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Assessment of Plant Nutrients Quality in Vermicompost Processed with *Ceiba pentandra* Fruit Waste by *Eudrilus eugeniae*

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ABSTRACT

Vermicompost is the one of the natural organic fertilizer, which is commonly available to plant. The present study was conducted to investigate the proximate composition of plant nutrients in vermicompost from plant waste using *Eudrilus eugeniae.* In the present study, compost was prepared using fruit peel waste of *Ceiba pentandra,* dried cow dung and humus soil. Six experiments were conducted for different concentration for the production of compost. After 40 days of experiment, dry weight of the compost and major macronutrient were determined. The dry weight of the vermicompost was considerably decreased than the control. The vermicompost produced by *Eudrilus eugeniae* had high major macronutrient such as nitrogen (N) (1.026 ± 0.012%), phosphorus (P) (0.149 ± 0.004%) and potassium (K) (0.845±0.0034%). The increased amount of available N, P and K shows the superior quality of vermicompost.

***Key words*:** Compost, Cow dung, *Eudrilus eugeniae, Ceiba pentandra,* Vermi-technology

The production of organic fertilizer from biodegradable organic waste using earthworms is named as vermicompost [1]. This composting process can convert all organic wastes into wealth [2]. Vermicompost is a natural organic biofertilizer that contains various macro and micro nutrients like nitrogen, phosphorus, potassium, manganese etc. [3]. Vermicompost is a new and promising choice for sustainable agriculture that is commonly used various agricultural and horticultural plants [4]. Vermicomposting is a promising procedure that has shown it's prospective in many challenging areas like agricultural waste execution, waste recycling and management of solid waste etc. [5]. The vermicomposting process consumes various types of agricultural wastes such as agricultural residues, cattle dung, sewage sludge and many organic industrial residues [6]. Earthworms are being used to treat a wide variety of organic wastes found in the land. The application of vermicompost in agricultural fields may stimulate the load of soil microorganisms and promotes plant growth by providing various micro and macro nutrients [7-8].

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The earthworm *Eudrilus eugeniae* is generally called as West African night crawler, found all over the word but largely found in West Africa [9]. The length of the earthworm is ranged from about 10-12 cm and the size may depend on the habitat of earthworms [10]. *E. eugeniae* can able to grow various temperature ranges from 25-30˚C, but the best growth was obtained at 30°C after 15-20 weeks [11-12]. It is common type of earthworm species extensively used for the production of vermicompost [13-14]. This present work is aimed to assessing the quantity of available nutrients in mixed plant waste processing vermicompost using *Eudrilus eugeniae.*

MATERIALS AND METHODS

Plant waste collection

Fruit peel waste of *Ceiba pentandra* (Family: *Malvaceae*) weighing about 5 kg was collected from in around of Cheyyar, Thiruvannmalai Dt. Tamil Nadu. The collected peel waste was dried and then chopped into small pieces. Then, it was manually ground with the aid of electrical mixer and only fine particles were separated by using sieve.

Pre-composting

The plant waste was pre-composted for 21 days before putting into vermicomposting process. During this process, along with plant waste dried cow dung powder was mixed with different ratio. The mixture of plant waste and cow dung (vermibed) was kept in plastic container for initial composting and initiation of microbial degradation and

softening of waste mixture. During this period, the waste mixture in different bedding was turned out periodically (after 5 days) for proper aeration and remove odour from decomposing wastes [15].

Earthworm collection

The earthworm *Eudrilus eugeniae* was collected from Vedhapuri Agricultural form in Chithathur, Thiruvannmalai Dt. Tamil Nadu. The collected worms were immediately transported into the laboratory and kept in earthen pot (5 L vol.), which was partially filled with a mixture of loamy and humus soil supplemented with cow dung, dry leaves and some vegetable wastes [16-17]. After 21 days earthworm of similar sizes was carefully selected from the earthen pots and used for further studies.

Experimental design

Composting process was carried out with six replicates in a series of 5 L capacity pots. Each pot was filled with dry humus soil, powdered form of plant waste and cow dung powder in different proportions and coded as experimental setup 1 to 6 and one setup without plant waste was used as control. In each experimental setup 10 earthworms were added for composting. The process of vermicomposting was carried out for a period of 40 days. The temperature and moisture content were maintained by sprinkling adequate quantity of water at frequent intervals [18-19].

Experimental setup

Control: Soil (2 Kg) + Cow dung (25 g)
Exp. 1: Soil (2 Kg) + Cow dung (25 g) + Plant waste (50 g)
Exp. 2: Soil (2 Kg) + Cow dung (25 g) + Plant waste (100 g)
Exp. 3: Soil (2 Kg) + Cow dung (25 g) + Plant waste (150 g)
Exp. 4: Soil (2 Kg) + Cow dung (50 g) + Plant waste (25 g)
Exp. 5: Soil (2 Kg) + Cow dung (50 g) + Plant waste (50 g)
Exp. 6: Soil (2 Kg) + Cow dung (50 g) + Plant waste (100 g)

Physico-chemical analyses

The homogenized vermicompost samples of each experimental setup (on the basis of 100 g dry weight) were collected at 50 days from each replicate pot. The collected vermicompost samples were processed for analyses of total nitrogen (N), phosphorous (P) and potassium (K). The N was measured by Kjeldahl method [20] and the total P and K contents of the samples were estimated by colorimetric method [21]. All the experiments were conducted in triplicate, each being repeated at least three times. The mean and SD of each replicate were calculated using statistical spreadsheet in Excel.

RESULTS AND DISCUSSION

Earthworm and plant waste

Now a day a wide variety of earthworm species like *Drawida willis, Eudrilus eugeniae, Eisenia andrei, Eisenia fetida, Lampito mauritii, Lampito rubellus, Megascolex mauritii* and *Perionnyx excavates* are utilized for the conversion of organic wastes into vermicompost [22-23]. Among these, the commonly available two species such as *Eudrilus eugeniae* and *Eisenia foetida* are widely used varieties in India [24]. Generally, vermicomposting by the earthworm *Eudrilus eugeniae* can be processed from various types of raw materials such as agricultural residues, sugar cane thrash, cattle manure, gaur gum, municipal solid waste, municipal, agricultural and mixed solid waste, onion waste, press mud, wooden or plastic waste and vegetable waste and floral waste mixture [25-26]. In the present investigation, a mixture of cow dung and fruit peel waste of *Ceiba pentandra* with different proportions were used as raw materials for vermicomposting.

Vermicomposting

Cow dung is a familiar raw material for the production of vermicompost used in various proportions. In the present study, vermicompost was processed with the addition of *Ceiba pentandra* fruit peel waste in different proportions. In this investigation, it was observed that the degradation or conversion rate of the fruit peel waste into compost was high and also the yield of the vermicompost was high. Total amount was considerably decreased by 0.004, 0.018, 0.064, 0.014, 0.052 and 0.059 Kg in Exp. 1 to Exp. 6 respectively. In this investigation, total quantity was significantly decreased in experimental setup 5, 4 and 1. Where as in the control, total quantity was slightly increased (Fig 1).

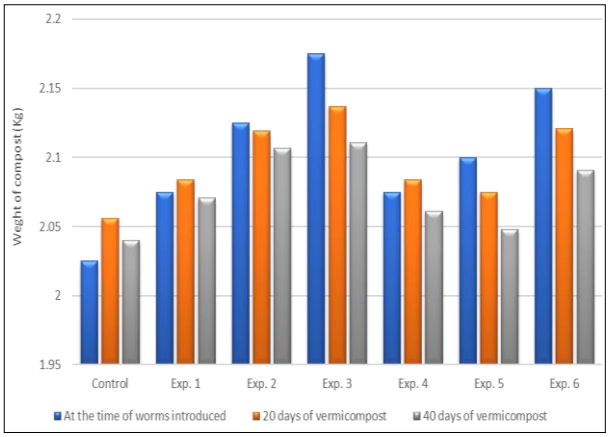

Fig 1 Weight of compost processed by *E. eugeniae* using *C. pentandra* fruit peel waste

Cow dung forms a most important place in earthworm diet and most kinds of animal dung are highly used for the preparation of vermicompost because they contain many nutritious food sources for earthworms [27]. The cow dung is able to increase the stability of the material to be converted into vermicompost as a feed for both microorganisms and earthworms [28]. It significantly minimizes the mortality rate and increases the length of the worms; also increase the worm's populations in the compost [29-30]. As well, the addition of *Ceiba pentandra* fruit peel waste as a raw waste material considerably increases the degree of vermicompost.

Physico-chemical analyses

In macro nutrient analysis, the available N content (%) of vermicompost was ranged from 0.924±0.0305% to 1.026±0.012. In this assay, maximum N content was recorded in experimental setup 2 followed by setup 1, 3, 6, 4 and 5. The available P content (%) was recorded as 0.125 ± 0.002, 0.198 ± 0.003, 0.154 ± 0.012, 0.172 ± 0.003, 0.211 ± 0.003 and 0.149 ± 0.004. The observed P content was maximum in experimental setup 5 and minimum in setup 1. High K content (0.845±0.0034 %) in the vermicompost was assessed in experimental setup 4 and low content (0.712±0.003 %) was observed in setup 1. Among this

experimental setup, the setup having an equal quantity of plant waste and cow dung shows high amount of N, P and K content than the other experimental setups (Fig 2).

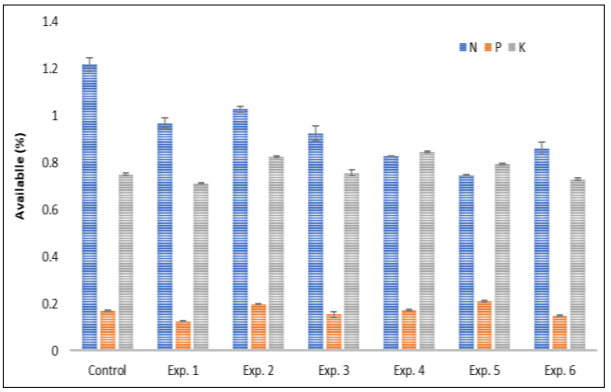

Fig 2 Available physico-chemical content (%) of vermicompost processed by *E. eugeniae* using *C. pentandra* fruit peel waste

The increased content of available N, P and K shows the superior quality of biocompost. Also, the ratio of available N: P: K mainly depends upon the quality of raw organic waste used for composting. The improvement of N content in vermicompost was probably due to the presence of proteins in the organic matter [32-33] and also the conversion of ammonium-nitrogen into nitrate [34]. The increased level P in the vermicompost suggests phosphorous mineralization. The vermicomposting process may convert the insoluble P into soluble forms with the assist of phosphate solubilizing microorganisms present in the gut [34-35]. Also, the microorganisms present in the gut of earthworms probably converted insoluble K into the soluble form by producing microbial enzymes [36]. These findings were supported by the work of [18, 19, 37].

CONCLUSION

Vermicomposting is a technology that focuses on the conservation of various waste resources and their sustainable utilization. It can also be used for the treatment of different organic wastes like plants, cardboard, paper, manures, food and bio-solids etc. This study reveals that the good quality of compost was obtained from experimental setup 2, 4 and 5 in 50 days. Also, it was observed that an equivalent concentration of cow dung and plant waste will give a good quality of vermicompost. It is an effective way to manage many organic plant wastes and also used to promote environmental sustainability by converting a waste into a value-added product.

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