

# Collection and management of vermicomposting of market waste

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**ABSTRACT.** Vegetable waste from households and markets contributes to contamination of the environment, changes in the global climate, and risks to human health. The techniques used for their management and disposal are inadequate. The goal of this study was to use the earth worm species *Eudrilus eugeniae* and *Eisenai fetida* to turn vegetable market trash into vermicompost. After 40 days, organic waste is allowed to decompose with the aid of earth worms, forming compost. The vermicompost was then collected and examined. Temperature, pH level, moisture content, and organic content were among the parameters that were assessed. The final product indicates that there is an increase in nutritional content. Vermicomposting encourages plant development and enhances soil quality, which is beneficial for handling many types of household, commercial, and agricultural waste. Vermicomposting is therefore an extremely nutrient-rich organic fertiliser.

## 1 Introduction

Massive amounts of solid waste accumulate as a result of population growth, urbanisation, industry, and agricultural output. Serious environmental problems have resulted from this. It is projected that India's per-capita garbage production will rise by 1-1.33% every year [15]. This trash needs to be transformed efficiently in order to be disposed of securely. This is accomplished by turning agricultural, urban, and agro-industrial waste into vermicompost and biocompost. Composting is a widely recognised environmentally beneficial method that may transform a wide range of waste materials into valuable agricultural inputs. The vermicomposting procedure reduces the harm to the environment. When applied, compost is a great source of humus and plant nutrients that enhance the soil's organic matter status and biophysical characteristics. Thus, this procedure maintains the soil's quality.

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The following are examples of agricultural and industrial waste: bran, rice husk, rice straw, wheat and other cereal straw, sugarcane trash, bagasse, molasses, cotton, mill waste, municipal rubbish, sewage sludge, waste from processing fruits and vegetables, dairy waste, etc. These resources still have a vast unrealized potential. In addition, other waste materials such as animal dung, poultry waste, and urban and rural waste can be bioconverted into organic manure. An estimated 750 million tonnes of organic waste are accessible in India each year, which may provide around 7.1, 3.0, and 7.6 million tonnes of nitrogen, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O, respectively [1]. As a result, these organic materials must be recycled and used effectively. Additionally, this aids in overcoming the resource limitation impeding growth. These factors have led to increased focus on the development of composting technologies.

More readily available nutrients are found in the various organic wastes, such as market trash, water hyacinth, and press mud. Nevertheless, there is a lack of recycling potential for these pollutants. After composting, this waste has the potential to significantly raise crop yields. The basic goal of composting is to use solid waste from plants and animals to produce crops. The primary goal of composting is to allow for sufficient mineralization while maximising the conversion of the initial carbon and other nutrients. Earthworms are a potential resource for the breakdown of any kind of organic waste, in addition to the use of cellulolytic and other microbial cultures to speed up the decomposition and enrichment of compost. The vermicomposting technique will efficiently transform market garbage into enriched manure in a way that is safe for the environment and quickly generates income from the waste [2]. Earthworms are used to break down organic wastes, such as sewage sludge, crop leftovers, animal dung, and industrial wastes, in order to create vermicompost [3]. The microbial population and NPK availability in vermicompost will both significantly increase [4]. There is little information available on the composting of market waste, the role that earthworms and microbial inoculants play in the process, and experimental data on this topic. In light of this, a study was conducted on the composting of market trash utilising earthworms and coprophilous microorganisms associated with cow dung as bioconversion agents.

## **1.1 Vermicomposting**

The capacity of a diverse range of micro- and macroorganisms known as the microflora to break down organic waste materials into useful resources that contain organic matter and plant nutrients is essential for preserving soil productivity. Earthworms' biodegradation activity is the primary component of vermicomposting, which keeps nutrients moving from one system to another. Earthworm population declines with soil deterioration, as seen, and earthworms are a sensitive indicator of soil degradation. In terms of nutrient availability, vermicomposting produces a higher-quality output than conventional composting methods. The differences in the organic matter transfer between vermicompost and compost can be partially explained by the techniques used for waste processing. Evidence exists that using earthworms to stabilize man-made waste from many sectors may be done successfully [16-21].

Earthworms were referred to be the "intestine of earth" by Aristotle and the "unheralded soldiers of mankind" by Charles Darwin due to their ability to digest a wide range of organic materials [5, 6]. Earthworms are involved in the breakdown of cellulose, the creation of soil, and the buildup of humus. The physical, chemical, and biological qualities of soil are negatively impacted by earthworm activity. Earthworms are special because they eat mostly organic wastes but only use a tiny amount of them for development, excreting the majority of the wastes in a partly digested state [7]. This is due to the fact that earthworms' intestines are home to a variety of microorganisms, hydrolytic enzymes, and hormones that aid in the quick breakdown of partially digested material. As a

result, complex organic matter can be converted into vermi-compost in 1-2 months [8], as opposed to the nearly 5-month duration of traditional composting [9].

The earthworms' multi-step process of digestion and vermicompost generation is a mechanism. The earthworm's gizzard is where the organic stuff is pulverised into a fine powder. Subsequently, the breakdown of these chemicals within the gut is aided by the hydrolytic enzymes, including urease, chitinase, lipase, amylase, cellulase, and other fermenting substances [10], which ultimately result in the formation of "casts". At last, these are referred to as "vermicomposts" [11].

"Epigeic" earthworms are the name given to such worms. Their capacity for rapid decomposition of litter, resilience to shocks, and effective biodegradation and nutrient release are some of their distinguishing qualities. Among the epigeic earthworms are *Lumbricus rubellus*, *Bimastus minusculus*, *L. festivus*, *Eisenia foetida*, *Eiseniella tetraedra*, *Lumbricus castaneus*, *B. eiseni*, *Dendrobaena veneta*, *Dendrodrilus rubidus*, and *D. octaedra*. The earthworms' activities cause the soil to loosen and become permeable. Porosity facilitates simple root penetration, drainage, water absorption, and aeration. Soil ecosystem maintenance is aided by the soil aggregates that earthworms and related bacteria generate. These aggregates consist of mineral granules that have been bound together to prevent soil compaction and erosion in both wet and dry conditions. By replenishing beneficial microorganisms, earthworms expedite the restoration of soil and increase its productivity [12]. As a result, earthworms have the ability to physically, chemically, and biologically design degraded, unproductive soils and land damaged by mining to become productive again. For this reason, earthworms are known as ecosystem engineers [13].

Since vermicomposting doesn't raise the temperature, it's best described as a non-thermophilic, bio-oxidative process that uses the biological activity of earthworms and other soil-dwelling bacteria to create extremely rich compost. This results in a finished product known as vermicompost. Vermicompost has excellent aeration and drainage, is porous, finely split, peat-like, has a high water-holding capacity, and has a higher microbial activity and buffering capacity. Numerous hormones and enzymes that control plant development are created during vermicomposting. These compounds increase soil biodiversity by encouraging the proliferation of beneficial microorganisms, which in turn promotes plant growth. Additionally, they aid in the management of pests, nematodes, and plant diseases, improving plant health and reducing production loss. In order to support sustainable agriculture and the safe treatment of waste from homes, businesses, and hospitals, vermi-compost presents an alluring alternative [14].

## **2 Materials and methods**

### **2.1 Collection of market waste**

The development of the vermicomposting technique employed market trash, or vegetable waste, that was gathered from Salem, Tamil Nadu, India. The ingredients had previously been roughly 5 cm cut with a knife.



**Figure 1.** Vegetable waste

**Table 1.** Physico-chemical properties of Market wastes

<b>Property</b>	<b>Value</b>
Lignin	5.39%
Cellulose	30.40%
Hemicelluloses	18.78%
Carbon	32.56%
Organic matter	51.56%
EC	1.21
pH	7.5

## 2.2 Earthworm selection for vermicomposting

The earthworms that live on the surface should only be used to produce vermicompost. The subterranean earthworm is not suited for vermicomposting. Potential worms for vermicomposting include African earthworms, red worms, and composting worms. For the investigation, adult earthworms such as *Eisenia fetida* and *Eudrilus eugeniae* were gathered.

## 2.3 Cattle dung

In the current investigation, cow dung was employed as the source of inoculants for the first treatment. Cattle dung has to be sun-dried before it can be used to generate vermicompost. It is necessary to predigest other waste with cow dung for 20 days before putting it in a vermibed to compost.

## 2.4 Steps in vermicomposting

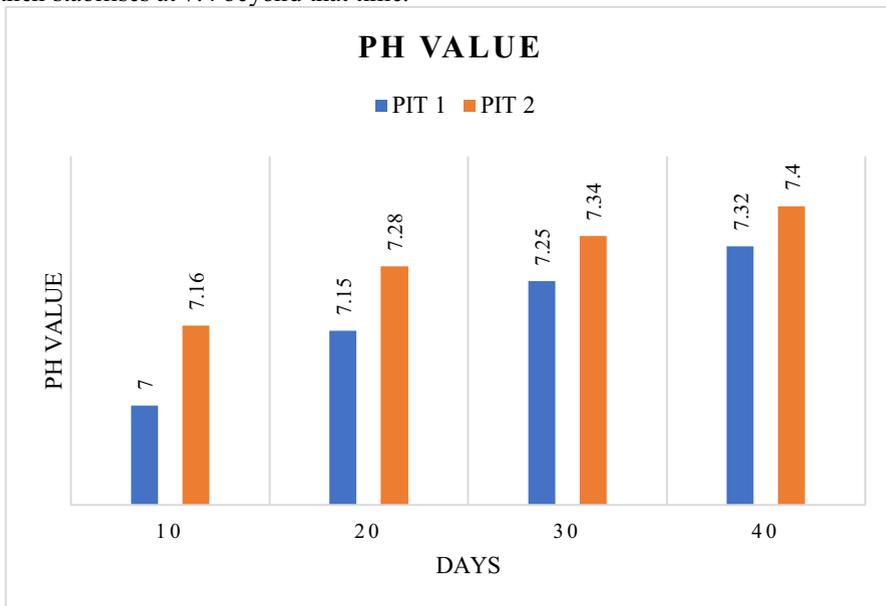
After the wastes had partially degraded for two weeks, vermicomposting was done. Following a two-week fermentation period, 100 earthworms per kilogramme of substrate were infected. The vermicompost was removed sixty days after the inoculation by scooping it layer by layer after it had been piled over a plain surface in direct sunlight. This allowed for the benefit of the earthworms' negative phototropic behaviour, as their population tended to decline and sink to the bottom. A moisture content of 65 to 75 percent was

maintained throughout this time, and the temperature created by fermentation was controlled by frequent turning that occurred twice a week. Due to its extreme softness, fermentation increases the organic wastes' accessibility to earthworms. The vermicomposting procedure lasted forty days, during which time the biochemical and physico-chemical parameters were estimated ten days apart.

### 3 Results and discussion

#### 3.1 Variation in pH with time

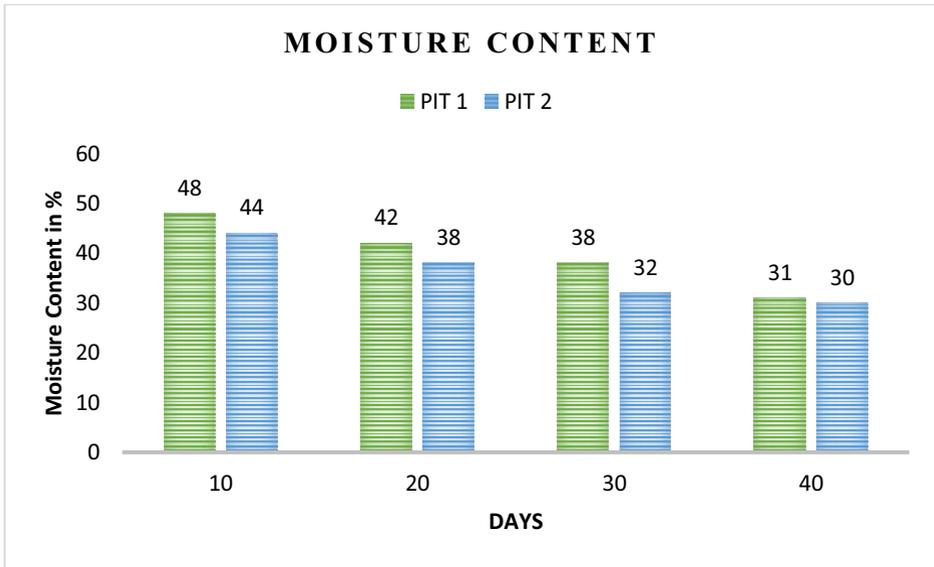
The optimal pH range for the procedure to work in is between 7.0 and 7.4. A gradual rise in pH was noted while vermicomposting with different pit types, as fig. 2 illustrates. The first change in pH might be caused by the action of bacteria on carbohydrates and the subsequent release of organic acids. Furthermore, the synthesis of ammonia by worms stabilising nitrogen raises pH. Ultimately, the pH rises until the vermicomposting process is completed. It is anticipated that this is due to the use of organic acids and an increase in the mineral content of trash. Decomposition may be slowed down by a pH of less than 7.2, while ammonia with an unpleasant odour may be released by a pH of more than 8. Low pH might be brought on by insufficient oxygen. The pH should rise as a result of rotating the pile to increase aeration. According to the graph, the pH value varies from 10 to 40 days, but then stabilises at 7.4 beyond that time.



**Figure 2.** pH value during Market waste composting

#### 3.2 Variation in moisture content with time

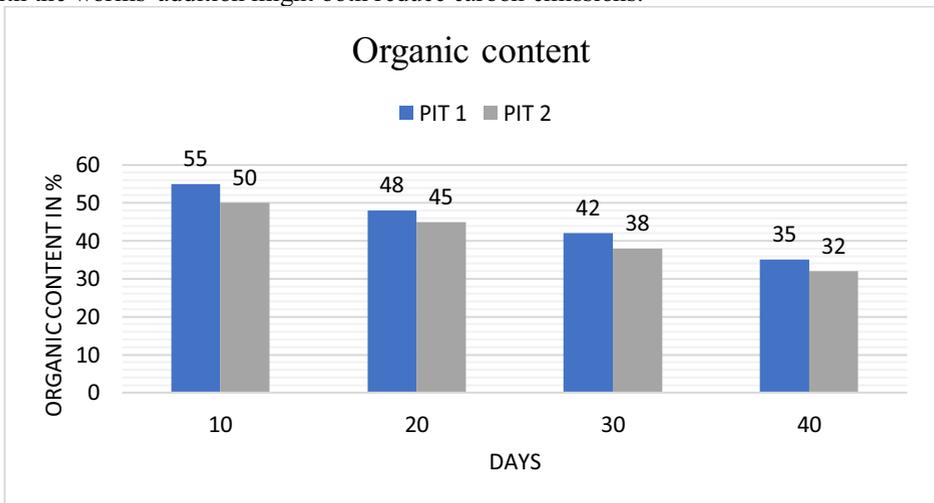
The ideal moisture content for the vermicomposting process is between 30 and 48%. The amount of moisture is minimal, which restricts biodegradation. When the water content increases, a large portion of the air in the composting bed's pores is replaced, creating an anaerobic environment. The observed moisture content was kept between 30 and 48%, as fig. 3 illustrates. The moisture content decreases as a result of evaporation brought on by the heat produced by cellular activity.



**Figure 3.** Moisture content during Market waste composting

### 3.3 Variation in organic content with time

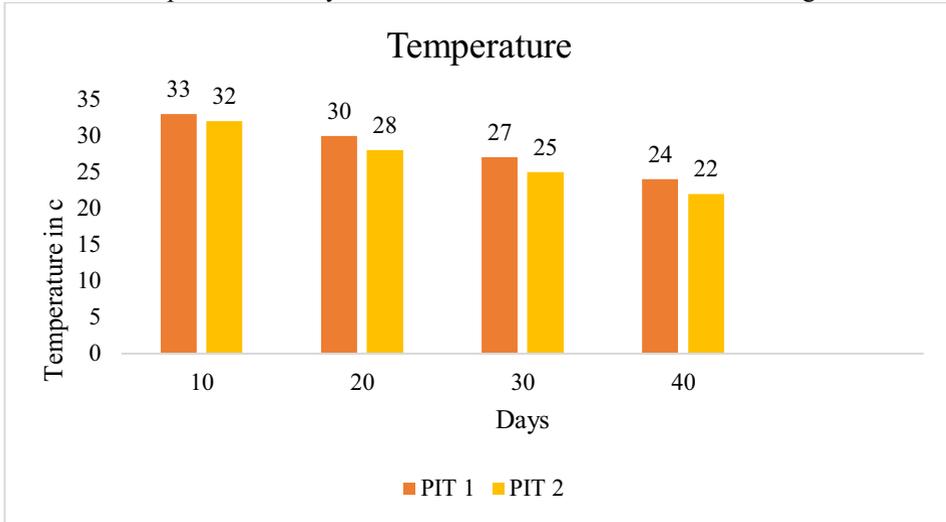
Figure 4 illustrates the variation in organic content over time. Vermicomposting had a major impact on the losses of organic content. During the vermicomposting process, a drop in the percentage of organic material was seen. It shows how the population of vermis breaks down garbage. Therefore, the concentration of organic material decreased from 55% to 32% during the vermicomposting process. Earthworms and other microorganisms' respiratory activity or the microbial mineralization of organic substances in conjunction with the worms' addition might both reduce carbon emissions.



**Figure 4.** Organic content during Market waste composting

### 3.4 Variation in temperature with time

Time-series temperature is shown in Fig. 5 It is evident that worms can develop and survive in a temperature range of 22 to 33°C. It has been found that temperatures exceeding 33°C are fatal for several species of earth worms. the variation in temperature between the room and the bed. It is evident that the bed's starting temperature was greater than the surrounding air. Up to 40 days, the bed temperature continues to drop. On the 40th day, nevertheless, it was noted that the outside temperature was lower than the temperature of the bed. The temperature rose by a maximum of 30 °C above the surrounding air.



**Figure 5.** Variation in temperature with time

## 4 Conclusion

Large amounts of garbage from many sources built up in the biosphere. Despite being a great source of plant nutrients, they exist in an inaccessible state. In addition, for optimal results to be obtained, they must be appropriately recycled using enhanced methods for composting and vermicomposting. In light of this, the current study was conducted to provide appropriate technologies for managing market wastes. The current study's findings indicate that microorganisms, then earthworms, are the most efficient recyclers of market trash, and that they have a significant impact on the growth and output of agricultural products. Compost material has a high nutritional value and efficiently transforms waste product into a valuable by-product through the composting process.

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