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Physico-chemical analysis of vermicompost produced from tea leaves waste mixed with cow dung using *Eudrillus eugeniae*

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Abstract
Vermicomposting is a simple biotechnological process of composting, in which earthworms are used to enhance the process of waste conversion and produce a better end product. In this present study, the role of earthworm in converting tea leaves waste into a valuable product is assessed. The tea leaves waste was mixed with cow dung and earthworm *Eudrillus eugeniae* and left for vermicomposting for 30 days. The vermibeds are properly maintained throughout the research. After 30 days, the vermicompost was collected and the physico-chemical parameters were analyzed. The reduction in pH and organic carbon were noticed at different time intervals. The result indicated that vermicomposting with *Eudrillus eugeniae* is better for changing tea leaves wastes into nutrient rich vermicasting in a short period of time. i.e. 30 days. Thus, the recycling of wastes through vermitechnology reduces the problem of non-utilization of agro wastes. Vermicompost provide a slow, balanced nutritional release pattern to plants in particular, releases of available N, Soluble K, Exchangeable Ca, Mg and P.

Keywords: vermicompost, tea leaves wastes, cow dung, *eudrillus eugeniae*

1. Introduction
India and many other developing countries are suffering from the disposal of solid waste due to urbanization and population density. The tea production in India was 979,000 tones as on year 2009. It accounts 31% of the global production. Presently, most of the industries dispose their tea leaves waste in open dumps or land areas which results in severe pollution of land and water. Proper disposal of tea leaves wastes from industries and kitchens is necessary for maintaining healthy environment.

The recycling of waste through vermitechnology reduces the problem of non-utilization of agro wastes [8]. Nutrients of vermicomposting are readily available to the earthworms and thereby increase their population. Vermicomposting is the safest and cheapest way for the proper disposal of the tea leaves waste without doing any harm to the environment. Vermicomposting is a bio-oxidation process in which, earthworm interacts with microorganisms and other soil fauna, accelerating the decomposition process and thereby stabilizes the organic matter.

Vermicompost is a method of enriching compost with the use of earthworms. Earthworms consume raw materials and excrete it in digested form called "worm cast", which is rich in nutrients, growth promoting substances, beneficial soil micro flora. Vermicompost is popularly called as black gold, due to its colour and quality in supplying nutrient to plants, enriching soils by improving physico-chemical and biological properties. Vermicompost as gaining popularity and become a major component of organic farming system [4].

Vermicomposting is a simple biotechnological process of composting, in which, certain species of earthworms are used to enhance the process of waste conversion and produce a better end product [4]. Earthworms consume various organic wastes and reduce the volume by 40-60%. Earthworm weighs about 0.5 to 0.6g, eats waste equivalent to its body weight, and produce cast about 50% of the wastes, it consumes in a day. The worm castings contain higher percentage of both macro and micronutrients than the garden compost [4].

There are about 24 tons of tea leaves wastes are released every year in India, whereas 900 million tons released all over the world. Dumping and burning of tea leaves waste causing both ground water and land pollution.

The present study has been taken up to recycle the tea leaves waste as vermicompost by using both cow dung and earthworm. The earthworm species chosen for this study, *Eudrillus eugeniae*, commonly referred as the African Night Crawler, occurs all over the world but mostly in the waste management of Southeast-Asian regions. This worm species can breakdown cellulose material without as much help from the soil bacteria and when they eat, they leave behind worm casting, that can be used as organic fertilizer [5].

2. Materials and Methods
The healthy adult African red earthworms (*Eudrillus eugeniae*) were purchased from Thanthai Han's Roever Agricultural College, Perambalur were used in this present study. Cow dung was procured from the dairy farm situated in the Kurumbalur village, Kurumbalur. Cow dung was spread for 10 days for shadow air drying, so that unwanted gases and heat were removed, which may harm the earthworms. Tea leaves waste was collected from the Kurumbalur Bharathidasan university Constituent College canteen, Kurumbalur, Perambalur.

3. Experimental Design

The experiment was carried out in a plastic bin of size 48 X 45 X 21cm were filled with mixture of cow dung and tea leaves waste. The plastic bin was spread with non-oven cloth to avoid spillage of compost as well as to avoid escape of earthworms. The bottom of the bin was uniformly spread with pure sand for about 1 inch height. Above this, the thoroughly mixed shadow dried tea leaves waste and cow dung was filled in the ratio of 1:1. Then 250g of earthworms were introduced into the substrate for vermicomposting. Then the vermicomposting bin was placed in the plastic tray to collect the vermiwash. The entire setup was maintained in a cool area for about 30 days. The substrate moisture content was maintained to 60-80% by sprinkling water every day. Once in 3 days, the surface of the substrate was ploughed well for better aeration with the help of wood stick to speed up the vermicomposting and to eliminate volatile toxic gases. At the end of the experiment worms, hatchlings and cocoons were removed. The vermicompost was sieved, air dried and stored in plastic bags for physico-chemical analysis.

4. Physico-Chemical Analysis

5g of air dried sample was dissolved in 50 ml of distilled water (1:10 ratio) and shaken well for 40 min. Then the supernatant was collected, filtered and the pH and EC of the filtrate was tested by using pH and EC meter. The porosity, water holding capacity, bulk density, organic carbon content (%), C:N ratio were determined as per standard protocols. The K, Ca, Mg, Cu, Fe, Zn were determined by using Atomic Absorption Spectrophotometer (Perkin Elmer analyst -100, New Jersey, USA). Total nitrogen and phosphorous contents were quantified by the standard methods.

5. Results and Discussion

The physico-chemical parameters of vermicompost at different time intervals (0-30 days) are presented in Table 1. The pH of the vermicompost is decreased from 7.6 to 7.0; whereas the EC significantly increased (36 % over control). The increment in the EC was probably due to the degradation of organic matter and thereby releasing minerals such as calcium, magnesium, potassium and phosphorous. Vermicompost converts tea leaves wastes into compost in 30 days, reduces the C:N ratio and retains more N, P and K. Vermicompost has improved the porosity and water holding capacity, whereas decreased the bulk density due to the high humus content [1, 6, 7]. The major and micronutrients were also increased significantly indicating that the degradation of organic materials releasing minerals such as exchangeable calcium, magnesium, phosphorous, potassium, nitrogen, copper and zinc [1, 3, 6, 7].

To sum up, vermicomposting of tea leaves wastes and cow dung is a natural, ecofriendly, cost-benefited, less laboured and speedy process where, earthworms are ingested the organic material and produced humus like vermicastings, otherwise called as "Black Gold". Vermicasting are rich in nutrient and thereby enriched the physico-chemical parameters of the soil. In addition, the reduced pH solubilizes the macro and micronutrients, which make them readily available to the plant kingdom.

Table 1: Physico-chemical parameters of vermicompost at different time intervals. The Data are mean values of three different experiments. (Data in parenthesis indicates % over control).

S. No	Parameters	0 – day	30th - day
1	pH	7.6	7.0 (92)
2	EC (mS/cm)	5.70	7.80 (136)
3	Water Holding Capacity (%)	34.21	56.54 (165)
4	Bulk Density (Kg m^{-3})	550	335 (61)
5	Porosity (%)	44.57	80.62 (180)
6	Organic Carbon (%)	13.62	9.51 (70)
7	C:N ratio	27.41	15.21 (56)
8	Nitrogen (%)	0.70	1.60 (229)
9	Phosphorous (%)	0.32	0.65 (203)
10	Potassium (%)	0.41	0.72 (176)
11	Calcium (%)	1.15	1.90 (165)
12	Magnesium (%)	0.28	0.32 (114)
13	Iron (ppm)	106	139 (127)
14	Zinc (ppm)	120	192 (160)
15	Copper (ppm)	108	165 53)

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