BioGecko

Vol 12 Issue 03 2023
ISSN NO: 2230-5807

Physico-Chemical Parameters and Bacterial Count on Vermicompost of Lumbricus Terrestris and Eudrilus Eugeniae

V. Pavithra, K. Anjalai
PG & Research Department of Zoology, Ethiraj college for Women, Chennai - 600 008.
Corresponding author - anjalai.bio@gmail.com

Abstract

The earthworm species that are indigenous to India are only found in that country's specific geographic area and are not found anywhere else in the world. The two endemic species of earthworms are Lumbricus terrestris and Penyonyxencavatus. It is necessary to import exotic earthworm species into India from other nations or places. They fall into the following categories: Eudilus eugeniae, Eisenia fetida. The most frequent use for them is in the preparation of vermicompost. Functional microbial group populations were significantly higher in vermicompost and vermicasts made from native earthworms than in alien worms. In addition to having a variety of enzymes, hormones, vitamins, antibiotics, and other vital nutrients for plant growth, earthworm compost also improves soil structure and water-holding capacity, which in turn increases crop productivity and quality. Vermicompost has microbial populations that are noticeably larger and more diverse than compost, but it also has higher nutrient concentrations and is probably going to produce salinity. When compared to soil treated with inorganic fertilizers or cattle manure, soil supplemented with vermicompost demonstrated superior plant growth. The purpose of this paper is to analyze a comparative study between two endemic and exotic species of earthworms. The Pahruli vermicompost farm in Cuddalore is where the exotic compost worm samples (Eudrilus eugeniae) were obtained. The preparation of compost involves the use of exotic worms, which are found throughout the world, including west Africa and other warm tropical regions. The Pahruli vermicompost farm in Cuddalore is where the samples of the endemic compost worm Lumbricus terrestris were obtained. Because they are native to and present in a particular geographic area, endemic worms are utilized in the compost preparation process. Regarded as a high-nutrient biofertilizer with a variety of microbial communities, vermicompost significantly enhances the growth and yield of various crops, vegetables, and other plants. Vermicomposting is the process of using earthworms to turn organic waste into materials that resemble finely broken peat. Exotic and endemic worms are the two types of worms used in vermicomposting; the results revealed significant differences in the plant nutrients and physico-chemical parameters of the vermicompost produced by these two worm species.

Keywords: Lumbricus terrestris, Eudrilus eugeniae, Physico-chemical parameters.

Introduction

Earthworms are known as farmers' friends because they improve plant and soil health. Earthworms do their job of pumping air into and out of the soil. They change the vital organic component that makes the soil stronger. For the preparation of compost, a large quantity of waste materials are used, including vegetable scraps, weeds, stubble, bhusa, sugarcane waste, sewage sludge, coconut waste, and cow dung. Compost manure can be produced from coconut waste and cow dung through anaerobic decomposition. Various soil types and crops can benefit from the application of compost (Manchala, Santhosh Kumar et al., 2017). The earthworm species that are indigenous to India are only found in that country's specific geographic area and are not found anywhere else in the world. The two endemic species of earthworms are Lumbricus terrestris and Penyonyxencavatus. It is necessary to import exotic earthworm species into India from other nations or places. The two types into which they are divided are Eisenia fetida and Eurdilus eugeniae. The most frequent use for them is in the preparation of vermicompost. Vermicompost and Vermicasts made from native earthworms had significantly higher populations of functional microbial groups than alien worms (Raphael and Velmourougane, 2012). The nutrient-rich vermicompost known as "Black gold" is accelerated in its decomposition process by the consumption of organic matter by earthworms. Applying vermicompost has a number of advantages, such as improving soil fertility and stimulating plant growth and soil health on a physical, chemical, and biological level. In fact, vermicompost can increase soil fertility in a physical, chemical, and biological sense. Vermicompost amendments to soil improve its aeration, porosity, bulk density, and water retention physically. Chemical properties such as pH, electrical conductivity, and organic matter content are also raised in order to increase crop yield (Su Lin Lim, Taet al., 2014).Since vermicompost organic manure has a major positive impact on the microbial population and soil properties, it is a better alternative for enhancing crop productivity, quality, and health. Earthworms found in soil are vital to agriculture because they break down organic waste by eating it and releasing the resulting castings. Most of the nutrients found in plants are found in vermicompost, including phosphates, nitrites, exchangeable calcium, and soluble potassium.

The physical, chemical, and biological characteristics of organic matter and soil are altered by the feeding, burrowing, and casting behaviors of earthworms to facilitate plant growth and nutrient uptake. Impact on the amount of soil organic carbon: Worm casts often have much higher levels of soil organic carbon and nutrients than the surrounding soil. Compared to the nearby By soil, the Drilosphere had substantially higher levels of total N and organic carbon. In 2002, Sudhakaret al. In addition to having a variety of enzymes, hormones, vitamins, antibiotics, and other vital nutrients for plant growth, earthworm compost also improves soil structure and water-holding capacity, which in turn increases crop productivity and quality. Vermicompost has microbial populations that are noticeably larger and more diverse than compost, but it also has higher nutrient concentrations and is probably going to produce salinity. According to Jayakumar Pathma and Natarajan Sakthivel (2012), soil treated with cattle manure or inorganic fertilizers did not exhibit the same level of plant growth as soil supplemented with vermicompost. Vermicompost is made from vegetable wastes, coconut waste, and cow dung. Thus, vermicomposting falls under the category of organic farming since it makes use of nearby resources and promotes improved nutrient availability and soil quality. Since organic fertilizers are made entirely of organic materials and don't contain any hazardous pesticides or fertilizers, they are always thought to be a more sustainable method of farming. Vermicompost, then, falls into the category of nutrient-rich organic fertilizers that enhance soil quality and encourage plant growth. The purpose of this paper is to analyze a comparative study between two endemic and exotic species of earthworms. This study's primary goals are to measure the amounts of nitrogen (N), potassium (K), and phosphorus (P) in vermicompost and to analyze the nutrient content in two distinct varieties of vermicompost.

Methods and Materials

The Pahruli vermicompost farm in Cuddalore is where the exotic compost worm samples (Eudrilus eugeniae) were obtained. The preparation of compost involves the use of exotic worms, which are found throughout the world, including west Africa and other warm tropical regions. The Pahruli vermicompost farm in Cuddalore is where the samples of the endemic compost worm

Lumbricus terrestris were obtained. Because they are native to and present in a particular geographic area, endemic worms are utilized in the compost preparation process. The common Indian earthworm, Lumbricus terrestris, is used to make vermicompost. It is relatively large, with a pinkish to reddish-brown color, and measures approximately 110-200 millimeters (4.3-7.9 in) in length and 7-10 millimeters (0.28-0.39 in) in diameter. 120–170 segments total, with 135–150 segments most frequently. The body is flattened at the posterior region, but otherwise has a cylindrical cross section. Dorsal pigmentation fades towards the back, with the head end's color ranging from dark brown to reddish brown. Instead of digging through the soil like endogenic species do, Lumbricus terrestris is a deep-burrowing anaerobic earthworm that creates deep vertical burrows and surfaces to feed on. It deposits casts of a combination of organic and mineral material on the soil's surface and removes litter from the soil's surface by dragging it down into the mineral layer. It reproduces at the soil's surface, living in semi-permanent burrows that it can either escape from or inhabit. However, partners stay anchored in their burrows, and repeated reciprocal burrow visits between neighbors precede mating. Their estimated lifespan is six years. The first sample, Lumbricus terrestris, is considered to be sexually reproducing, with individuals exchanging sperm with one another. On the soil, copulation takes place (Plate 1). The worm Eudrilus eugeniae is widely referred to as the “African nightcrawler”. For studies involving cells and molecules, the worm makes an excellent model. Because of its remarkable capacity for regeneration, it grows more quickly—it can reach maturity in as little as five weeks. It gains 12 mg of body weight each day and can withstand temperature variations between 15 and 30°C. Body length: Complete matures measure 90–185 mm, but under ideal culture conditions, they can reach up to 250–400 mm. In the terminal "zone of growth," they taper posteriorly and become thinly flattened. Breadth: roughly 4–8 mm Average adult value of about 1.0, or ideal range of 5.0–6.0. Larger worms may add segments, as indicated by segments 161–211 or 250–300; the constriction of 40–46 observed in some ancient specimens may be artifactual. Reddish-brown dorsum that fades posteriorly; bright blue/green iridescents visible from cuticle diffraction in the anterior region; ventrum beige; clitellum darker (occasionally lighter) than surrounding areas Prostomium: Open epilobous and small (Plate 1).

The sample's study period ran from October 6, 2022, to January 6, 2023. It took about 45 to 50 days to prepare and process the samples completely. The sample is examined in a lab for additional analysis to determine its nutritional value and other PHYSICO-CHEMICAL characteristics (Plate 2). The earthworms, Lumbricus terrestris, were given 7 kg of cow dung, 400 grams of coconut waste, and 150 grams of cow dung. The mixture was allowed to mix thoroughly and left undisturbed for two days. After two days, the sample was sprayed with water to keep it moist and wet for almost ten days after the earthworms copulated and shed their cocoons in the soil. After 15 days, the cocoons hatched to release juveniles, and after 45 to 50 days, the sample was kept in a dry and moist place, away from direct sunlight. (Shelf 2). Eudrilus eugeniae: 7 kg of cowdung combined with 400 grams of coconut waste and 100 grams of earthworms (Eudrilus eugeniae) should be well mixed and left undisturbed for two days. After two days, spray water should be applied to keep the sample moist and wet for almost ten days. After that, it takes 12 days for the cocoons to hatch and release juveniles, which begin to produce output in 35 to 45 days. Since they reproduce quickly, the sample should be kept in a dry and moist location away from direct sunlight. Following a three-month study period, the vermicompost from samples 1 and 2 was fully extracted. The vermicompost was then sieved through a large steel mesh net to remove any remaining large impurities, such as coconut coir, and twice a day, water was sprayed to keep the sample moist. The sample should then be separated and stored in a dry, dark place to prevent direct sunlight damage. The sample's quality can then be assessed using microbial and physiological-chemical analyses, as well as by mixing vermicompost with soil and measuring pH, total nitrogen, potassium, and phosphorus.

Plate - 1	Plate – 2
	
Lumbricus terrestris	*Eudrilus eugeniae*

Physico-Chemical Parameters

S. NO	PARAMETERS	UNITS	METHODS
1	pH		Shoemaker Mc Lean and Pratt (1961)
2	Conductivity	ds/m	EC meter and ohm law
3	Total Nitrogen	%	Kjelddahl flask method
4	Total Potassium	%	Toth and prince flame photometer
5	Total phosphorus	%	Bray's(1945) and Olsen method(1954)

Results & Discussion

The result obtained from the study with respect to comparison of vermicompost of two different species of earthworms *Lumbricus terrestris* and *Eudrilus eugeniae*are are:

- pH: According to Table 1, the pH of the vermicompost made from Lumbricus terrestris was 9.16%, while the pH of Eudrilus eugeniae was 6.30%. When comparing Lumbricus terrestris to Eudrilus eugeniae, the pH value was higher in the former. Since ammonia is produced during the decomposition of nitrogenous substrates, which makes up a significant portion of the nitrogenous matter expelled by earthworms, it can be concluded that the native worms had a high pH due to the higher level of alkanity caused by the presence of different microbial activity during the vermicompost formation process. Eudrilus eugeniae had a low alkaline level due to the presence of proper microbial controlled activity during the vermicompost formation process. This and the reports by Usman Ali, Nida Sajid, et al. (2015) are comparable. While a neutral pH is appropriate for worms to function properly, the ideal range is said to be 4.5–9%. He proposed that during the decomposition process, microbial activity modifies the physical-chemical characteristics of waste. Different intermediate species that produce different types of waste exhibit different behaviors in terms of pH shift during the decomposition process, which modifies pH based on the fact that negatively and positively charged groups led to either neutral or acidic pH. This range (6–7) of vermicompost is said to increase plant nutrient availability, such as NPK (Edwards and Bohlen 1996). Suthar's (2007) similar results also revealed an overall pH value decrease of 3.5–9.5% during the vermicomposting process.

- Conductivity: The current conductivity results indicated 0.97 ds/min. Eudrilus eugeniae and Lumbricus terrestris had respective values of 0.28 ds/m (Table 1). The conductivity difference was greater in Lumbricus terrestris and less in Eudrilus eugeniae because the former are deep dwellers and have a very strong soil water-holding capacity, whereas the latter have a low conductivity because they are surface dwellers. According to Richard et al. (1954), the highest was 6.7 ds/m, while the lowest was 3.22 ds/m. The increased conductivity during the vermicomposting process was consistent with that of the previous period, likely because the organic matter degraded and released minerals like exchangeable calcium, magnesium, potassium, and phosphorus in the form of cations in the vermicompost. According to Tognetti et al. (2005), a hydro operating bio reactor demonstrates significant physico-chemical changes in conductivity as a result of vermicomposting vegetable wastes. The conductivity is used to determine the soil's water-holding capacity and the salinity risk posed by vermicompost.
- Table 1 shows that the total nitrogen values for Eudrilus eugeniae and Lumbricus terrestris were 0.882% and 0.487%, respectively. The nitrogen content of Eudrilus eugeniae was found to be higher in the current study than that of Lumbricus terrestris. This difference in behavioural activity feeding mechanism may have increased the amount of bacteria in the earthworm's gut, which in turn raises the soil's nitrogen content when vermicompost is applied. According to (Usman ali, et al., 2015), vermicompost made from groundnuts had the highest total nitrogen recorded (3.21%), while vermicompost made from maize stock had the lowest total nitrogen (1.15%). Variations in the total nitrogen content of the vermicompost are ascribed to the substrates that the worms digested, as different kinds of straw have varying nitrogen contents. The current results describe procedures for the analysis of chemical constituents in soil, plant, water, fertilizer, animal manure, and compost samples. They are also consistent with the finding of total nitrogen in a soil, which found that the total nitrogen in vermicompost made from all substrates was high and significantly greater in soil.
- Lumbricus terrestris and Eudrilus eugeniae were found to have a total potassium content of 0.538% and 0.608%, respectively (Table 1). The findings indicated that there were only minor variations in the potassium content of Eudrilus and Lumbricus, primarily because of the potassium that was already present in the soil. However, if we added more potassium through vermicompost, the level might rise and there might be minor variations in the potassium content of the vermicompost made from the two different worm species. According to Sinha et al. (2009), vermicompost made from cow dung had the highest total potassium content (12.70 mg/g), which was also enhanced by microbial inoculation. The vermicompost made from elephant grass had the highest potassium content (20 mg), and according to Tognettia et al. (2005), the total potassium in the vermicompost in a backyard was 8.2 grams. It improves tolerance to heat, cold, and drought in addition to disease

resistance. Although it is also naturally present in soil, growing plants absorb it, so we must add additional potassium to the soil through vermicompost.

- The total phosphorus content of the vermicompost in Eudrilus eugeniae and Lumbricus terrestris was found to be 0.608% and 0.339%, respectively (Table 1).When compared to Lumbricus terrestris, Eudrilus eugeniae displayed a higher level of total phosphorous. The amount of phosphorus in the vermicompost may vary depending on the degree of feeding mechanism and microbial activity as well as the physical-chemical characteristics of the materials used in the process; however, there are also minor differences between the vermicompost of two worms. The substrates' nature may be the cause of the variation in difference. This suggested that the constant addition of P to the soil was most likely the result of low release from the vermicompost, while the activity of the soil microorganisms contained in the vermicompost was primarily responsible for the release of Phosphorus (Arancon et al., 2006). The increased P level in vermicompost indicates phosphorus mineralization. During this process, worms used P-solubilizing microorganisms to convert insoluble P into soluble P forms. By employing vermicompost, the phosphatase found in earthworms' stomachs increases the amount of phosphorus that is available for plant growth through the soil (Padmavathi Amma et al., 2008). Thus, if the soil lacks phosphorus, vermicompost could raise the P content of the soil. Phosphorus stimulates the growth of roots, seeds, and flowers. Phosphorus usually stays in the soil already. Increased phosphorus in the soil promotes new growth and is abundant in vermicompost.In the vermicompost, Eudrilus eugeniae (26 x 10(4)) and Lumbricus terrestris (2.3 x 10(4)) had the highest total bacterial count (Table 2). Comparing Eudrilus eugeniae to Lumbricus terrestris, the former's bacterial count is higher while the latter's is lower. Similar findings were also reported by Parthasarathi et al. (2007), who found that the number of microorganisms in the gut of earthworms fed on soil varied either little or more than in those fed on decomposing leaves. The bacteria that are present in earthworms' guts are the only source of information about the number of bacteria in vermicompost. After a month of vermicomposting, the earthworms significantly decreased the amount of both bacteria and fungi. Earthworms can directly lower microbial biomass by consuming only certain types of bacteria and fungi. or indirectly by quickening the microbes' resource depletion (Schönholzer F., et al., 1999). The duration of composting can be shortened by inoculating microorganisms. According to Muhammad Yasir et al. (2009), bacterial community changes are a key factor in the vermicomposting process.

Conclusion

Regarded as a high-nutrient biofertilizer with a variety of microbial communities, vermicompost significantly enhances the growth and yield of various crops, vegetables, and other plants. Vermicomposting is the process of using earthworms to turn organic waste into materials that resemble finely broken peat. Exotic and endemic worms are the two types of worms used in vermicomposting; the results revealed significant differences in the plant nutrients and physico-chemical parameters of the vermicompost produced by these two worm species. While the pH of Eudrilus eugeniae was under control, Lumbricus terrestris has a higher alkaline pH due to preparation for specific control measures. The vermicompost's conductivity and salinity levels are crucial for the soil's ability to retain water and the ideal salinity required for plant growth. The conductivity level of Eudrilus eugeniae is lower than that of Lumbricus terrestris. While the total nitrogen content of Eudrilus eugeniae was at the right level for the soil to use and spur plant growth rapidly, the nitrogen content of Lumbricus terrestris is lower than that of Eudrilus eugeniae, so results take longer to appear. Since gram positive bacteria are more prevalent in Eudrilus than in Lumbricus terrestris, the total potassium content of Eudrilus eugeniae was higher than that of Lumbricus terrestris due to the microbial communities present in the vermicompost of bacteria. As a result, potassium must be continuously added to the soil as supplements because the soil needs it for the growth of crops and other plants. The total phosphorus content of Eudrilus was high and good, while that of Lumbricus terrestris was slightly lower, with a significant difference observed in the vermicompost. The total amount of vermicompost produced varies by one kilogram as well. For every seven kilograms of cow dung, Eudrilus eugeniae yields 4.500 kg, while Lumbricus terrestris yields 3.500 kg. This indicates that while Eudrilus eugeniae is a fierce predator and surface dweller, Lumbricus terrestris is a gentle and deep-dwelling organism. After comparing various vermicompost parameters, it was determined that Eudrilus eugeniae produced good vermicompost yields and that the physico-chemical parameters were also at an appropriate level. However, there were only minor differences when compared to Lumbricus terrestris, which showed good water holding capacity, conductivity, and pH when mixed with soil for future research. Proper development of both worms was also achieved, and by conducting numerous studies in this vermicompost field, the fertility and growth factor of the soil was increased. Vermicompost is widely used in organic farming and is helpful for sustainable agriculture. In addition, it helps students develop their young entrepreneurship by allowing them to engage in small businesses like vermicompost businesses in their homes and colleges, where they can make money and hone their business skills. Currently, many colleges assist students in learning about business skills by holding programs and bazaars where they can make money.

TABLE 1
PHYSICO-CHEMICAL PARAMETERS OF *Lumbricus Terrestris*

AND *Eudrilus Eugeniae* IN VERMICOMPOST

S. NO	PARAMAETERS	LUMBRICUSTERRESTIS	EUDRILUSEUGENIAE
1	pH	9.16	6.30
2	Conductivity	0.97 ds/m	0.28 ds/m
3	Total Nitrogen (N)	0.487 %	0.882 %
4	Total phosphorous (P)	0.339 %	1.283 %
5	Total potassium (K)	0.538 %	0.608 %

TABLE 2
TOTAL BACTERIAL COUNT OF *Lumbricus Terrestis*

AND *Eudrilus Eugeniae* IN VERMICOMPOST

S. NO	PARAMAETERS	LUMBRICUS TERRESTIS	EUDRILUS EUGENIAE
1	Total BacterialCount	$2.3x\ 10^4$	$26x\ 10^4$

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