

Assessment of Physicochemical Properties, Manurial Value and Mineral Composition of Vermicompost Prepared from Poultry Deep Litter

Kaushalendra Kumar^{1*}, Chandrahas², Durgesh Nandini³, Ravi Ranjan Kumar Sinha⁴, Sanjay Kumar⁵ and Kirti Saurabh⁶

ABSTRACT

This study was conducted to evaluate the physicochemical properties, manurial value, and mineral composition of vermicompost prepared from poultry deep litter and dry tree leaves. Poultry deep litter was used as the primary substrate, while dried leaves of Ashoka, Peepal, Semal, and Banyan trees were used as carbonaceous material to maintain an optimum C:N ratio of 25:1. Alkaline pretreatment using NaOH (0.2 mol/kg) was applied to enhance decomposition, and earthworms (*Perionyx ceylanesis*) were used for vermicomposting. The experiment was conducted for 90 days under controlled moisture and pH conditions. Significant changes ($P < 0.05$) were observed in physicochemical parameters during vermicomposting, including reduction in pH, organic matter, crude fibre, and total carbon, along with an increase in total ash and dry matter. Manurial values such as potassium and calcium increased, while nitrogen and phosphorus showed a gradual decline. Mineral elements including zinc, manganese, and iron increased significantly ($P < 0.05$) during the composting period. The results indicate that poultry deep litter combined with dry tree leaves can be efficiently converted into nutrient-rich vermicompost suitable for agricultural use.

Keywords: Vermicomposting, Poultry deep litter, Physicochemical properties, Manurial value, Mineral composition

ARTICLE INFO

Received on	:	23/02/2026
Accepted on	:	21/03/2026
Published online	:	31/03/2026



INTRODUCTION

Agriculture and livestock sectors generate large quantities of organic wastes that create serious environmental and management challenges, if not properly utilized. Among livestock industries, the poultry sector has expanded rapidly worldwide due to the increasing demand for eggs and poultry meat. India's total poultry population is around 851.8 million birds, country produces roughly 5.18 million tonnes of chicken meat and 149.11 billion eggs annually, ranking 4th and 2nd in the world, respectively (BAHS, 2025). This growth has resulted in the generation of substantial quantities of poultry waste, including poultry litter, manure, feathers, feed residues, and bedding materials. India generates approximately 3.30 million tonnes of poultry litter waste each year (Vandanadevia et al., 2025). Poultry waste is rich in organic matter and essential plant nutrients such as nitrogen, phosphorus, and potassium. However, its improper disposal can lead to several environmental problems such as foul odour, pathogen spread, greenhouse gas emissions, and contamination of soil & groundwater (Joshi et al., 2020; Thakur et al., 2023). In many developing countries, including India, traditional disposal practices such as dumping, burning, or direct land application often results in nutrient imbalance, soil degradation, and public health risks.

Therefore, environmentally sound and economically viable strategies are required to convert poultry waste into value-added products.

Biological waste treatment technologies such as composting and vermicomposting have emerged as sustainable approaches for recycling organic residues into nutrient-rich organic fertilizers. Vermicomposting is a biotechnological process in which earthworms and microorganisms convert organic wastes into a stabilized product (Thirunavukkarasu et al., 2023). During this process, earthworms fragment organic materials and enhance microbial activity, resulting in faster decomposition and improved nutrient mineralization. The final product is a fine, peat-like material rich in available nutrients, beneficial microorganisms, and humic substances that improve soil fertility and crop productivity (Srivastava and Beohar, 2008; Muruganandham and Parimala, 2018). Poultry litter mixed with carbon-rich materials such as dry tree leaves, produce high-quality vermicompost within a short period while also reducing pathogenic microorganisms (Thakur et al., 2023; Abd Rashid et al., 2024).

¹Associate Professor, Department of Animal Nutrition, Bihar Veterinary College, Patna, India

²Dean, College of Veterinary and Animal Sciences, Kishanganj, Bihar, India

³M.V.Sc. Scholar, Department of Animal Nutrition, Bihar Veterinary College, Patna, India

⁴Associate Professor, Department of LPM, Bihar Veterinary College, Patna, India

⁵Professor, Department of Animal Nutrition, Bihar Veterinary College, Patna, India

⁶Scientist, ICAR-Research Complex for Eastern Region, Patna, India

*Corresponding Author E-mail: drkaushalbv@gmail.com

Considering the rapid expansion of the poultry industry and the increasing demand for organic fertilizers, the utilization of poultry deep litter and dry tree leaves through vermicomposting offers a sustainable solution for waste management and nutrient recycling. Therefore, the present study aims to prepare vermicompost from poultry deep litter and dry tree leaves and to evaluate its physicochemical properties, manurial value, and mineral composition.

MATERIALS AND METHODS

Substrates for vermicomposting and chemical treatment

This work was conducted at Poultry Research and Training Centre, Bihar Animal Sciences University, Patna, Bihar. Poultry deep litter (mature) was utilized in this experiment for vermicompost production. Along with deep litter, fallen dried leaves from different plants available at poultry farm were utilized as feeding substrate to earthworms. Dried tree leaves were mainly of Ashoka tree (*Saraca asoca*), Peepal tree (*Ficus religiosa*), Semal tree (*Bombax ceiba*) and Banyan tree (*Ficus benghalensis*) that were present within the farm premises. Pooled samples of these leaves were taken for proximate analysis along with poultry deep litter. For present experiment, alkali pre-treatment of deep litter and tree leaves were performed using sodium hydroxide (NaOH) by making solution of 0.2 mol/kg with water with the objective of breaking lignocellulosic bonds of litter and making it available for digestion by earthworms. The solution prepared was allowed to cool overnight before being used for the pretreatment. Earthworms of *Jai Gopal* (*Perionyx ceylanesis*) species were procured from the KVK, Jehanabad, Bihar. Earthworms were brought to the experimental site on 16th day of experiment and measured amount of vermi-culture was added on the top of substrate in each treatment (1 kg vermi-culture per 100 kg of total substrates).

Experimental design

The experimental material was prepared by adjusting the C:N of poultry deep litter with fallen dried leaves as 25:1. Alkaline pretreatment of deep litter with NaOH was performed in both group and designated as T1 (control) and T2 (treatment). Alkaline pretreatment was given with NaOH @0.2 mol/kg. The amount of deep litter and dry leaves were measured and arranged in different layers to allow pre-digestion. The first layer was of dry leaves followed by poultry deep litter and then again leaves, same trend is followed till all the ingredients were consumed and it was made sure that the topmost layer was of leaves. Alkaline solution was sprinkled in both groups after every layer in order to maintain the moisture content between 40-50%. These materials were turned regularly at three days interval. After pre-digestion period of 15 days, the ingredients were added in to the pits and earthworms were added. The earthworms were added @ 1 kg per 100 kg of organic material. The details of the treatments were presented in table 1.

Physicochemical properties, Proximate analyses, Manurial value and Mineral estimation

Various physicochemical properties studied for vermicompost production include temperature, pH and

electrical conductivity (EC) which were measured at weekly intervals. For recording of the above parameters, a digital soil tester with probe (Venesto®) was used. The probe was inserted at three different sites of each vermicomposting pit, and average of three values were taken for record. To measure EC, approx. 10 g of sample was mixed with 100 mL of water and then the solution was filtered, then EC meter was inserted into the solution to record the values.

The oven dried sample was utilized for estimation of all the proximate principles i.e. moisture, dry matter, crude protein, ether extract, total ash, crude fibre, at 0, 45 and 90 days using the established method outlined in the AOAC (2000) guidelines. Manurial value of vermicompost involves estimation of N, P, K content and other minerals present in the vermicompost at different time intervals. Analysis of nitrogen by Kjeldahl method, phosphorus by colorimetric method (Koeing and Oslen method), potassium by flame photometer method. Calcium (Ca) was estimated by titration method (Talpatra et al., 1940). Other estimated trace minerals include zinc (Zn), copper (Cu), manganese (Mn) and iron (Fe) were estimated by AAS (Atomic Absorption Spectrophotometer). At the end of the experiment, the amount of vermicompost produced in treatment was determined.

Statistical analysis

Finally, collected data were subjected to statistical analysis as per Snedecor and Cochran (1994), using statistical package for the social sciences (SPSS) tool, version-2021. The results were expressed as mean \pm standard error (SE). Differences between treatments were analyzed using an independent sample t-test, while variations across different time intervals were analyzed using one-way and two-way ANOVA. Mean comparisons were performed using Duncan's Multiple Range Test (DMRT). Differences were considered significant at $P < 0.05$ and highly significant at $P < 0.01$.

RESULTS AND DISCUSSION

The experimental setup for vermicomposting utilized poultry deep litter as the primary substrate under two treatments: Control (T1) consisting solely of poultry deep litter, and Treatment (T2) where poultry deep litter was supplemented with dry leaves. Both treatments were standardized with respect to substrate quantity, chemical amendment, environmental conditions, and earthworm inoculation to ensure comparability. Both treatments were prepared using 100 kg poultry deep litter as the base substrate. Treatment T2 was supplemented with 27 kg dry leaves, while the control (T1) contained only poultry litter. The addition of dry leaves in T2 likely improved the carbon content and structural porosity of the substrate, thereby maintaining the C:N ratio at 25:1, which is considered optimal for efficient vermicomposting. Details of treatment adopted for vermicomposting are presented in table 1.

An alkaline amendment of NaOH at 0.2 mole kg^{-1} (800 g per 100 kg substrate) was applied uniformly in both treatments to facilitate initial decomposition and reduce possible ammonia

toxicity from poultry litter. The pH was maintained between 7.0 and 7.5, and moisture content was regulated at 40–50%, providing favourable conditions for microbial activity and earthworm survival. Both treatments were inoculated with 1.0 kg of the earthworm species *Perionyx ceylanesis* (Jai Gopal), which is widely recognized for its rapid organic matter degradation and adaptability to tropical vermicomposting systems. The experiment was conducted over duration of three months, allowing sufficient time for substrate stabilization and vermicompost formation. The principal variation between treatments was the inclusion of dry leaves in T2, which likely enhanced aeration and balanced the nitrogen-rich poultry litter, potentially improving decomposition efficiency and vermicompost quality compared to the control.

Table 1: Details of treatments adopted for vermicomposting

Attributes	Control (T1)	Treatment (T2)
Quantity of poultry deep litter (kg)	100	100
Quantity of dry leaves (kg)	0.0	27.0
Amount of NaOH (mole/kg) (800 g in 100 kg)	0.2	0.2
C:N ratio	25:1	
pH	7.0-7.5	
Moisture (%)	40-50	
Earthworm species and quantity	Jai Gopal (<i>Perionyx ceylanesis</i>) species and 1.0 kg	
Duration of experiment	3.0 months	

Proximate composition, physicochemical properties and mineral contents of substrates used for vermicomposting

The proximate composition, physicochemical properties, and mineral contents of poultry deep litter and dry leaves used as substrates for vermicomposting are presented in Table 2. Poultry deep litter recorded significantly higher moisture content ($32.02 \pm 0.60\%$) compared to dry leaves ($10.43 \pm 0.19\%$). In contrast, dry leaves showed higher dry matter ($89.57 \pm 0.19\%$) and organic matter ($86.94 \pm 0.17\%$) than poultry deep litter ($67.98 \pm 0.60\%$ and $65.42 \pm 0.20\%$, respectively). These results clearly indicate the contrasting nature of the two substrates, where poultry litter acts as a nitrogen-rich material and dry leaves function as a carbonaceous bulking agent. Similar findings were reported by Suthar (2009), who observed that agricultural residues and dry leaves possessed higher organic carbon and dry matter compared to animal manures used in vermicomposting systems. With respect to nutrient composition, poultry deep litter contained higher total N ($1.95 \pm 0.03\%$) and crude protein ($12.16 \pm 0.16\%$) than dry leaves ($1.17 \pm 0.06\%$ and $7.31 \pm 0.38\%$, respectively), confirming its nitrogen-rich nature. On the other hand, dry leaves showed higher total C ($50.43 \pm 0.10\%$) than poultry deep litter ($37.94 \pm 0.11\%$). Consequently, the C:N ratio was substantially higher in dry leaves (43.21 ± 2.31) than

in poultry deep litter (19.51 ± 0.31). The higher C:N ratio of dry leaves indicates their suitability as a carbon supplement for balancing nitrogen-rich poultry waste during vermicomposting. Similar observations were reported by Gajalakshmi and Abbasi (2004), who suggested that mixing poultry waste with plant residues improves decomposition efficiency and stabilizes the composting process.

Poultry deep litter also exhibited higher total ash ($34.59 \pm 0.20\%$), acid insoluble ash ($8.04 \pm 0.15\%$), and essential minerals such as C ($2.77 \pm 0.08\%$), P ($2.18 \pm 0.04\%$), and K ($1.81 \pm 0.09\%$) compared to dry leaves. These results are in agreement with the findings of Adhikari *et al.* (2009), who reported that poultry litter contains higher mineral fractions than plant-based residues. However, dry leaves showed comparatively higher ether extract ($3.59 \pm 0.33\%$) than poultry deep litter ($1.30 \pm 0.09\%$), which may be attributed to the presence of waxes and lipophilic compounds in plant leaves. The pH (8.29 ± 0.12) and EC ($2.05 \pm 0.17 \text{ dS m}^{-1}$) of poultry deep litter indicated a slightly alkaline and moderately saline nature, which is typical of poultry-based organic wastes. Similar findings have been reported by Edwards *et al.* (2011) and Rathinam *et al.* (2018), who observed alkaline pH and higher EC values in poultry litter compared to plant residues. Therefore, the compositional differences between poultry deep litter and dry leaves suggest that their combined use could provide a balanced substrate for vermicomposting by improving nutrient availability, carbon–nitrogen balance, and structural characteristics of the composting material. The integration of nitrogen-rich poultry litter with carbon-rich dry leaves may therefore enhance earthworm activity and accelerate the stabilization process, resulting in nutrient-rich vermicompost.

Table 2: Proximate composition, physicochemical properties and mineral contents of poultry deep litter and dry leaves used for vermicomposting

Attributes	Poultry deep litter	Dry leaves
Moisture (%)	32.02 ± 0.60	10.43 ± 0.19
Dry matter (%)	67.98 ± 0.60	89.57 ± 0.19
Organic matter (%)	65.42 ± 0.20	86.94 ± 0.17
Total Nitrogen (%)	1.95 ± 0.03	1.17 ± 0.06
Crude protein (%)	12.16 ± 0.16	7.31 ± 0.38
Total ash (%)	34.59 ± 0.20	13.07 ± 0.18
Crude fibre (%)	24.67 ± 1.21	20.48 ± 0.63
Ether extract (%)	1.30 ± 0.09	3.59 ± 0.33
Acid insoluble ash (%)	8.04 ± 0.15	5.95 ± 0.28
Total Carbon (%)	37.94 ± 0.11	50.43 ± 0.10
Ca (%)	2.77 ± 0.08	0.67 ± 0.04
P (%)	2.18 ± 0.04	0.40 ± 0.04
K (%)	1.81 ± 0.09	ND

Attributes	Poultry deep litter	Dry leaves
pH	8.29±0.12	ND
EC (dS/m)	2.05±0.17	ND
C:N	19.51±0.31	43.21±2.31

ND: Not detected

Physicochemical characteristics of vermicompost

The physico-chemical properties of poultry deep litter during vermicomposting are presented in Table 3. Temperature remained almost similar in both the control (29.36 ± 0.18 °C) and treatment (29.27 ± 0.26 °C), and the difference was not significant ($P > 0.05$). The nearly uniform temperature in both groups indicates the maintenance of stable mesophilic conditions, which are considered ideal for earthworm survival and microbial decomposition. Similar results were reported by Suthar (2009), who observed that vermicomposting generally proceeds under stable mesophilic temperature conditions without excessive heat generation. Moisture content differed significantly ($P < 0.05$), with higher moisture recorded in the treatment ($50.14 \pm 0.68\%$) compared to the control ($45.99 \pm 0.17\%$). The higher moisture content in the treatment may be attributed to the addition of dry leaves, which improve water-holding capacity and provide a more porous substrate. Adequate moisture is known to enhance microbial activity and earthworm metabolism, thereby accelerating organic matter decomposition. Comparable findings were reported by Gajalakshmi and Abbasi (2004), who emphasized that optimum moisture content plays a crucial role in improving vermicomposting efficiency.

A significant reduction ($P < 0.05$) in pH was observed in the treatment (7.32 ± 0.07) compared to the control (7.69 ± 0.07). The decrease in pH may be attributed to the formation of organic acids and increased microbial respiration during the decomposition process. Similar observations were reported by Adhikari et al. (2009), who reported a gradual decline in pH during vermicomposting of organic wastes due to organic acid formation and mineralization of organic matter. Electrical conductivity (EC) showed a slight increase in the treatment (2.18 ± 0.05 dS m⁻¹) compared to the control (2.05 ± 0.04 dS m⁻¹), although the difference was not statistically significant ($P > 0.05$). The increase in EC may be associated with the release of soluble mineral salts during the degradation of organic substrates. Similar results were observed by Rathinam et al. (2018), who reported an increase in EC values during vermicomposting of poultry waste due to nutrient mineralization. Results indicate that vermicomposting significantly influenced important physico-chemical parameters of poultry deep litter, particularly moisture and pH ($P < 0.05$), while maintaining stable temperature and EC conditions ($P > 0.05$). These changes reflect active biological decomposition and stabilization of organic residues, leading to improvement in substrate quality during the vermicomposting process.

Table 3: Physico-chemical properties of poultry deep litter undergoing vermicomposting

Attributes	Control	Treatment
Temperature (°C)	29.36±0.18	29.27±0.26
Moisture (%)	45.99±0.17	50.14±0.68
pH	7.69±0.07	7.32±0.07
EC (dS/m)	2.05±0.04	2.18±0.05

Values having different superscripts a,b varies significantly ($P < 0.05$) between columns.

Proximate composition changes during vermicomposting at different time intervals

The changes in proximate composition of poultry deep litter during vermicomposting at different time intervals are presented in Table 4. Significant variations were observed in most parameters both over time and between treatments ($P < 0.01$; $P < 0.05$), indicating active biological decomposition and stabilization of the organic substrates. Dry matter content increased progressively from day 0 to day 90 in both treatments, with comparatively higher values recorded in the treatment (56.60%) than in the control (54.14%) at the end of the composting period. The increase in dry matter may be attributed to gradual moisture loss and continuous decomposition of organic substrates during vermicomposting. Similar results were reported by Suthar (2009), who observed a significant increase in dry matter content during vermicomposting of organic wastes due to reduction in moisture and organic matter degradation. Organic matter showed a consistent declining trend over time in both groups. It decreased from 66.03% to 53.17% in the control and from 65.27% to 47.34% in the treatment. The greater reduction observed in the treatment indicates enhanced mineralization of organic matter through the combined action of microorganisms and earthworms. Similar findings were reported by Adhikari et al. (2009), who observed a significant reduction in organic matter during vermicomposting due to microbial respiration and carbon loss in the form of CO₂. Crude protein content decreased significantly ($P < 0.01$) with the progress of vermicomposting, declining from 16.00% to 9.37% in the control and from 8.50% to 6.25% in the treatment. This reduction may be attributed to the degradation of complex proteins and their conversion into simpler nitrogenous compounds during compost stabilization. Comparable results were reported by Gajalakshmi and Abbasi (2004), who noted a significant decline in protein content during vermicomposting of organic residues.

Total ash content increased significantly ($P < 0.05$) from day 0 to day 90 in both treatments, reaching 46.82% in the control and 52.66% in the treatment. The increase in ash content reflects the concentration of mineral components following the decomposition of organic matter. Similar observations were

reported by Rathinam *et al.* (2018), who reported a significant increase in ash content during vermicomposting of poultry waste. Ether extract showed non-significant ($P>0.05$) fluctuations during the composting period, indicating minimal changes in lipid fractions. In contrast, crude fibre content decreased gradually ($P<0.05$) in both treatments, suggesting effective degradation of fibrous components by microbial and earthworm activity. Acid insoluble ash also declined significantly ($P<0.01$) over time, indicating gradual decomposition of resistant mineral fractions. Similarly, total carbon decreased from 38.30% to 30.84% in the control and from 37.86% to 27.46% in the treatment, reflecting carbon mineralization and release as CO_2 during vermicomposting. Therefore, the results clearly demonstrate substantial biochemical transformation of poultry deep litter during vermicomposting, characterized by reduction in organic matter, crude protein, fibre, and carbon, along with a corresponding increase in mineral ash content, indicating stabilization and maturation of the compost.

Table 4: Proximate composition at different time intervals during vermicomposting

Time duration	Control	Treatment
Dry matter (%)		
Day-0	47.90 ^{aA} ±0.21	45.86 ^{aA} ±0.16
Day-45	49.45 ^{aA} ±0.98	50.82 ^{bB} ±0.61
Day-90	54.14 ^{bB} ±0.16	56.60 ^{cC} ±1.29
Organic matter (%)		
Day-0	66.03 ^{bB} ±1.17	65.27 ^{bB} ±0.41
Day-45	60.42 ^{bB} ±0.69	53.85 ^{aA} ±2.28
Day-90	53.17 ^{bA} ±2.02	47.34 ^{aA} ±1.31
Crude protein (%)		
Day-0	16.00 ^{bC} ±0.50	8.50 ^{bB} ±0.13
Day-45	13.87 ^{bB} ±0.43	7.84 ^{bB} ±0.95
Day-90	9.37 ^{bA} ±0.12	6.25 ^{aA} ±0.44
Total ash (%)		
Day-0	33.97 ^{aA} ±1.17	34.73 ^{aA} ±0.41
Day-45	39.58 ^{aA} ±0.69	46.15 ^{bB} ±2.28
Day-90	46.82 ^{bB} ±2.02	52.66 ^{bB} ±1.31
Ether extract (%)		
Day-0	1.47±0.12	1.27±0.09
Day-45	1.15±0.03	1.15±0.14
Day-90	1.08±0.11	1.51±0.12

Crude fibre (%)		
Day-0	24.67 ^{bB} ±1.21	18.46 ^{cB} ±1.21
Day-45	20.98 ^{bAB} ±0.13	14.69 ^{aA} ±0.41
Day-90	18.15 ^{bA} ±0.82	14.83 ^{aA} ±0.60
Acid insoluble ash (%)		
Day-0	10.04 ^{bB} ±0.15	6.74 ^{aA} ±0.29
Day-45	9.01 ^{bAB} ±0.24	6.09 ^{aA} ±0.13
Day-90	7.87 ^{bA} ±0.52	5.95 ^{aA} ±0.18
Total carbon (%)		
Day-0	38.30 ^{aB} ±0.67	37.86 ^{cB} ±0.23
Day-45	35.05 ^{bB} ±0.41	31.23 ^{aA} ±1.32
Day-90	30.84 ^{bA} ±1.17	27.46 ^{aA} ±0.76

Values having different superscripts a,b, and A,B,C varies significantly ($P<0.01$; $P<0.05$) between columns and rows, respectively.

C:N ratio and manurial values of vermicompost at different time intervals

The changes in C:N ratio and manurial values of vermicompost derived from poultry deep litter at different time intervals are presented in Table 5. Significant variations were observed in both between treatments and across time ($P<0.01$; $P<0.05$), indicating active nutrient transformation during the vermicomposting process. The C:N ratio differed significantly between control and treatment ($P<0.01$). In the control group, the C:N ratio increased significantly from 14.96 at day 0 to 20.55 at day 90 ($P<0.05$). In contrast, the treatment maintained comparatively higher values throughout the composting period, ranging from 27.85 at day 0 to 27.65 at day 90, and the changes over time were not significant ($P>0.05$). The variation in C:N ratio reflects differential rates of carbon degradation and nitrogen transformation during vermicomposting. Similar findings were reported by Suthar (2009), who observed significant variations in C:N ratio during vermicomposting due to progressive carbon mineralization.

Nitrogen content decreased significantly ($P<0.05$) over time in both treatments and remained consistently higher in the control compared to the treatment ($P<0.01$). Nitrogen declined from 2.56% to 1.51% in the control and from 1.36% to 1.01% in the treatment by day 90. The reduction in nitrogen may be attributed to mineralization, microbial utilization, and possible volatilization losses during the composting process. Similar findings were reported by Adhikari *et al.* (2009), who reported a significant reduction in nitrogen content during vermicomposting due to mineralization and ammonia volatilization. Phosphorus content also showed significantly higher values in the control compared to the treatment

($P < 0.01$), although changes over time were not statistically significant ($P > 0.05$). The values declined from 1.43% to 1.18% in the control and from 1.10% to 0.77% in the treatment during the composting period. The slight reduction in phosphorus content may be associated with leaching losses or redistribution of nutrients during decomposition. Comparable findings were reported by Gajalakshmi and Abbasi (2004), who reported moderate variations in phosphorus content during vermicomposting of organic wastes. Potassium content increased significantly ($P < 0.05$) with time in both treatments, increasing from 1.49% to 1.90% in the control and from 1.43% to 1.89% in the treatment. However, no significant difference ($P > 0.05$) was observed between the treatments. The increase in potassium may be attributed to the concentration effect caused by decomposition of organic matter and release of soluble mineral salts. Similar trends were reported by Rathinam et al. (2018), who observed a significant increase in potassium content during vermicomposting of poultry waste. Calcium content showed a gradual increase during the composting period, from 2.67% to 2.90% in the control and from 2.55% to 3.06% in the treatment. The increase was significant over time in the treatment ($P < 0.05$), although differences between control and treatment were not significant ($P > 0.05$). The increase in calcium content may be attributed to mineralization of organic matter and concentration of mineral fractions during compost stabilization. The results clearly indicate dynamic changes in nutrient composition during vermicomposting, with significant temporal variations in C:N ratio, nitrogen, potassium, and calcium content, reflecting the progressive mineralization and stabilization processes occurring in poultry deep litter compost.

Table 5: C:N ratio and manurial values of vermicompost at different time intervals

Time duration	Control	Treatment
C:N ratio		
Day-0	14.96aA±0.21	27.85bA±0.58
Day-45	15.79aA±0.32	24.88bA±0.75
Day-90	20.55aB±0.51	27.65bA±2.69
N (%)		
Day-0	2.56bC±0.08	1.36aB±0.02
Day-45	2.22bB±0.07	1.25aA±0.01
Day-90	1.51bA±0.02	1.01aA±0.07
P (%)		
Day-0	1.43bA±0.11	1.10aA±0.12
Day-45	1.36bA±0.13	0.96aA±0.08
Day-90	1.18bA±0.21	0.77aA±0.06

Time duration	Control	Treatment
K (%)		
Day-0	1.49aA±0.02	1.43aA±0.04
Day-45	1.73aB±0.06	1.63aAB±0.07
Day-90	1.90aB±0.03	1.89aB±0.09
Ca (%)		
Day-0	2.67aA±0.12	2.55aA±0.13
Day-45	2.79aA±0.13	2.87aAB±0.02
Day-90	2.90aA±0.11	3.06aB±0.08

Values having different superscripts a,b, and A,B,C varies significantly ($P < 0.01$; $P < 0.05$) between columns and rows, respectively.

Mineral composition of vermicompost at different time intervals

The mineral composition of vermicompost derived from poultry deep litter at different time intervals is presented in Table 6. Overall, most mineral elements showed an increasing trend during the vermicomposting period, indicating progressive mineralization and stabilization of organic matter. Copper (Cu) content increased gradually from day 0 to day 90 in both treatments, rising from 46.56 to 58.11 ppm in the control and from 50.39 to 66.59 ppm in the treatment. However, the differences between treatments and across time were not statistically significant ($P > 0.05$). The gradual increase in copper content may be attributed to the concentration effect resulting from decomposition of organic matter. Similar trends were reported by Suthar (2009), who observed a gradual increase in micronutrient content during vermicomposting of organic wastes. Zinc (Zn) content showed a significant increase over time in the treatment ($P < 0.05$), particularly at day 90 where it reached 117.97 ppm compared to 82.55 ppm in the control. No significant differences were observed between treatments at day 0 and day 45, indicating that the enrichment became more evident during the later stages of compost stabilization. Comparable findings were reported by Adhikari et al. (2009), who reported a significant increase in zinc concentration during vermicomposting due to mineralization of organic substrates. Manganese (Mn) content was significantly higher in the treatment compared to the control ($P < 0.05$) at all time intervals. It increased from 115.64 to 150.05 ppm in the control and from 128.22 to 166.44 ppm in the treatment, showing significant variation over time within the treatment group ($P < 0.05$). The increase in Mn content may be attributed to decomposition of organic matter and release of bound micronutrients during vermicomposting. Similar results were reported by Rathinam et al. (2018), who observed a significant increase in Mn content during vermicomposting of poultry waste. Iron (Fe) content increased markedly with composting

time in both treatments, showing significant differences across time ($P < 0.05$). The values increased from 615.12 to 967.28 ppm in the control and from 713.81 to 989.74 ppm in the treatment by day 90, although differences between treatments were not statistically significant ($P > 0.05$). The increase in Fe concentration may be attributed to the mineralization of organic matter and the relative concentration of mineral fractions during the composting process. Similar observations were reported by Gajalakshmi and Abbasi (2004), who reported that vermicomposting, leads to progressive enrichment of micronutrients due to decomposition and stabilization of organic residues. Results indicate a gradual enrichment of micronutrients such as Zn, Mn, and Fe during vermicomposting, which enhances the nutrient value of the final product. The increase in mineral elements reflects active microbial decomposition and stabilization of poultry deep litter, resulting in nutrient-rich vermicompost suitable for agricultural use.

Table 6: Mineral content of vermicompost at different time intervals

Time duration	Control	Treatment
Cu (ppm)		
Day-0	46.56±1.92	50.39±4.50
Day-45	49.63±6.74	61.32±1.43
Day-90	58.11±2.38	66.59±4.72
Zn (ppm)		
Day-0	70.91 ^{aA} ±3.22	77.94 ^{aA} ±4.96
Day-45	83.53 ^{aA} ±4.62	88.35 ^{aA} ±4.41
Day-90	82.55 ^{aA} ±2.58	117.97 ^{aB} ±4.79
Mn (ppm)		
Day-0	115.64 ^{aA} ±14.78	128.22 ^{bA} ±3.66
Day-45	119.12 ^{aA} ±4.76	155.15 ^{bAB} ±8.36
Day-90	150.05 ^{aA} ±8.37	166.44 ^{bB} ±5.68
Fe (ppm)		
Day-0	615.12 ^{aA} ±28.67	713.81 ^{aA} ±23.83
Day-45	684.83 ^{aA} ±39.01	849.25 ^{aAB} ±12.82
Day-90	967.28 ^{aB} ±15.85	989.74 ^{aB} ±28.51

Values having different superscripts a,b, and A,B varies significantly ($P < 0.05$) between columns and rows, respectively.

CONCLUSION

The present study demonstrated that poultry deep litter can be effectively converted into nutrient-rich vermicompost, particularly when supplemented with dry leaves. Addition of dry leaves improved the C:N ratio, moisture retention, and

substrate structure, thereby enhancing decomposition efficiency. Significant changes were observed in physico-chemical properties, proximate composition, and mineral content during the 90-day vermicomposting period. The treatment showed improved moisture level, reduced pH, higher mineral enrichment, and better stabilization of organic matter compared to the control. Overall, the results confirm that integrating poultry deep litter with dry leaves is an efficient and sustainable approach for producing high-quality vermicompost suitable for agricultural applications.

ACKNOWLEDGEMENT

The authors express their gratitude to the Vice Chancellor and Directorate of Research Bihar Animal Sciences University, Patna, Bihar, India for providing necessary support for this study.

REFERENCES

Abd Rashid, Omar F N, Sabri N F, Chuah N F and Samsuddin N Z. 2024. Manipulating chicken waste for improved vermicomposting substrate. *Bioresources Environment* 2(3): 155–164.

Adhikari B K, Barrington S, Martinez J and King S. 2009. Effectiveness of three bulking agents for food waste composting. *Bioresource Technology* 100(12): 2959–2964.

AOAC. 2000. Official Methods of Analysis. 17th ed. The Association of Official Analytical Chemists, Gaithersburg, MD, USA.

BAHS. 2025. Basic Animal Husbandry Statistics. Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, New Delhi.

Edwards C A, Arancon N Q, and Sherman R. 2011. Vermiculture technology: Earthworms, organic wastes, and environmental management. CRC Press, Boca Raton, USA.

Gajalakshmi S and Abbasi S A. 2004. Earthworms and vermicomposting: A review. *Waste Management* 24(4): 305–311.

Joshi T N, Nepali D B, Sah R, Bhattarai T and Midmore D J. 2020. A comparison of composting and vermicomposting for the disposal of poultry waste. *Animal Production Science* 60(7): 986–992.

Muruganandham M and Parimala S A G. 2018. Utilization of poultry droppings amended with different organic waste in vermicomposting using local earthworms *Perionyx ceylanensis*. *International Journal of Biological Research* 3(1): 32–36.

Rathinam A, Raja P and Suganthi P. 2018. Vermicomposting of poultry waste and evaluation of nutrient status of vermicompost. *Journal of Environmental Biology* 39(3): 381–386.

- Snedecor G W and Cochran W G. 1994. *Statistical Methods*. 9th ed. The Iowa, State University Press, Ames, Iowa.
- Srivastava R K and Beohar P A. 2008. Production of *Eisenia foetida* and vermicompost from poultry waste. *Asian Journal of Biological Sciences* 3(2): 395–398.
- Suthar S. 2009. Vermicomposting of vegetable market waste using *Eisenia fetida*: Impact of bulking material on earthworm growth and compost quality. *Bioresource Technology* 100(2): 593–598.
- Talapatra S K, Roy S C and Sen K C. 1940. The analysis of mineral constituents in biological materials. I. Estimation of phosphorus, calcium, magnesium, sodium and potassium in food stuffs. *Indian Journal of Veterinary Science and Animal Husbandry* 10: 243-258.
- Thakur R, Chandrahas, Kumar N, Gaur G K, Singh M, Tarafdar A, Verma M R and Tiwari V. 2024. Changes in microbiota and parasitic load of poultry manure undergoing value addition through different techniques for their safe disposal or utilization. *Indian Journal of Experimental Biology* 62(3): 199–205.
- Thirunavukkarasu A, Sivashankar R, Nithya R, Sathya A B, Priyadharshini V, Kumar B P, Muthuvenia M and Krishnamoorthy S. 2023. Sustainable organic waste management using vermicomposting: a critical review on the prevailing research gaps and opportunities. *Environmental Science: Processes Impacts* 25(3): 364-381.
- Vandanadevia V S, Aparna S and Meenakshi R P. 2025. Composting – a viable option for converting poultry manure into a nutrient-rich manure. *World's Poultry Science Journal* 81(4): 1259–1284.

Citation:

Kumar K, Chandrahas, Nandini D, Sinha R R K, Kumar S and Saurabh K. 2026. Assessment of physicochemical properties, manurial value and mineral composition of vermicompost prepared from poultry deep litter. *Journal of AgriSearch* 13(1): 30-37.