Bioconversion Efficiency of Megascolex konkanensis in Composting

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ABSTRACT

Vermicomposting enhance the process of waste conversion and produce a better end product. In this study vermicomposting was carried out using Megascolex konkanensis in various substrates: Cow dung, coir pith, sawdust I (Teak), sawdust II (jackfruit), banana stems spathe (Coconut), coffee bean peel, weed eichornia, leaf litter and tea decotion. The substrates are precomposed for 10 days. Ten worms of Megascolex konkanensis was introduced in each vermireactor and two runs of composting were carried. The biomass variation of the worm, percentage recovery of vermicast and juvenile production were recorded in each run. The recovery of vermicast was more efficient in the second run. It was found that the percentage recovery of vermicast was more in the cow dung, coffee bean peel and least in spathe. The increase in biomass and vermicast prove that the species is a voracious feeder of organic wastes and can be used extensively for vermiculture. The bacterial count was found to be more in the substrate cow dung, followed by weed eichornia and least in spathe. Bacterial count was more in the vermicast than compared to gut region. Cow dung, coffee bean peel, coir pith, eichornia were found to be the more preferred substrate by the worm. Pollutant free products are recovered which will increase the soil fertility and also aid in waste disposal.

Keywords: vermicomposting; vermireactor, bioconversion, reproductive efficiency, bacterial count

Introduction

Vermicomposting is a safe, hygienic and odourless way of processing organic waste. It can be done either on-site or at a separate location, and the end products can be used for local benefit. The processing capacity of the worm farm depends on the population of earthworms in the system. Earthworms aerate the soil to allow air, water and nutrients to reach deep within the soil and contribute to its faunal biomass. The vermicomposting process include two major phases, an active phase during which earthworms process wastes which largely depends on the gut- associated processes (GAPs) and the maturation phase during which the microbes take over the decomposition of the earthworm processed organic materials. The resultant earthworm cast undergo cast-associated processes (CAPs), which are closely associated with aging processes. The present study was carried out to study the bioconversion efficiency of *Megascolex konkanensis* using ten different substrates namely, Cow dung, coir pith, sawdust I (Teak), Sawdust II (Jackfruit), Banana stem, Spathe (Coconut), Coffee bean peel, weed eichornia, leaf litter and tea decotion. This study also focus on the microbial population present seen in the gut and vermicast. These microbes play an important role in the bioconversion efficiency of earthworms.

Materials and Methods

Megascolex konkanensis were procured from the rubber plantation at Kuravilangadu. They were kept in the laboratory culture unit containing Cow dung, coir pith, sawdust I (Teak), Sawdust II (Jackfruit), Banana stem, Spathe (Coconut), Coffee bean peel, Weed eichornia, Leaf litter and Tea decotion as the substrates. Laboratory vermireactors were employed for the experimental culture. In each reactor 10 healthy adult worms were introduced. They were picked randomly from the laboratory culture unit. The reactor bed was kept at approximately 50-60% moisture by the periodic sprinkling of adequate quantity of water (Abbasi and Ramaswamy, 2001). After 45 days the castings were harvested, adults and juveniles were collected and enumerated. The reactors were fed with same quantity of fresh feed for the second run. Same numbers of earthworms were introduced for second run. Net increase in biomass, percentage recovery of vermicast were noticed in this study. The earthworm from different substrates was subjected to the study of microbial population present in the gut and vermicast using serial dilution technique (Walksman, 1917). The bacterial population is identified using morphology and gram staining reactions (Hensyl 1994).

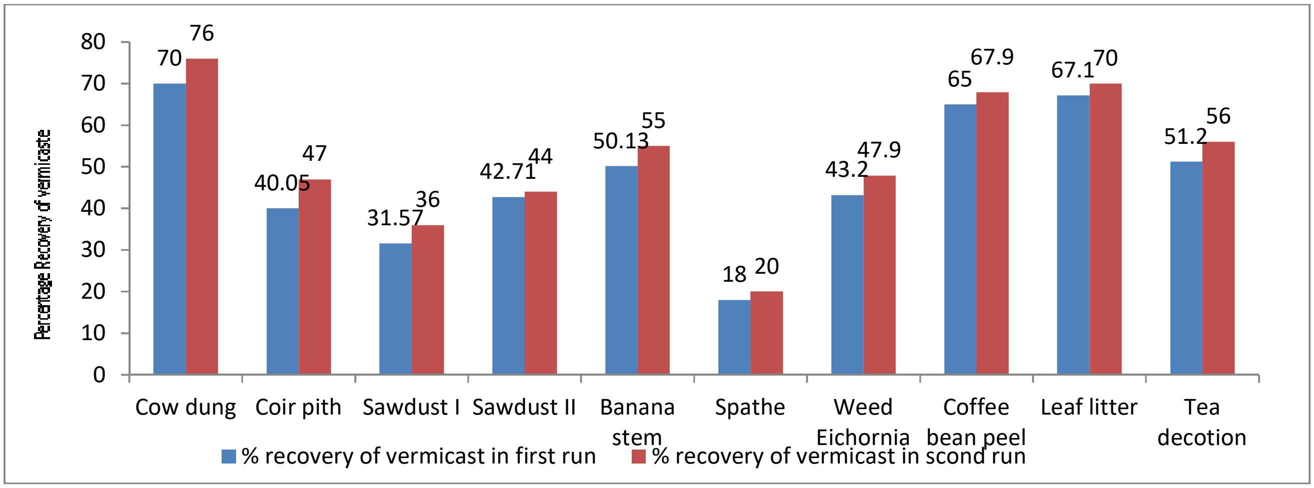
Result and Discussion

In the first run the vermireactor bed with Cow dung, Coir pith, Sawdust I (Teak), Sawdust II (Jackfruit), Banana stem, Spathe (Coconut), Coffee bean peel, Weed eichornia, Leaf litter and Tea decotion shows a vermicast recovery of 70,40.05,31.57,42.71,50.13,18, 43.2, 65,67.1 and 51.2% respectively (Graph 1). In the second run the vermicast recovery was 76,47,36,44, 55, 20, 47.9, 67.9, 70 and 56% (Graph 1). The average vermicast recovery as the fraction of the feed mass in the first run was found low in most of the reactors (Table 1) as the earthworms took some time to acclimatize with the changeover to various substrates.

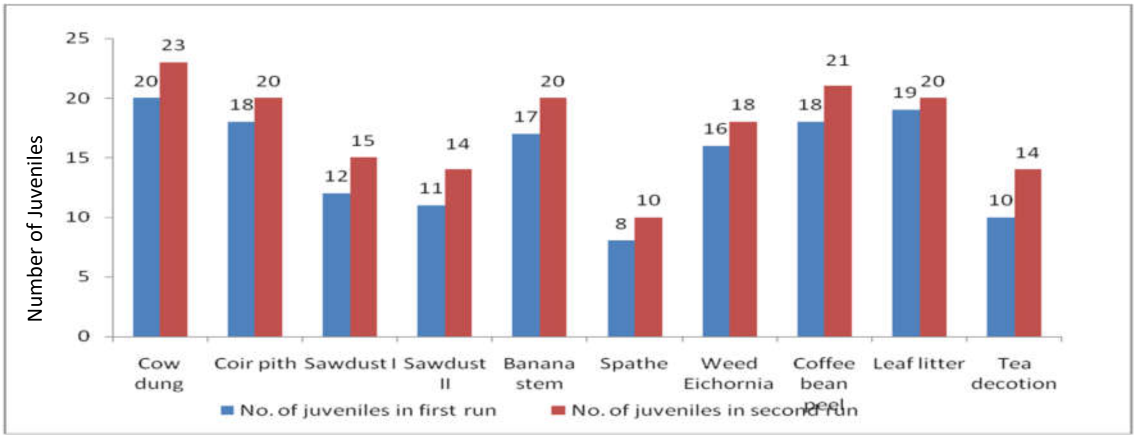
TABLE 1: BIOMASS VARIATION OF EARTHWORMS BEFORE AND AFTER FIRST AND SECOND RUN OF VERMICOMPOSTING

Sl	Substrate	Initial weight of Earthworms (gm)	Final weight of Earthworms (gm)	Net increase in biomass (gm)	Initial weight of earthworms (gm)	Final weight of earthworms (gm)	Net increase of biomass (gm)
1	Cow dung	0.42± 0.09	2.04±0.02	1.62±0.01	2.04±0.02	3.96±0.01	1.92±0.01
2	Coir pith	0.28±0.03	1.21±0.06	0.93±0.01	1.21±0.06	2.96±0.01	1.75±0.01
3	Sawdust I	0.22±0.01	1.25±0.04	1.03±0.01	1.25±0.04	2.51±0.03	1.26±0.02
4	Sawdust II	0.32±0.02	1.36±0.04	1.04±0.01	1.36±0.04	2.64±0.02	1.28±0.01
5	Banana stem	0.22±0.01	1.53±0.03	1.31±0.02	1.53±0.03	3.04±0.01	1.51±0.03
6	Spathe	0.22±0.02	1.53±0.03	1.31±0.02	1.33±0.02	2.53±0.02	1.2±0.01
7	Weed Eichornia	0.33±0.03	1.33±0.02	1.0 ±0.02	1.9±0.02	3.13±0.01	1.23±0.02
8	Coffee bean peel	0.99±0.06	1.4±0.01	0.41+0.01	1.4±0.01	3.36±0.01	1.96±0.01
9	Leaf litter	0.22±0.01	1.65±0.02	1.43±0.01	1.9±0.02	3.75±0.03	1.85±0.02

GRAPH 1: PERCENTAGE RECOVERY OF VERMICAST AFTER FIRST AND SECOND RUN



GRAPH 2: REPRODUCTIVE EFFICIEN



CY AFTER FIRST AND SECOND RUN

The bioconversion efficiency and percentage recovery is mainly depended on the nature and condition of the feed which plays a vital role in the performance of the worm. The recovery of vermicast was more efficient in the second run (Graph 1). It was found that the percentage recovery of vermicast was more in the cow dung, leaf litter and least in spathe. The pH values ranged between 6-8. Biomass variation of earthworms after vermicomposting was found to increase considerably (Table 1). A change in pH of soil or waste is sometimes a factor that limits the distribution, number and species of earthworms (Barois and Aranda (1995), (Ismail, 1997) and Vasanthi and Ranjith Singh (2013)). *Megascolex konkanensis* produced 149 juveniles in the first run and 175 in the second run (Graph 2).

The earthworm from different substrates was subjected to the study of microbial population present in the gut and vermicast. Microbial concentrations were seen more in the substrate cow dung, followed by weed eichornia and least in spathe (Table 2). Serial dilutions of gut and cast samples showed more concentration of microbes in dilution 10^{-1}. Numbers of dividing cells accounted in total for approximately 12% of all bacteria, increasing from foregut to hindgut. (Schönholzer *et al*., 1999). Earthworms attained high bioconversion efficiency in composting organic waste and this links the interaction between microbes and the breakdown of organic substance. Gut region facilitate the inhabitance of microbial community that also involved in the worm metabolic reactions, and effect in the health, fecundity of worm and production of worm cast. The survival of microorganisms in the earthworm gut depends on their capacity to resist to digestive enzymes of microbial or earthworm origins, intestinal mucus, $CaCO_3$ or to bacteriostatic and microbial substances (Brown, 1995). The increase in the counts of bacteria along the gut of all earthworms analyzed, suggests the growth of microbial population in the gut probably due to increase in availability of nutrients in the gut. Microbial abundance is directly related to ingested material that also related to the production of worm casting effectively. Gut region facilitate the inhabitance of microbial community that also involved in the worm metabolic reactions, and effect in the health, fecundity of worm and production of worm cast (Zhang *et al*., 2000).

Table 2: Comparison of bacterial population in different substrates

Source	Cow dung (10^{-1})	Weed Eichornia (10^{-1})	Spathe (10^{-1})
Anterior gut	121	108	94
Posterior gut	98	84	73
Vermicast	129	118	111

Species which are capable of dwelling in high percentage of organic material along with high adaptability to environmental changes, with high fecundity rate, high rate of consumption, digestion, assimilation and growth possess a better potential for vermicomposting process. The tenacity of earthworms for specific food types reflects their metabolic capacity (Brown and Doube, 2004). The present study showed that the coffee bean peel, coir pith leaf litter, eichornia can be used as suitable substrate for vermicomposting; It can be developed as a good tool for organic solid waste management.

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