Open Access

J. Glob. Innov. Agric. Sci., 2024, 12(3):681-684
ISSN (Online): 2788-4546; ISSN (Print):2788-4538
DOI: https://doi.org/10.22194/JGIAS/24.1387
http://www.jgiass.com

Society for Innovative Agiculture

The Ability of Earthworms to Influence the Ratio of C/N during Vermicomposting Process from Different Remnants

Sara Munthir Mubdir[1,*], Sua'd Khairi Abid Al-Wahab[2] and Khanssa S. Farman[3]

[1]Diyala Education, Directorate Ministry of Education, Diyala, Iraq; [2]Department of biology, collage of education for pure science, university of Diyala, Iraq; [3]Department of biology, collage of education for pure science, university of Diyala, Iraq
*Corresponding author's e-mail: sara.monthir.mobdir@uodiyala.edu.iq

This study aimed to investigate the carbon to nitrogen ratio (C/N) in vermicomposts produced from mixtures of cabbage, beans, and tea remnants combined with cardboard at a 1:1 ratio, totaling 2 kilograms, using two different types of worms: Lumbricus terrestris and Eisenia fetida. The results indicated that vermicompost produced by Eisenia fetida exhibited a significant decrease in C/N ratio by 18.60, whereas that produced by Lumbricus terrestris had a C/N ratio of 20.723. Regarding interactions, the highest initial C/N ratio among cabbage remnants, irrespective of worm type, was 25.000, whereas the lowest ratio after processing was 1.936 for tea remnants, showing significant differences. Across all remnants, there was a consistent decrease in C/N ratio post-processing, with cabbage remnants exhibiting the highest initial ratio of 25.00 before earthworm addition and tea remnants showing the lowest ratio of 8.530 after earthworm processing, indicating significant variation.
Keywords: Earthworm, vermicompost, C/N ratio, recycling plant, *Eisenia fetida*, *Lumbricus terrestris.*

INTRODUCTION

The C/N ratio is considered to be the main indicator for evaluating the degree of development of organic matter, which means its ability to rapidly decompose in the soil. Without the decomposition process, organic matter would have accumulated on the surface of the earth. The C/N ratio differs from one organic substance to another. For example, it is 400:1 in sawdust, 80:1 in Palm wicker, 20:1 in Alfalfa plants, and 60:1 in Baghdad garbage. The mean of carbon to nitrogen in microorganisms that exist in the soil is 8, as they take two-thirds of carbon to obtain energy, whereas the last third is for formation and growth (Salloum, 2020). They also use nitrogen for growth and thus the nutritional balance occurs when the C/N ratio is 24. However, if the C/N ratio is less than that, nitrogen will be released into the soil so that the plants can get benefit from and if it is higher than that, the nitrogen will be present in the soil solution for the microorganisms to benefit from. The decomposition process is slow and results in assimilation within the bodies of microorganisms, but if the C/N ratio is 30:1, the decomposition process will be medium-speed and hence will be a balance between mineralization and assimilation. Nonetheless, if it is from 20:1 (such as the Alfalfa plant), the decomposition process will be fast and thus will be a mineralization process, whose properties are close to those of soil humus (Al-Saidi *et al*., 2021; Sarheed, 2022). The C/N ratio plays a major role during the vermicomposting process, as it provides the correct ratio for earthworm feeding and is essential for microbial activity. The quality of vermicompost, the growth and reproduction of worms depend on the C/N ratio (Biruntha *et al*., 2020). Boruah *et al*. (2019) mentioned that vermicompost maturity can be confirmed by the N/C ratio, and it usually tends to decrease due to the decomposition of organic matter, the reduction of organic carbon and the increase of nitrogen through worms and their secretion of nitrogen. This was observed by Wang *et al*. (2019) at the beginning of their experiment on wastewater using the *E. fetid* worm. The C/N ratio was 15, 22, and 27 at the beginning, whereas it became 12, 16, and 20, respectively at the end of the experiment. Furthermore, Biruntha *et al*. (2020) found a decrease in the final C/N ratio compared to the control, that is, treatments without worms. These treatments are seaweed, sugar cane waste, coconut pulp, and cow dung, using a worm *Eudrilus eugeniae*. Manure, bio-waste, and food are high in nitrogen due to their increased porosity allowing air to flow, so they must be mixed with another carbon matter that gives structural rigidity to tolerance high humidity levels in the litter. For instance, food waste contains a high percentage of water, which prevents the flow of air and

Mubdir, S.M., S.K.A. Al-Wahab and K.S. Farman. 2024. The Ability of Earthworms to Influence the Ratio of C/N during Vermicomposting Process from Different Remnants. Journal of Global Innovations in Agricultural Sciences 12:681-684.
[Received 19 May 2024; Accepted 17 July 2024; Published 13 Aug 2024]

thus becomes stinky and slows down the decomposition process. If shredded newspaper is mixed with it, the added carbon will balance the C/N ratio. (Sherman, 2018).

MATERIALS AND METHODS

1- Two species of worms were used: *fetida Eisenia* and *Lumbricus terrestris*, and three kinds of plant remnants mixed with cardboard, which are Cabbage, bean husks, tea, as well as cardboard.
2- The remnants of shredded cardboard were soaked in water for a whole night. Then, the remnants of Cabbage and bean husks were chopped. The remnants of tea were collected from household leftovers and dried in the sun before use to prevent rotting.
3- Plastic boxes of 24 boxes were prepared and covered with burlap bags. A kilo of cardboard was mixed with the remnants of Cabbage, bean husks, and tea at a ratio of 1:1 respectively. Three replications were left, in addition to two kilos of cardboard without plant remnants.
4- 50 grams, equivalent to 50 worms of E. *fetida* were placed in the first 12 boxes, and *L. terrestris* worms were placed in the second 12 boxes. The litter was moistened with distilled water and the pH, temperature and humidity were measured with a special device throughout the experiment period at each weekend.
5- Before the experiment, care must be taken to wash Cabbages and bean husks prior use in order not to affect the worms, pesticides that were sprayed on the plant, or the plants may contain insect eggs or flies that feed on both types of worms.
6- Samples were taken from plant remnants before and after the experiment. The samples were dried in oven at a temperature of 48 °C for a whole day. Then they were grinded by an electric mill and passed through a sieve with a capacity of 2 mm. The samples were weighed with a sensitive electric balance and collected in envelops to estimate the C/N ratio.

***C/N Ratio Estimation*:**

***Estimation of organic carbon*:** The organic cardboad was estimated as in Walkeley and Black (1934) using potassium dichromate, and then the organic carbon content of the organic matter was calculated using the following law:

$$\text{Organic carbon \%} = 10\,(1 - T/S)$$

10: volume of potassium dichromate solution; T: volume of ferrous sulphate consumed by titration in the sample state; S: volume of ferrous sulphate consumed by titration in the plank state

***Estimation of total nitrogen*:** The total nitrogen was estimated as reported in Odeh and Shamsham (2008).

Using the equation:

$$\text{Total N \%} = (A-B) * N * E * 100/1000 * W$$

A and B: the volume of sodium hydroxide solution (ml) consumed in calibrating the control and the sample, respectively.

N: the sodium hydroxide converter used in the titration; E: equivalent weight of nitrogen; W: weight of the sample (manure or remnants)

To find the value of N/C Ratio, the value of organic cardboard is divided by the value of nitrogen.

RESULTS AND DISCUSSION

It is noted from Table 1 that the C/N ratio in organic remains containing *Esinia fetida* decreased by 18.680 in contrast with *Lumbricus teristrris*, which amounted to 20.723. This is consistent with Suthar (2009) who used *Esinia fetida* to Decompose plant leaves and found a decrease in the C/N ratio as compared to control samples, and in contrast, an increase was found in the percentage of nitrogen, phosphate, potassium, and carbon. It also agrees with Suparno (2017), as it was found that the C/N ratio decreased in the remnants of *Lumbricus terrestris* from 46.08 to 8.46, and a decrease was found in the environment of *Esinia fetida* from 46.08 to 6.52. The reason for the decrease in the C/N ratio was due to the decrease in carbon and the increase in nitrogen. Bearing in mind that the decrease in carbon is due to the process of decomposition from complex bonds to simpler bonds due to the use of carbon by worms and living organisms to obtain the

Table 1. The ratio of carbon to nitrogen in plant remnants.

Remnants		Worms		Mean
		E. fetida	***L. terrestris***	
C/N Ratio before add earthworm	Cabbage	25.000[a]	25.000[a]	25.000[a]
	Beans	22.533[b]	22.133[bc]	22.333[b]
	Tea	15.386[f]	15.386[f]	15.386[e]
	Cardboard	22.600[b]	22.600[b]	22.600[b]
C/N Ratio after add earthworm	Cabbage	20.400[e]	21.733[cd]	21.066[d]
	Beans	20.433[e]	21.800[c]	21.116[d]
	Tea	1.936[g]	15.133[f]	08.530[f]
	Cardboard	21.166[d]	22.000[bc]	21.583[c]
Mean		18.680[b]	20.723[a]	

*Different letters indicate a significant difference at p≤ 0.05 according to Duncan's multiple-range tests.

energy necessary for respiration. An increase in nitrogen levels occurs as a result of mineralization, which is the transformation of organic into inorganic nitrogen due to enzymes in addition to the nitrogen produced by worm feces, or even due to the increasing nitrification process carried out by bacteria in the environment (Shweta, 2020). Concerning the interaction, the highest percentage of Cabbage remnants was 25.000 for the two types of worms before adding earthworm, and the lowest percentage was 1.936 for tea remnants after adding earthworm, with high significant differences. Notes were recorded in this regard during the experiment. It was clear that tea remnants decomposed faster than the rest of the remnants for both types of worms. Yadav *et al*. (2019) stated that the worm manure has a low ratio of carbon to nitrogen, and this is consistent with the results of the experiment, as all remnants had the highest C/N ratio before adding earthworm, however, those ratios decreased after adding earthworm. The reason for the high C/N ratio in Cabbage may be heat. (Prasetya and Talkah, 2013) pointed out that when the temperature in the worm litter increases, the microbial oxygen consumption increases, and thus the percentage of oxygen available to the earthworm decreases. Therefore, the feeding and decomposition activity slows down. The mean of all remnants witnessed a decrease in the percentage after adding earthworms. The highest percentage was 25.00 for Cabbage remnants before adding earthworms, while the lowest percentage was 8.530 for tea remnants, and that is a significant difference. (Prasetya and Talkah, 2013) considered that the decrease in the C/N ratio to 20 indicates the maturity of vermicompost, and this is consistent with what was found by Abu Bakar *et al*. (2014) with a decrease in the C/N ratio in the remnants of some plants, including Cabbage, from 27.14 to 24.66, during 70 days.

Conclusion: Both types of earthworms contributed to increasing the decomposition of organic waste, as the C/N ratio decreased after adding the worms compared to before adding them, and the largest rates of decomposition of organic matter were in tea waste, as it was 15.386 before adding *E.fetida* and 1.936 after adding it, and it was before adding *Lumbricua. terrestris* 15.386 to 15.133. The reason for the decrease in tea waste is the preference of worms for it.

***Authors contributions statement*:** S. Mubder, designed, and completed the experiments; S. Al-Wahab, Apriliani prepared the draft; K. Farman reviewed and finalized the draft.

***Conflict of interest*:** The authors declare no conflict of interest.

***Ethical statement*:** This article does not contain any studies regarding humans or Animals.

***Availability of data and material*:** We declare that the submitted manuscript is our work, which has not been published before and is not currently being considered for publication elsewhere.

***Code availability*:** Not applicable.

***Consent to participate*:** All authors participated in this research study.

***Consent for publication*:** All authors submitted consent to publish this research. article in JGIAS.

***SDG's Addressed*:** Responsible Consumption and Production.

REFERENCES

Abu Bakar, A., S.N.A. Syed Mohd Gawi, N.Z. Mahmood and N. Abdullah. 201. Vermicomposting of vegetable waste amended with different sources of agro-industrial by-product using *Lumbricus rubellus*. Polish Journal of Environmental Studies 23:1491-1498.

Al-Saidi, M., P. Das and I. Saadaoui. 2021. Circular economy in basic supply: Framing the approach for the water and food sectors of the Gulf cooperation council countries. Sustainable Production and Consumption 27:1273-1285.

Biruntha, M., N. Karmegam, J. Archana, B.K. Selvi, J.A.J. Paul, B. Balamuralikrishnan and B. Ravindran. 2020. Vermiconversion of biowastes with low-to-high C/N ratio into value added vermicompost. Bioresource Technology 297:122398.

Boruah, T., A. Barman, P. Kalita, J. Lahkar and H. Deka. 2019. Vermicomposting of citronella bagasse and paper mill sludge mixture employing Eisenia fetida. Bioresource technology 294:122147.

Odeh, Mahmoud and Shamsham, Samir. 2008. Soil fertility and plant nutrition - the practical part. Directorate of University Books and Publications.

Prasetya, B. and A. Talkah. 2013. The study of vermicomposting optimization of organic waste. International Journal of Advances in Engineering & Technology 6:1505.

Salloum, Mohamed Obeid. 2020. Soil Fundamentals (Theoretical Part). Anbar University, College of Agriculture

Sarheed, Bassam Ramadan. 2022. Soil organic matter (theoretical part). Anbar University, College of Agriculture

Shweta. 2020. Effect of Heavy Metaltoxicity on Biomolecules and Antioxidative Enzymes in Earthworm, Eisenia Fetida. [With CD Copy] (Doctoral dissertation, Zoology, CCSHAU, Hisar).

Suparno, Budi Prasetya, Abu Talkah and Soemarno.2017. THE STUDY OF vermicomposting optimization of organic waste. University of Brawijaya Student, Malang, Indonesia. International Journal of Advance Resources 5:37-43.

Suthar, S. 2009. Impact of vermicompost and composted farmyard manure on growth and yield of garlic (*Allium stivum* L.) field crop.

Walkley, A. and l.A. Black. 1934. An examination of the Degtjareff Method for Determining soil Organic matter, and proposed modification of the chromic Acid Titration Method. soil science 37:29-38.

Wang, L., Y. Li, S.O. Prasher, B. Yan, Y. Ou, H. Cui and Y. Cui. 2019. Organic matter, a critical factor to immobilize phosphorus, copper, and zinc during composting under various initial C/N ratios. Bioresource technology 289:121745.

Yadav, A. and V.K. Garg. 2019. Biotransformation of bakery industry sludge into valuable product using vermi-composting. Bioresource technolog 274:512-517.