

## Recycling of floral waste of Marigold (*Tagetes erecta*) into valuable organic fertilizer by using *Eisenia foetida*

Subhakant Khandual<sup>1</sup>, Sunita Satapathy<sup>2\*</sup>

<sup>1,2</sup> Department of Zoology, School of Applied Science, Centurion University of Technology & Management, Odisha, India

### Abstract

The safe and environmentally harmonious management of solid wastes become a major issue in many cities of developing nations. In India, worshipping is the way of living and people offer various offerings to the deities out of which flowers are found in huge quantity. After fulfillment of their purpose, flower along with other waste, find their way in to the garbage or left of on the open places, water bodies was, causing environmental problems. This flower waste can be utilized in different way to produce valuable products to save environment from pollution. Odisha is considered as one of the holy states of India. Jatni city is nearer to the temple city Bhubaneswar. The flower waste is generated from temple and floral shops of Jatni city was assessed for Vermicompost. In this study, floral waste consisted of variety of flowers out of which marigold (*Tagetes erecta*) was chosen as it was found in maximum amount. In present study different proportion of mixture of soil, cow dung, and floral wastes in 20%, 40%, 60%, 80% and 100% were taken to perform vermicomposting process using *Eisenia foetida* an earth worm species. The experiment was designed in small scale by taking rectangular containers with different proportion of flower waste with variation of contents ratios. Analysis of various physic-chemical parameters were carried out before and after vermicomposting. Vermicomposting of floral waste is an eco-friendly method to get valuable products which will lead to healthier and waste free environment.

**Keywords:** floral waste, vermicompost, *Eisenia foetida*, physic-chemical parameters

### 1. Introduction

Wastes are discarded substantial products of human activities that are regarded as unwanted or useless (Kimenju and Groote; 2008) [18] India is a developing country and is facing waste disposal crisis, but solutions are not impending. Since, it is being realized that waste can be used in industrial processes and also for the generation of energy, appropriate waste management is being explored. Today, management of waste is a challenge accompanied by numerous factors adding constraints and complexity to the process. Like other developing countries the cities and towns of India also suffer with solid waste management (Kaur and Joshi 2002) Therefore it is generally understood that proper waste management helps to protect health, environment and also preserves natural resources.

Flowers come as waste from various sources like hotels, marriages, gardens, temples, and various other cultural and religious ceremonies. In India, religion is a path of life and it is an intrinsic element of the entire Indian culture. In India temples the deities offer with flower along with other subsequent substances such as leaves of different plants, coconut shells, milk and curd are piled up in each temple and then disposed off exclusively in water bodies (Singh and Singh, 2007) [2].

In the temples these flowers are offered by devotees and in many flower shops also many flower are left unused everyday become waste. These waste materials weighing 3.5-4 tons per day is left behind in the city of temples (Mishra, 2013) [21]. India is a country of festivals and many occasions are celebrated around the year that eventually leads to generation of solid waste. This proportion of waste is generally neglected and requires due consideration. Degradation of floral waste is a very slow process as

compared to kitchen waste degradation (Jadhav *et al.*, 2013) [14]. Therefore, there is a need for proper and ecofriendly process of floral waste treatment.

Although there are many ways of organic waste treatment but composting is one of the most acceptable for quality environment and organic farming. Biological processes such as composting followed by vermicomposting to convert floral waste in useful organic fertilizer would be great benefit. In this process, energy rich and complex organic substances have been bio-oxidized and trasformed in to stabilized products by combined action of earthworm and microorganisms. In present day, management of waste is a challenge accompanied by numerous factors adding constraints and complexity to the process (The Expert Committee, Ministry of Urban Development, Government of India, 2000).

The most important objectives of the study are to develop efficient technology like vermicomposting for environmentlly safe management of the floral waste of temples of Jatani city and also to see its effect on soil and plant growth. Vermicomposting of floral waste not only prevent damages to natural sources but help, to some extent, in cleaning the nature.

### 2. Material and Methods

#### 2.1 Collection, Segregation and shredding of floral waste

The floral waste was collected from the Khanduali temple, near by the CUTM campus of Jatani city. As the use of marigold flower was more the amount of floral waste was more, so marigold flower was considered as the floral waste for the study. The collected flower waste from temples non-biodegradable part was removed by hand sorting and the

biodegradable waste i.e garlands and flowers were segregated and shredded into small pieces.

## 2.2 Air Drying/ Pre-composting of floral waste

The segregated floral waste was allowed to air dry by spreading over paper for 2 days. The air-dried samples were then subjected to pre-composting for 10 days to make them suitable for the process of vermicomposting because its thermophilic nature helps in mass reduction and pathogen reduction (Nair *et al.*, 2006).

## 2.3 Collection, drying sieving of Soil and cow dung

Soil and cow dung were collected from the garden area of Centurion University of Technology and Management (CUTM) campus, Bhubaneswar, Odisha. After collection, the soil and the cow dung were sun dried then the sample was crushed in to tiny particle and by sieving process the large and unwanted materials were separated.

## 2.4 Selection of earthworm species

For vermicomposting process certain species of earthworm are essential. For this study *Eisenia fetida* were collected from the vermicomposting unit of CUTM campus after reviewing literatures. These earthworms were propagated and maintained at room temperature in the mixture of soil and cow dung at the zoology laboratory of CUTM campus. These earthworms were kept in that condition till they introduced in to the experimental set up.

## 2.5 Preparation of floral composting

The dried samples of soil, cow dung were sieved by diameter of 3.55 mm sieve. The sieving materials were measured by the help of weighing machine. The floral waste was also measured and mixed with cow dung in the ratio of 3:2, and was set for a week to decompose After processing the floral compost was obtained that used for vermicomposting.

## 2.6 Experimental design for vermicomposting

The experiment was started with formation of different proportions such as (5:5-, control, 8:2-(S+CW)+FWc(floral waste composting), 6:4-(S+CW)+FW, 4:6-(S+CW)+FW, 2:8-(S+CW)+FW and 1kg of FW ) of composting mixture using 6 plastic pots labelled as C, F1, F2, F3, F4, and experimental (E). Each proportion F1, F2, F3, F4, E was contained with 20%, 40%, 60%, 80% and 100% of floral waste respectively with adding rest proportion of soil and cow dung (S+CW) whereas control contained 50% of soil and 50% of cow dung. All the proportions were allowed to mix uniformly with adding water upto form wet mixture and allowed for composting upto a 10 days. The sample of dry and wet both from each pot were kept for physico-chemical analysis of pre-vermicomposting mixture. Water was sprinkled in regular interval for maintaining the moisture of the mixture during composting.

## 2.7 Introduction of earthworm

After 10 days of partial decomposition of the composting material 4 number of adult earthworms of species *E.foetida* having average 8-13 cm are introduced to each pot after forming the vermibed by using the pre-vermicomposting mixture into layers. Slurry (cow dung +water, 2:1) was added to the mixture as a nutrient material at the time of

introduction of earthworm and it was also given with in time interval of 5-6 days during the experiment.

## 2.8 Method of vermicomposting

Vermicomposting process was initiated after adding the earthworm *E. foetida* in plastic pot containing the mixture. That pots were placed in a shaded area for observing decomposition. It can be done indoors because worms are very sensitive to extreme hot and cold temperature. Plastic pots were sprinkled with water after turning it upside down to maintain moisture content and added slurry for the nutrition of earthworm in regular interval.

Process was monitored till the surface of plastic pots appear black granular coated humus material on its upper surface (vermicasts) indicated vermicomposting process almost completed and watering was stopped before 4-5 days of harvesting, prepared vermicompost was stacked so that the earthworms settle at the bottom and the vermicompost was collected from the top. The harvested vermicompost was filtered through fine sieve in order to get uniform vermicompost. The pH and electrical conductivity, moisture content of vermicompost were monitored using laboratory instruments.

As a whole, vermicompost can be nutritionally enriched like other organic manures that produced at low cost makes it very attractive for practical application.

## 3. Result and Discussion

The physio-chemical like pH, moisture content and electroconductivity were easily controlled and indicated progress of vermicomposting. Graphical analysis of pH, electro-conductivity and moisture content were studied. From the present experimental work it was found that each proportion varies with their physio-chemical variables studied and observed with respect to elecrtro conductivity, pH and moisture content. The better output was observed in both F2 and F3 as compared to other pots in respect to all physico-chemical parameteer. Consumption of floral organic wastes by earthworm rapidly fragmented into finer particle through the muscular grinding organ gizzard and releases dark black granular vermicast (Lakshmi Prabha *et al* 2014). During vermicomposting the earthworms were obtained their nutrition from microorganism that grow upon the wastes (Jadhav *et al*, 2013) [15]. Earthworm are aerators that it emits sufficient oxygen to oxidize foul smell producing, compounds like H<sub>2</sub>S, mercaptans, skatol, etc. to make odourless vermicompost during the process of compost formation because of the oxygen rich hemoglobin circulation through the skin of the earthworms (Nagavallema *et al*, 2000) The moisture content was maintained at 60%-70% by sprinkling water into all pots, whereas it was more in control (Table-1 & Graph-1). Similarly, the temperature was maintained below 35°C to avoid overheating of the wastes because exposure of the earthworms to temperatures above this, even for short periods can kill them (Taiwo and Oso, 2004). The pH was maintained within 6.8 to 7.2 i.e. due to slightly acidic to neutral in all pots except F2 and F3 which was observed alkaline to nearly neutral (Table-2 & Graph-2). It might have caused by the microbial nitrification process of nitrifying bacteria present in wastes to release volatilization of ammonical nitrogen and H<sup>+</sup>. (Eklind and Kirchmann, 2000, Singh, *et al* 2005) [2]. The increase in EC in initial stage might have been due to release of different mineral

salts in available forms. The available salts were converted into insoluble salts which may be the reason for the reduction of EC as the composting process further progressed (Nisha Jain, 2016). From this present study it was also observed that the survival of earthworm was suitable with respect to all physico-chemical parameters in case of all pots but the result is favourable more towards F2 and mostly to F3 which also indicated the possibility growth of earthworms in all pots to produce juveniles.

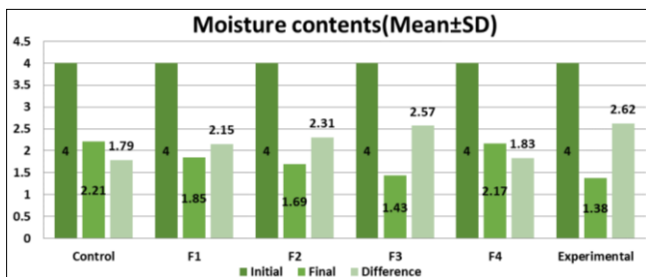
**Table 1:** Colour and odour of vermicompost in all proportions after completion of vermicomposting

Sl. No.	Observations	Colour of vermicompost	Odour of vermicompost
1	Control	Dark brown	Odourless
2	F1	Dark Brown	Odourless
3	F2	Black	Odourless
4	F3	Black	Odourless
5	F4	Black	Odourless
6	Experimental	Black	Odourless

N.B. –Earthworm (EW), Vermicomposting (VC)

**Table 2:** Initial and Final reading of Moisture content in all proportions during vermicomposting floral waste

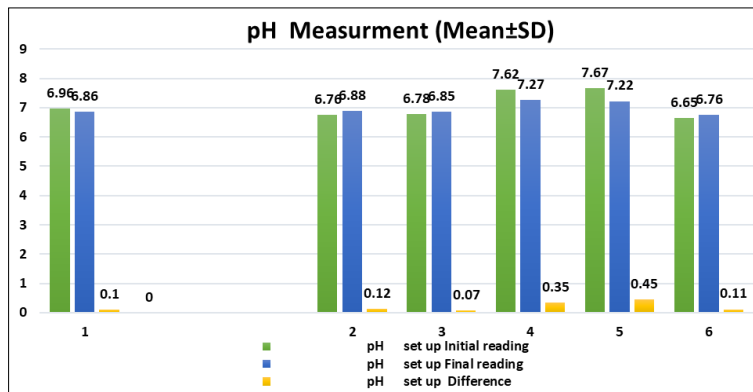
SL.NO.	Observation	Experimental set up	Moisture contents (Mean±SD)		
			Initial reading of waste in gm.	Final reading after drying of wastes in gm.	Difference
1	Control	5:5	4.00	2.21	1.79
2	F1	8:2	4.00	1.85	2.15
3	F2	6:4	4.00	1.69	2.31
4	F3	4:6	4.00	1.43	2.57
5	F4	2:8	4.00	2.17	1.83
6	Experimental	1 kg	4.00	1.38	2.62



**Graph 1:** Graphical presentation of moisture content in all proportions observed from vermicomposting floral waste

**Table 3:** Initial and Final reading of pH in all proportions during vermicomposting floral waste

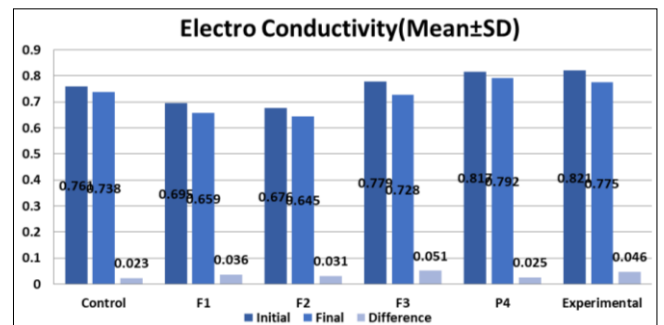
SL. NO.	Observation	Experimental set up	pH (Mean±SD)		
			Initial reading	Final reading	Difference
1	Control-C	5:5	6.96	6.86	0.10
2	F1	8:2	6.76	6.88	0.12
3	F2	6:4	6.78	6.85	0.07
4	F3	4:6	7.62	7.27	0.35
5	F4	2:8	7.67	7.22	0.45



**Graph 2:** Graphical presentation of pH in all proportions observed from vermicomposting floral waste

**Table 4:** Initial and Final reading of Electro-conductivity in all proportions during vermicomposting floral waste

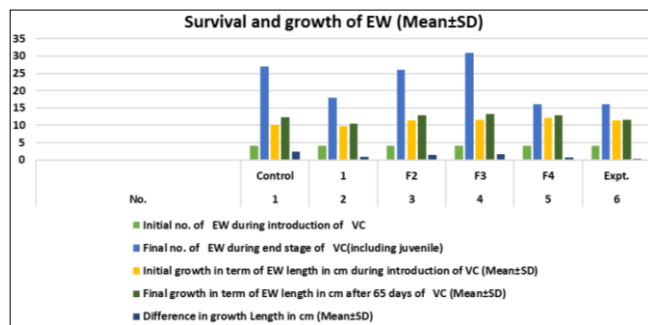
SL. NO.	Observations	Experimental setup	Electro-conductivity (Mean±SD)		
			Initial reading	Final reading	Difference
1	Control	5:5	0.761	0.738	0.023
2	F1	8:2	0.695	0.659	0.036
3	F2	6:4	0.676	0.645	0.031
4	F3	4:6	0.779	0.728	0.051
5	F4	2:8	0.817	0.792	0.025
6	Experimental	1 kg	0.821	0.775	0.046



**Graph 3:** Graphical presentation of pH in all proportions observed from vermicomposting floral waste

**Table 5:** Survival and growth of EW in Mean±SD of Intial and Final reading during vermicomposting floral waste

SL. No.	Observations	Initial no. of EW during introduction of VC	Final no. of EW during end stage of VC including juvenile)	Initial growth in term of EW length in cm during introduction of VC (Mean±SD)	Final growth in term of EW length in cm after 65 days of VC (Mean±SD)	Difference in growth Length in cm (Mean±SD)
1	Control	4	27	10.12	12.4	2.28
2	1	4	18	9.62	10.5	0.88
3	F2	4	26	11.4	12.8	1.4
4	F3	4	31	11.63	13.2	1.57
5	F4	4	16	12.2	12.9	0.7
6	Expt.	4	16	11.32	11.6	0.28

**Graph 4:** Survival and growth of EW in Mean±SD of Intial and Final reading during vermicomposting floral waste

## 5. Conclusion

The floral waste of temple or floral shop from the present study was observed and studied that the waste of marigold (*Tagetes erecta*) are rapidly degradable in vermicomposting technique within 60-70 days obtained with dark black colour vermicompost than the natural process of degradation. The study also provides a sound basis that vermicomposting is a suitable technology for bioconversion of flowers in to value added compost and reduction of solid waste pollution. Vermicomposting is a natural process which increases soil fertility as it adding nutrients as soil elements, various enzymes and it also maintain the pH and salinity through vermic activity in the soil. Thus, vermicompost technology can be successfully applied in temples as a solid waste management strategy with flower as the major organic waste. The results obtained from the present study proved that the potential of *Eisenia foetida* in vermicomposting technology was effective for degradation of flower waste amended with proportion of cattle manure. The earthworm enriched the end product with high carbon nitrogen profile as confirmed through different parameters helped to reduce volume of agro waste but also generate additional revenue.

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