International Journal of Plant & Soil Science

Volume 35, Issue 13, Page 230-234, 2023; Article no.IJPSS.100256
ISSN: 2320-7035

Making Vermicompost from Kitchen Waste with Vermicomposting Technology

Abhimanyu Kumar [a++], Arman Ali [a++], Yash Verma [a++], Robin [b#], Asharani Patel [a†] Paramita Deb [a†] and Deepak Maurya [a†*]

[a] *School of Agricultural Sciences, G D Goenka University, Sohna-122 103, Gurugram, Haryana, India.*
[b] *School of Medical and Allied Sciences, G D Goenka University, Sohna-122 103, Gurugram, Haryana, India.*

Authors' contributions

This work was carried out in collaboration among all authors. Authors AP and DM conceptualized and prepared the manuscript. Authors PD critically supplemented the manuscript and data analysis. Authors AK, AA, Robin and YV for assisting the manuscript. All authors read the final version of the manuscript, provided necessary suggestions and approved it for publication.

Article Information

DOI: 10.9734/IJPSS/2023/v35i133009

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/100256

Original Research Article

Received: 09/03/2023
Accepted: 16/05/2023
Published: 25/05/2023

ABSTRACT

Rapid urbanization, industrialization, technological development, and population growth have created serious problems with rising solid waste generation, and managing such enormous amounts of waste is becoming increasingly difficult. Each year, more than one billion tonnes of solid trash are produced, and they end up unscientifically in the environment, creating costs for society, the economy, and the ecosystem. The proper management of this massive volume of

[++] *Student of Agriculture;*
[#] *Student of Radiology;*
[†] *Assistant Professor;*
**Corresponding author: E-mail: deepak.maurya@gdgu.org;*

garbage presents significant difficulties for humanity. Researchers from all over the world are looking for fresh, cutting-edge, and environmentally sustainable waste management technology. Biological approaches are more suited for waste treatment since they can be economical and recycle different waste components into useful end products. One such efficient biological waste management technique is vermicomposting, which uses bacteria to help earthworms break down garbage. Vermicomposting is a naturally occurring bio-oxidative decomposition process that takes place in mesophilic environments and is further facilitated by the biochemical activity of microorganisms.

Keywords: Vermicompost; kitchen waste; earthworms; vermiculture and organic matter.

1. INTRODUCTION

"Due to the low efficiency of collection, disposal, or valorization, the rapid expansion of KW (kitchen waste) is one of the main concerns during the urbanization process, which is now seriously creating a challenge to proper waste management and embarrassing the urban development. In order to address these issues, the circular economy (CE) is a widely accepted waste management strategy. Its goals include lowering waste production, enhancing the circularity of raw materials used, extending the lifespan of resources, and completing the economic and ecological cycles of resource flows" [1]. The three-phase separation could be observed to significantly reduce the heterogeneous nature of kitchen waste, allowing for the following bioconversions and the creation of a variety of products with added value [2]. Due to inadequate infrastructure, poor planning, a weak regulatory framework, and a lack of funding, the majority of developing nations like India lack mechanisms for effective waste management [3]. "Furthermore, one of the major obstacles to effective bioconversion is the huge gap between policy and implementation. The most widely employed carbon sources for BC synthesis in static or agitated cultures are various soluble carbohydrates such glucose, sucrose, fructose, maltose, and xylose, while starch, glycerol, and ethanol have also been thoroughly studied" [4]. Vermicomposting is a straightforward biological method of composting that uses certain earthworms to speed up the waste-to-product conversion process and produce a higher-quality final product. Garg et al. [5] the earthworms can survive in environments with pH levels of 0 to 40, but their potential for regeneration is greater at 25 to 40 degrees Celsius, 40 to 45 percent moisture content, and partially decomposed organic matter, which is rich in nitrogen [6,7]. Several research has shown that vermicomposting can produce safe pathogen levels, which may be facilitated by microbial and enzymatic activity. As an added benefit, this process also has the advantage of making vital plant nutrients more soluble, which aids in plant utilization [8,9]. A significant portion of the petrifying organic waste that ends up in landfills or is dumped into roadsides and waterways in many developing nations is the organic kitchen waste produced by restaurants and canteens. The primary issues with composting food scraps are their high moisture content, the necessity for bulking substrate, and their unsuitable composition for worms. Hence, composting of raw waste needs regular attention to moisture management, waste ingredients, the ratio of carbon and nitrogen that affects composting, and the length of composting. The experiment's goal was to determine how pre-thermo composting affected the problems that occurred during the vermicomposting of kitchen trash in order to shorten the composting process and enhance the quality of the finished compost. Vermicomposting has been used to recycle kitchen waste, yard waste, and municipal waste, as well as to bio-convert organic waste into vermicompost that is nutrient-dense. The undigested discharged excreta of earthworms do not decompose quickly because the process of vermistabilization is caused by microbial degradation of organic materials within the gut of earthworms. Around the world, research on the vermicomposting of various wastes is gaining momentum [10-13]. However, there are not many reports on the chemical changes that occur while the earthworm breaks down organic waste [14,15]. Vermicomposting is crucial because it turns trash into money by utilizing inexpensive eco-friendly methods and earthworm activity. From the perspective of a healthy environment, vermicomposting is the most important method of managing kitchen waste.

1.1 Research Gap

Vermicompost production technology from kitchen waste is not properly standardized.

2. MATERIALS AND METHODS

Collection of material household kitchen waste was collected, dried by air drying, and ground into little bits. The mixture's moisture level was kept between 60% and 70%, and it was then placed in plastic containers wrapped with paper and punctured with holes to allow for aeration in order to produce the final composted product. This mixture was manually stirred and re moistened for enough microbial activity at regular intervals.

2.1 Collection and Culturing of the Earthworm

Adult earthworms, *Eisenia fetida*, were chosen at random from a variety of stock cultures kept for the vermiculture. The collection of kitchen wastes that were employed as substrate were gathered from the trash and from the Hostel in the Sohana area. For biological and visual analysis, all samples were maintained at room temperature.

Target sample: Kitchen waste.

Type of Sampling: conventional.

Pit Size: 1m × 1m× 1m.

Tools to be used: Spades, Shovel, Sieves, Packaging machine, Vermicompost shed and Bucket.

3. RESULTS AND DISCUSSION

Food wastes with high organic and moisture content are problematic to collect, transport, and store, and if they are not treated before disposal, they can seriously pollute the environment. In tiny systems to handle kitchen waste, operation performance may differ from system to system in comparison to windrow composting due to the variable nature of food waste elements and the bulking agent. In the current investigation, there was a noticeable reduction in waste volume of 85% and 79%, respectively. “Scientific investigations have established the viability of using earthworms as a treatment technique for numerous waste streams besides producing organic fertilizers. Vermicomposting results in the bioconversion of the waste stream into two useful products, earthworm biomass and vermicompost” [16]. Kitchen waste material is characterized with high values of pH, organic carbon. The process of vermicomposting activity significantly modified the physical and chemical properties of kitchen waste material that can be a key factor for organic farming. It is indicated that during vermicomposting the pH declines in Table 1 (from 9 to 8.25) with the advancement of vermicomposting period (from 0 to 60 days). Higher reduction in pH in the polyculture reactors was observed by Suthar & Singh [17]; Khwairakpam & Kalamdhad [18]. It might be on account of high mineralization of nitrogen and phosphorus into nitrates/nitrites and ortho-phosphate.

The highest values of organic carbon, organic matter and C:N ratio were obtained in control (0 day) i. e. 2%, 3.44% and 2.10 respectively and lowest values were obtained after 60 days of vermicomposting i.e. 1.20%, 2.06% and 0.8% respectively. These data are also supported by Elvira et al. [19], who observed “20 to 42% loss of carbon as CO_2 during vermicomposting of paper mill and dairy sludge”. “Moreover, the increase in earthworm population might also be attributed to the C: N ratio decreasing with time” [20].

It is clearly evident from the result of Table 1 that the values of Nitrogen, available phosphorus and exchangeable potassium increased over 60 days of vermicomposting. Lowest values of total nitrogen (0.95%), available phosphorus (0.25%) and exchangeable potassium (1.25 %) were found in control (0day). Moreover, as the time period increases during vermicomposting, these parameters also increases and their maximum values i.e. nitrogen (1.50 %), phosphorus (0.36%) and potassium (1.76%) were obtained after 60 days of vermicomposting. Gunadi and Edwards [21] also carried out a study and demonstrated that after six months of vermicomposting, the nitrogen content in the end product was high.

All the parameters mentioned in Table.1 clearly indicates that Verm technology reduces the amount of waste and also improves the nutrient content of the product (vermicompost) can be to be used as a biofertilizer in agricultural practices.

Kitchen waste material's physical and chemical characteristics were considerably altered by the vermicomposting process, making it a valuable tool for organic farming.

Table 1. Effect of vermicompost on different phyco-chemical parameter of kitchen waste vermicompost

Sl. No.	Parameters	0 days	30 days	60 days
01	pH	9.00	8.45	8.25
02	Electrical conductivity (Ec)ds/m	0.983	0.884	0.881
03	Organic carbon (OC) (%)	2.00	1.55	1.20
04	Organic matter (%)	3.44	2.67	2.06
05	Nitrogen (%)	0.95	1.06	1.50
06	Phosphorous (%)	0.25	0.32	0.36
07	Potassium (%)	1.25	1.39	1.76
08	C:N	2.10	1.46	0.80

4. CONCLUSION

Prior to vermicomposting, thermo composting was useful for reducing mass, stabilizing pH and moisture, and stabilizing waste. Following thermo composting, worm composting was successful in rendering the pathogens inactive. This study showed that treating kitchen garbage with 9 days of thermo-composting and then 2.5 months of vermicomposting produced compost that was pathogen-free. Vermicomposting is a good process for converting various types of organic wastes (household and industrial) into value-added material, according to experimental data. Vermicompost produced from various organic sources is analyzed.

5. FUTURE PROSPECTS

Food and kitchen trash are a great source of organic carbon that may be used to create a variety of chemicals and high-value molecules. Although there are a number of benefits and restrictions associated with turning food waste into value-added goods, there is currently a shortage of appropriate technology for effective conversion. The diverse character of the trash is mostly to blame for this technological obstacle. However, there is a tremendous market for a green, eco-friendly method for turning food waste into products with added value. For the proper management of food and kitchen waste, adjustments must be made to the technology and tactics now in use. Therefore, in-depth research is needed in this area to make it economically viable.

ACKNOWLEDGEMENT

The authors thank School of Agricultural Sciences, GD Goenka University, Sohna, Gurgaon, Haryana for providing the required materials and research lab for the conduct of research trail.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Paes LAB, Bezerra BS, Deus RM, Jugend D, Battistelle RAG. Organic solid waste management in a circular economy perspective–A systematic review and SWOT analysis. Journal of Cleaner Production. 2019;239:118086.
2. Zamri MFMA, Hasmady S, Akhiar A, Ideris F, Shamsuddin AH, Mofijur M, Mahlia TMI. A comprehensive review on anaerobic digestion of organic fraction of municipal solid waste. Renewable and Sustainable Energy Reviews. 2021;137:110637.
3. Sharholy M, Ahmad K, Mahmood G, Trivedi RC. Municipal solid waste management in Indian cities- a review. Waste Manag. 2000;28:459–467.
4. Campano C, Balea A, Blanco A, Negro C. Enhancement of the fermentation process and properties of bacterial cellulose: a review. Cellulose. 2016;23:57-91.
5. Garg S, Zisser H, Schwartz S, Bailey T, Kaplan R, Ellis S, Jovanovic L. Improvement in glycemic excursions with a transcutaneous real-time continuous glucose sensor: a randomized controlled trial. Diabetes Care. 2006;29(1):44-50.
6. Badrinath SG, Kale JR, Noe TH. Of shepherds sheep and the cross-autocorrelations in equity returns. The Review of Financial Studies. 1995; 8(2):401-430.

7. Nagavallemma KP, Wani SP, Lacroix S, Padmaja VV, Vineela C, Rao MB, Sahrawat KL. Vermicomposting: Recycling wastes into valuable organic fertilizer. Global Theme on Agroecosystems Report no. 2004;8.
8. Chan PL, Griffiths DA. The vermicomposting of pre-treated pig manure. Biological Wastes. 1988;24(1):57-69.
9. Hartenstein R, Bisesi MS. Use of earthworm biotechnology for the management of effluents from intensively housed livestock. Outlook on Agriculture. 1989;18(2):72-76.
10. Elvira C, Sampedro L, Dominguez J, Mato S. Vermicomposting of wastewater sludge from paper-pulp industry with nitrogen rich materials. Soil Biology and Biochemistry. 1997;29(3-4):759-762.
11. Frederickson J, Butt KR, Morris RM, Daniel C. Combining vermiculture with traditional green waste composting systems. Soil biology and Biochemistry. 1997;29(3-4):725-730.
12. Reinecke AJ, Viljoen SA, Saayman RJ. The suitability of *Eudrilus eugeniae Perionyx excavatus* and *Eisenia fetida* (Oligochaeta) for vermicomposting in southern Africa in terms of their temperature requirements. Soil Biology and Biochemistry. 1992;24(12):1295-1307.
13. Singh S, Singh J, Kandoria A, Quadar J, Bhat SA, Chowdhary AB, Vig AP. Bioconversion of different organic waste into fortified vermicompost with the help of earthworm: A comprehensive review. International Journal of Recycling Organic Waste in Agriculture. 2020;9(4):423-439.
14. Albanell E, Plaixats J, Cabrero T. Chemical changes during vermicomposting (*Eisenia fetida*) of sheep manure mixed with cotton industrial wastes. Biology and Fertility of Soils. 1988;6:266-269.
15. Ghosh M, Chottopadhya GN, Baral K, Munsi PS. Possibility of using vermicompost in Agriculture for reconciling sustainability with productivity. In Proceding of the Seminar on Agrotechnology and Environment. 1999 December; 64:68.
16. Sharma S, Pradhan K, Satya S, Vasudevan P. Potentiality of earthworms for waste management and in other uses. J. Amer. Sci. 2005;1(1):4-16.
17. Suthar S, Singh S. Comparison of some novel polyculture and traditional monoculture vermicomposting reactors to decompose organic wastes Ecol. Eng. 2008;33:210-219.

    DOI:http://dx.doi.org/10.1016/j.ecoleng.2008.04.004
18. Khwairakpam M, Kalamdhad AS. Vermicomposting of vegetable wastes amended with cattle manure. Res. J. Chem. Sci. 2011;1(8):49-56
19. Elvira C, Sampedro L, Benitez E, Nogales R. Vermicomposting of sludges from paper mill and dairy industries with Eisenia andrei: a pilot-scale study. Biores. Technol. 1998;63:205-211.
20. Ndegwa PM, Thompson SA, Das KC. Effects of stocking density and feeding rate on vermicomposting of biosolids. Biores Technol. 2000;71:5-12.
21. Gunadi B, Edwards CA. The effect of multiple application of different organic waste on the growth fecundity and survival of *Eisenia foetida* (Savigny) (Lumbricidae). Pedobiol. 2002; (31):199-209.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/100256