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An Investigation Comparing the Properties and Nutrients of Vermi Compost and Domestic Organic Waste Compost

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Abstract:- Composting is a commonly used technique for repurposing organic waste. This approach has been suggested as a method to help reintegrate materials back into the production cycle. Vermicomposting is an eco-friendly technology that reduces pollution and creates high-quality compost efficiently and cost-effectively. Earthworms, known as 'ecosystem engineers,' can alter and enhance soil quality, leading to increased plant growth. Earthworms have garnered significant interest for their potential in remediating soils contaminated with Potentially Toxic Elements (PTEs), either on their own or in conjunction with other soil organisms and additives. Food waste from households is disposed of in landfills, leading to a significant loss of resources and energy, contributing to the greenhouse effect, and endangering water sources. Composting is a widely used method for managing solid organic waste and may be utilised in every household to create high-quality compost. Households contribute significantly to overall food waste and play a crucial role in tackling food waste disposal challenges.

This paper focuses on producing vermicompost from cow dung and home compost from kitchen waste, analyzing their nutrient content (moisture, NPK), and conducting laboratory tests. Collection of Soil and cow dung and kitchen waste was done from local area of Kargi Road Kota, District Bilaspur (CG) (LAT 22.290674, LONG 82.021537) and vermi samples and Domestic compost samples are also prepared in Kargi road Kota, District Bilaspur (CG).The Properties of samples of vermicompost and samples of domestic compost were analyzed and examined after 7, 15, and 30 days.

Keywords:- *N for Nitrogen, K for Potassium, P for Phosphorus.*

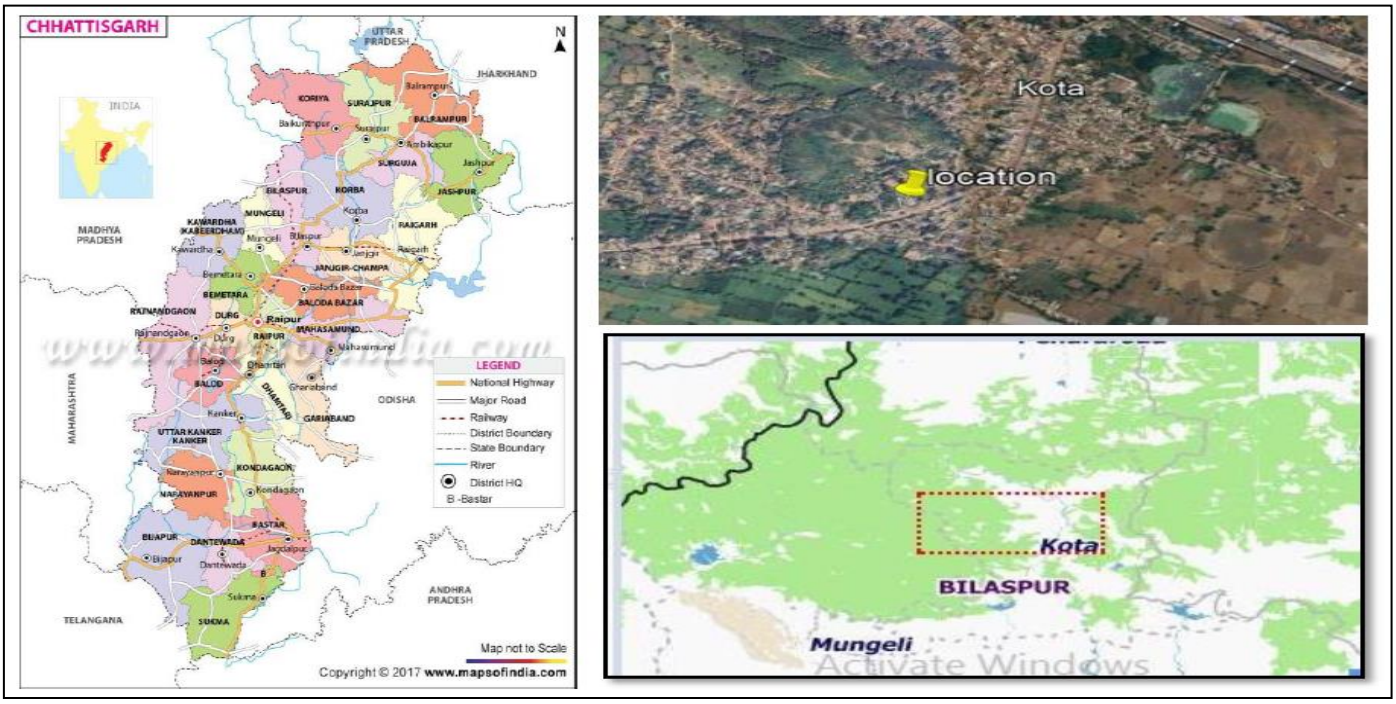

Fig. 1: Location of Workplace

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I. INTRODUCTION

A. *Compost*

Compost can be defined as a mixture of ingredients used as plant fertilizer and to improve soil's physical, chemical, and biological properties. It is commonly prepared by decomposing plant and food waste, recycling organic materials, and manure. The resulting mixture is rich in plant nutrients and beneficial organisms, such as bacteria, protozoa, nematodes, and fungi. Compost improves soil fertility in gardens, landscaping, horticulture, urban agriculture, and organic farming, reducing dependency on commercial chemical fertilizers. The benefits of compost include providing nutrients to crops as fertilizer, acting as a soil conditioner, increasing the humus or humic acid contents of the soil, and introducing beneficial microbes that help to suppress pathogens in the soil and reduce soil-borne diseases.

B. *Vermicompost*

Vermicompost is formed when earthworms ingest organic matter and aerobically decompose it at room temperature with the help of microorganisms. Vermicomposting, often known as worm composting, creates a rich organic soil supplement that is full of beneficial microbes and a variety of plant nutrients. This recycling process transforms organic waste elements that were previously thought of as rubbish into beneficial biofertilizer for plants and crops. Previous studies illustrated that vermi-compost constitutes a promising alternative to inorganic fertilizers in promoting plant growth (Ansari et al., 2016; Chauhan and Singh 2015; Sinha et al., 2011).Stimulation of plant growth may depend mainly on the biological characteristics of vermi-compost, the plant species used, and the cultivation conditions (Edwards et al., 2004).Vermicomposting is the most effective nutrient recovery method. Weed management and the usage of two-stage compost products in the agro-industry could benefit from the current research. (Heena Kauser et al., 2022).Findings showed that vermi-compost is the best-suited germination and growing media, which not only improved the soil health but also promoted seed germination and plant growth (Irsa Shafique et al.).Sarat Ganti on his Topic “Vermicomposting” states that vermicomposting is a biological technique of converting organic wastes in to a rich soil amendment. In this paper a thorough literature is done regarding the impacting factors for a vermicomposting unit followed by design of pit for a vermicomposting and the number of earthworms required for the obtained amount waste.An experiment was conducted to produce vermicompost, Containers were prepared and worms were added to them. Paper waste, sludge, and regular compost were added, The pH, Ec, C/N, total N, available P, total K, and total Ca of the residues were measured before adding them and converting them into vermicompost by earthworms. The results showed a decrease in pH, Ec, and C/N, as it gave (6.01 and 1.89 dSm-1 and 10) respectively, while the concentrations of (total N, available P, total K, and total Ca) were (1.8%, 284.4mgkg-1, 242.7mgkg-1 and 0.034% respectively.

Vermi compost improves soil and drainage while increasing the number of nutrients available to plants.

Fig 2: Vermicomposting uses Worms to Decompose Waste and Make Nutrient-Rich “Worm Manure”

C. *Domestic Organic Waste Compost*

- *Home Composting*

Home composting is the process of using household waste to make compost at home. Composting is the biological decomposition of organicwaste by recycling f ood and other organic materials into compost. Home composting can be practiced within households for various environmental advantages, such as increasing soil fertility, reduce landfill and methane contribution, and limit food waste.

- *History of Home Composting*

While composting was cultivated during the Neolithic Age in Scotland, home composting experienced a much later start. Indoor composting, also known as home composting, was discovered in 1905 by Albert Howard who went on to develop the practice for the next 30 years.

J.I. Rodale, considered the pioneer of the organic method in America, continued Howard’s work and further developed indoor composting from 1942 on. Since then, various methods of composting have been adapted.[4] Indoor composting aided in organic gardening and farming and the development of modern composting. It originally entailed a layering method, where materials are stacked in alternating layers and the stack is turned at least twice.

Fig. 3: Closed Bin Home Composting using a Polystyrene Box

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➢ *Kitchen Waste Composting*

Kitchen waste composting is the act of using your kitchen waste and food scraps, which are organic materials (greens and browns), to create compost beneficial for enriching soil and growing plants and crops. Surprisingly, most people are unaware that food scraps are good sources of vitamins and minerals. These give the soil nutrients to become healthier, trickling down the minerals to the crops planted into it. Composting kitchen waste is a highly sustainable method. In addition, when it comes to making kitchen waste compost, expert knowledge is not required. Anyone can start making a compost pit. This is because composting is not a specialized skill exclusive to those with prior farming or agricultural experience.

Fig. 4: Kitchen Wastes

D. Objectives of the Study

- To prepare vermi compost and study its characteristic properties.
- To prepare domestic compost and study its characteristic properties.
- To perform the NPK Test and moisture test.
- To study Comparisons between vermi and domestic compost.

II. MATERIAL

A. Materials, Proportioning and Properties

➢ *Materials*

- *Cow Dung*

At the simplest level, composting requires gathering a mix of "greens" (green waste) and "browns" (brown waste). Greens are materials rich in nitrogen, such as leaves, grass, and food scraps. Browns are woody materials rich in carbon, such as stalks, paper, and wood chips.

Cow dung-Cow dung, also known as cow manure, is primarily digested grass, along with some grains, fruits, and/or vegetables, depending on the diet of cattle. It contains remnants of the straw, hay, bedding, grains, and other organic materials used to feed the animals, so it's not just cow faces. Cow manure is full of nutrients and good for growing plants. Its 3-2-1 NPK composition—3% nitrogen, 2% phosphorus, and 1% potassium—makes it the ideal fertilizer for practically all varieties of plants and crops. It is due to the fact that it naturally restores nutritional balance to fields.

Fig. 5: Cow Dung

Cow dung is sometimes used along with worm castings for Vermicompost. Many horticulturists believe that both cow and worm castings are one of the best soil supplements on the market. Worms frequently consume extremely nutritious things, such as food scraps and manures, which determine the nutrient content of the castings. In contrast, cow dung offers a range of nutrients that support plant growth in a form that is simple for plants to absorb. The structure of cow dung promotes the development of bacteria and fungi that are advantageous to plant growth. Additionally, castings include a variety of chemical elements that are thought to encourage plant growth.

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B. Domestic Organic Waste

➤ *Home Compost*

Table 1: Home Compost Material

Green material	Brown material
Fresh grass or leaves	Dry leaves
Fruits	Branches
Flowers	Paper likes newspaper
Coffee ground	Cardboard
Tea leaves	Corn cobs
Garden waste	Egg shells

Table 2: Material not Used for Home Compost

Material	Reason
Meat / fish (including bones)	It Creates odor and attracts pests
Dairy products like (eggs, milk butter, etc.)	It Creates odor and attracts pests
Fats and oils	It Creates odor and attracts pests
Pet feces	Might have harmful parasites, bacteria, viruses, etc. to humans
Coal ash	Might have harmful substances to plants


Fig. 6: Kitchen waste

C. Soil

From a general perspective, "soil" is a very broad term and refers to the loose layer of earth that covers the surface of the planet. The soil is the part of the earth's surface, which includes disintegrated rock, humus, inorganic and organic materials. For soil to form from rocks, it takes an average of 500 years or more. The soil is usually formed when rocks break up into their constituent parts. When a range of different forces acts on the rocks, they break into smaller parts to form the soil. These forces also include the impact of wind, water, and salts' reaction.

III. METHODELOGY AND DATA ANALYSIS

A. Proportion Methods

In this method wastes are converted into compost as vermi compost and domestic organic waste using appropriate proportion of waste materials and composts are prepared and kept for 25 to 30 days.

The compost is taken out from bucket after its period gets over and is subjected to the Moisture, Nitrogen, Phosphorus and Potassium test and the values are taken for all prepared compost and by comparing their values we get the desired result.

B. Preparing of Vermi Compost

➤ *Calculation of Materials*

- Weight of bucket – 1.84 kg
- Soil weight – 7.06 kg
- Cow dung weight – 32.32 kg
- Weight of Earthworms – 0.128 kg
- Water – 2 liters
- Jaggery gram flour slurry – 250 grams

➤ *Proportion of Vermicompost*

Final Total weight of vermicompost = 14.62 kg

➤ *Procedure Adopted for Making Vermi Compost*

- *Procedure*

✓ First take the empty bucket and make small holes in the bucket and measure the weight of the bucket.
✓ Fill 1/3rd of the bucket with soil.
✓ Prepare the jaggery gram flour slurry and mix it with cow dung.
✓ Fill the bucket with prepared cow dung.
✓ Then spread Earthworms into the bucket.
✓ Cover the above surface of the bucket with wet gunny bags and leave it for 25 days to become vermi compost.
✓ After every 2 days interval pour water into gunny bags to provide moist condition for warms.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24MAR1116

- ✓ After 25 days the vermi compost is ready in wet condition then the vermi compost is taken out from the bucket and place it in open for 1 days
- ✓ Then it is refined with strainer and Earthworms are separated from compost.
- ✓ Finally, vermi compost is ready for use.

Fig. 7: Vermi Procedure

C. Domestic Organic Waste

➢ *Calculation of Materials*

- Weight of bucket – 0.405 kg
- Soil weight – 2 kg
- Kitchen waste weight – 6 kg
- Water and curd slurry – 100 grams

➢ *Proportion of Domestic Waste Compost:*
Final Total weight of domestic compost= 1.303 kg

➢ *Procedure Adopted for Making Domestic Organic Waste*

- First take the empty bucket and make small holes in the bucket and measure the weight of the bucket.
- Fill 0.5 kg of soil in the bucket.
- Then for 2nd layer fill 2 kg of collected kitchen waste in the bucket.
- For 3rd layer fill 0.5 kg of soil into the bucket.
- Then for 4th layer again put 2 kg of collected kitchen waste in the bucket.
- For 5th layer fill bucket with 0.5 kg of soil.
- For 6th layer fill the bucket again with 2 kg of collected kitchen waste
- Then pour curd and waste slurry into the bucket for proper decomposer.
- Then finally filled the bucket with 0.5 kg of soil.
- Close the bucket and leave it for 25 days to prepare.
- After 25 days the domestic organic waste compost is ready in wet condition then the domestic organic waste compost is taken out from the bucket and place it in open for 1 day and then it is refined with strainer.
- Finally, Domestic compost is ready for us.

Fig. 8: Domestic Compost Procedure

D. Lab Procedures for Moisture and N P K

➢ *Oven Drying Method for Moisture*

- *Lab Procedure:*

✓ Place the moist compost sample in the container and use weighing balance for weight of sample as W_1.
✓ Hot air oven drying is maintained at a temperature of 80 degree Celsius.
✓ After that compost sample is placed in oven drying.
✓ Compost sample is kept for 24 hours in oven drying.
✓ After 24 hours remove sample from oven and place it.
✓ After the cooling of compost sample, again take weight of samples W_2 and calculate the moisture content Calculation formula

$$\text{Moisture content}(\%) = \left(\frac{(W_1 - W_2)}{W_1}\right) \times 100$$

Fig 9: Oven Drying Machine

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- *Kjeldahl Method for Nitrogen*

- *Lab Procedure:*

- ✓ First step is making solutions:
- ❖ Take 1 liter volume conical flask in making solution with 3.2 gm $KMnO_4$ and distilled water.
- ❖ Take 1 liter volume conical flask in making solution with 25 gm NaOH and distilled water.
- ❖ For mixed Indicator – 100ml ethanol + 0.07 gm methyl red + 0.1 gm Bromocresol green dyes.
- ❖ Boric acid solution – 1-liter volumetric flask making solution with 20 gm boric acid + 800 ml warm water + 20ml mixed indicator + NaOH.

- ✓ Sample prepared – Take 100 ml conical flask – 5 gm compost sample + distilled water
- ✓ In third step there are 3 basic procedures:
- ❖ **Digestion:** In digestion process organic compound react with H_2SO_4 and give $(NH_4)_2SO_4$

  Compost sample + $H_2SO_4 \longrightarrow (NH_4)_2SO_4$

  Compost + $KMnO_4$ + NaOH $\longrightarrow$ Ammonia
- ❖ **Distillation:** In distillation process used NaOH

  $(NH_4)_2SO_4 + NaOH \longrightarrow Na_2SO_4 + NH_3$

  $NH_3 + H_2O \longrightarrow NH_4OH$

  $NH_4OH + H_3BO_3$ (Boric acid with indicator) $\longrightarrow$ $NH_4(B(OH)_4)$ (Green colour)

  $2NH_4OH + 4H_3BO_4 \longrightarrow 2(NH_4)_2B_4O_7 + 7H_2O$
- ❖ **Titration:** In Titration process $NH_4(B(OH)_4)$ react with 0.1 N H_2SO_4 standard solution and give Ammonium sulphate in pink colour

  $NH_4(B(OH)_4) + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + H_3BO_3$ (Ammonium sulphate)

  $(NH_4)_2B_4O_7 + H_2SO_4 + 5H_2O \longrightarrow 4H_3BO_3 + (NH_4)_2SO_4$

- *Calculation Formula:*

$$\text{Nitrogen (\%)} = \frac{(1.4 \times V \times N)}{W}$$

Where, V = Acid used in titration (ml)
N = normality of standard acid
W = Weight of sample (gm)

- *Flame Photometer Method for Potassium*

- *Lab Procedure:*

- ✓ First step is making solutions:
- ❖ Take 1 liter volume conical flask in making solution with 77.09 kg Ammonium Acetate and distilled water and also maintain pH Level = 7
- ❖ Take 1 liter volume conical flask in making solution with 1.907 kg potassium chloride (KCL) and distilled water.
- ✓ Second step is prepared compost – 5 gm compost sample + 25 ml ammonium acetate and after doing this shake 30 min and then sample is filter by filter paper.
- ✓ Making 5 potassium standard solution-A volume include 5 ml, 10 ml, 15 ml, 20 ml, 25 ml of the standard 100 ppm potassium solution were taken into the 100 ml volumetric flask, respectively and separately.
- ✓ After setup the machine will calibrate five standard solution and sample and distilled water can be used after calibrating each standard solution.
- ✓ After calibrating the sample, machine will give the result in ppm.

- *Calculation Formula:*

$$\text{Potassium(\%)} = \frac{\text{Reading value in PPM}}{10000}$$

- *Spectrophotometer or Colorimeter for Phosphorous*

- *Lab Procedure:*

- ✓ First step is making solutions:
- ❖ Take 1 liter volume conical flask in making solution with 42 gm sodium bicarbonate and distilled water.
- ❖ Take 150 ml volume conical flask in making solution with 20 gm Ammonium Molybdate and distilled water.
- ❖ Take 50 ml volume conical flask in making solution with 0.89 gm Ascorbic acid and distilled water.
- ❖ Take 100 ml volume conical flask in making solution with 0.274 gm Antimony potassium tartrate and distilled water.
- ❖ Take 1 liter volume conical flask in making solution with 0.43 gm potassium disulphate and distilled water.
- ✓ **Second step is making mixed Regent solutions:** Take 100ml volume conical flask in making mixed regent solution with 50 ml sulphuric acid + 15 ml Ammonium molybdate + 30 ml Ascorbic acid + 5 ml Antimony potassium tartrate
- ✓ **Making 5 standard solution:** A volume include 1 ml, 2 ml, 3 ml, 4 ml, 5 ml of the standard 100 ppm potassium disulphate and 16 ml mixed regent solution were taken into the volumetric flask, respectively and separately.
- ✓ Preparation of compost:
- ❖ Compost sample – 2.5 gm compost sample + 50ml Sodium bicarbonate + charcoal (a pinch) and after doing this shake 30 min and then sample is filter by filter paper
- ❖ Blank sample – 50 ml Sodium bicarbonate + charcoal (a pinch) and after doing this shake 30 min and then sample is filter by filter paper
- ✓ After the sample is ready, we will decolorize the sample:
- ❖ 50 ml volumetric conical flask – 10 ml compost sample + Diphenly (Indicator) – yellow color solution
- ❖ Yellow color solution + 5 ml sulphuric acid – colorless solution ready
- ❖ 50 ml volumetric conical flask – 10 ml blank sample + Diphenly (Indicator) – yellow color solution
- ❖ Yellow color solution + 5 ml sulphuric acid – colorless solution ready
- ✓ After colorless sample we will color the sample:
- ❖ 100 ml conical flask – compost sample + 8 ml mixed regent + distilled water = blue color
- ❖ 100 ml conical flask – blank sample + 8 ml mixed regent + distilled water = blue color

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- ✓ After setup the machine will calibrate five standard solution and sample (compost and blank sample).
- ✓ After calibrating the sample, machine will give the absorbance value in ppm.

Fig. 10: Spectro Photo Meter Machine

- ➢ *Calculation:*

$$\text{Phosphorous (\%)} = \frac{\text{Reading value in PPM}}{10000}$$


Fig. 11: Test Performing in Lab

E. Testing of Prepared Compost

- ➢ *Comparision between Vermi and Domestic Organic Waste*

Table 3: comparison of Vermi and Domestic Organic Compost after 7 Days

S. No.	**Content**	**Vermi compost after 7 days (%)**	**Domestic compost after 7 days (%)**
1	MOISTURE	33.25	12
2	NITROGEN	2.5	0.7
3	PHOSPHOROUS	1.8	0.8
4	POTTASIUM	1.4	1.0

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Table 4: Comparison of Vermi and Domestic Organic Compost after 15 Days

S. No.	Content	Vermi compost after 15 days (%)	Domestic compost after 15 days (%)
1	MOISTURE	30.2	11.75
2	NITROGEN	2.6	0.8
3	PHOSPHOROUS	1.7	0.8
4	POTTASIUM	1.5	1.2

Table 5: Comparison of Vermi and Domestic Organic Compost after 30 Days

S. No.	Content	Vermi compost after 30 days (%)	Domestic compost after 30 days (%)
1	MOISTURE	40.35	15.85
2	NITROGEN	2.8	0.8
3	PHOSPHOROUS	2.0	0.9
4	POTTASIUM	1.8	1.2

F. Comparision Graph of Vermi and Domestic Compost

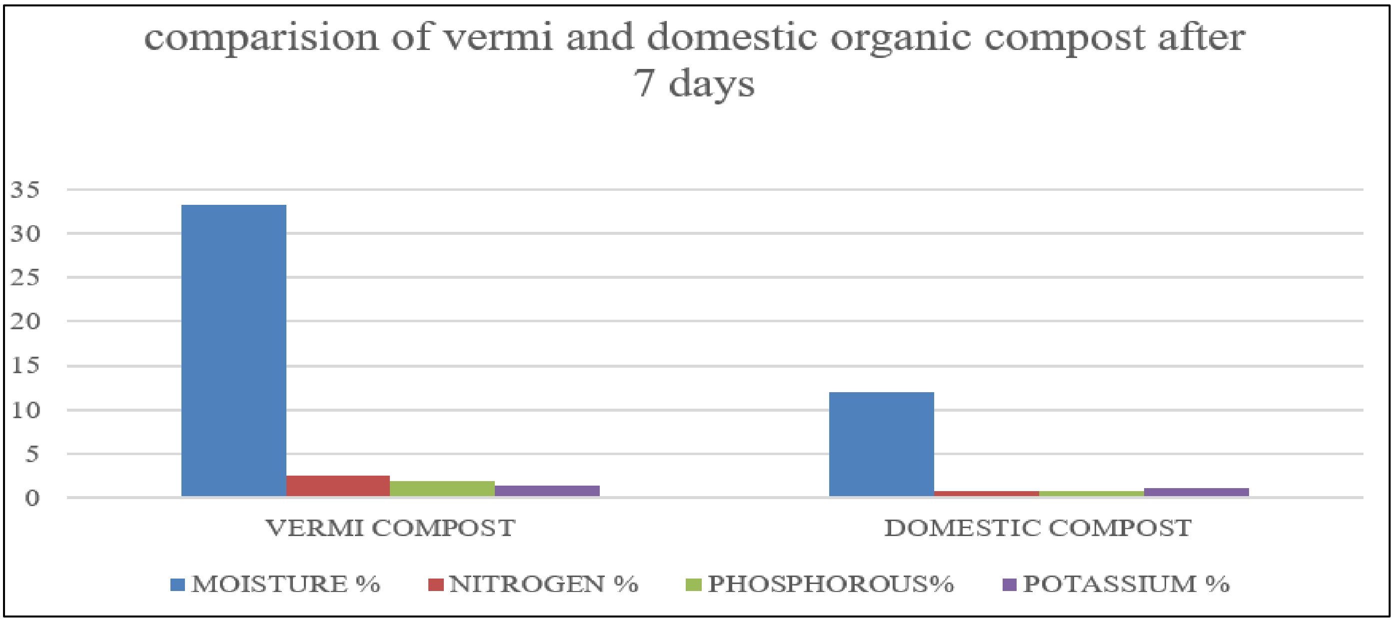

Fig. 12: Comparision Graph of Vermi and Domestic Compost After 7 Days

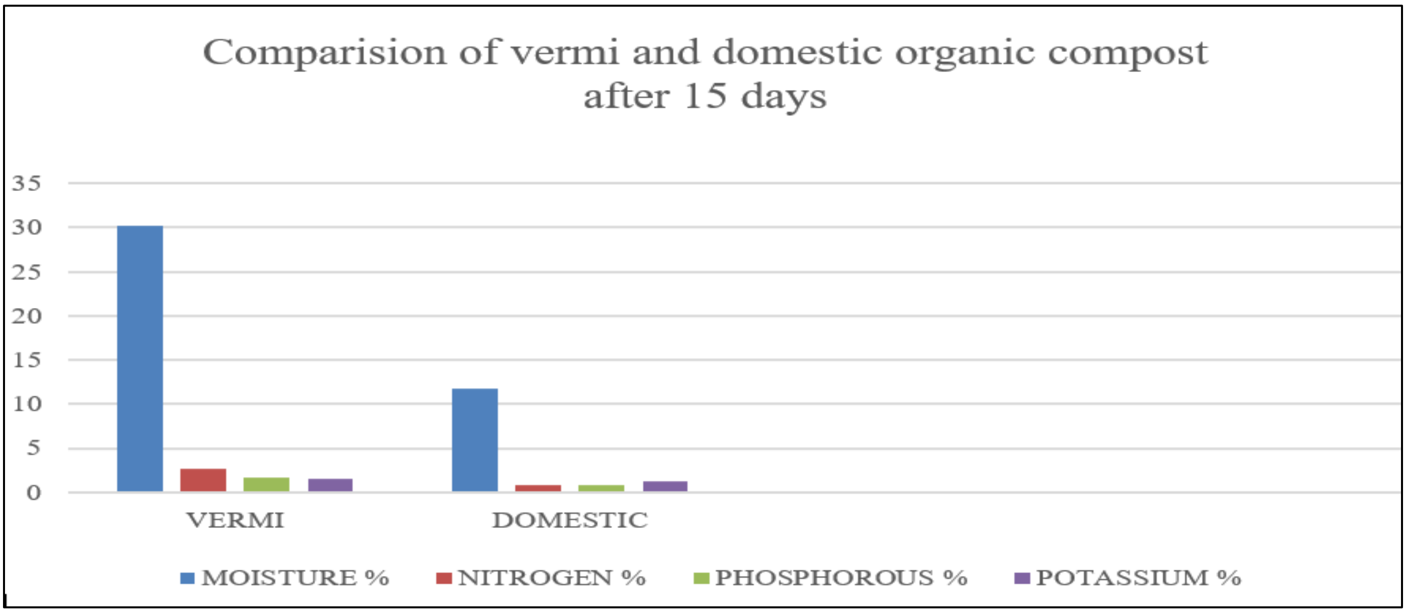

Fig. 13: Comparision Graph of Vermi and Domestic Compost After 15 Days

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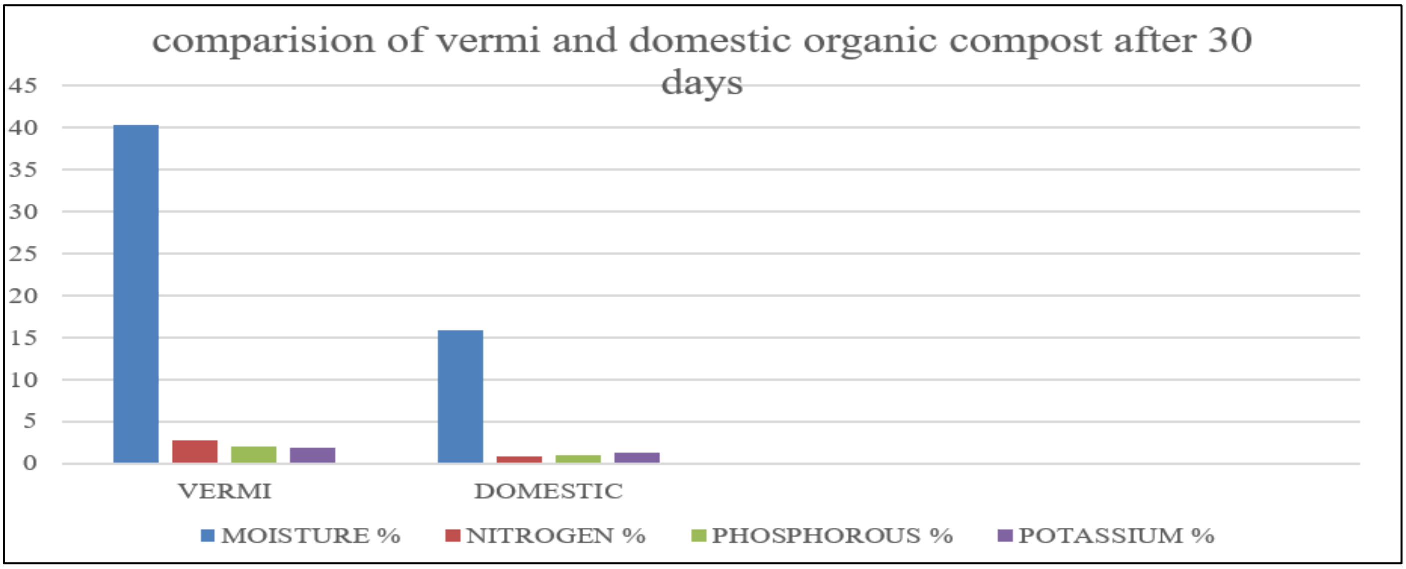

Fig. 14: Comparision Graph of Vermi and Domestic Compost After 30 Days Results and Discussions

➢ *Vermi Compost*

- After the samples are prepared and tested after 7 days the Moisture content is found to be 33.25%, Nitrogen content is found to be 2.5%, Phosphorous content is found to be 1.8% and potassium content is found to be 1.4%.
- After the samples are prepared and tested after 15 days the Moisture content is found to be 30.20%, Nitrogen content is found to be 2.6%, Phosphorous content is found to be 1.7% and potassium content is found to be 1.5%
- After the samples are prepared and tested after 30 days the Moisture content is found to be 40.35%, Nitrogen content is found to be 2.8%, Phosphorous content is found to be 2.0% and potassium content is found to be 1.8%.

➢ *Domestic Compost*

- After the samples are prepared and tested after 7 days the Moisture content is found to be 12%, Nitrogen content is found to be 0.7%, Phosphorous content is found to be 0.8%and potassium content is found to be 1.0%.
- After the samples are prepared and tested after 15 days the Moisture content is found to be 11.75%, Nitrogen content is found to be 0.8%, Phosphorous content is found to be 0.8%and potassium content is found to be 1.2%
- After the samples are prepared and tested after 30 days the Moisture content is found to be 15.85%, Nitrogen content is found to be 0.8%, Phosphorous content is found to be 0.9%and potassium content is found to be 1.2%

➢ *Comparsion Result of Vermi and Domestic Compost*

- *After 7 Days*

✓ Moisture in vermi compost - 33.25% and domestic waste compost – 12%
✓ Nitrogen in vermi compost – 2.5% and domestic waste compost – 0.7%
✓ Phosphorous in vermi compost – 1.8% and domestic waste compost – 0.7%
✓ Potassium in vermi compost – 1.4% and domestic waste compost –1.0 %

- *After 15 Days*

✓ Moisture in vermi compost – 30.20% and domestic waste compost – 11.75%
✓ Nitrogen in vermi compost – 2.6% and domestic waste compost – 0.8%
✓ Phosphorous in vermi compost –1.7 % and domestic waste compost – 0.8%
✓ Potassium in vermi compost – 1.5% and domestic waste compost –1.2%

- *After 30 Days*

✓ Moisture in vermi compost – 40.35% and domestic waste compost – 15.85%
✓ Nitrogen in vermi compost – 2.8% and domestic waste compost – 0.8%
✓ Phosphorous in vermi compost –2.0% and domestic waste compost – 0.9%
✓ Potassium in vermi compost – 1.8% and domestic waste compost –1.2%

IV. CONCLUSION AND APPLICATION

A. *Conclusion*

- The Moisture content of vermi is more than Domestic compost
- The Nitrogen content of vermi is more than Domestic compost
- The Phosphorous content of vermi is more than Domestic compost
- The potassium content of vermi is more than Domestic compost

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In this paper a thorough research is conducted which involves the entire parameters required for vermicomposting and domestic composting, the design consideration their criteria for selection and the quantity of worms and waste required are all included in this paper. This paper provides the basis for the process of vermicomposting and domestic composting and N, P, K testing

Therefore, the vermi compost and Domestic compost both composts are suitable to make and can be easily prepared with low cost and it helps for recycling the wastes and increase the productivity for plants growth when used.

➢ *Applications of Vermicompost*

Vermicomposting is environmentally friendly and is widely used in agriculture. These organic wastes contain organic carbon and plant nutrients in appreciable amounts.

- Vermicomposting can also be used as a technique for domestic wastewater management.
- Vermicompost can be used in organic farming and small-scale sustainable farming.
- Vermicompost has several excellent properties and has many advantages when applied to the soil.
- Vermicompost is an excellent nutrient-rich organic fertiliser, which helps plants to grow well and give better yields.
- Adding vermicompost, which is rich in organic compounds, to the soil, plays a fundamental role in improving productivity.
- Vermicompost can also be used as a growth regulator as it contains all essential plant nutrients in appropriate proportions. Thus, it is complete and balanced plant food.
- Vermicompost is high in proteins and other essential nutrients. Therefore, it is also used as an alternative in aquaculture feed.
- Regular use of vermicompost extract promotes plant growth, keeps plants healthier and fights plant diseases.

➢ *Application of Kitchen Waste Compost*

- Environmental impacts of food waste compost application on soil.
- Application of effective microorganism in food waste composting.
- Application of food waste compost on soil microbial population in groundnut cultivated soil.

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