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Chemical changes during vermicomposting of Mentha waste using *Eudrilus eugeniae*

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Abstract
Vermicomposting is bio-stabilization of organic wastes through agency of epigeic earthworms. Methods of vermicomposting are simple and they require lower inputs of money and labor. Though, vermicomposting practice is gaining some popularity with support of different governmental and non-governmental organizations, but significant acceptance of farmers is yet to be visualized. Some scientists do not recommend wide scale use of vermicomposting. According to them the quality of vermicompost is not good enough to completely replace the chemical fertilizers and use of exotic worms may have adverse effect on indigenous earthworm biodiversity. The demand of soil for nutrients is very high and several years may be required to re-establish biological properties of the soil and to get sustainable results. There is no scientific basis to believe that epigeic worms will harm the endogeic and anecic worms because they have their own specific needs of feed stuffs and habitat. The quality of vermicompost may be improved by using mixture of waste with proper C/N ratio and by managing optimum conditions of pH, bulk density, aeration and moisture content in the medium. A study was conducted to prepare vermicompost from Mentha waste and to determine chemical quality of vermicompost for find out its nutrient richness. For this study three experimental and three control plastic containers of 80x40x20 cm size were used for composting. 20 cm thick bedding of sand and garden soil was prepared in each container and 100 adult *Eudrilus eugeniae* were introduced in each container. 5 kg of 15 days air dried Mentha waste was spread uniformly over the bedding material of all containers. pH, total N,P,K were carried out following standard methods. Results show changes in chemical properties of Mentha waste during 30 days of composting with and without earthworms. pH of compost decreases 10.2 to 8.2 in the serially observations after each 10 days. While the total percentage of NPK is good enough after the composting period. It can be concluded with fruitful outcome that Mentha waste can be converted into high quality valuable compost at small or large level.

Keywords: mentha waste, chemical changes, vermicomposting, *Eudrilus eugeniae*

1. Introduction

Mentha waste is one of the major sources of municipal solid waste. In India, crop waste is a large part of organic nature and contributes 30% to 40% of urban solid wastes (Kale, 1998). Under the present environmental conditions vermicompost technology offers recovery of valuable resources like manure from such type of wastes. Vermicomposting is a process of production of vermicompost through stabilization of organic waste by earthworm activity. The process of vermistablization is due to microbial decomposition of organic matter within the gut of earthworms and thus the undigested released excreta of earthworm does not undergo rapid decomposition (Mitchell, 1997) [19]. Research on vermicomposting of a variety of wastes is gaining momentum thought the world (Reinecke *et. al.* 1992; Elvira *et. al.* 1997; Mitchell 1997; Singh 1997; Frederickson *et. al.* 1997; Edwards 1998; Agrawal 2005) [21, 8, 19, 22, 9, 6, 1]. However, reports on the chemical changes during vermicomposting of the organic waste are scarce (Albanell *et. al.* 1988; Ghosh *et. al.* 1999; Chaudhari *et. al.* 2000) [2, 10]. The aim of present investigation is to find chemical changes during the composting of menthe waste by earthworm *Eudrilus eugeniae.* Such type of study is necessary to determine the time of vermistablization for harvesting of quality compost from a particular type of waste.

2. Materials and Methods

Six large plastic containers of 80×40×20cm size (three control, three experimental) were used for composting. Tem minute holes were made at the base of container to avoid water logging. In each container bedding of 20 cm thickness was prepared with a layer of sand of 10 cm thick topped with 10 cm of garden soil, to make an initial support medium for earthworms. 100 adult earthworms, *Eudrilus eugeniae*, weighting about 150 g were introduced into each of three vermicomposting experimental sets. The remaining three without earthworms were maintained as controls. The surface of containers was covered by a plastic net bearing some holes of 1 cm in each of the sets (experimental and control). Mentha waste collected from local sources was chopped to reduce the size and volume by about 50-60%. The waste was then air dried for 15 days. The following were the chief ingredients of menthe waste: (i) menthe leaves; (ii) menthe pulp; (iii) menthe oil residues. Mentha waste was mixed properly before loading. After one day of earthworm inoculation, 5 kg of menthe waste was spread uniformly over the bedding material in each of the containers (both control and experimental). Water was sprinkled gently over the substrates to maintain moisture percentage. The upper layer of organic waste was turned over periodically for proper aeration. The composting was continued up to 30^{th} day.

Samples were collected on every 10^{th} day and dried at 40oC and finally powdered. Moisture content was determined by drying at 105ºC (Gravimetric method), total N by the Kjeldahl method. The pH was measured by digital ELICO pH meter using suspensions of the material. Chemical analysis of total P and K were carried out following standard methods (Jackson, 1973) [12].

3. Results

Results show changes in chemical properties of Mentha waste (Table-1) during its 30 days of composting with and without earthworms. Absence of earthworms in Mentha waste during the first 10 days of experimentation was probably due to high pH (>9.5) and unpalatable aromatic substances produced both by plant material and microorganisms at early stages of decomposition (Lee, 1985) [18]. With the progress of composting pH decreased slowly with a lower trend in the experimental set (>7.6) in comparison to control (>8.2) up to 30 days. Carbon dioxide and organic acids produced during microbial metabolism probably decrease the pH during composting (Hartenstein and Hartenstein, 1981) [11]. It is likely that the comparatively lower pH during the vermicomposting process due to the additional contribution made by the earthworms.

Nitrogen content reduced significantly (0.06) during the vermicomposting process (Table-1). This is probably due to NH3 volatilization, incorporation into earthworm tissue and leaching into the bedding material. The relatively high level of N during the last 20 days of vermicomposting compared to composting (Table-1) is probably contributed by earthworms through excretion of NH4 and secretion of mucus. The remainder of nutrients followed more or less similar trend to P content increased at a fluctuating level while K level remained almost static during composting with and without earthworms. Ghosh *et al.* (1999) [10] reported higher level of transformation of phosphorus from organic to inorganic state, and thereby into available forms during vermicomposting compared to simple composting. Rise in the level of P content during vermicomposting is probably due to mineralization and mobilization of P due to bacterial activity of earthworms (Krisnamoorty; 1990).

The level of micronutrients in the vermicompost is less than that of the compost following 30 days of composting (Table-1). But the macronutrients increased to a greater degree in the container soil with earthworms after 30 days. Which indicates that soluble nutrients had leached from the worm worked material so that their levels in the worm worked containers were higher than the controls (Table-1). Lowering of nutrients during vermicomposting confirmed the previous observation of Hartenstein and Hartenstein; 1981 and Mitchell; 1997. Such lowering is possibly due to incorporation into earthworm tissue as well as leaching of nutrients into bedding material (Mitchell; 1997) [19].

Table 1: Physicochemical analysis of composted Mentha waste with and without earthworms at different time intervals

Parameter	Initial (0 Days)	Without Worms (control) days			With worms (Experimental) days		
		10	20	30	10	20	30
pH	10.2 ±0.002	9.6±0.003	9.1±0.002	8.2±0.004	9.6±0.003	8.7±0.003	8.5±0.005
Total N (%)	3.51±0.05	3.11±0.06	2.38±0.07	1.95±0.07	3.12±0.05	2.59±0.03	2.21±0.06
Total P (%)	0.89±0.02	1.09±0.04	1.12±0.02	1.08±0.02	1.12±0.04	1.05±0.02	1.46±0.02
Total K (%)	2.10±0.03	2.02±0.02	1.89±0.04	1.52±0.02	2.02±0.06	1.56±0.04	1.13±0.04

4. Discussion

Earlier it was reported by Russell that earthworms rapidly decomposes organic matter and increases nitrification in the soil which increases crop production. Later on it was observed that epigeic earthworms can be used for bioconversion of large amount of organic wastes in to high quality compost and the process is known as vermicomposting (Kale *et.al.,* 1982; Edwards, 1998; Benitz *et.al.*, 2000; Aira *et.al.* 2002; Agarwal O.P. 2005; Rangnathan, 2006) [15, 6, 3]. Kale and Krishnamoorty (1982) [15] reported that different spices of earthworms have different preferences towards organic matter and cattle dung is the best medium for vermiculture.

The increased trend of NPK in the vermicompost is good for compost. Kale (1995) [13] reported that composition of the vermicompost as total Nitrogen 0.5 to 1.5%, available phosphorus 0.1 to 0.3 % and available potassium 0.15 to 0.56 % is good for compost. The vermicompost acts an excellent base for the establishment and multiplication of beneficial microbes.

The findings of present study are similar to the findings of earlier workers. Vermicomposting of Mentha waste is a tuff type of composting due to unhygienic effects of Mentha waste. But simple method of vermicomposting of Mentha waste should be a good event and it will help in solving problems of solid waste management and in improving community health.

5. Conclusions

It may be concluded from the study that menthe waste (mixture of Mentha leaves, Mentha pulp) can be recycled as both small and large vermicomposting level. The method is simple, efficient and user friendly. The vermicomposting of Mentha waste acts as an excellent base for the establishment and multiplication of beneficial microbes. NPK ratio of vermicompost produced from menthe waste is more beneficial than the ratio of simple compost. This type of composting can be completed in small area of home garden or field and can be used in all types of crops. This can also be used for self-employment.

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