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NUTRIENT COMPOSITION OF VERMICOMPOST PRODUCED FROM VEGETABLE AND TEMPLE WASTE: AN ECO-FRIENDLY APPROACH TO ORGANIC WASTE MANAGEMENT

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ABSTRACT:

Vermicomposting is an eco-friendly solution to manage organic waste. The end product is vermicompost which typically contains nitrogen (N), phosphorus (P), and potassium (K) in a balanced ratio. The NPK value of vermicompost can vary depending on the feedstock and the conditions of the vermicomposting process. The present study was carried out to compare the NPK value of compost prepared from vegetable and temple waste by using earthworms. The selected earthworm species for this study was *Eisenia fetida*. Cow dung, vegetable, and temple waste were used in a ratio of 1:1 for vermicompost preparation. The experiment spanned approximately 60 days. The comparative NPK analysis of vermicompost derived from vegetable wastes and temple wastes demonstrates that both vermicomposts are effectively used as organic fertilizers. Vegetable waste generally produces vermicompost with higher concentrations of nitrogen (N), phosphorus (P), and potassium (K) compared to temple waste, highlighting its potential as a more nutrient-rich option for plant growth, contributing to a more sustainable waste management approach by utilizing readily available organic materials from both sources.

Keywords: - Vermicomposting, Vermicompost, Earthworms, Nitrogen, Phosphorus, Potassium.

INTRODUCTION:

Vermicomposting is a biotechnique for converting biodegradable waste into organic manure with the help of earthworms and the compost produced is good organic manure. It produces compost by utilizing earthworms to turn the organic waste into high-quality compost that consists mainly of worm-cast and decayed organic matter (Devi and Prakash 2015). Vermicomposting helps to convert organic wastes into highly nutrient fertilizers for plants and soil (Gajalakshmi and Abassi 2004). Vermicompost is composed of nutrients such as Nitrogen, soluble Potassium, exchangeable Calcium, Magnesium, and Phosphorus and microelements such as Fe, Mo, Zn, and Cu (Theusnissen et al. 2010 and Mistry et al. 2015) along with beneficial microorganisms that enhance soil fertility. The vermicompost contains plant growth regulators which the plants easily take up. Vermicompost is a peat-like material with excellent structure, porosity, aeration, drainage and moisture-holding capacity (Edwards et al. 2011). It improves the physical, chemical and biological properties of soil and contributes to its organic enrichment (Ansari and Jaikishun 2011; Chauhan and Singh 2011). Vermicompost, an organic fertilizer rich in NPK, micronutrients, and beneficial soil microbes is a sustainable alternative to chemical fertilizers and is an excellent growth promoter and protector for crop plants (Sinha et al. 2011 and Chauhan and Singh 2015). Using organic fertilizers like vermicomposting could effectively solve the problem where it could substitute the chemical inputs in crop productivity and

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reduce the economic cost. On the other hand, it may also lead to organic produce which fetches higher prices in the market. The increase in living standards has created a growing demand for such organic produce, or cultivation using only natural pesticides and fertilizers, which are perceived to be healthier for consumers and environment friendly (Kaplan, 2016). Earthworms are effectively used to recycle dewatered sludge from municipal and industrial wastewater treatment plants and wet organic residues from food processing industries in New Zealand (Quintern, 2011) and globally (Edwards et al. 2011). Vermicomposting is increasingly becoming the strategy of choice, transforming this sludge and wastes into a safe and highly valued fertilizer and soil conditioner known as vermicast for uses in agriculture, horticulture, nurseries, and recreation areas (Lazcano and Dominguez. 2011; Zandonadi and Busato, 2012; Hemandez et al. 2015; Joshi et al. 2015 and Sinha et al. 2013). Considering the immense importance of vermicompost the present research work was focused on the comparison of the nutrient composition of vermicompost produced from vegetable and temple waste by examining the nitrogen, phosphorus and potassium content of the vermicompost.

MATERIALS AND METHODS:

2.1 Selection of Earthworm Species

Eisenia fetida was chosen for this study due to its efficiency in decomposing organic waste. The earthworms were brought from Mukul Mushroom Farm and Vermicomposting Projects, Bharatwada, Nagpur.

2.2 Maintenance of Earthworm

E. fetida was cultured and maintained in a tank of 1m X 1m X 1m tank at the Department of Zoology, Dada Ramchand Bakhru Sindhu Mahavidyalaya, Nagpur. They were acclimatized in cow dung and used for various experimental setups.

2.3 Collection of Organic Waste Materials

Vegetable waste was collected from household kitchens, while temple waste (floral and organic offerings) was gathered from local temples. The waste materials were segregated, and unwanted material was removed. The cleaned material was finely sliced before being introduced into the vermicomposting system.

2.4 Experimental Setup for Vermicomposting

For the present study, three different bedding sets for vermicomposting were prepared. The first bedding container comprises pre-decomposed cow dung, the second vermibed was prepared with cow dung and pre-decomposed vegetable waste in a ratio of 1:1 and the third container contains cow dung and pre-decomposed temple waste in a ratio of 1:1. The containers were kept in shed covered with gunny bag. They were constantly monitored throughout the study (Table 1). Water was regularly sprinkled over the vermibeds to hold the moisture content of 60 to 70%. Fifty healthy, matured E. fetida of 10- 12cm length and 4.49-5.86g weight were introduced in experimental containers. Each setup was maintained for 60 days under controlled conditions, including moisture regulation and aeration.

Table 1: Experimental Setup of Vermicomposting

Container	Vermicomposting Bed	Period of vermicomposting
1	Cow dung	60 Days
2	Cow Dung + Vegetable Waste	60 Days
3	Cow Dung + Temple Waste	60 Days

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2.5 Maintenance of Culture Beds

The vermicomposting containers were kept in a shed and constantly monitored throughout the period of study. Water was regularly sprinkled over the vermibeds to hold the moisture content. The containers were covered with gunny bags for ventilation and to prevent predators.

2.6 Analysis of Vermicompost

The nutrient composition of vermicompost prepared from vegetables and temple waste was analyzed using standard laboratory procedures. The parameters analyzed were pH level, temperature, electric conductivity (EC), and concentrations of nitrogen (N), phosphorus (P), and potassium (K). The pH of all the experimental vermicompost beds was measured with the help of a pH meter, temperature with the help of a thermometer, and electric conductivity with the help of a conductivity meter. The Nitrogen (N) was estimated using the Micro-Kjeldahl method, Phosphorus (P) was determined using spectrophotometric analysis and Potassium (K) was measured using a flame photometer.

2.7 Data Analysis

Statistical analysis of the data was stated in terms of mean ±SEM. The difference between the groups was statistically determined by the Student't' test (Dalgaard, 2008). A significant level of $P<0.05$ was accepted.

RESULT & DISCUSSION:

The physical parameters pH, Temperature and Electric conductivity of the compost were recorded before and after completion of the experiment (Table 2). The pH of cow dung compost was 8.1. the pH of the vegetable and temple waste composts showed significantly similar values. The pH of each compost is in the range of 7.6 – 7.8. The temperature and EC of cow dung compost were as noted in Table 2. The nutrient values of vermicompost obtained were presented in Table 3. The nitrogen (N), Phosphorus (P), and Potassium (K) content (%) of cow dung vermicompost is low and higher in cow dung + vegetable and temple waste compost. When the vermicompost of cow dung + vegetable waste and cow dung + temple waste was compared, vegetable vermicompost contained more nutrients than temple waste.

With the increasing demand for sustainable agricultural practices, organic fertilizers like vermicompost have gained attention as an alternative to chemical fertilizers. The excessive use of synthetic fertilizers has led to soil degradation, loss of microbial diversity, and environmental pollution. In contrast, vermicomposting provides an eco-friendly and cost-effective method for converting organic waste into a nutrient-rich soil amendment. Vermiculture is a cost-effective, eco-friendly and environmentally sound tool for waste management (Banu et al. 2001; Asha et al. 2008; Kashmiri, 2020). Vermicomposting involves the breakdown of organic matter through the activity of earthworms and beneficial microbes into fertilizer (Gurav and Pathade, 2011). The process conditions monitored include temperature, moisture content, pH and electrical conductivity (Chanda et al. 2011; Ansari and Rajpersaud, 2012; Manyuchi et al. 2012). The resulting compost, known as vermicompost, is rich in essential plant nutrients such as nitrogen (N), phosphorus (P), and potassium (K), along with beneficial microorganisms that enhance soil fertility. Studies have shown that different organic waste sources significantly influence the nutrient composition of vermicompost, making it essential to analyze and compare compost from various inputs. The present study presented the

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effects of different organic waste combinations on vermicomposting efficiency by assessing key parameters such as pH, temperature, and nutrient composition (NPK content).

Among the different organic waste materials, vegetable waste and temple waste are widely available yet often underutilized. Vegetable waste, which includes discarded peels, leaves, and spoiled produce, is rich in organic carbon and essential nutrients. Temple waste, consisting of flowers, leaves, and other biodegradable offerings, also contains valuable organic matter that can be effectively composted. The present study investigated NPK content of vermicompost derived from cow dung, vegetable and temple waste. The findings indicate significant variations in all parameters across the three setups i.e. cow dung, cow dung + temple waste, and cow dung + vegetable waste. The increase in earthworm weight in all three setups suggests favorable conditions for *Eisenia fetida* during the vermicomposting process. The highest weight gain was observed in the cow dung setup**,** which may be due to the stable and balanced nutritional composition of cow dung, providing an optimal environment for earthworm growth. However, the earthworms in the vegetable and temple waste setups showed comparatively lower weight gain**,** possibly due to the presence of additional organic waste, which may have led to fluctuating microbial activity, decomposition rates, and variations in available nutrients. The slight increase in acidity in these setups could have also influenced earthworm metabolism and activity. Maintaining an optimal pH range is essential for the survival of earthworms and microbial activity. The study showed a slight decline in pH over 60 days in all setups, with the most significant drop in the temple waste setup (8.6 to 8.1). This reduction may be attributed to the decomposition of cow dung and temple waste, which likely increased the production of organic acids. Interestingly, the cow dung and vegetable waste setup remained nearly constant (8.2 to 8.6), suggesting a buffering effect due to the presence of vegetable waste, which might have neutralized the acidic components formed during decomposition. The decrease in pH in other setups highlights the importance of monitoring acidity levels to ensure optimal vermicomposting conditions. Temperature plays a crucial role in vermicomposting as it affects the metabolic rate, reproduction, and overall activity of earthworms. The temperature in all setups increased slightly over 60 days**,** indicating active microbial decomposition and heat generation due to organic matter breakdown. The highest increase was recorded in the cow dung and vegetable setup (28°C to 30°C), which suggests that vegetable waste decomposition produced more heat compared to cow dung alone. This may be due to the higher moisture content and faster degradation of vegetable matter. However, the observed temperatures remained within the optimal range (15°C to 30°C), ensuring no negative impact on earthworm survival. The analysis of Nitrogen (N), Phosphorus (P_2O_5), and Potassium (K_2O) content in the final vermicompost revealed significant differences among the three setups. The cow dung and vegetable waste and cow dung and temple waste setups had the highest NPK values, whereas the cow dung setup had the lowest NPK content. The higher NPK values in temple and vegetable waste-based compost suggest that these materials contributed to increased microbial activity, faster decomposition, and enhanced nutrient availability. The lower NPK content in cow dung alone indicates that while cow dung is a good organic substrate, the addition of other biodegradable waste materials significantly improves the nutrient profile of the final vermicompost. These findings support the use of temple and vegetable waste as effective organic

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additives in vermicomposting to enhance soil fertility and nutrient enrichment.

The study demonstrates that adding temple and vegetable waste to cow dung significantly enhances vermicomposting efficiency by improving nutrient composition (NPK content) while maintaining suitable conditions for earthworm survival. However, minor challenges such as pH fluctuations and increased heat generation must be carefully managed to optimize the vermicomposting process. Vegetable waste, rich in readily available organic matter like peels and stems, tends to yield vermicompost with higher NPK levels due to its naturally higher nitrogen content to temple waste, which often includes offerings like flowers and leaves with a different nutrient profile. While temple waste can still be effectively vermicomposted, its nutrient content may vary depending on the types of offerings used. It might be lower in NPK but could still provide valuable micronutrients like zinc, manganese, and iron. Utilizing both vegetable and temple waste through vermicomposting significantly reduces the amount of organic waste going to landfills, contributing to an eco-friendlier waste management strategy. Overall, comparing the NPK content of vermicompost derived from vegetable and temple waste provides valuable insights into maximizing the potential of both waste streams for sustainable agriculture, promoting resource utilization and minimizing environmental impact.

Table 2: Physical properties of Vermicompost prepared by using vegetable and temple waste

Sr. No.	Vermicompost prepared using	pH		Temperature (^{0}C)		Electric Conductivity (EC) (dS m-1)	
		0 Day	60 Day	0 Day	60 Day	0 Day	60 Day
1	Cow dung	8.2±0.02	8.1±0.33	27±0.08	28±0.17	0.68±0.08	0.70±0.07
2	Cow Dung + Vegetable Waste	8.4±0.24	8.6±0.23	26±0.10	27±0.21	0.69±0.07	0.78±0.11
3	Cow Dung + Temple Waste	8.3±0.22	7.8±0.09	26±0.07	28±0.11	0.70±0.10	0.75±0.05

Table 3: N, P and K content of Vermicompost prepared by using vegetable and temple waste

Sr. No.	Vermicompost prepared using	Total Nitrogen as N (%w/w)		Total Phosphorous as P2O5 (%w/w)		Total Potassium as K2O (%w/w)	
		0 Day	60 Day	0 Day	60 Day	0 Day	60 Day
1	Cow dung	0.44±0.03	0.48±0.08	0.40±0.06	0.42±0.06	0.09±0.08	0.11±0.05
2	Cow Dung + Vegetable Waste	0.46±0.19	0.92±0.07	0.42±0.08	0.53±0.11	0.81±0.12	0.18±0.08
3	Cow Dung + Temple Waste	0.45±0.08	0.87±0.04	0.41±0.09	0.52±0.23	0.082±0.19	0.16±0.12

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CONCLUSION:

The study demonstrates that adding temple and vegetable waste to cow dung significantly enhances vermicomposting efficiency by improving nutrient composition (NPK content) while maintaining suitable conditions for earthworm survival. However, minor challenges such as pH fluctuations and increased heat generation must be carefully managed to optimize the vermicomposting process. Vegetable waste, rich in readily available organic matter like peels and stems, tends to yield vermicompost with higher NPK levels due to its naturally higher nitrogen content to temple waste, which often includes offerings like flowers and leaves with a different nutrient profile. While temple waste can still be effectively vermicompost, its nutrient content may vary depending on the types of offerings used. It might be lower in NPK but could still provide valuable micronutrients like zinc, manganese, and iron. Utilizing both vegetable and temple waste through vermicomposting significantly reduces the amount of organic waste going to landfills, contributing to an eco-friendlier waste management strategy. Overall, comparing the NPK content of vermicompost derived from vegetable and temple waste provides valuable insights into maximizing the potential of both waste streams for sustainable agriculture, promoting resource utilization and minimizing environmental impact.

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