludge. In: Edwards, C. A., Neuhauser, E. F. (eds) Earthworms in Waste and Environmental Management. SPB Academic Publishing, The Hague, pp. 9–20.

11- Reinecke, A. J.,Viljoen, S. A. (1990a) The influence of feed-ing patterns on growth and reproduction of the

vermicom-posting earthworm *Eiseniafetida* (Oligochaeta). Biology and Fertility of Soils 10, 184–187.

12- Reinecke, A. J.,Viljoen, S. A. (1990b) The influence of worm density on growth and cocoon production of the compost worm *Eiseniafetida* (Oligochaeta). Revue d'Ecologie et de Biologie du Sol 27, 221–230.

13- Shanthi, N. R.,Bhoyar, R. V., Bhide, A. D. (1993) Vermicom-posting of vegetable wastes. Compost Science and Uti-lization 1, 27–30.

14- Suthar S (2007) Composting potential of Perionyx sansibaricus (Perrier) in different waste material. Biores Technol 98:1231–1237

15- Yadav A, Garg VK (2010) Bioconversion of Food Industry Sludge into value-added product (vermicompost) using epigeic earthworm Eisenia fetida. World Revi Sci Technol Sust Dev 7(3):225–238

****