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POTENTIAL OF VERMICOMPOST PRODUCED FROM WATER HYACINTH USING *EISENIA FETIDA*

N. G. Tamil selvi[1], S. Sridevi[2*]

1. Department of Zoology, Government Arts College, C. Mutlur, Chidhambaram, Tamilnadu, India.
2. Department of Zoology, Annamalai Universty, Chidhambaram, Tamilnadu, India.

ABSTRACT: Water hyacinth is one of the fast growing notorious aquatic weed. However, the weed can be effectively used in the wastewater treatment and in the control of eutrophication and pollution of water bodies which provided the weed can be properly managed. Management through harvesting removal though highly desirable has not been successful. The removed biomass usually proves a nuisance. High water content, accumulation of pollutants like heavy metals and apparent presence of some irritant compounds, make the harvested biomass not very useful. Use of the harvested biomass for mushroom culturing and vermicomposting of the spent substrate is believed to make the use of water hyacinth for wastewater treatment and for the control of pollution of water bodies both feasible and viable. In the present study, use of water hyacinth biomass as substrate for vermicomposting of water hyacinth along with cow dung has been tried. Vermicomposting was carried out on water hyacinth biomass mixed with cow dung in the ratio of 1:3. Constituents of the water hyacinth biomass (may be heavy metals or certain irritant substances specific to water hyacinth biomass) must not be allowing survival of earthworms especially under the stressed environmental conditions like temperature and humidity. A 45th day study of vermicomposting resulted in the reduction in carbon content, total potassium and increase in calcium. The heavy metal concentration (i.e. Cu, Zn, Ni, Cr, Mg, Pb) were found to be less in vermicomposts than in initial feed mixtures.

Keywords: Water Hyacinth, Earthworm, Vermicompost, humidity, temperature, heavymetals.

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Corresponding Author: Dr. S. Sridevi* Ph.D.
Department of Zoology, Annamalai Universty, Chidhambaram. Tamilnadu. India.

1. INTRODUCTION

Vermicomposting is a biotechnological process that transforms energy rich and complex organic substances into stabilized humus-like product known as vermicompost. It improves soil structure, aeration and increasing water holding capacity. Earthworm as a potential biological tool should be much better understand to make organic farming and sustainable development with the use of selected species of earthworms [14]. Earthworms were specialized to live in decaying matter and can degrade it into fine particulate materials were high in available nutrients with considerable potential and soil activities [10]. Origin of water hyacinth is South America and Venezuela in particular. Water hyacinth polluted water bodies that would be converted from palatable to unpalatable by producing a fowling smell. Mostly the water hyacinths grow very well in sewage water. Vermicompost was proved to be an efficient technology for providing better phosphorous nutrition from organic waste which is in accordance with [17]. The reduction of organic carbon is due to the respiratory activity of earthworm and microbes [9]. The nitrogen availability was more during vermicomposting[7].It possesses some potential values like making composting and mulching [16]. The mineralization of potassium was more in vermicompost of water hyacinth which indicates the role of earthworm and microbes in mineralization process [30]. Large numbers of reports are available regarding utilization of water hyacinth, for example use as paper pulp, poultry/veterinary feed, materials for furniture, carries bags, source of medicinal etc.; however, none of them proved to be economically viable options. The only utilization option of water hyacinth that has been found to be economically viable is the treatment of biodegradable waste waters [19].The nutrients are changed to assimilable forms in the gut, that are more rapidly taken up by the plants [18]**.**The normal water bodies such as ponds, lakes, and canals are contaminated with sewage water. This was the indicator either the water was contaminated or not. Nowadays the controlling of this aquatic weed was a major problem but through the vermitechnology, this problem was easily solved. The other effect of the fast growth of these weeds affects the physical interference with fishing obstruction of shipping routes and losses of water in irrigation systems due to higher evaporation and interference with hydroelectric schemes and increased sedimentation by trapping silt particles. It also restricts the possibilities of fishing from the shore and causes hygienic problems [2]. Vermicomposts are products of a non-thermophilic biodegradation of organic materials through interactions between earthworms and microorganisms [1]. Some of these earthworms include *Eisenia fetida, Lumbricus rubellus, Amyanthes diffrigens and Eudrillus engineac* [15]. These earthworms improve the soils' physical, chemical and biological conditions for plant growth and nutrient uptake. The accelerated decomposition of plant litter and organic matter by these organisms improve soil fertility by releasing mineral elements in the forms that are available for uptake by plants [6]. The estimated biomass production of parthenium is 5-8 t/ ha/year [29, 30] but still Water hyacinth tops the list of all aquatic weeds and now spread to all around the country. Vermicompost are characterized by high porosity, aeration, drainage, water holding capacity and microbial activity [9, 8, 4, 3]. Vermicompost is made up primarily of C, H and O, and contains nutrients such as NO_3, PO_4, Ca, K, Mg, S and micronutrients which exhibit similar effects on plant growth and yield as inorganic fertilizers applied to soil [17]. Similarly, vermicompost contains a high proportion of humic substances (humic acids, fulvic acids and humin) which provide numerous sites for chemical reaction; microbial components known to enhance plant growth and disease suppression through the activities of bacteria (Bacillus), yeasts (Sporobolomyces and Cryptococcus) and fungi (Trichoderma), as well as chemical antagonists such as phenols and amino acids [15]. The presence of heavy metals in the final vermicompost of phumdi biomass raises serious concern about the unwanted environmental impact, as a result of extreme application of vermicompost to the agricultural lands. Heavy metal uptake by plants the resulting accumulation in human tissues through the food chain causes both health and environment concerns [34].

2. MATERIALS AND METHODS

2.1. Collection and decomposition of water hyacinth

Fresh water hyacinth plants were collected from a natural drain infested with water hyacinth was collected in Annamalai University. The harvested biomass was washed with running water. The plants were cut into pieces of 2-3 cm long pieces and sun dried for 2-3 days. The dried biomass is stored for use as and when required. The dried water hyacinth biomass (both combined and roots, leaves and shoot separately) was powdered and listed parameters given in table 3.1 were analyzed. One week old cow dung was used in an experiment because fresh cow dung can be dangerous for earthworms due to decomposition process when the generation of heat take place that can kill to earthworms.

2.2. Preparation of Vermibed

To preparing the vermin bedthe predecomposed water hyacinth was weighed and mixed with dried cow dung in 1:3 (WH+CW) ratio in plastic troughs of 45X35X15 cm. The substrates were moisture to hold 70 to 80 percent of moisture content by the sprinkling of adequate quantities of water at regular interval and kept for 24 hours stabilization. Five hundred healthy clitellate of *Eisenia foetida* were introduced in a plastic trough. The vermicomposting processes were carried out in the rearing room. The substrates were turned once in a week and maintained up to 45 days. The experiment was done by using proper control and triplicates.

2.3. Physico chemical parameters

The vermicompost was analyzed for various physicochemical parameters such as pH, EC, N, P, K, and C:N ratio.Analytical Procedure The followings chemical parameters of each bedding materials were analyzed: Organic carbon was determined by the Walkley-Black method. Total Kjeldhal nitrogen (TKN) was determined according to Bremner & Mulvaney procedure. Available phosphorus was analyzed by employing Olsen’s method and Potassium was determined by ammonium acetate extractable method (Simard, 1993). All the above nutrients and C/N, C/P ratios were analyzed.

3. RESULTS AND DISCUSSION

There are reports that concentrations of exchangeable cataions such as Ca, Mg, Cu, I, S, and Zn and also available NPK, sodium and organic carbon in the vermicompost were higher than those in the surrounding soil. Vermicompost can be described as being nutritionally superior to other organic manures. Instead, it is a unique way of manure production. The fertility value and heavy metal concentration of vermicompost produced using waste is given in Figure 1 and 2.

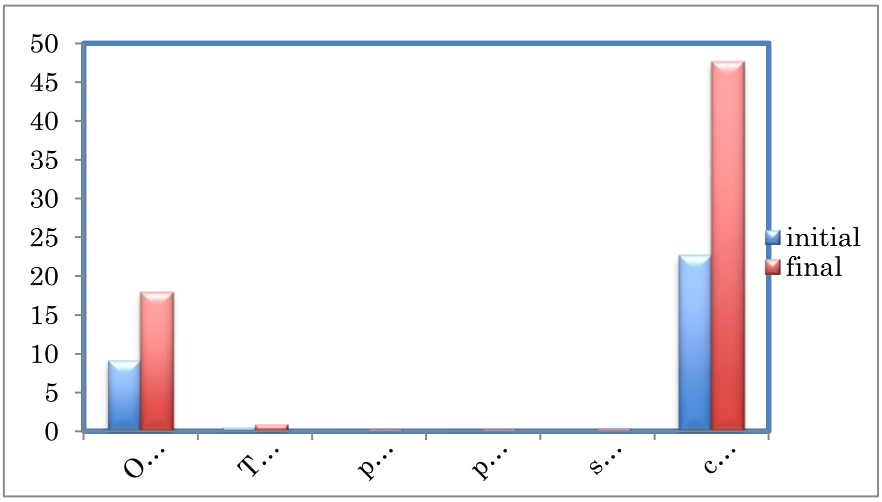

Figure 1: The Chemical Concentration of Vermicompost using *Eisenia fetida.*

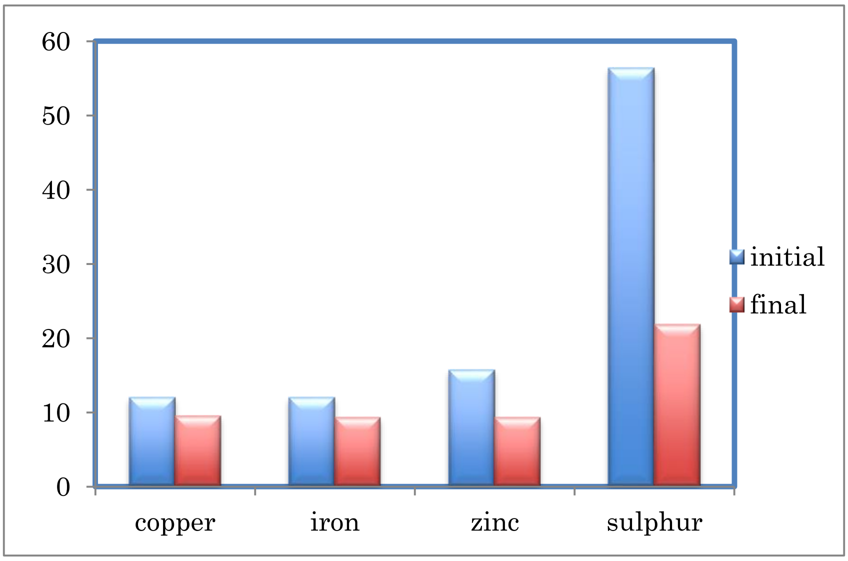

Figure 2: Heavy metal Concentration of Vermicompost using *Eisenia fetida.*

DISCUSSION

The results show a high increase in nitrogen, potassium, phosphorus and a high decrease in organic carbon, C/N, C/P ratio in the experiment set up using earthworms. There was a 20.7%, 26.2% and 23.3% decrease in organic carbon in the first, second and third sets of test experiment respectively.

In control, it was 25.6%., 21.5% and 26.4% respectively. The reduction in organic carbon during the first 3-4 months of vermicomposting could be due to the respiratory activity of earthworms and microorganisms [6,12]. The increase in organic carbon after 3-4 months was probably due to the addition of earthworms cast, which are rich in organic carbon. There was a 133%, 133% and 149% increase in nitrogen in the first, second and third sets of test experiment respectively. In control, it was 11.8%, 13.3 % and 42% respectively. [5].The supplemented number of micro flora present in the gut of earthworms might have played an important role in this process and increased the nutrients' concentration in the vermicompost [23]. Furthermore, nutrients were increased during the process which might be due to net loss of dry mass [28]. Vermicomposting with *Eisenia foetida* of crop residues and cattle dung resulted in significant reduction in C: N ratio and increase in N. There was a 109.2%, 60% and 53% increase in phosphorus in the first, second and third set of test experiment respectively. In control, it was 28.1%, 22.5% and 14.9% respectively. *Eisenia foetida* helps to increase the microbial activity and release the nitrogen, potassium and calcium as suggested by [11]. Some workers have reported higher content of NPK and micronutrients in vermicompost [13, 7]. The studies clearly indicate that use of worms is highly useful in composting of otherwise toxic plant material.The exchangeable fraction of Mn was dominant in the initial feed mixture but in the final vermicompost it was converted into less mobile fractions such as reducible, oxidizable and residual. The exchangeable fraction of Zn was reduced in all trials. The residual fraction of Zn, Ni, Pb, Cd and Crwas dominant in all trials from initial to final compost. The exchangeable and carbonate fractions of Cu,Ni, and Cr were reduced in all trials. The Cu was mainly present in reducible and oxidizable fractions in the vermicompost. The Fe was mainly found in oxidizable fraction in all trials. The residual fraction of Ni, Pb and Cd contributed about 94–99% of total fraction. The exchangeable fraction of Cd was notfound after 15th day of vermicomposting period. The reducible and oxidizable fractions of Ni, Cd and Pb were not found during the vermicomposting process. *E. fetida* was incredibly effective for reduction ofbioavailability of heavy metals during the vermicomposting of water hyacinth mixed with cattle manureand sawdust reported [21].The presence of total heavy metals in final product does not causes toxicity, but toxicity is dependent on metal concentration, toxicity, mobility in free form, the route of uptake mechanism and the bioavailability if it is accumulated in plants [33]. The highly toxic form Cr (VI) is converted to nontoxic form Cr (III) through metabolic process in mitochondrial and cytoplasmic fractions has also been demonstrated in *E. fetida* [19].

4. CONCLUSION

As a processing system, the vermicomposting of organic waste is very simple. Worms ingest the waste material - break it up in their rudimentary gizzards - consume the digestible portion, and then excrete a stable, humus-like material that can be immediately marketed and has a variety of documented benefits to the consumer. Vermitechnology can be a promising technique that has shown its potential in certain challenging areas like augmentation of food production, waste recycling, management of 15 solid wastes etc. There is no doubt that in India, where on side pollution is increasing due to accumulation of organic wastes and on the other side there is shortage of organic manure, which could increase the fertility and productivity of the land and produce nutritive and safe food. So the scope for vermicomposting is enormous.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are base of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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