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STUDIES ON THE EFFICIENCY OF EARTHWORM, *EUDRILUS EUGENIAE* IN THE BIOCONVERSION OF VEGETABLE AND FLOWER WASTES MIXED WITH TARTRAZINE

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Abstract:

The efficiency of earthworm, *Eudrilus eugeniae* was studied in the bioconversion of wastes such as flower and vegetables and, in the wastes mixed with the commonly used food colouring agent tartrazine into micro and macro nutrients. The work was carried out for 35 days in the laboratory by maintaining control and wastes mixed with tartrazine separately. The bioconversion of the wastes into vermicompost is considered as an indicator of the potential nature of the earthworm. The nutrients analysis indicated that the nitrogen, phosphorous and potassium levels were increased in the flower and vegetable wastes and also nitrogen level in the tartrazine treated vegetable wastes. In contrast, the ferrous level was decreased in all the treatments except in the tartrazine treated flower waste which revealed increased level. Manganese and zinc were also increased significantly ($p<0.01$) in all the treatments execpt the level of zinc in the flower waste treated with tartrazine. Besides, the other nutrient i.e., copper showed decreasing level in the vegetable waste treated with tartrazine and in the rest of the treatments, it showed increasing level. Similar to nutrients, physical characters such as electrical conductivity and pH were also increased. The observed results showed the potential nature of the earthworm in the bioconversion of vegetable and flower waste for 35 days.

Key Words: *Eudrilus eugeniae*, Tartrazine, Micro Macro Nutrient & Vegetable and Flower Wastes

Introduction:

The efficiency of earthworms in soil processing due to their burrowing nature and composting of organic matters have been realized and it may solve the problems of waste processing and management to a large extent. The earthworm has been fortunate to degrade wastes and turn them into a fertilizer by the process of vermicomposting; thus acquired product is recognized as vermicomposts. Vermicomposting is a simple biotechnological process, in which certain species of earthworm are used to enhance the process of waste conversion and produce better end products (Gandhi *et al*., 1997).

Edwards and Burrows (1988) reported that vermicompost has an abundant fine structure and highly saturated with nutrients which are freely available for plants intake. Even vermicompost is rich in both the bacterial and fungal components (Vivas *et al*., 2009). Hypothetically, vermicomposting do not produce odor or stenches if planned appropriately and actions of earthworms can decrease the fermentation procedure which possibly can avoid them from being injured by anaerobic fumes, methane, etc., (Chuoui 2010).

Applied use of earthworms in the breakdown of a wide range of organic residues, including sewage sludge, animal wastes, crop residues, kitchen waste and industrial refuse to produce vermicomposting, has been recommended (Van Gestel *et al*., 1992). The importance of the earthworms in waste management, environmental conservation, organic farming and sustainable agriculture has been highlighted by several workers (Senapati, 1992).

The vegetable waste includes vegetable, and flowers can be converted into potential plant nutrients enriched resource compost that can be utilized for sustainable land restoration practices (Suthar and Singh, 2008). Vermicompost possess higher and more soluble level of major nutrients such as nitrogen, phosphorus, potassium, calcium and magnesium (Reddy and Okhura, 2004). *Euderilus eugeniae* could be considered an ideal species for vermicomposting because it is handled and harvested more easily than the others (Dominguez *et al*., 2000). Earthworms are well known natural machineries and are voracious feeders. They excrete a large part of these consumed materials in a semi digested form. Vermicomposts contain plant growth hormones, plant growth regulating substances and humic acids which enhance plant growth and productivity. Since the earthworm is an important species for the bioconversion of different wastes, *Eudrilus euginae* has been taken for its wide adaptivity and efficiency in the recycling of waste materials. Based on the merits of the *Eudrilus*, it is proposed to find out the bioconversion efficiency as well as the effect of commonly used food colouring agent tartrazine on the efficiency of the conversion of waste into compost.

Material and Methods:

Eudrilu eugeniae Vermi bed

Eudrilu eugeniae, collected form Chithathur, Thiruvanamalai District, Tamil Nadu was brought to laboratory for acclimatization. *Eudrilus eugeniae* grows well at a temperature of more than 25^0C but the best growth was observed at 30^0C. It is locally available in and around the South Tamil Nadu.

Vermi bed was prepared as per the standard procedure. The Earthworms were kept in an earthen pot, which was half filled with a mixture of loamy and humus soil supplemented with cow dung and moistened with tap water. The earthworms were kept in earthen pot for a minimum of 20 days, in order to allow them to adapt to experimental conditions. During the period of acclimatization, the worms were fed with air dried cow manure. Earthworms of similar sizes were carefully selected from the earthen pots for further studies. The present study was carried out in the Zoology laboratory.

The selected Flower and Vegetable wastes were collected from Vembakkam market, near Cheyyar Taluk and mixed thoroughly with 2kg of soil separately. This mixture was placed in the form of heaps under shady place. Watering was done regularly twice in a day in order to maintain the optimum temperature and moisture. This set up was maintained for 35 days.

Tartrazine, an orange-colored, water soluble powder is widely used in food products, drugs, cosmetics and pharmaceuticals, in a way to improve the esthetic quality of a food products. Moreover, this food colorant is used in cooking in many developing countries as a substitute for saffron.

Experimental Methods:

In the experiment, predigested vegetable and flower wastes were taken separately in a pot and mixed with soil. The experimental set up was maintained in the laboratory with the introduction of earthworm *Eudrilus eugniae.* In another pot, the same mixture was taken with tartrazine (a food colouring chemical) then released earthworm. Suitable control was maintained. The waste mixtures were allowed to pass through earthworm guts for vermicomposting. The moisture content of the organic substrates in each pot was maintained between 60% and 65% throughout the study period by sprinkling water after every 24 hours. The experiment was conducted by randomized design with three replications. In the vermicompost materials the experimental set up was maintained till 35 days. After that the compost material was subjected to the analysis of various physico-chemical parameters such as pH, Electrical Conductivity (EC), and the macro and micro nutrients such as total Nitrogen (N), Total Phosphorus (P), Total Potassium (K), Total Manganese (Mn), Total Zinc (Zn), Total Copper (Cu), and Total Iron (Fe). The data obtained were subjected to statistical analysis to understand the significance of the result by using students't' test.

Results:

The conversion of vegetable and flower waste into vermicompost was studied by analyzing micro and macro nutrients using *Eudrilus eugeniae* in our laboratory. The results were represented in the fig (1-9).

FIG 1. ANALYSIS OF NITROGEN IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES

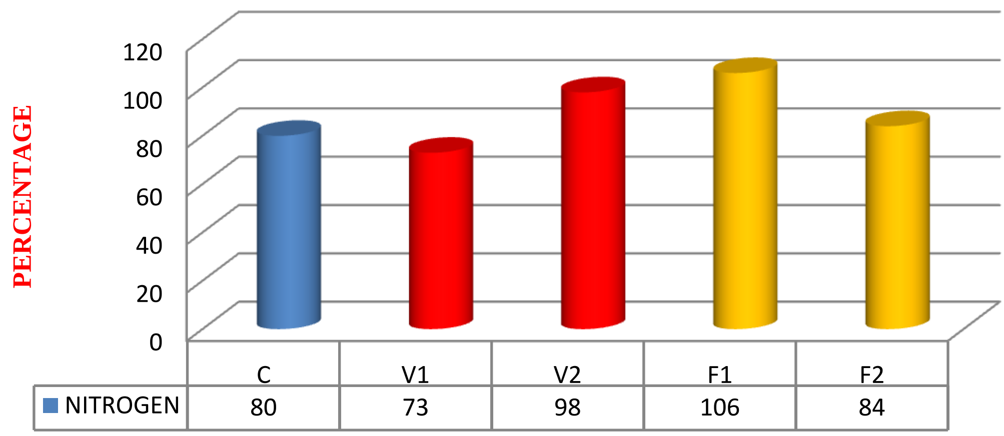


FIG 2. ANALYSIS OF PHOSPHORUS IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES

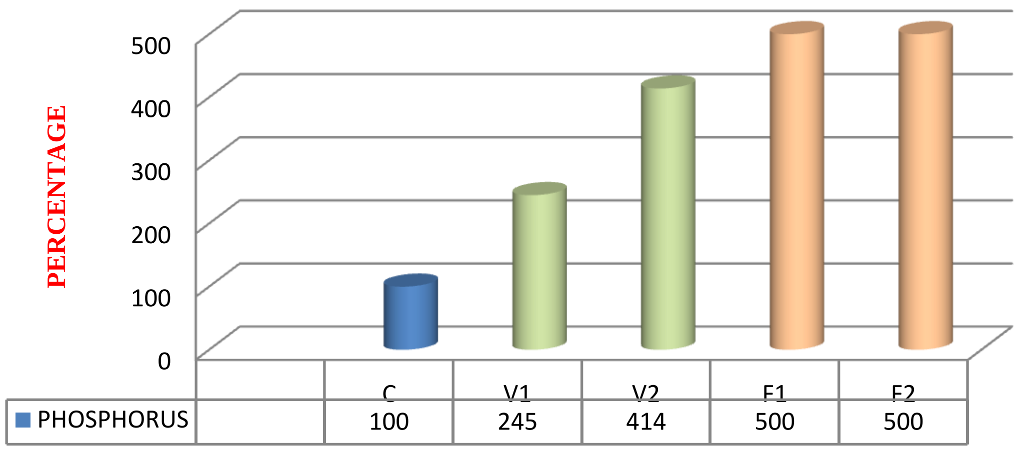


FIG 3. ANALYSIS OF POTASSIUM IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES

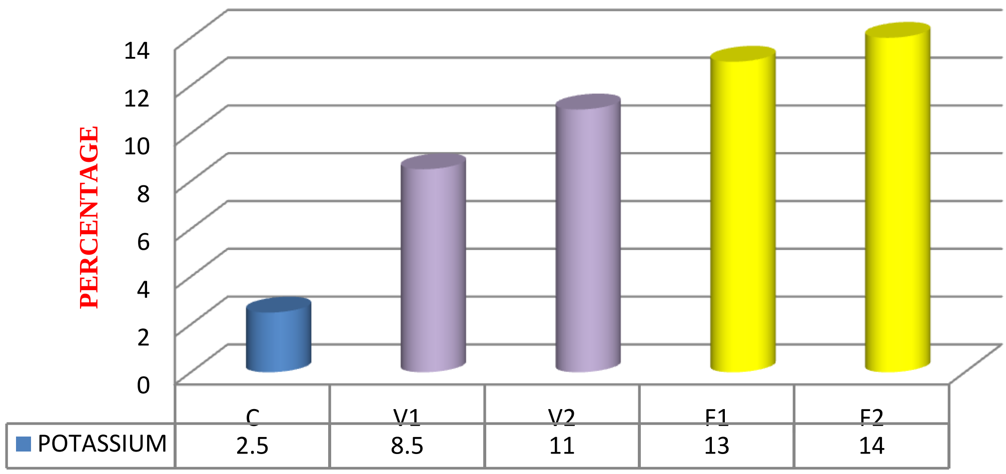


FIG 4. ANALYSIS OF FERROUS IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES

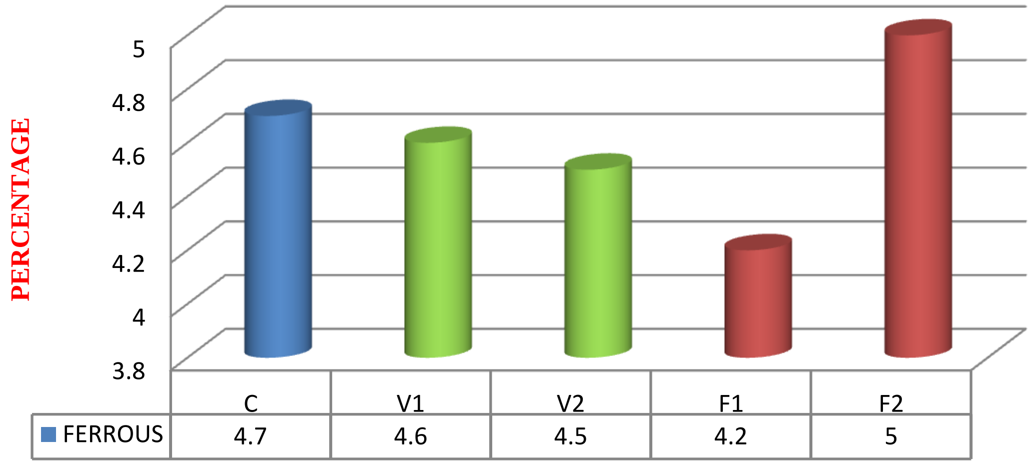


FIG 5. ANALYSIS OF MANGANESE IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES

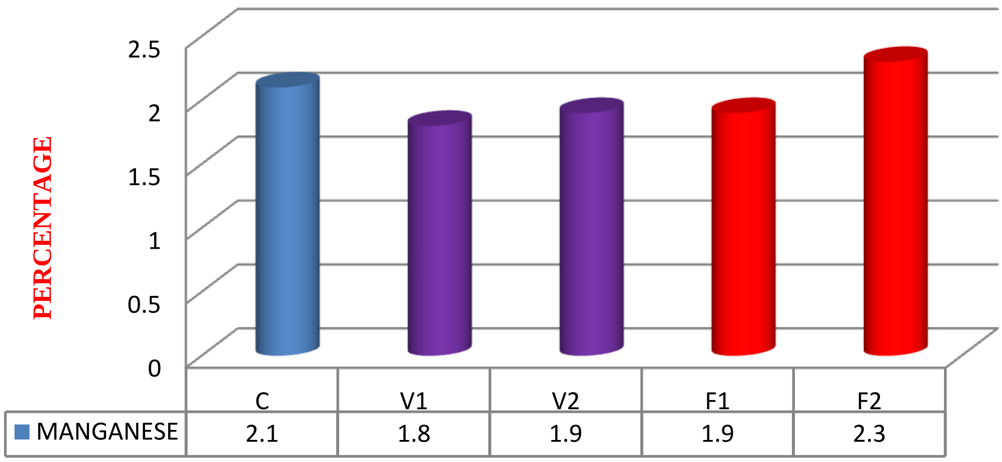


FIG 6. ANALYSIS OF ZINC IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES

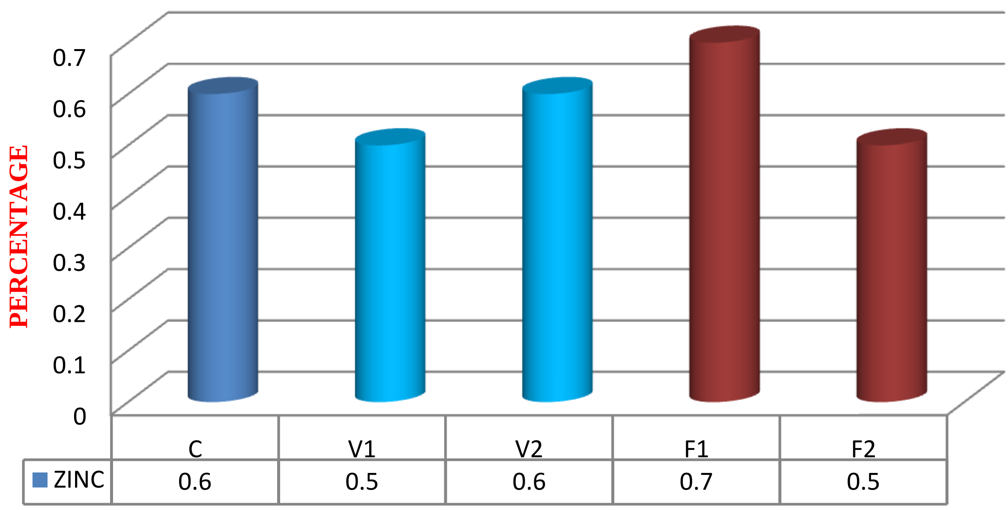


FIG 7. ANALYSIS OF COPPER IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES

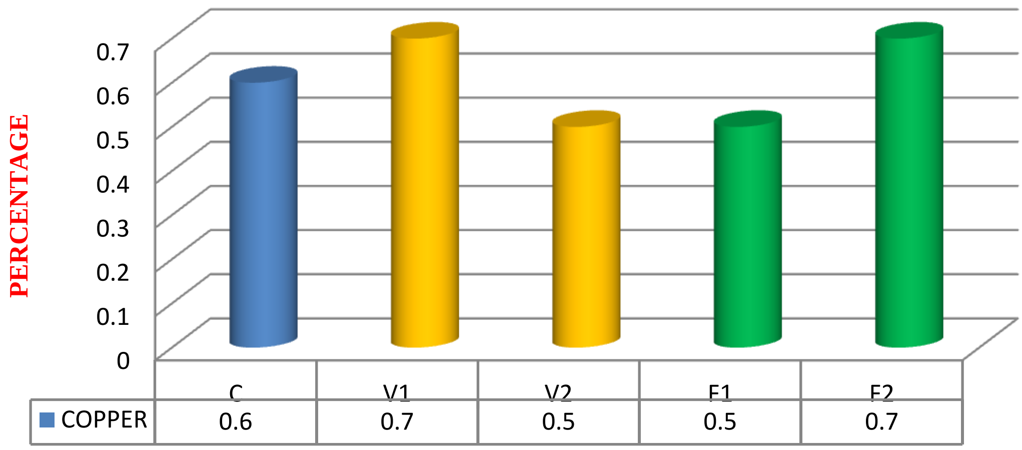


FIG 8. ANALYSIS OF ELECTRICAL CONDUCTIVITY IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES

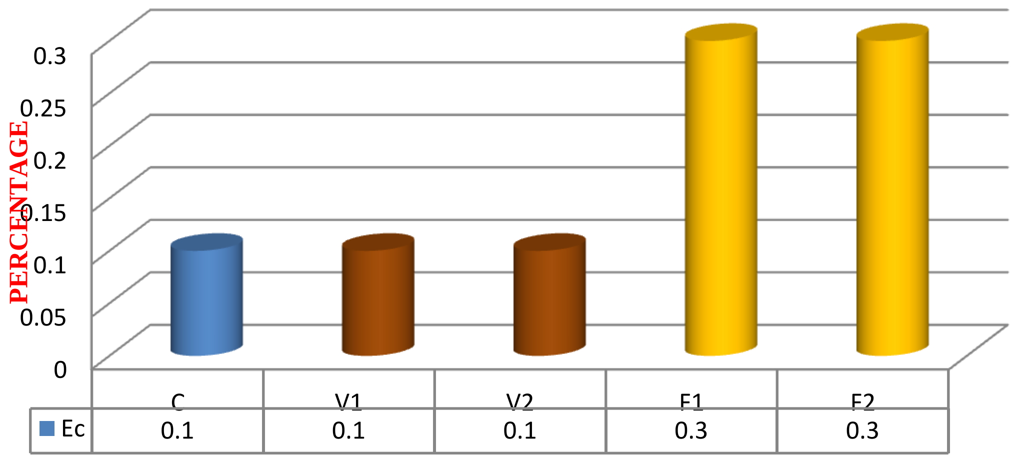
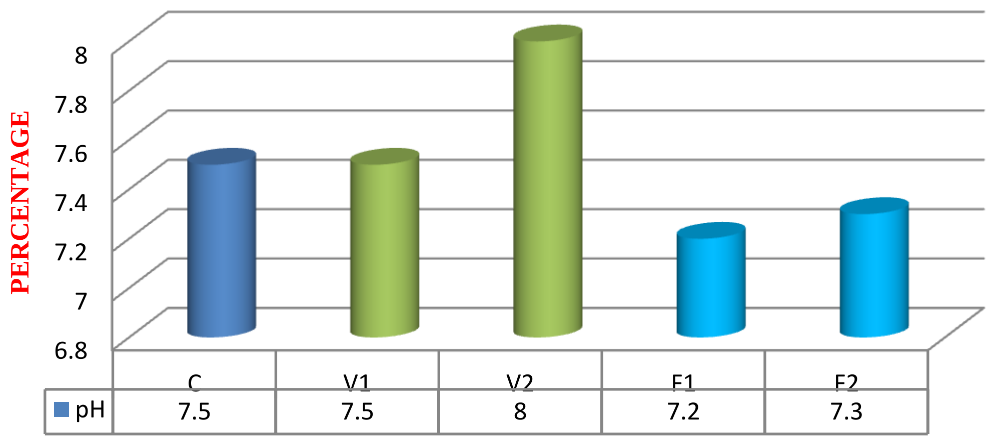


FIG 9. ANALYSIS OF pH IN THE VERMICOMPOST OF VEGETABLE AND FLOWER WASTES



C=Control, V1=Vegetable Waste (Control); V2=Vegetable Waste (Tartrazien Treated)
F1=Flower Wast (Control) F2=Flower Waste (Tartrazien Treated)

The vermicompost obtained from the control showed various levels of nutrients. Among the various nutrients, the nitrogen level was 80±2.5 mg and it was increased in the flower waste compost and in the waste treated with tartrazine when compared with the control. In the other two experiments of vegetable and flower waste with tartrazine treatment, the nitrogen level was same as that of control. In contrast to the nitrogen, phosphorus showed significant increases in all the experiments and similar trend of increase was also noticed in the potassium analysis. The increasing level of phosphorous and potassium when subjected to statistical analysis, showed statistical significance ($P < 0.01$).

The micronutrients showed heterogeneous trends in the experimental vermicompost. The analysis of compost for manganese showed increased level only in the flower waste mixed with tartrazine alone and rest of the results showed insignificant decreasing in the level where as in the zinc, a gradual increase was observed in all treatments except flower waste mixed with tartrazine. In contrast to manganese and zinc, the copper showed different levels in the vegetable and flower waste compost. Flower waste with tartrazine and vegetable waste compost alone showed increased level of copper where as in the vegetable waste mixed with tartrazine and flower waste compost showed decrease of copper level.

Physical properties of vermicompost were studied by analyzing electrical conductivity and pH. The EC was 0.1 ± 0.02 in the control and the same level was observed in the vegetable and flower wastes with tartrazine treatment, whereas in flower waste compost with tartrazine, the EC was 0.3 ± 0.02. The increasing values showed statistical significance. In contrast to the EC value, the pH showed 7.5 ± 0.9 in the control and vegetable waste compost. An increased level of pH was observed in the vegetable waste with tartrazine treatment where it was 8.0 ± 1.1. In the flower waste and with tartrazine, it was decreased to 7.2 ± 1.1 and 7.3 ± 1.2 respectively. The statistical analysis revealed insignificant changes in the experimental analysis.

Discussion:

Vermicompost is generally known as a nutrient rich source of organic materials used in large and small scale sustainable organic farming. The process of composting, through earthworms, is an eco-biotechnological process that transforms energy rich complex organic substances in to a stabilized vermicomposts (Bansal *et al*., 2000). The stabilization of organic material, involves the joint action of earthworms and micro organisms. Although microbes are responsible for biochemical degradation of organic matter, earthworms are potential component of the process, conditioning the substrate and altering the biological activity. Vermicomposting accelerates the mineralization of metabolites and subsequently enriches the product with more available form of soil nutrients. The energy crisis in the country has resulted in a steep increase in the price of fertilizers which in turn hits the small and marginal farmers. Under such situation, recycling of waste is the only alternative for providing a renewable supplementary source of nutrients for crop plant in the countryside. In India crop residues, tree wastes, animal wastes, urban and rural wastes, agro-industries by-products, etc., are the major resources which can be converted into bio-fertilizers if used scientifically. Otherwise, these wastes pose environmental problems like foul smell, occupying large spaces, production of disease carrier microbes. Biological material like earthworm is a boon to minimize the pollution caused by mismanagement of these organic wastes by enhancing the process of degradation of complex substances. These resources have vast and diversified potentials for waste recycle bio-fertilizer production, land reclamation, environmental detoxification and food sources. These bio- fertilizers can replace chemical fertilizer to some extent and create a better environment for the growth of plants. Vermi- technology has gained momentum in recent years due to its manifold benefits. It is an eco-friendly and cost effective technology using earthworms as bioreactors for converting organic materials into valuable compost. Research on vermicomposting by using various wastes has been successfully going on throughout the world (Reinecke *et al.,* 1992). In the present study, the commonly available vegetable and flower waste were subjected to compost process by using *Eudrilus euginae*.

The conversion of waste into nutrients for 35 days has been studied. The results showed the various levels of nutrients. The nitrogen level was increased in the flower and vegetable waste.Nirmala Natarajen and Gajendiran (2015) have also reported the increase of nitrogen level in the compost material. The present data clearly suggested that nitrogen increase in vermicomposted material was directly related to the physico-chemical properties of the initial substrates. Bedding materials modify the physical structure of waste and accelerate the waste mineralization rate in vermibeds. Bensal and Kapoor *et al.,* (2000) suggested that hydrolytic enzyme production plays an important role in C and N cycle in waste decomposition system and was drastically influenced by the availability of easily degradable organic compounds in vermibeds. Suthar (2007) has also reported the N increase in the compost material. The increasing trend of N in the vermicomposts produced by the earthworm species in the present study corroborated with the findings of earlier reports (Bouche *et al.,* 1997).

The enhancement of N in vermicompost was probably due to mineralization of the organic matter containing proteins (Kaushik and Garg, 2003) and conversion of ammonium nitrogen into nitrate. Earthworms can boost the nitrogen levels of the substrate during digestion in their gut adding their nitrogenous excretory products, mucus, body fluid, enzymes, and even through the decaying dead tissues of worms in vermicomposting subsystem (Suthar, 2007). Similar to nitrogen, potassium and phosphorous also increased in the compost. Delgado *et al.*, (1995) who demonstrated the presence of higher K concentration in the end product prepared from sewage sludge. The increase in K of the vermicompost in relation to that of the compost was probably due to the physical decomposition of organic matter during passage through the gut, coupled with enzymatic activity in worm's gut, which may have caused its increase. The microorganisms present in the worm's gut probably converted insoluble K into the soluble form by producing microbial enzymes. In contrast to the increasing of nitrogen, phosphorus and potassium, ferrous showed decreasing level when compared to control except in the flower waste mixed with tartrazine. Besides, manganese, zinc and copper are same level when compared with control. The results indicated that not much significance has been noticed in the various analyses as showed in the figure (1-9).

The pH of waste is sometimes a factor that limits the distribution, numbers and species of earthworms. Several researchers have stated that most of the earthworms prefer a pH of about 7. However, *Lumbricus terrestris* occurs in soils with pH 5.4 in Ohio, USA (Olson, 1928). Further, he has reported that *Lumbricus terrestris* was not very sensitive to pH. In our study the slight decrease or same level of pH with that of control was observed. This result is well supported by Edwards (1995) who have reported a wide range of pH 5.0 to 9.0 for maximizing the productivity of earthworms in the waste management. Singh *et al*., (2005) revealed that earthworms play a significant role in the processing of substrates having different initial pH.

The near neutral pH of vermicompost may be attributed by the secretion of NH^{+}_{4} ions that reduce the pool of H^{+} ions (Haimi and Huhta, 1987) and the activity of calciferous glands in earthworms containing carbonic anhydrase that catalyzes the fixation of CO_2 as $CaCO_3$, thereby preventing the fall in pH. The increased trend of pH in the vermicompost and compost samples is in consistence with the findings of Tripathi and Bhardwaj (2004) and it was due to higher mineralization, whereas the present findings are in contradiction to the findings of Suthar and Singh, (2008). Ndegwa *et al*., *(*2000) who reported lower pH. Fares *et al*., (2005) found the increased pH at the end of the composting process, which was attributed to progressive utilization of organic acids and increase in mineral constituents of waste.

The increased EC during the period of the composting and vermicomposting processes is in consistence with that of earlier workers (Jadia and Fulekar, 2008) which was probably due to the degradation of organic matter releasing minerals such as exchangeable Mg, K, and P in the available forms, that is, in the form of cations in the vermicompost and compost (Tognetti *et al*., 2005).

The study clearly indicates that waste materials when converted, it contains nutrient rich materials which will be utilized as fertilizer of natural origin. It is highly preferable than the artificial fertilizers. The technological process helps the farmers to utilize the waste of different origins. Epigeic worms are capable of converting all the organic waste into manure with free odour and operating costs are negligible as compared to conventional methods of wastes treatment. The final vermicomposts were rich in important plant nutrients such as N, P, K, Fe, Zn, Cu and Mn which indicated their agricultural value as a soil conditioner. These results also indicated the economic utilization of different wastes which will reduce the burden on the municipal councils. Moreover, the vermicompost and compost of vegetable market waste possessed higher nutrient contents probably because it comprised of a mosaic of materials compared to that of flower waste.

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References:

1. Bouche,M., F. Al-addan, J. Cortez,(1997)., "Role of earthworms in the N cycle: a falsifiable assessment," Soil Biology and Biochemistry, vol. 29, no. 3-4, pp. 375–380,
2. Bansal. S, and Kapoor.K. K, (2000) "Vermicomposting of crop residues and cattle dung with *Eisenia foetida*," Bioresource Technology, vol. 73, no. 2, pp. 95–98,
3. Chaoui.H. (2010). Vermicasting (or Vermicomposting): Processing Organic Wastes through Earth worms Ontario, Ministry of Agriculture, Food and Rural Affairs, Characterization and Possibilities of Reutilization of Solid Wastes from a Waste Paper BasedPaper Industry. Global. J. Environ. Res. 4 (1).
4. Delgado, M., M. Bigeriego, I. Walter, and R. Calbo, (1995). "Use of California red worm in sewage sludge transformation," Turrialba, vol. 45, pp. 33–41
5. Dominguez, J., Edwards, C. A. and Webster (2000). Vermicomposting of sewagesludge: Effect of bulking material on the growth and reproduction of the earthworm *Eiseni andrei*. Pedobiologia. 44:24-32.
6. Edwards, C. A., and Burrows, (1988). The potential of earthworm composts as plant growthmedia. In: Edwards, C. A., Neuhauser, E. (Eds) Earthworms in Waste and Environmental
7. Edwards, C.A., (1995). Historical overview of vermicomposting. Bio Cycle, 56–58.
8. Fares, F, A. Albalkhi, J. Dec, M. A. Bruns, and J.M. Bollag, (2005) "Physicochemical characteristics of animal and municipal wastes decomposed in arid soils," Journal ofEnvironmental Quality, vol. 34, no. 4, pp. 1392–1403.
9. Gandhi M, Sangwan V, Kapoor, K.K., and Dilbaghi N. (1997). Composting of household wastes with and without earthworms. Environment and Ecology 15(2):432–434

10. Haimi.J, and Huhta, V, (1987). "Comparison of composts produced from identical wastes by vermistabilization and conventional composting," Pedobiologia, vol. 30, no. 2, pp.137–144,
11. Jaida, C. D, and Fulekar. M.H, (2008). "Vermicomposting of vegetable waste: a bio physicochemical process based on hydro operating bioreactor," African Journal of Biotechnology, vol. 7, pp. 3723–3730,
12. Kaushik,P .and V. K. Garg,(2003) "Vermicomposting of mixed solidtextile mill sludge and cow dung with the epigeic earthworm *Eisenia foetida,*" Bioresource Technology, vol. 90, no. 3, pp. 311–316,
13. Ndegwa, P.M, Thompson, S.A and Das, K.C,(2000) "Effects of stocking density and feeding rate on vermicomposting of biosolids," Bio resource Technology, vol. 71, no. 1, pp. 5–12,
14. Nirmala Natarajan and Gajendran M, (2015). Vermicomposting of paper mill sludge with cowdung, pig waste and water hayacinth in to valuable manure using earthworm *Perionyx excavates*. International Journal of Recent Scientific Research. 6, (5):.4038-4043,
15. Olson.H. W (1928), The earthworms of Ohio-Ohio Biological Survey Bulletin, 7:47-90.
16. Reinecke AJ, Viljoen SA, Aayman RJ, (1992) The suitability of *Eudriluseugeniae*, *Perionyxexcavatus* and *Eiseniafetida* (Oligochaeta) for vermicomposting in southern Africa in terms of their temperature requirements. Soil. Biol.Biochem; 24(12):1295-1307
17. Reddy. M.V, and Okhura,(2004) "Vermicomposting of rice-straw and its effects on sorghum growth, "Tropical Ecology, vol. 45, pp. 327–331,
18. Singh N.B; Khare, A.K; Bhargava. D.S; Bhattacharya.S (2005) Applied Ecology and Environmental Research, 4:85-97.
19. Suthar,S. (2007) "Nutrient changes and biodynamics of epigeic earthworm Technology, vol. 98, no.8, pp. 1608–1614,
20. Suthar.S, and Singh. S, (2008) "Vermicomposting of domestic waste by using two epigeic earthworms (*Perionyxexcavatus* and *Perionyxsansibaricus*)," International Journal of Environment Science and Technology, vol. 5, no. 1, pp. 99–106,
21. Senapati, B. K., (1992).Vermibiotechnology: An option for recycling of cellulosic waste in india. In: New trends in Biotechnology. (Eds. Subba Rao, M. S., Balgopalan, C. and Ramakrishnan, S.V.). Oxford and IBH publishing Co. Pvt. Ltd. pp. 347-358.
22. Tognetti, C, Laos. F, Mazzarino, M.J, and Hernandez, M.T, (2005) "Composting vs. vermicomposting: a comparison of end product quality," Compost Science and Utilization, vol.13, no. 1, pp. 6–13,
23. Tripathi G, and Bhardwaj P. (2004) Comparative studies on biomassproduction, life cycles and composting efficiency of *Eiseniafetida* (Savigny) and *Lampitomauritii* (Kinberg), Bioresource Technology 92:275-283.
24. Vivas A., Moreno B., García-Rodríguez S.,Benítez, E.(2009) Assessing the impact of composting and vermicomposting on bacterial community size and structure, and microbial functional diversity of an olivemill waste. Bioresource Technology, 100: 1319-1326
25. Van Gestel, C.A. Ven-van Breemen and Baerselman, R. (1992). Influence of environmental conditions on the growth and reproduction of the earthworm *Eisenia andrei*in an artificial soil substrate. Pedobiol.36: 109- 120.