

## Performance of *Lumbricus Rubellus* (Red Worm) on Different Animal Wastes

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### Abstract

A study was conducted to investigate the comparative of animal wastes on the., *lumbricus rubellus* mass production and efficiency. In this study, worm, s growth performance, numbers of worms and physic-chemical characteristics of produced vermicompost were tested at in The Environmental studies and Research Institute(ESRI), Genetic engineering and Biotechnology Research Institute (GEBRI) University of Sadat city. Sadat city, Egypt. during the period from 2018 and 2019.

The epigieic earthworm *Lumbriscus Rubellus* (Red Worm) was provided by Central Laboratory for Agricultural Climate (CLAC), Agricultural Research Center (ARC), Indoor system of vermicomposting was used in this investigation for producing the vermicompost, The experiment was couducted under ( 30 -34 oC) and (70-74%) Humidity, the examined animal waste were (Cow dung – Horse waste –Sewage sludge –Rabbit droppings).

Results revealed that horse waste showed the highest values of Growth performance, number of worms was(91.67, 87.33, 87, 62.67)respectively, number of cocoons was(182.3, 179, 173.3, 133.3) respectively, during the process of composting.Total element of nutrient whereas recorded from ( horse waste, rabbit dropping, sewage sludge and cow dung), respectively. on the other hand the lowest values Growth performance, number of worms, number of cocoons resulted with sewage sludge composted.

**Keywords:** Vermicompost, Epigieic Earthworms, *Lumbricus Rubellus*(Red worm)

### 1. Introduction

Vermicomposting (Worm composting)is defined as a process in which earthworms play a major role with microbes in the conversion of organic solid waste into more stabilized dark, earth-smelling soil conditioner and nutrient-rich compost that is rich in major and micronutrients [1]. During vermicomposting, organic matter is stabilized by the enhanced decomposition (humification) in presence of earthworms, but by a non-thermophilic process [2-4]. The great advantage of worm composting is that this can be done indoors and outdoors, thus allowing year round composting. It also provides apartment dwellers with a means of composting. Vermicomposting allows obtaining organic sources of nutrients for

the crops in relatively less time, which are physically, nutritionally and biochemically improved over composts. Vermicomposting is defined as a low cost technology system for processing or treatment of organic waste Having established their efficiency in converting organic substances to composts, they are widely used in vermicomposting for waste management, production of soil amendment and other uses [5]. The conversion of organic waste into vermicomposting started in the United State and United Kingdom in the 1980s [6]. Whole or portions of earthworms are traditionally used as fish bait in the United State. Their commercial production or permaculture for fish bait was stated in the 1950. Vermicomposts, especially those from animal waste sources,

usually contained more mineral elements than commercial plant growth media, and many of these elements were changed to forms more that could be readily taken up by the plants, such as nitrates, exchangeable phosphorus, and soluble potassium, calcium, and magnesium. The main objective of this study was to evaluate the performance of vermicompost production via ( Red worm) *Lumbriscus Rubellus* on different (animal Wastes), .

## 2. Materials and Methods

### 2.1 Earth Worm Type

The epigieic earthworm *Lumbriscus Rubellus* (Red Worm) was provided by Central Laboratory for Agricultural Climate (CLAC), Agricultural Research Center (ARC), Indoor system of vermicomposting was used in this investigation for producing the vermicompost, Twelve holed plastic boxes (35 x 52 x 15 cm) were established as indoor system of vermicomposting. Each three of holed plastic boxes had 60 worm divided to three replicates for every Animal Waste. Which contained one species of epigieic earthworms (Red Worm) and four Treatments contained three replicates for each waste. Worm diameter: 0.4 – 6 mm and worm length: 80 – 120 mm.

### 2.2 Pre-Composting The Raw Materials

The final mix of raw materials soaked in water for 0.5 to 1 hour to make sure it is not any drier before feeding the worms. Worms should be avoiding the thermophilic stage (increase temperature above 35 oC cause the death of earthworms in vermicompost systems) through control the feeding rate of earthworm. The epigieic earthworm consume as much as their weight of different wastes, the feeding rate of earthworm was 90% of the earthworm weight [7].

### 2.3 Feeding of Earth Worm

The substrate for vermicomposting was prepared by mixing pre-composted (rice straw – Animal Wastes -) [8]. Animal Wastes(Cow dung – Horse waste) was collected from a private farm in Bader city, Behaira Governorate, Egypt. Rabbit droppings was collected from Genetic engineering and Biotechnology Research Institute (GEBRI ), University of Sadat city, Sadat city, Egypt. Sewage sludge was collected from Wadi El-Natroun Drain off station, Wadi El-Natroun Governorate, Egypt [9,10] Each tray was filled with 1000 gm of substrate, respectively 700gm, 300gm, Thereafter, a total of adult worms of *lumbricus Rubellus*, were introduced into respective designated experimental trays. Each tray was covered with jute cloth to protect the worms from predators. Temperature and moisture content were maintained by sprinkling water twice a day, In each tray, porous plastic sack were made at the bottom to facilitate good drainage and aeration. The process of vermicomposting was carried out for 100 days.

### 2.4 Experimental Design

Twelve holed plastic boxes (35 x 52 x 15 cm) were established as indoor system of vermicomposting. Each three of holed plastic boxes had 60 worm divided to three replicates for every Animal Waste. Which contained one species of epigieic earthworms (Red Worm) and four Treatments from three replicates for each waste. and four plastic boxes without using any earthworms as a control. whereat The plastic box contains on one waste.

### 2.5 Sample Collection and Physico-Chemical Analysis

Physico-chemical analysis was done in The Environmental and food biotechnology laboratory, Genetic engineering and Biotechnology Research Institute (GEBRI ), University of Sadat city, Sadat city, From each replicate, about 200g of sample was taken at the end of the process. To analysis Nitrogen (N), , potassium (K) and organic carbon (OC). Electrical conductivity (EC) and pH of harvested vermicompost were also recorded at the end of the process. The N content was determined by Kjeldahl method while, Determination of total kjeldahl in explant (NH<sub>4</sub>-N). (APHA, 2005). Kjeldahl method was used for determination of total nitrogen contents in plant materials.

- **Digestion Unit**

About 1 gram of grounded plant materials were mixed with 10 ml conc H<sub>2</sub>SO<sub>4</sub> and the mixture was digested for 1 h at 400 oC with digester (Behr- Germany).

- **Distillation Unit**

The reaction was distilled and 45 ml 40% NaOH was added. The net result solutions were received in flask containing 50 ml 4% Boric acid solution. This solution was neutralized with 0.02 N H<sub>2</sub>SO<sub>4</sub> [11].

### 2.6 Metal Determination by ICP-MS

For metals determination Harvested waste materials were dried at 65 °C for 72 h and then ground with a mill. A total of 0.5 g of each sample was then digested with 10 ml of a mixture of 69% HNO<sub>3</sub>, conc HCl (3:1 v/v) in a heating digester (DK 20, VELP Scientifica, Milan, Italy).

Plant extracts were filtered through disposable 0.2 µm PTFE syringe filters (DISMIC-25HP, Advantec, Tokyo, Japan). The metal concentrations in these extracts were determined by means of inductively coupled plasma-mass spectroscopy (ICP-MS) (iCAP, Thermo, Germany). Certified reference materials (Merck, Germany) were included in the analyses. The recovery of metals was within the certified limits. Qtegra software was used for average and relative standard deviation calculation [12].

Rabbit. d	Cow dung	H. waste	Sewage	unit	Parameter
69.8	79.56	76.82	5.67	%	Humidity
30.2	20.44	23.18	94.33	%	Total solid
7.56	7.66	7.73	7.51	(wt/v)	pH (2:5)

124.00	863.00	156.00	720.00	Us/cm(wt/v)	EC (2:5)
78.0	47.5	48.0	98.0	%	Ash(wt/100g)
33.80	49.80	35.90	45.20	%	Total protein (wt/100g)
18.4734	17.64	20.0934	13.6134	%	TOM (wt/100g)
7.563	11.163	9.8	10.263	%	TOC (wt/100g)
22.38	22.42	27.30	22.71	%	C/N ratiowt/100g)
0.1222	0.1009	0.429	0.7026		SAR

**Table 1: The Chemical and Physical Characteristics of Animal wastes presented in Table 1**

N	Element	Sewage	Horse waste	Cow dung	Rabbit droppings
1	7Li	2.88	0.13	0.66	0.33
2	11B	14.10	15.45	8.91	2.44
3	23Na	290.84	47.71	47.78	20.80
4	24Mg	232.37	61.84	206.63	99.01
5	27Al	1255.46	206.26	510.29	102.54
6	39K	1355.54	727.65	543.59	128.04
7	44Ca	342.55	92.40	423.55	138.40
8	48Ti	660.27	165.07	693.40	195.57
9	52Cr	11.54	1.54	4.18	1.13
10	55Mn	38.13	11.81	56.65	13.10
11	57Fe	3304.16	591.64	1536.92	317.03
12	59Co	1.34	0.05	0.42	0.44
13	60Ni	8.77	1.30	2.12	1.04
14	63Cu	25.89	3.97	10.82	4.60
15	66Zn	137.81	26.21	133.93	21.67
16	71Ga	13.43	2.76	3.11	2.75
17	88Sr	43.10	16.41	47.10	21.37
18	107Ag	2.28	7.94	16.17	16.74
19	111Cd	0.73	0.06	0.69	0.72
20	115In	52.12	12.47	9.83	9.61
21	137Ba	29.21	24.04	26.28	9.40
22	208Pb	45.93	3.22	18.75	4.93
23	209Bi	102.49	63.25	124.04	124.85

**Table 2: All of Nutrients and Heavy Metals Indicated in Table 2**

**• Statistical Analysis**

The randomized factorial design was applied, and data were the examination of variation. Separation of means between treatments was determined using LSD test at 5% [13].

**3. Results and Discussion**

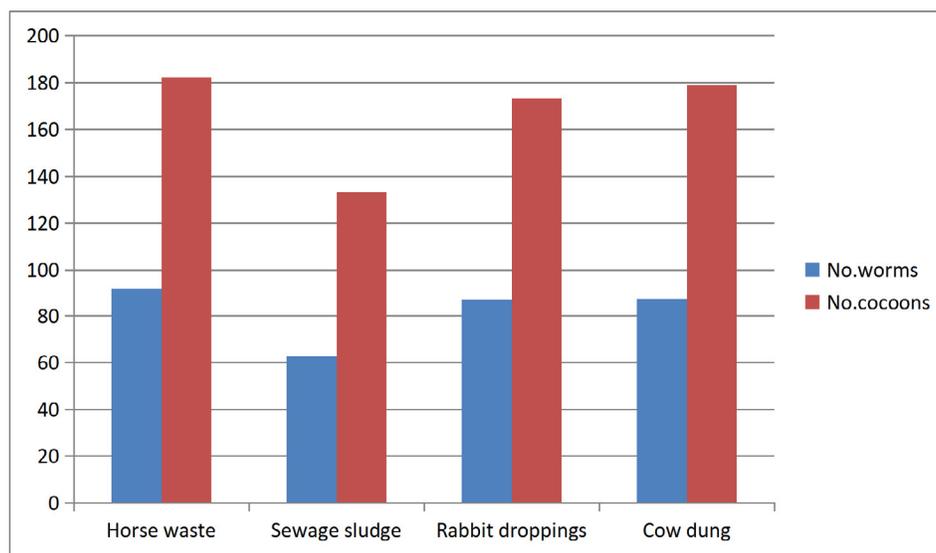
**3.1 The Reproductive of L.rebellus on Different Animal Wastes**

Results in Table (3) showed that the highest number of produced worms of L.rebellus was on Horse waste followed by Rabbit

droppings and Cow dung compared with Sewage sludge [14]. This waste had the lowest number of produced worms, whereas Horse waste, Rabbit droppings and Cow dung had nonsignificant effects but Sewage sludge had a significant effect, (produced worms means= Adult worms + Juvenile worms not baby worms ) irrespective of The Rate of mortality whereas it had a resemble circumstances(passive method), Moreover Cocoons had a Similar results [15,16].

Treatment	No.worms	No.cocoons
Horse waste	91.67A	182.3A
Sewage sludge	62.67B	133.3B
Rabbit droppings	87.00A	173.3A
Cow dung	87.33A	179.0A
LSD value	15.05	15.42

**Table 3: Growth Parameters of L.rebellus on Different Animal Wastes**



**Figure 1: Means of Growth Parameters of L.rebellus on Different Animal Wastes**

This Results may be attributed to the aeration of These wastes(Horse waste, Rabbit droppings and Cow dung) Conversely of Sewage sludge, or That attributed to The highest Level of organic matter of These wastes.

### 3.2 The Effect of L.rebellus on Organic matter(animal wastes)

Element	Sewage fixed by(RW)	Horse waste fixed by(RW)	Cow dung fixed by(RW)	Rabbit droppings fixed by(RW)
Li	0.193	0.220	0.134	0.237
B	1.186	1.185	0.781	1.166
Na	387.28	465.64	359.40	450.66
Mg	268.82	317.47	167.33	319.99
Al	11.05	13.08	9.09	8.96
K	175.21	192.47	132.63	189.29
Ca	35.94	43.13	21.75	41.73
Ti	4.658	5.628	2.779	5.280
Cr	0.625	0.554	0.523	0.443
Mn	4.370	3.392	2.151	1.879
Fe	15.092	22.380	13.967	12.689
Co	0.544	0.622	0.246	0.601
Ni	0.490	0.549	0.313	0.348
Cu	13.105	10.543	8.521	8.128
Zn	13.640	53.808	10.811	15.731
Ga	4.221	0.356	0.255	0.397

Sr	25.462	30.709	15.857	30.099
Ag	31.308	2.287	1.982	0.747
Cd	0.132	0.058	0.071	0.106
Ln	19.597	1.130	0.715	1.270
Ba	17.461	14.117	9.295	10.335
Pb	20.712	10.224	4.636	4.362
Bi	123.850	18.775	2.794	4.265

**Table 4: Chemical Characteristics of Vermicompost Produced by The Epigieic Earthworms *Lumbriscus Rubellus* (Red Worm) on different Animal Wastes**

Parameter	Unit	Sewage fixed by(RW)	Horse waste fixed by(RW)	Cow dung fixed by(RW)	Rabbit droppings fixed by(RW)
Humidity	%	18.242	33.585	18.618	20.502
Total solid	%	81.758	66.415	81.382	79.498
PH(2:5)	(wt/v)	7.230	7.560	7.120	7.190
EC(2:5)	Us/cm(wt/v)	389.0	523.0	366.0	411.0
Ash(wt/100gm)	%	71.0	51.0	65.2	68.0
Total protein (wt/100gm)	%	29.5	25.1	22.9	30.1
TOM(wt/100gm)	%	23.760	25.614	22.322	23.296
TOC(wt/100gm)	%	13.200	14.230	12.401	12.942
C/N Ratio(wt/100gm)	%	44.746	56.693	54.153	42.997
SAR	%	0.205	0.181	0.168	0.208

**Table 5: Physico - Chemical Characteristics of Vermicompost Produced by the Epigieic Earthworms *Lumbriscus Rubellus* (Red Worm) On Different Animal Wastes**

Results in Table ( 4 ) indicated that all nutrients generally decreased after earth worms treatment, This Results may be attributed to the metabolic of earthworms. Vermicomposts are products derived from the accelerated biological degradation of organic wastes by earthworms and microorganisms. Earthworms consume and fragment the organic wastes into finer particles by passing them through a grinding gizzard and derive their nourishment from microorganisms that grow upon them. This minerals are detained inside their tissues. The process accelerates the rates of decomposition of the organic matter, alter the physical and chemical properties of the material, leading to a humification effect in which the unstable organic matter is fully oxidized and stabilized [17,18].

Consequently heavy metals had a resemble results, The similar differences in chemical compositions of the vermicompost based on the substrate used, the highest elemental values were recorded in vermicomposts from horse waste, rabbit dropping, sewage sludge and cow dung, respectively) [19,20]. This results may be attributed to The highest Level of organic matter of These wastes vermicomposts contained adequate amounts of macronutrients and trace elements of various kinds but were dependent on the sources of the earthworm feedstock, (Erratic results) [21,22]. The highest elemental concentrations were recorded in horse waste With (7.560) PH, (523.0 us/cm) EC, (25.1%) Total protein,

(25.614%) Total organic matter, (14.230%) Total organic carbon, (56.693%) C/N Ratio and The lowest elemental concentrations were recorded in Cow dung with only (7.120) PH, (366.0 us/cm) EC, (22.9%) Total protein, (22.322%) Total organic matter, (12.40 %) Total organic carbon, (54.153 %) C/N Ratio, except for The highest level of Ash was(71.0) in sewage but The lowest level of Ash was(51.0) in horse waste, The highest level of Total protein was(30.1) in Rabbit droppings but The lowest level of Total protein was(22.9) in Cow dung, The highest level of C/N Ratio was(56.693%) in horse waste but The lowest level of C/N Ratio was(42.997%) in Rabbit droppings [23-26].

#### 4. Conclusion

In the present study, *L. Rubellus* (Red Worm), showed better growth performance of earth worm number in Horse waste, Rabbit droppings and Cow dung compared with Sewage sludge, it had the lowest number of produced worms whereas all nutrients generally decreased after earth worms treatment and the highest elemental values were recorded in vermicomposts from horse waste, rabbit dropping, sewage sludge and cow dung, respectively. It could be conclude that “ when animal wastes contained high level from organic matter, earth worm number and quality of vermicompost would be increase”.

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## References

1. Abul-Soud, M., Hassanein, M. K., Ablmaaty, S. M., Medany, M., & Abu-Hadid, A. F. (2009). Vermiculture and vermicomposting technologies use in sustainable agriculture in Egypt. *J. Agric. Res*, 87(1).
2. Atiyeh, R. M., Arancon, N. Q., Edwards, C. A., & Metzger, J. D. (2002). The influence of earthworm-processed pig manure on the growth and productivity of marigolds. *Bioresource technology*, 81(2), 103-108.
3. Elvira, C., Goicoechea, M., Sampedro, L., Mato, S., & Nogales, R. J. B. T. (1996). Bioconversion of solid paper-pulp mill sludge by earthworms. *Bioresource Technology*, 57(2), 173-177.
4. Elvira, C., Sampedro, L., Benitez, E., & Nogales, R. (1998). Vermicomposting of sludges from paper mill and dairy industries with *Eisenia andrei*: a pilot-scale study. *Bioresource technology*, 63(3), 205-211.
5. Hand, P., Hayes, W. A., Satchell, J. E., & Frankland, J. C. (1988). *The vermicomposting of cow slurry* (pp. 49-63).
6. Guerrero R.D. (2009). Vermicompost and vermiform production. MARID agribusiness technology Guide 22p.
7. Abul-Soud M.A, Emam M.S.A, Abdrabbo M.A.A, Hashem F.A, Abd-Elrahman Shaimaa H., (2014) Sustainable urban horticulture of sweet pepper via vermicomposting in summer season. *J. adv. Agric.* 3:pp.110-122.
8. Gandhi and U. S. Sundari, (2012). "Effect of Vermicompost Prepared from Aquatic Weeds on Growth and Yield of Eggplant ( *Solanum melongena* L.), " *Biofertilizers and Biopesticides*, vol. 3, no. 5, pp. 5–8.
9. Yadav, A., Gupta, R., & Garg, V. K. (2013). Organic manure production from cow dung and biogas plant slurry by vermicomposting under field conditions. *International Journal of Recycling of organic waste in agriculture*, 2(1), 21.
10. Ludibeth, S. M., Marina, I. E., & Vicenta, E. M. (2012). Vermicomposting of sewage sludge: earthworm population and agronomic advantages. *Compost Science & Utilization*, 20(1), 11-17.
11. American Public Health Association[APHA] (2005) *Standard Methods for the Examination of Water and Wastewater* 22<sup>nd</sup> ed. APHA, Inc. Washington, D.C.
12. Lambers, H., Chapin III, F. S., & Pons, T. L. (2008). *Plant physiological ecology*. Springer Science & Business Media.
13. Steel, R.G.D. and Torrie, J.H. 1980. Principles and procedures of statistics, a biometrical approach. Second Edition. McGraw-Hill Book Co., New York, NY, 137-177.
14. Piya, S., Shrestha, I., Gauchan, D. P., & Lamichhane, J. (2018). Vermicomposting in organic Agriculture: Influence on the soil nutrients and plant growth. *International Journal of Research*, 5(20), 1055-1063.
15. Loh, T. C., Lee, Y. C., Liang, J. B., & Tan, D. (2005). Vermicomposting of cattle and goat manures by *Eisenia foetida* and their growth and reproduction performance. *Bioresource technology*, 96(1), 111-114.
16. Fadaee, R. (2012). A review on earthworm *Eisenia fetida* and its applications.
17. Albanell, E., Plaixats, J., & Cabrero, T. (1988). Chemical changes during vermicomposting (*Eisenia fetida*) of sheep manure mixed with cotton industrial wastes. *Biology and fertility of soils*, 6(3), 266-269.
18. Orozco, F. H., Cegarra, J., Trujillo, L. M., & Roig, A. (1996). Vermicomposting of coffee pulp using the earthworm *Eisenia fetida*: effects on C and N contents and the availability of nutrients. *Biology and fertility of soils*, 22(1), 162-166.
19. Angelova, V. R., Akova, V. I., Artinova, N. S., & Ivanov, K. I. (2013). The effect of organic amendments on soil chemical characteristics. *Bulgarian Journal of Agricultural Science*, 19(5), 958-971.
20. Abu Bakar Azizi, A. B. A., Choy MayYee, C. M., Zalina Mahmood Noor, Z. M. N., & Abdullah Noorlidah, A. N. (2015). Effect on heavy metals concentration from vermicomposting of agro-waste mixed with landfill leachate.
21. Businelli, M., Perucci, P., Patumi, M., & Giusquiani, P. L. (1984). Chemical composition and enzymic activity of some worm casts. *Plant and Soil*, 80(3), 417-422.
22. Werner, M., Cuevas, R., (1996) *Vermiculture in Cuba*. Biocycle. Emmaus, PA., JG Press. 37:pp. 61-62.
23. Piya, S., Shrestha, I., Gauchan, D. P., & Lamichhane, J. (2018). Vermicomposting in organic Agriculture: Influence on the soil nutrients and plant growth. *International Journal of Research*, 5(20), 1055-1063.
24. Anindita Gogoi, A. G., Sudipta Biswas, S. B., Janumoni Bora, J. B., Bhattacharya, S. S., & Manish Kumar, M. K. (2015). Effect of vermicomposting on copper and zinc removal in activated sludge with special emphasis on temporal variation.
25. Sahariah, B., Goswami, L., Kim, K. H., Bhattacharyya, P., & Bhattacharya, S. S. (2015). Metal remediation and biodegradation potential of earthworm species on municipal solid waste: A parallel analysis between *Metaphire posthuma* and *Eisenia fetida*. *Bioresource Technology*, 180, 230-236.
26. Angelova, V. R., Akova, V. I., Artinova, N. S., & Ivanov, K. I. (2013). The effect of organic amendments on soil chemical characteristics. *Bulgarian Journal of Agricultural Science*, 19(5), 958-971.

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