Comparative Efficiency of *Eisenia Fetida* and *Perionyx Ceylanensis* in Vermicomposting Implications for Sustainable Agriculture

Birendra Kumar Savita[1], Dr. Kiran Gupta[1], Dr. Sukrat Sinha[2] , Mirza Zishan Beig[1]*

[1]Department of Zoology, Nehru Gram Bharati (Deemed to be University) Kotwa – Dubwal, Prayagraj-221505
Email:kiranunizoo@gmail.com
[2]Department of Zoology, Sri Venkateswara College, Benito Juarez Marg, University of Delhi-110021

***Corresponding Author:** Mirza Zishan Beig
*Department of Zoology, Nehru Gram Bharti (Deemed to be University), Prayagraj, Uttar Pradesh.

ABSTRACT
The use of Vermicompost is gaining attention as a sustainable alternative to chemical fertilizers. This study compares the efficiency of two earthworm species, Eisenia fetida from Australia and the Indian variety Perionyx ceylanesis (Jai Gopal), in producing high-quality vermicompost. Parameters such as organic matter decomposition rate, moisture content, pH, and nutrient availability were measured to assess the compost quality. The study found that Eisenia fetida decomposes organic matter faster, while Perionyx ceylanesis produces compost with a balanced pH and higher microbial diversity. These results highlight the potential of utilizing a combination of both species to achieve optimal vermicompost quality, contributing to sustainable agricultural practices.

Keywords: Vermicomposting, Eisenia fetida, Perionyx ceylanesis, sustainable agriculture, compost quality, microbial diversity.

INTRODUCTION
Vermicomposting is a rapid process that involves the bio-oxidation of the waste, the biological breakdown of the waste, and the stabilization of the waste as a consequence of the complex interactions between various species of earthworms and microorganisms. This method is also referred to as vermico-composting in some circles. The upshot of this is a phenomenon known as humification, in which organic stuff that was unstable is completely oxidized and then stabilized. The procedure quickens the rate at which the organic matter is broken down, which results in changes to both the material's physical and chemical characteristics. Vermicomposting, often known as VC, is a technique that involves the use of earthworms to convert organic waste into a material that is similar to humus and is known as vermicompost. Vermicompost often contains a significant amount of a wide array of essential nutrients. According to Kale et al. (1982), the process of composting has the potential to transform any and all of these different kinds of waste into rich materials. The effectiveness of the VC in terms of its positive effects on the physical, chemical, and biological characteristics of the soil, as well as its function as a source of nutrients, is directly influenced by the quality of the compost. In addition to this, the effectiveness of the VC is contingent on the quality of the compost. According to Bernal et al. (2009), the innovative paradigm of compost is that in order for it to be used safely in soil, it must first achieve a specific level of stability and maturity in addition to having a high nutritional value. This is in addition to the fact that it must have a high nutrient value.

Vermicompost essential component of non-artificial farming methods
Vermicompost is an essential component of non-artificial farming methods such as organic agriculture, sustainable agriculture, and environmentally friendly agriculture. Its ability to raise the nutrient density of crops and increase the fertility of soil makes it an indispensable component of these farming approaches. This is due of the possibilities that are presented by vermicompost. Vermicompost is an essential component of organic farming systems because it contains properties that are useful and helpful for the growth of plants. It enhances the soil's physical, chemical, and biological characteristics, in addition to the soil's organic content, which can rise by a factor of 4.5 or even 4.5 times the original amount. Vermicomposting has been demonstrated time and again to be the most successful approach to treating an organic component of municipal solid waste. Vermicomposting resulted in a decreased emission of harmful gases (including $CH4$, $NH3$, and other pollutants), as compared to the standard composting procedures that are often used.
It is generally agreed upon that using earthworms as part of a treatment process for solid organic waste is among the most successful approaches. These wastes include those that are produced by human activity as well as agricultural activity and animal activity. Food wastes make for the biggest percentage of economic losses in India, which is not surprising given that India's yearly production of agricultural waste is roughly 350 million tonnes. These losses can be ascribed to excessive wasting, infection by rodents, or deposition in municipal garbage dumpsters, all of which result in pungent aromas owing to high levels of biological decomposition. These scents can be related to the high levels of biological decomposition. One of the earthworm species known as Eisenia fetida is responsible for the efficient decomposition and rotting of natural debris, which results in the production of high-quality organic compost from these discarded materials.

Eisenia fetida is one of the earthworm species that is very helpful in the process of decomposing and breaking down natural remnants. It is possible for it to ingest as much as half of its body weight in a single day if it pushes itself to do so. The actions of earthworms, such as feeding, burrowing, and casting, improve the physical, chemical, and biological characteristics of organic matter and soil. This results in an increase in the development of agricultural crops in a way that is both natural and free of any potential hazards.

Biological characteristics:

- Eisenia fetida: is a species of earthworm that is known in common parlance as the red wiggler or the tiger worm. It is able to make a successful living in a diverse variety of environmental circumstances and responds well to composting.
- Jai Gopal (Perionyx ceylanesis): Also known as the Indian variety, the term "Gopaljee" may be used to refer to a particular indigenous earthworm variation that may be found in India. It is absolutely necessary to determine the specific species in order to make proper comparisons.

Reproductive rates:

- *Eisenia fetida*: It is well known that this species has a strong potential for reproduction. It is capable of laying cocoons that contain many eggs, and its population can quickly grow if the conditions are appropriate..
- Jai Gopal (*Perionyx ceylanesis)*: It is necessary to conduct research and carry out observations on a species-specific basis in order to determine the reproduction rates of the Indian variation..

Economic feasibility and practicality:

- Evaluate the availability, cost, and ease of procuring and maintaining populations of both earthworm species.
- Consider the practicality of using each species in large-scale vermicomposting operations, including factors such as handling, transportation, and market demand for the resulting vermicompost.

It's important to note that conducting a comprehensive comparative study may require expertise in vermicomposting, collaboration with local researchers or institutions, and access to suitable facilities for experimentation.
By comparing the performance and characteristics of *Eisenia fetida* and the Indian variety Jai Gopal (*Perionyx ceylanesis)*, we will gain insights into their respective abilities to improve the quality of vermicompost and make informed decisions regarding their utilization in vermicomposting practices.

Vermiculture and environmental management

Vermiculture is the technique of cultivating earthworms in large numbers for the purpose of mass production, with the many goals of waste management, soil fertility and detoxification, and vermicompost production for environmentally responsible agriculture. The method was initially used in the middle of the 20th century, and in 1970, the Netherlands played host to the very first substantial studies, which were soon replicated in England and Canada. Later methods of vermiculture were adopted in the countries of the United States of America, Italy, the Philippines, Thailand, China, Korea, Japan, Brazil, France, Australia, and Israel (Edward, 1988). Large vermicomposting factories with a capacity of 1000 metric tons have been built in Wales in the United Kingdom (Frederickson, 2000). According to Edward (1988), in 1978–1979, the American Earthworm Technology Company established a three-acre "vermicomposting farm" with a capacity of producing 500 tons of vermicompost per month. Vermiculture has been reported to be an effective method for the control of sewage sludge and effluents from densely housed cattle in the United States by Collier (1978) and Hartenstein and Bisesi (1989). During the years 1985-1987, Japan imported 3,000 metric tons of earthworms from the United States for the purpose of degrading waste cellulose (Kale,1991). According to Kale (1991), the Aoka Sangyo Co. Ltd. processes waste from the paper pulp and food industries at three factories with a capacity of one thousand tons per month each. This results in the monthly production of 400 t of vermicompost as well as 10 t of live earthworms. In Japan, the Toyhira Seiden Kogyo Co. uses rice straw, municipal sludge, sawdust, and paper waste in their vermicomposting process, which involves 20 plants and produces 2-3 thousand t per month in total (Edward, 1988).
Vermiculture is used in Italy for the purpose of decomposing sludges produced by municipalities and paper mills. After more than 15 days of mixing and aeration, aerobic and anaerobic sludges are combined, and then five kilograms of earthworms are introduced to 5000 cubic meters of sludge. According to Ceccanti and Masciandaro (1999), the transformation from sludge to vermicompost takes around eight months. Vermiculture is being actively promoted and practiced on a wide scale in Australia as part of a program called the "Urban Agriculture Development Program," which recycles trash from metropolitan areas. The 'Worm Grower Association' in Australia has more than 1200 members, making it the largest such organization in the world. Vermiculture facility at Sydney Waters, which is located in New South Wales, has 40 million worms and has the capacity to breakdown up to 200 tons of municipal trash every week. The St. George Hospital in Sydney is installing a plant that will biodegrade the trash from its kitchen and provide fertilizer for the hospital gardens. Since 1998, the Redland Shire Council in Queensland, Australia has been using a vermicompost facility with a capacity of 20,000 metric tons per hour (tpa-1) to treat sewage sludge and manure from pig farms (Lotzof, 2000). Even though India has the capacity to produce 400 million t of vermicompost yearly from waste degradation (Sinha,1996), the country has not yet fully recognized the significance of vermiculture. In India, Senapati (1992) highlighted the significance of vermiculture with regard to the treatment of all cellulosic wastes. Earthworms were used to manage coir

waste in India, according to Gunathilagraj and Ramesh (1996) and Gunathilagaraj and Ravignanam (1996), respectively. Both of these studies were conducted in 1996. Vermicomposting and waste management on features of sugar plant waste, solid wastes from aromatic oil companies, and distillery wastes in India have each been recommended for by Kale et al., (1993), Seenappa and Kale (1993), and Seenappa et al., (1995), respectively.

OBJECTIVES OF THE STUDY

1. To study on Vermiculture and environmental management
2. To study on Vermicompost essential component of non-artificial farming methods

RESEARCH METHOD

Vermicomposting or conversion of organic wastes into usable manure is done out by several kinds of Earthworm. One of the most regularly utilized species used frequently for vermicomposting is Eisenia fetida. Recently a new variety was produced by Indian veterinary Research Institute, Izzatnagar ,Bareilly known as Jai Gopal (Perionyx ceylanesis) which is generated by mating and selection of Eisenia foetida and Eudrilus eugeneae. The addition of vermicompost in soil enhances soil physical, chemical and biological features and aid in development of plants without destroying environment.

Waste that is municipal solid (MSW)

Municipal solid waste (MSW) is gathered from the Lucknow region, which is the headquarters of the Uttar Pradesh municipality and is situated in the Barabanki district on the east, Unnao district on the west, Raebareli district on the south, and Sitapur and Hardoi districts on the north all encircle it. The city is situated in India on the Gomti River's northwest bank. It is used in the procedure after the removal of glass fragments, metal, clothing, and polythene coverings. Before the Municipal Solid Waste (MSW) was sent to the Vermi-Biotechnology Lab (Plate III), it was air dried in jute bags.).

Elephant Dung Collection

The excrement of elephants collected from the Chandrika Devi Temple, which is located in the gomati river neighborhood of Lucknow. In order to reduce the amount of time it took for the rubbish to disintegrate, it was dried and then used as a material for bedding.

METHOD

Getting the experimental media ready

In order to conduct the experiment at hand, ten different components of municipal solid waste were blended with elephant dung. These components were created in the following sequence:

Table 1 Getting the experimental media ready

Treatments	MSW+ED Proportion	Weight of MSW + ED/Kg
C1 C2	ED	1000g
T1 T6	1:9	100 + 900
T2 T7	2:8	200 + 800
T3 T8	3:7	300 + 700
T4 T9	4:6	400 + 600
T5 T10	5:5	500 + 500

C1, T1 – T5 – MSW + ED used for Eisenia fedita
C2, T6 – T10 – MSW + ED used for Perionyx ceylanesis

The volumes of municipal solid waste and ED that were specified before were weighed (dry weight) and thoroughly mixed with forty to fifty percent moisture. Each proportion was blended with 200 grams of soil at Lampito, which is located in Mauritius. Different plastic troughs with a diameter of 40 centimeters and a depth of 15 centimeters were used to transport the feed mixtures. Ten days were allotted to the feed substrates participating in the present experiment so that they may start the process of spontaneous disintegration (Plate III).

Earthworm Vaccination

A preclitellate E. fetida and Perionyx ceylanesis earthworm was weighed and then injected at a rate of 15 grams per kilogram of each combination. This was done after the predecomposition process had been completed. The nylon mesh-covered plastic troughs were maintained at room temperature (27± 2 degrees Celsius) and relative humidity levels ranging from 60–70 percent. A total of three copies were stored for each and every combination. For the purpose of inoculating substrates T1 through T5, E. fetida was used, and Perionyx ceylanesis was utilized for the purpose of inoculating substrates T6 through T10. Controls C1 and C2 (which did not include MSW) were maintained from each other and were subjected to independent care for each and every worm kind.

Chemical evaluation

For the purpose of conducting a chemical analysis, samples of the initial substrates and vermicompost were collected from each treatment on day 0, day 15, day 30, day 45, and day 60 during the course of the experiment. After being allowed to air dry, the samples were then sieved and placed in polythene bags for the purpose of storage.

1 Calculating electrical conductivity (EC) and pH

The method described in the ISI Bulletin (1982) was used in order to compute pH and EC. In a beaker with a capacity of 100 milliliters, 5.0 grams of dry material was combined with fifty milliliters of distilled water. With the help of a glass rod, the liquid was well mixed. After a period of thirty minutes, the pH and EC were identified with the use of digital pH and conductivity meters.

2 Calculating carbon dioxide (OC)

The following empirical approach was used in order to accurately determine the amount of organic carbon present in the sample. In a muffle furnace, a constant mass silica crucible was used to cook a dry sample weighing 1.0 grams for two hours at a temperature of 550 degrees Celsius. The crucible was weighed once again after it had been allowed to cool down.

$$\text{Total carbon (\%)} \quad \frac{\text{Initial mass} - \text{Final mass}}{\text{Initial biomass}} \times 100$$

$$\text{Organic carbon (\%)} = \frac{\text{Total carbon (\%)}}{A}$$

A = a constant 1.724 (Walkely and Black, 1934)

3 Calculating total nitrogen (N%) percentage

For the purpose of determining the total nitrogen concentration of the vermicompost samples, the Kjeldahl method was used. In order to use this approach, there were two processes that were required: i) Sample digestion, which included producing NH4+ from the nitrogen component that was present in the compost sample. and determining the amount of NH4+ that is present in the digest using distillation.

DATA ANALYSIS

E. Fetida and l Perionyx ceylanesis growth and reproduction

For the purpose of determining whether or not the use of earthworms for waste treatment is viable, it is required to have a fundamental knowledge of the survival, development, and reproduction of earthworm species. The most common method for determining the growth of earthworms is to measure their weight increase. Milligrams, grams, or percentages are the specific units that are used to express the growth rate.

Vermicomposting is mesophilic processes that involves the collaboration of earthworms, microorganisms, and microarthropods in order to biooxidize and stabilize organic material. For the management of organic waste, vermicomposting is a process that is not only acceptable but also hygienic and cost-effective. Vermicomposting is an alternate approach that may be used for the management of municipal solid waste and the recovery of nutrients from it.

Table 2. E. fetida and P. ceylanesis -produced vermicompost from MSW with ED had a bacterial population (CFU × 106 g-1; p<0.05).

Substrate Proportions	E.fetida					Substrate Proportions	**P. ceylanesis**				
	Vermi composting days						Vermi composting days				
	0	15	30	45	60		0	15	30	45	60
C1	417.46±1.77	468.48±2.12	486.74±2.21	520.78±2.25	648.34±2.33 (55.39)	C2	338.55±2.09	431.64±2.12	476.92±2.42	499..67±2.16	518.71±2.19 (53.25)
T1	393.77±2.53	456.64±2.12	479.45±2.17	566.59±2.48	603..67±2.08 (53.43)	T6	331.73±2.07	415.46±2.17	442.71±2.12	491.80±2.20	510.83±1.76 (54.07)
T2	390.42±2.32	464.97±1.91	599.71±2.16	.672.87±2.16	749.93±1.83 (92.49)	T7	321.87±1.76	458.60±2.05	481.20±1.83	524.19±2.41	593.60±2.05 (84.73)
T3	361.11±1.84	457.61±2.10	466.93±1.99	472.51±2.02	519.57±1.95 (49.45)	T8	312.51±2.03	341.90±2.12	371..67±2.04	405.51±1.87	468.61±1.87 (50.54)

T4	351.07±2.22	421.45±1.98	437.38±1.78	481.67±2.09	501.67±1.92 (42.29)	T9	292.86±2.17	329.09±1.89	368.89±2.22	395.88±2.19	414.42±2.32 (41.78)
T5	307.50±1.95	331.84±2.11	366.80±1.78	406.57±1.90	418.95 ±1.88 (36.70)	T10	287.69±1.88	297.19±2.06	314.88±1.83	352.00±1.82	392.72±2.04 (36.45)

Analysis of variance	Sum of square	Mean of square	F-value	P-value	Analysis of variance	Sum of square	Mean of square	F-value	P-value
Rows	118938.7	23787.73	14.79487	3.92E-06	Rows	20929.17	4185.833	1.095444	0.393493
Columns	143391.3	35847.83	22.29569	3.9E-07	Columns	99770.08	24942.34	6.347526	0.00157

C1 & C2 – Control, T1 & T6 (10% MSW + 90% ED), T2 & T7 (20% MSW + 80% ED), T3 & T8(30% MSW + 70% ED), T4 & T9(40% MSW + 60% ED), T5 & T10 (50% MSW + 50% ED), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (P<0.05). (+/–) – Percent change of increase or decrease over the initial.

Table 3. The vermicompost from MSW with ED caused by E. fetida and Perionyx ceylanesis had a fungal population (CFU × 105 g-1; p<0.05).

Substrate Proportions	E.fetida					Substrate Proportions	**P. ceylanesis**				
	Vermi composting days						Vermi composting days				
	0	15	30	45	60		0	15	30	45	60
C1	145.17±2.35	156.23±1.86	242.48±1.74	256.94±2.16	279.75±1.90 (92.70)	C2	138.17±2.35	166.64±1.76	175.18±2.20	184.04±1.34	214.85±1.84 (55.68)
T1	131.43±1.43	172.48±1.45	191.69±1.19	214.30±1.09	247.45±1.27 (88.49)	T6	128.47±1.43	159.42±1.88	172.29±2.48	196.91±2.09	228.40±1.82 (77.78)
T2	133.14±2.20	207.67±2.06	238.05±1.04	258.23±1.28	312.30±2.43 (98.1)	T7	132.32±1.20	197.21±1.02	206.44±1.45	228.48±1.46	239.54±1.51 (81.60)
T3	127.27±1.18	153.81±2.23	177.97±1.76	206.49±2.34	228.43±1.25 (79.34)	T8	127.25±1.56	139.86±2.28	153.93±1.62	166.22±2.22	190.87±1.72 (49.60)
T4	115.56±2.10	135.12±1.35	143.28±1.82	165.01±2.45	197.29±2.14 (71.30)	T9	106.53±2.15	118.49±2.23	137.61±1.67	149.65±1.86	155.08±2.25 (46.20)
T5	103.19±2.40	113.31±1.42	127.46±1.38	161.62±1.60	168.86±1.45 (.67.10)	T10	101.92±2.40	106.56±1.67	118.34±1.92	121.83±2.31	136.78±2.16 (34.65)

Analysis of variance	Sum of square	Mean of square	F-value	P-value	Analysis of variance	Sum of square	Mean of square	F-value	P-value
Rows	33544.95	6708.991	19.7656	4.03E-07	Rows	23857.24	4771.448	31.29352	8.43E-09
Columns	47140.97	11785.24	34.72093	9.73E-09	Columns	17.672.97	4408.242	28.91144	4..67E-08

C1 & C2 – Control, T1 & T6 (10% MSW + 90% ED), T2 & T7 (20% MSW + 80% ED), T3 & T8(30% MSW + 70% ED), T4 & T9(40% MSW + 60% ED), T5 & T10 (50% MSW + 50% ED), Initial (0) – Worm unworked substrates, Mean ± SD of six observations, (P<0.05). (+/–) – Percent change of increase or decrease over the initial.

The enzyme activity of vermicompost collected from both species is, on average, higher than that of vermicompost collected from other species. In both municipal solid waste and ED mixtures, the incorporation of earthworms led to a significant increase in the amount of enzyme activity that was present. The enzyme activity was much higher in comparison to the initial compost, notably in terms of the activities of cellulase, amylase, protease, phosphatase, and dehydrogenase. The changes that were observed in the activity of enzymes are detailed in the following explanation.

Activity of cellulase

The quantity of cellulase activity that was present in the vermicompost that was generated by E. fetida and Perionyx ceylanesisover the period of sixty days.

1. E. fetida

At the sixty-first day, the vermicompost that was generated by E. fetida exhibits a rise in the activity of the cellulase enzyme. Initially, the cellulase activity was low and it was recorded as C1 (7.01±0.07 mg glucose g soil-1h-1); T1(6.81±0.041 mg glucose g soil-1h-1); T2 (7.04±0.023 mg glucose g soil-1h-1); T3 (5.72±0.016 mg glucose g soil-1h-1); T4 (5.33±0.025 mg glucose g soil-1h-1); T5(4.90±0.19 mg glucose g soil-1h-1) respectively. The enzyme activity was found to be at its peak in T1 on the sixty-first day, followed by T2, C1, T3, T4, and T5 in that order. There was a discernible increase in the enzyme's activity over time.

2. P. ceylanesis

The activity of the cellulase enzyme steadily rises as the process of vermin composting with Perionyx ceylanesis progresses towards completion. The cellulose activity was modest in the beginning, and the following is how it was recorded: The results of the experiment showed that C2 generated 6.88±0.016 mg glucose g soil-1h-1, T6 produced 6.61±0.014 mg glucose g soil-1h-1, T7 produced 6.99±0.011 mg glucose g soil-1h-1, T8 produced 5.62±0.015 mg glucose g soil-1h-1, T9 produced 5.21±0.023 mg glucose g soil-1h-1, and T10 produced
4.76±0.012 mg glucose g soil-1h-1. On the sixty-first day, it was discovered that the enzyme activity was at its peak in T7, followed by T6, C, T8, T9, and T10 in fast succession. T7 was the greatest enzyme activity. On the 60th day, the cellulase activity increased to 7.45±0.51 in T6, 8.02±0.78 in T7, 6.62±0.32 in T8, 6.17±0.77 in T9, and 5.73±0.38 in T10. These values indicated that the cellulase activity was increasing. The enzyme T7 was discovered to have the highest cellulose enzyme activity, and it was followed by other enzymes in the order that is shown below: The order of T6 is as follows: T6 > C2 > T8 > T9 > T10 1.

Amylase activity

Amylase activity was seen in the vermicompost that was generated by E. fetida and Perionyx ceylanesis over the course of a period of sixty days. Every single one of the treatments, in addition to the control, which was comprised of a mixture of municipal solid waste and ED, shown an increase in amylase activity.

1) E. fetida

An increase in amylase activity (mg glucose g-1h-1) was seen in E. fetida up to the sixty-first day, and this rise was observed in both the control group and the treatment group. On day 2, it was discovered that the amylase activity was rather high, with a measurement of 6.11±0.0014 mg glucose g-1h-1. In terms of the percentage change made in comparison to the initial activity, it was followed by C1 (47.79%), T1 (46.00%), T3 (41.01%), T4 (39.31%), and T5 (35.12%). The percentage change that was the largest was 57.06%, which was seen in T2.

2) P. ceylanesis

Perionyx ceylanesis also saw an increase in amylase activity, and this increase persisted for a period of up to sixty days. The T7 treatment, which consisted of 6.00±0.01mg glucose g-1h1, exhibited the maximum enzyme activity on the 60th day, whereas the T10 treatment, which consisted of 44.12±0.011 mg glucose g-1h-1, revealed the level of activity that was the lowest. The mild activity that was seen in other treatments stands in stark contrast to these findings.

Earthworms have been found to be responsible for producing changes in the population of bacteria that are present in a variety of organic wastes throughout the process of vermicomposting. This has been shown via research. Furthermore, it has been shown that these bacteria have a higher metabolic efficiency than other species. This improvement occurred during the process of vermicomposting sugar industrial wastes. The total number of microbial population and microbial activity were reported to have increased in vermicomposts created from banana trash and cow dung in comparison to natural composts that had not been treated by worms. An increase in the populations of microorganisms in the vermicompost of E. fetida was seen in the current experiment, which is analogous to the data that were presented earlier in this paragraph. vermicomposting sugar industrial wastes at a temperature of 31 degrees Celsius and a moisture content of anywhere between 60 and 70 percent is also consistent with the reports of the improvement of microbial population, microbial activity, and nutritional contents in the vermicompost. This was determined via the process of studying the differences between the two types of compost. It was claimed that the impact of the worm E. fetida on the microbial biomass, structure, and microbial activity was obtained by vermicomposting. This was accomplished through the use of continuous feeding vertical reactors, which are designed to handle a higher volume of waste. The findings demonstrated that the vermicompost that was produced from food waste resulted in an increase in the number of soil microbial communities, including bacteria, fungus, and actinomycetes. Furthermore, the vermicompost product that was formed from tannery fermented waste combined with cowdung and leaf litter showed a considerable increase in both the microbial population and activity within the vermicompost product. This was in contrast to the combination that served as the control. The earthworm P. ceylanesis was able to use these waste mixes via the stomach and digest them with enzyme activity, which resulted in the generation of manure that was rich in nutrients.

CONCLUSION

Vermicomposts that are produced by E. fetida include a wide variety of microbial communities. These communities include bacteria, fungi, and actinomycetes, and they are present in varied proportions of municipal solid waste and ED mixture. It is feasible to draw the conclusion that the vermicompost of E. fetida has higher microbial communities in all municipal solid waste with ED treatments than the vermicompost of Perionyx ceylanesis would have. This result can be reached by taking into account the debate that came before it. Another possible explanation for this mismatch is because the casts of the worms have certain properties.

REFERENCES

[1] Agüero, C. L. Barnett, J. Brown, M. Gilek, B. J. Howard, E. Ilus, U. Kautsky, L. Kumblad, B. Naeslund, and S. M. Wright . Identification of candidate reference organisms from a radiation exposure pathways perspective, Deliverable 1. In FASSET, Framework for Assessment of Environmental Impact (P. Strand, N. Beresford, R. Avila, S. R. Jones and C. M. Larsson, Eds.), pp. 1–48. European Community, Luxembourg, 2001. Google Scholar

[2] Agüero, F. Alonzo, M. Björk, P. Ciffroy, D. Copplestone, J. Garnier-Laplace, R. Gilbin, M. Gilek, T. Hertel-Aas, and I. Zinger . Derivation of Predicted-No-EffectDose-Rate values for ecosystems (and their sub-organisational levels) exposed to radioactive substances, Deliverable 5. In ERICA, Environmental Risk from Ionising Contaminants: Assessment and Management (J. Garnier-Laplace and R. Gilbin, Eds.), pp. 1–88. European Community, Luxembourg, 2006. Google Scholar

[3] UNSCEAR, Sources and Effects of Ionizing Radiation. 1996 Report to the General Assembly, with Scientific Annex, pp. 1–86. United Nations, New York, 1996. Google Scholar

[4] ICRP, A Framework for Assessing the Impact of Ionising Radiation on Non-Human Species. Publication 91, Annals of the ICRP, Vol. 33, Elsevier, Amsterdam, 2003. Google Scholar

[5] M. D. Wood, J. D. Knowles, J. H. Whittaker, D. Coppelstone, H. M. Malcolm, and S. Bielby . In Developing Experimental Protocols for Chronic Irradiation Studies on Wildlife, pp. 3–101. R&D Technical Report P3-101/SP7, Environment Agency, Bristol, England, 2003. Google Scholar

[6] D. J. Spurgeon, J. M. Weeks, and C. A M. Van Gestel . A summary of eleven years progress in earthwrm ecotoxicology. Pedobiologia 47:588–606.2003. Google Scholar

[7] OECD, Test No.222: Earthworm reproduction test (Eisenia fetida/ Eisenia andrei). In OECD Guidelines for the Testing of Chemicals, Vol. 1, no. 2, pp. 1–18. Organisation for Economic Co-operation and Development, Paris, 2004. Google Scholar

[8] Klok and A. M. de Roos . Impact of toxicants on earthworm populations: a modeling approach. In Advances in Earthworm Ecotoxicology, Proceedings from the Second International Workshop on Earthworm Ecotoxicology, 2–5 April 1997 (S. C. Sheppard, J. D. Bembridge, M. Holmstrup and L. Posthuma, Eds.), pp. 295–309. SETAC Press, Pensacola, FL, 1997. Google Scholar

[9] Reinecke and S. A. Reinecke . Earthworms as test organisms in ecotoxicological assessment of toxicant impacts on ecosystems. In Earthworm Ecology, 2nd ed. (C. A. Edwards, Ed.), pp. 299–319. CRC Press, Boca Raton, FL, 2004. Google Scholar