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ASSESSMENT OF QUALITY OF COMPOST PREPARED FROM KITCHEN WASTE

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Abstract
Urbanization and rapid increase in population has resulted in a tremendous increase in the quantity of municipal solid waste. It has become a major threat to environment. Composting is one of the popular methods of converting the organic waste to nutrient rich soil conditioner and organic fertilizer. It is an environment friendly and economical method for recycling organic solid waste. This study focuses on converting kitchen waste to compost and checking the quality of the compost by analysing the physical and chemical properties. The results of these properties were found to be within the recommended range of standard values which indicate that this technique is a viable method for sustainable waste management.

Key Words: Composting, kitchen waste, waste management

I. INTRODUCTION

Composting has received lot of attention in the past few years due of the pollution caused by dumping of waste and the search for suitable methods for treating waste. Waste volumes are rapidly increasing and causing environmental damage. Open dumping and sanitary landfill are a major method for waste disposal. The land filling of biodegradable waste is leading to health hazards and environmental degradation due to the production of highly polluting leachate and landfill gases. Composting is an effective method of waste treatment. It is an aerobic biological process in which microorganisms convert biodegradable organic matter into humus. Composting will lead to volume and mass reduction of solid waste and return of organic substances to the nature as biofertilizer (Pathak et al, 2011, Saswat et al, 2022, Shailendra et al, 2015). In cities like Mumbai precious land of several thousands of acres which are used as dumping grounds will be saved, if decentralised composting is implemented. The quality of compost is evaluated by the maturity and stability indices which is an indication of the level of completion of the composting process. Certain physical and chemical properties indicate the quality of the compost. These parameters can be easily determined in the laboratory.

II. MATERIALS AND METHODS

Preparation of Compost:

Aerobic composting was carried out in a ferro-cement pit with a mesh on the top to allows aeration for continuous supply of oxygen to the bacteria. The wet waste generated in the college canteen kitchen was processed in the compost pit. At the base of the pit dry leaves were spread and above this layer, compost prepared in the college was added as an inoculum (Meetali et al, 2023). On this, wet waste was spread in a uniform way. Before spreading the fresh wet waste, previous days waste was mixed thoroughly so that the bacteria receive sufficient amount of oxygen. Water was sprinkled as and when required to maintain moisture level. The compost was ready in 3 months. It was sun dried and powdered for analysis.

The pH, bulk density, electrical conductivity, porosity, moisture content, water holding capacity, total organic matter, organic carbon content, nitrogen content, C/N ratio, calcium, magnesium, potassium and phosphorus content were determined.

Determination of pH

25 ml of distilled water was added to 10 gm of compost. The solution was stirred and allowed to stand for 60 minutes. The supernatant was separated using Whatman filter paper No. 41 and the filtrate was used for taking the readings. pH of the filtrate was measured using a calibrated pH meter.

Determination of bulk density

The compost was dried at 110^0C for 90 minutes until constant weight was obtained. Weighed compost was transferred in a measuring cylinder and the level occupied by the compost was noted. The bulk density was calculated from the equation:

$$\text{Bulk Density} = \frac{\text{Weight of compost (gm)}}{\text{Volume of compost (cm}^3\text{)}}$$

Determination of electrical conductivity

10 gm dried compost was mixed with 25 ml of distilled water. The solution was stirred and allowed to stand for 60 minutes. The supernatant was separated using Whatman filter paper No. 41 and the electrical conductivity of the filtrate was measured on a conductometer.

Determination of porosity

The compost was taken in a measuring cylinder and the volume was noted as sample volume. A known volume of water was taken in another measuring cylinder. The compost was saturated with water up to the surface level. The volume of the water used is equal to the pore volume. The porosity was calculated from the equation:

$$\% \text{ Porosity} = \frac{\text{Pore volume}}{\text{Sample volume + Pore volume}} \times 100$$

Determination of moisture content

A weighed amount of compost was taken. The compost was dried in an oven at 110°C till constant weight was obtained. The moisture content was calculated from the equation:

$$\% \text{ Moisture content} = \frac{\text{loss of water}}{\text{Weight of compost before drying}} \times 100$$

Determination of water holding capacity

25g of compost was taken in a funnel layered with filter paper. The funnel was placed on a measuring cylinder. 50ml water was poured on it. The filtrate was collected and the volume was measured in a measuring cylinder. The water holding capacity was calculated from the equation:

$$\% \text{ Water holding capacity} = \frac{\text{Volume of water retained}}{\text{Weight of sample}} \times 100$$

Determination of total organic matter

A weighed amount of compost sample was taken in a crucible and dried in an oven at 110^0C. The crucible was placed above a Bunsen burner and heated till the sample was converted to ash. The crucible ash was weighed. The percentage of total organic matter was calculated from the equation:

$$\% \text{ Total Organic matter} = \frac{\text{Weight of compost after heating}}{\text{Weight of compost before heating}} \times 100$$

Determination of organic carbon content

The organic carbon content present in the compost was estimated by Walkley - Black method.

Determination of nitrogen content

Total nitrogen was estimated by Kjeldahl method

Determination of C/N ratio

It is the ratio of organic carbon content to the nitrogen content

Determination of Calcium, Magnesium, Potassium and Phosphorus Content

Calcium and magnesium content were determined by titration with EDTA (Ethylene Diamine Tetra Acetic acid) Potassium content was determined using flame photometer and Phosphorus content was analyzed using colorimeter.

III. STATISTICAL ANALYSIS

The different samples were analyzed in triplicates and the mean standard deviation was reported by using Microsoft Excel 2020.

IV. RESULTS

The compost obtained was brown in color, had a granular texture and no foul smell.

Figure 1

Initial stage of kitchen waste

Final stage of kitchen waste

Table 1 Results of physical and chemical parameters of compost

Parameters	Result
pH	7.8 ± 0.2
Bulk density gm / cm^3	0.902 ± 0.02
Electrical conductivity (mmho/ cm)	5.28 ± 0.03
Porosity %	54 ± 0.4
Moisture content %	43 ±0.5
Water holding capacity %	58 ± 1
Total Organic matter %	29.6 ± 0.01
Organic carbon content %	17.8 ± 0.03
Nitrogen content %	0.98 ± 0.03
C/N ratio	18.1
Calcium %	3.8 ± 0.03
Magnesium %	0.29 ± 0.03
Potassium %	0.58 ± 0.04
Phosphorus %	0.95 ± 0.02

pH of the compost indicates its acidic or alkaline nature. Compost microorganisms require neutral to acidic conditions and the desirable pH range is 5.5 to 8 (Azim et al, 2017). The pH value of the compost as seen in the above table is 7.8 which is in the acceptable range. A neutral pH is suitable for the growth of most of the plants.

Bulk density of compost is the ratio of the weight of the compost per unit volume. It indicates soil compaction and is an important parameter for growth of plants. A high bulk density can limit microbial growth. The value of bulk density of the compost sample was 0.902 gm /cm^3 which is in the desirable range (Nisha, 2016).

Soluble salts in the compost are measured in terms of electrical conductivity. Generally, it is in the range of 1 to 10 mmho/cm (David, 2019, Tracy, 2014). High salt levels will be harmful to plants. The electrical conductivity of the sample was 5.28 mmho/cm which is in the prescribed range.

Porosity is the free air space between the compost particles. A porous compost will allow free movement of air which will maintain aerobic condition. The value of porosity of the compost sample was found to be 54 % which agrees with that reported by Mayur et al (2019).

Moisture content of the compost is the amount of water present and is expressed as percentage. Moisture value less than 30 % will limit bacterial activities and a value higher than 65% will decrease porosity and create anaerobic conditions in the compost (Razmjoo et al, 2015). The moisture content of the sample was 43 % which is in the desired range.

Water holding capacity is the ability to hold water in the spaces in the compost and is an important agronomic parameter. The value of water holding capacity of the compost sample was 58 % which agrees with the value obtained by (Sujatha et al, 2016).

Total organic matter is the measure of carbon material in the compost and it is in the range of 25-40 % in most of the compost (Tracy, 2014). As observed in the above table, the compost sample has 29.6 % organic matter which is in the recommended range. A value less than 30 % indicates a stable and mature compost (Ayesha et al, 2016). Organic matter content is initially high which decreases in the finished product (David, 2019).

Organic carbon is a source of energy for the microbes during the composting process. The organic carbon content of the sample was 17.8% which is in agreement with the results reported by (Khater et al, 2015).

Nitrogen is required to form proteins and is an important macronutrient. Compost can be a significant source of nitrogen. The normal range in finished compost is 0.5-2.5 % (David, 2019). The nitrogen content of the sample was 0.98 % which falls in the desirable range (Tracy, 2014).

C/ N ration is an important parameter since it indicates the quality of the compost. A ratio in the range of 15-20 indicates a finished product (Tracy, 2014). If the C/N ratio is more than 30 the compost may immobilize nitrogen when added to soil and if the C/N ration is less than 20 then it will break- down organic nitrogen to inorganic nitrogen which will be available to plants (David, 2019). Compost containing large amount of green material will have low C/N while compost having more dry material will have high C/N (Guy Sela, 2019). The C/N ratio of the sample was found to be 18.1 which is in the recommended range (Tracy, 2014).

Calcium content was found to be 3.8 %, Magnesium content was 0.29 %, Potassium content was 0.58 % and Phosphorus content was 0.95% which are in agreement with the values reported by (Dan Sullivan et al, 2018, Guy Sela, 2019). All these macronutrients which are essential for plant growth. An imbalance in these macronutrients can impact the plant growth.

V. CONCLUSION

The results of the present study indicate that kitchen waste can be easily converted to organic fertilizer by composting process and it produces stable and mature compost. Since the values of the physical and chemical parameters are within the acceptable range, the compost generated in the college is of very good quality and can be used as a good soil conditioner. The composting method can be applied for home composting, in housing societies, educational institutions, hotels and offices. This will reduce the landfill space, environmental pollution and greenhouse emissions. It is the best option for management of wet waste since it is an environment friendly and sustainable method. The use of chemical fertilizers to increase crop production leads to environmental pollution. The biofertilizer obtained from the composting of kitchen waste can be an alternative to chemical fertilizer. Composting is thus a successful wet waste management strategy to convert wastes into resources.

VI. ACKNOWLEDGMENT

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