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WORM BIOMASS AND VERMICOMPOST PRODUCTION BY THE EPIGEIC EARTHWORM, PERIONYX EXCAVATUS BY USING DIFFERENT ORGANIC WASTES

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ABSTRACT As the epigeic earthworms are known to be efficient and potential biodegrades and nutrient releasers, tolerant to wide range of ecological disturbances, aids in litter communication and efficient decomposers. Therefore, the present study was undertaken to find out the influence of various organic wastes (such as False Ashoka waste-FAW (*Polyalthia longifolia*), Parthenium waste-PW (*Parthenium hysterophorus*), Cotton residue waste-CRW (*Gossypium*), Lawn grass waste-LGW (*Agrostis*) and Cattle manure-CM) on the production of worm biomass and vermicompost by the epigeic earthworm, *Perionyx excavatus* along with control compost experiments without worms (in triplicates) to know the potentiality of this worm species in processing of various organic wastes for the production of worm biomass as vermiprotein and vermicompost as biofertilizer. Both compost and vermicompost experimental pots were terminated after 35 and 70 days time intervals. Observations were made with respect to number of old and new adult worms, new sub-clitellates, juveniles, cocoons with their weight were noted to determine the total worm biomass (Gross biomass), biomass ratio (WBR) and Fold Increase in Worm Number (FIWN). Percent compost and vermicompost produced out of different organic waste were also calculated at the end of each experiment at35 and 70 days.
The results of the present study revealed that the biomass of *Perionyx excavatus* such as Gross worm biomass (GWB), Worm biomass ratio (WBR) and Fold increase in worm number (FIWN) increased from 35days to 70 days time intervals in all the organic wastes (FAW, PW, CRW, LGW and CM). It was maximum in CM and minimum in FAW among all the organic wastes. There is a significant variation was noticed in worm biomass production (GWB, WBR, and FIWN) among and between all the organic wastes except between few organic wastes at 35 and 70 days time intervals. The vermicompost production was more as compared to normal compost in all the organic wastes. Further, both compost and vermicompost production were more in CM followed by LGW, CRW, PW and minimum in FAW among all organic wastes. The significant difference was also observed in the production of compost and vermicompost among and between different organic wastes except between few organic wastes at different time intervals.
Based on the results, it can be concluded that the earthworm, *Perionyx excavatus* is an efficient epigeic earthworm species, effectively used in vermicomposting for the production of vermicompost and as well as in vermifarming in the production of worm biomass as vermiprotein. Further, earthworm biomass, compost and vermicompost production primarily depends on nature of organic wastes and secondly on the potentiality of earthworm species used in the experimental studies.

KEYWORDS : Worm biomass, Compost, Vermicompost, Organic wastes, Epigeic earthworm, Perionyx excavatus.

INTRODUCTION

In recent years, human activities are thriving many problems such as deforestation, soil erosion, environmental pollution, waste management etc. Today, the major problem in front of us is to manage the wastes produced by the human activities. These wastes create foul smell, cause different diseases, pollutants to soil and water, and upset the health of humans as well as domestic animals. To solve this problem, the methods opted should be more eco-friendly and cost effective one. Vermitechnology is one of the best alternative solutions for such problems, it is a method of culturing earthworms to degrade variety of organic wastes so as to produce vermicompost as biofertilizer as well as worm biomass as vermiprotein. Earthworms are described as "unheralded soldiers" of mankind and friend of farmer. It is also stated that earthworm is the "intestine of earth" as it digests tons of soil. These tubular creatures do miracles on the earth by converting wastes into wealth, trash into treasure, garbage into black gold, black gold into green gold [3].

Selection of particular earthworm species for vermicomposting technology is mainly based on their reproductive potential, growth rate, and the range of tolerance to changing ecological factors and their feeding habit [16,35,39,41]. The most promising earthworm species used in vermicomposting are *Eisenia fetida, Eisenia andrei, Eudrilus euginiae and Perionyx excavatus.* These epigeic earthworms are efficient and potential bio-degraders and nutrient releasers, tolerant to wide range of ecological disturbances, aids in litter communication and efficient decomposers.

The benefits of vermicomposting in recycling of various organic wastes such as animal wastes [6,43,10,4,1,22,30], crop residues [38,26,33,5], industrial wastes [11,19,44,14,2,24], sewage sludge [29,8] have been reported.

Among the epigeic earthworm species that have been widely used in vermicomposting of organic wastes in the tropics are *Eudrilus eugeniae* and *Perionyx excavatus* [13]. *Perionyx excavatus,* a commercially produced tropical earthworm known as "blues / Indian blues" is useful for vermicomposting in tropical and subtropical regions [7]. The selection of particular earthworm species is required to accelerate breakdown and stabilization of organic wastes [1].

Hence, the present study was undertaken to find out the influence of different locally available organic wastes on the worm biomass and vermicompost production by using epigeic earthworm, *Perionyx excavatus* over a period of 35 days and 70 days, so as to know the potentiality of this worm species in processing of various organic wastes in the production of worm biomass as vermiprotein and vermicompost as biofertilizer.

MATERIALS AND METHODS

1. Collection and stabilization of organic wastes

The production of worm biomass and vermicompost study was carried out in various locally available organic wastes such as False Ashoka waste-FAW (*Polyalthia longifolia*), Parthenium waste-PW (*Parthenium hysterophorus*), Cotton residue waste-CRW (*Gossypium*), Lawn grass waste-LGW (*Agrostis*). Before starting experiments, all raw organic wastes were collected in enough quantity and chopped into small pieces and allowed them to dry for few days under shade. All the four organic wastes were mixed with cattle manure (CM) in 10:1 (v/v) proportion to maintain proper C/N ratio. Daily sprinkling of tap water was done to maintain moisture content of about 70% to 80% and allowed to stabilize for microbial degradation for about one week. Cattle manure (CM) alone was used as standard control against other mixed organic wastes used in the experiment.

2. Collection and Inoculation of earthworms

The earthworms were obtained from the University of Agricultural Sciences, (UAS) Dharwad. These were cultured in cattle manure for mass multiplication as stock for further experimental use. Each stabilized organic waste was transferred to an earthen pot of size 11cm diameter X 10cm height (in triplicate) as experimental pots. To each experimental pots five sexually matured *Perionyx excavatus* were inoculated for 35 and 70 days after noting their weight. Simultaneously, to know the role of earthworms in vermicomposting, another set without earthworms as composting sets served as control were also maintained in triplicates. All experimental pots (both compost and vermicompost) were kept in an uncontrolled laboratory conditions. Sufficient food and moisture content of about 70% - 80% was maintained throughout the experimental period.

3. Termination of experiments

All the experimental pots, both vermicompost and compost pots in triplicates were terminated after 35 and 70 days time intervals. Observations were made with respect to number of old and new adult worms, new sub-clitellates, juveniles, cocoons with their weight. This is to determine the total worm biomass (Gross biomass), biomass ratio and Fold Increase in Worm Number (FIWN). Gross worm biomass (GWB) was calculated by adding weight of all new individuals of various stages (Adults, sub-adults, juveniles, and cocoons) at the end of experiment multiplied by the initially inoculated five adult earthworms. Worm biomass ratio was calculated from initial weight and final worm weight and FIWN was also measured from initially inoculated five worm number and final worm number of all stages. Percent compost and vermicompost produced out of different organic waste were calculated at the end of each experiment (35 and 70 days' time intervals) by isolating degraded and non-degraded materials with the help of 0.2mm sieve.

4. Statistical analysis

Statistical analysis of data like significant variation and correlation between different parameters were carried out by ANOVA and correlation co-efficient were carried through SPSS (1.6) programme.

RESULTS AND DISCUSSION

Results of the present study with respect to initial worm weight (IWW), Final worm weight (FWW), Gross worm biomass (GWB – FWW), Worm biomass ratio (WBR), Fold increase in worm number (FIWN), percent compost and vermicompost produced by the epigeic earthworm, *Perionyx excavatus* produced out of different organic wastes at 35 & 70 days time intervals and their significant values were represented in the Table - 1 to 6 and Graph - 1 to 2.

1. Worm biomass production

The Gross worm biomass (GWB), Worm biomass ratio (WBR) and FIWN of *Perionyx excavatus* in all the organic wastes including CM increased from 35 to 70 days time intervals (Table - 1). Hence there is a positive correlation with increase in Gross worm biomass (GWB), Worm biomass ratio (WBR) and FIWN with number of days i.e., as the number of days increases, the Gross worm biomass, FIWN also increases from 35 to 70 days time intervals. The mean Gross worm biomass (GWB) weight of *Perionyx excavatus* in False ashoka waste-FAW (*Polyalthia longifolia*), Parthenium waste-PW (*Parthenium hysterophorus*), Cotton residue waste-CRW (*Gossypium*), Lawn grass waste –LGW (*Agrostis*) and Cattle manure-CM (control) were 3.96±0.05 & 7.37±0.60; 3.08±0.53 & 8.45±0.28; 3.65±0.21 & 8.66±0.97; 3.75±0.32 & 10.25±0.30; 3.73±0.29 & 13.41±0.63 at 35 and 70 days time intervals respectively (Table - 1; Graph - 1). The maximum Gross worm biomass (GWB) was noticed in cattle manure-CM (3.73±0.29 and 13.41±0.63) and it was minimum in False Ashoka waste-FAW (3.96±0.05 and 7.37±0.60). There is a significant variation (F = 51.349 and P = 0.00) in Gross worm biomass (GWB) of *Perionyx excavatus* among and between all the organic wastes (Table – 1 and Table – 2) except between 70 days of FAW and 70 days of PW, 70 days of CRW; between 35 days of PW and 35 days of CRW, 35 days of LGW, 35 days of CM; between 35 days of CRW and 35 days of PW, 35 days of LGW, 35 days of CM; between 70 days of FAW and 70 days of PW, 70 days of LGW; between 35 days of LGW and 35 days of PW, 35 days of CRW, 35 days of CM (Table – 2).

Similarly, the Worm biomass ratio (WBR) was calculated from initial worm weight and final worm weight of *Perionyx excavatus* in FAW, PW, CRW, LGW and CM (control) were 5.13±0.03 & 9.51±0.59; 3.93±0.61 & 10.93±0.48; 4.65±0.29 & 11.02±1.16; 4.85±0.37 & 13.31±0.57; 4.98±0.33 & 17.92±0.60. Maximum and minimum Worm biomass ratio (WBR) was observed in CM and FAW respectively (Table - 1; Graph - 1). Here also, significant difference was noticed among and between different organic wastes from initial worm weight to final worm weight of this earthworm except between 70 days of FAW and 70 days of PW, 70 days of CRW; between 35 days of PW and 35 days of CRW, 35 days of LGW, 35 days of CM; between 70 days of PW and 70 days of CRW, 70 days of LGW; between 35 days of CRW and 35 days of LGW, 35 days of CM; between 70 days of CRW and 70 days of LGW; between 35 days of LGW and 35 days of CM (Table – 3).

There is a drastic increase in the FIWN of *P. excavatus* from initially inoculated five earthworms from 35 days to 70 days time intervals. The FIWN in FAW, PW, CRW, LGW, CM (control) were 3.13±0.24 & 10.06±0.66; 0.33±0.33 & 15.66±0.85; 4.60±0.75 & 17.86±1.84; 5.13±0.98 & 20.73±2.26; 1.66±0.54 & 27.00±0.98 respectively (Table – 1 & Graph – 1). The maximum number of FIWN was noticed in CM (1.66±0.54 and 27.00±0.98) and it was minimum in FAW (3.13±0.24 and 10.06±0.66) at 35 and 70 days time intervals respectively (Table-4).

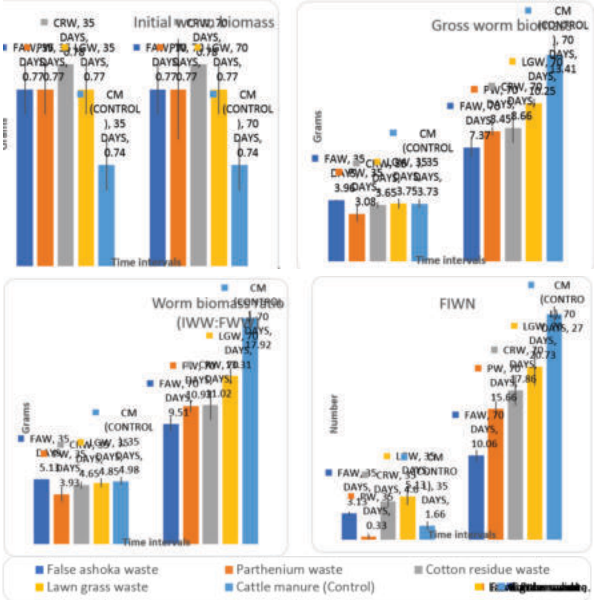
According to Meharaj and Manivannan [27], the growth rate (mg/worm/day) is an excellent and acceptable parameter to compare the growth of any earthworm species. The growth rate of earthworm is affected by the type and quality of feeding materials [18]. Growth and reproduction of earthworms require OC, N, P and cellulose, which are obtained from litter, grit and microbes [9,34]. Earthworm's growth, maturation and reproduction potentials are not only influenced by environmental conditions alone but are also strongly affected by the availability and quality of food provided [12,32,36,11]. The maximum worm biomass gained about 600mg $worm^{-1}$ by *Perionyx excavatus* is cultured in animal dung was reported by Hallat *et. al.*, [15], this is drastically more than as we observed in our studies.

The variations in Gross worm biomass (GWB), Worm biomass ratio (WBR), FIWN of *P. excavatus* at 35 and 70 days time intervals in different organic wastes in the present study may be due to difference in time period of biodegradation and nature and palatability of raw organic wastes, growth and reproduction potentiality of this earthworm and prevailing conditions etc. (proportion of organic waste and cattle manure (10:1)). Loehr *et.al.*,[21] have used sewage sludge as food source to culture *P. excavatus* and reported that they have reached maximum worm biomass at about 100 days time intervals. Murchie [31] have also experimentally proved about the existence of significant relationship between increase in worm weight and type of feed substrate, which may be reasonably attributed to the nutritional quality of the substrate. The palatability, physico-chemical characteristics and nutrient status of organic wastes affect the efficiency and potentiality of earthworms such as their growth and reproduction, which in turn influence on decomposition process of any organic wastes [7,40]. Reinecke and Venter [37] have observed that the increase in worm biomass is dependent upon the feeding habit and activity of earthworms. Ismail [17] have also reported about the biomass production by the compost worm depends upon the type and quality of organic substrates that is used as feed substrate.

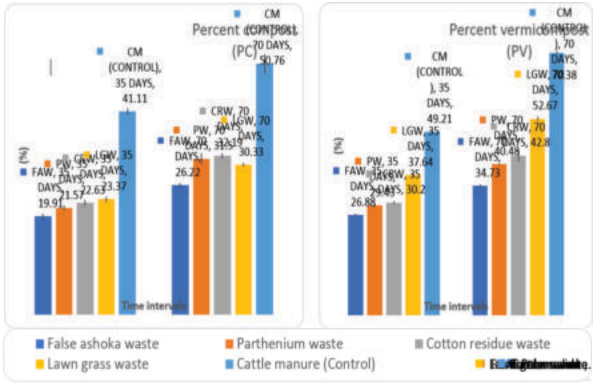
Table 1: Initial worm weight (IWW), Gross worm biomass (GWB), Worm biomass ratio (WBR), Fold increase in worm number (FIWN), Percent vermicompost& compost produced out of different organic wastes at 35 and 70days time intervals and their significant values at P ≤ 0.05 level. Data are in Mean ± SE.

Sl. No.	Organic wastes	Days (Time intervals)	Initial worm weight (IWW)	Final worm weight (FWW)	Gross worm biomass (GWB)	Worm biomass ratio (IWW : FWW)	Fold increase in worm number (FIWN)	Percent Compost (PC)	Percent vermicompost(PV)
1	False Ashoka waste (FAW)	35	0.77±0.01	3.88±0.06	3.96±0.05	5.13±0.03	3.13±0.24	19.91±0.58	26.88±0.46
		70	0.77±0.01	5.96±0.03	7.37±0.60	9.51±0.59	10.06±0.66	26.22±0.38	34.73±.41
2	Parthenium waste (PW)	35	0.77±0.01	3.07±0.54	3.08±0.53	3.93±0.61	0.33±0.33	21.57±0.50	29.43±0.40
		70	0.77±0.02	6.08±0.00	8.45±0.28	10.93±0.48	15.66±0.85	31.50±1.14	40.48±0.29

3	Cotton residue waste (CRW)	35	0.78±0.00	3.53±0.20	3.65±0.21	4.65±0.29	4.60±0.75	22.63±0.65	30.20±0.42
		70	0.78±0.00	5.08±0.00	8.66±0.97	11.02±1.16	17.86±1.84	32.19±0.52	42.80±1.60
4	Lawn grass waste (LGW)	35	0.77±0.01	3.62±0.30	3.75±0.32	4.85±0.37	5.13±0.98	23.37±0.59	37.64±0.55
		70	0.77±0.01	6.11±0.00	10.25±0.30	13.31±0.57	20.73±2.26	30.33±0.36	52.67±0.59
5	Cattle manure(CM) (Control)	35	0.74±0.01	3.69±0.27	3.73±0.29	4.98±0.33	1.66±0.54	41.11±0.63	49.21±0.41
		70	0.74±0.01	7.13±0.00	13.41±0.63	17.92±0.60	27.00±0.98	50.76±1.96	70.38±0.46
6	F-VALUE	0.842	39.741	51.349	65.052	66.170	124.668	393.114	
7	P-VALUE at ≤0.05	0.588	0.000	0.000	0.000	0.000	0.000	0.000	



Graph 1: Initial worm biomass (IWB), Gross worm biomass (GWB), Worm biomass ratio (WBR), fold increase in worm number (FIWN) of the epigeic earthworm, *Perionyx excavatus* cultured in different organic wastes at 35 and 70 days time intervals. Data are in Mean ± SE.



Graph 2: Percent compost-PC (without worms) and percent vermicompost-PV by the earthworm, *Perionyx excavatus* produced out of different organic wastes at 35 and 70 days time intervals. Data are in Mean ± SE.

Table 2: Significant variations (P ≤ 0.05) observed in Gross worm biomass (GWB) produced by *P. excavatus* out of different organic wastes at 35 & 70 days' time intervals.

Sl. No.	Organic wastes	Days or time intervals	FAW		PW		CRW		LGW		CM (Control)	
			35	70	35	70	35	70	35	70	35	70
1	FAW	35	----	0.00	**0.22**	0.00	**0.66**	0.00	**0.76**	0.00	**0.74**	0.00
		70	0.00	---	0.00	**0.13**	0.00	**0.07**	0.00	0.00	0.00	0.00
2	PW	35	**0.22**	0.00	----	0.00	**0.42**	0.00	**0.34**	0.00	**0.35**	0.00
		70	0.00	**0.13**	0.00	----	0.00	**0.76**	0.00	0.01	0.00	0.00
3	CRW	35	**0.66**	0.00	**0.42**	0.00	----	0.00	**0.88**	0.00	**0.90**	0.00
		70	0.00	**0.07**	0.00	**0.76**	0.00	----	0.00	0.03	0.00	0.00
4	LGW	35	**0.76**	0.00	**0.34**	0.00	**0.88**	0.00	----	0.00	**0.98**	0.00
		70	0.00	0.00	0.00	0.01	0.00	0.03	0.00	----	0.00	0.00
5	CM (Control)	35	**0.74**	0.00	**0.35**	0.00	**0.90**	0.00	**0.98**	0.00	----	0.00
		70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----

Table 3: Significant variations (P ≤ 0.05) observed in Worm biomass ratio (WBR) by *P. excavatus* out of different organic wastes at 35 & 70 days' time intervals.

Sl. No.	Organic wastes	Days or time intervals	FAW		PW		CRW		LGW		CM (control)	
			35	70	35	70	35	70	35	70	35	70
1	FAW	35	----	0.00	**0.16**	0.00	**0.56**	0.00	**0.73**	0.00	**0.86**	0.00
		70	0.00	---	0.00	**0.10**	0.00	**0.08**	0.00	0.00	0.00	0.00
2	PW	35	**0.16**	0.00	---	0.00	**0.39**	0.00	**0.27**	0.00	**0.21**	0.00
		70	0.00	**0.10**	0.00	---	0.00	**0.91**	0.00	0.00	0.00	0.00
3	CRW	35	**0.56**	0.00	**0.39**	0.00	----	0.00	**0.81**	0.00	**0.69**	0.00
		70	0.00	**0.08**	0.00	**0.91**	0.00	----	0.00	0.01	0.00	0.00
4	LGW	35	**0.73**	0.00	**0.27**	0.00	**0.81**	0.00	----	0.00	**0.87**	0.00
		70	0.00	0.00	0.00	0.00	0.00	0.01	0.00	----	0.00	0.00
5	CM (control)	35	**0.86**	0.00	**0.21**	0.00	**0.69**	0.00	**0.87**	0.00	----	0.00
		70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----

Table 4: Significant variations or difference (P ≤ 0.05) observed in Fold Increase in Worm Number (FIWN) produced by *P. excavatus* out of different organic wastes at 35 & 70 days' time intervals.

Sl. No.	Organic wastes	Days or time intervals	FAW		PW		CRW		LGW		CM (control)	
			35	70	35	70	35	70	35	70	35	70
1	FAW	35	----	0.00	**0.09**	0.00	**0.36**	0.00	**0.22**	0.00	**0.36**	0.00
		70	0.00	----	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PW	35	**0.09**	0.00	----	0.00	0.01	0.00	0.00	0.00	**0.41**	0.00
		70	0.00	0.00	0.00	----	0.00	**0.18**	0.00	0.00	0.00	0.00

3	CRW	35	**0.36**	0.00	0.01	0.00	----	0.00	**0.74**	0.00	**0.08**	0.00
		70	0.00	0.00	0.00	**0.18**	0.00	----	0.00	**0.08**	0.00	0.00
4	LGW	35	**0.22**	0.00	0.00	0.00	**0.74**	0.00	----	0.00	0.04	0.00
		70	0.00	0.00	0.00	0.00	0.00	**0.08**	0.00	----	0.00	0.00
5	CM (control)	35	**0.36**	0.00	**0.41**	0.00	**0.08**	0.00	0.04	0.00	----	0.00
		70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----

Table 5: Significant variations or difference ($P \leq 0.05$) Percent compost –PC (without worms) produced out of different organic wastes at 35 & 70 days' time intervals.

Sl. No.	Organic wastes	Days or time intervals	FAW		PW		CRW		LGW		CM (control)	
			35	70	35	70	35	70	35	70	35	70
1	FAW	35	----	0.00	**0.19**	0.00	0.03	0.00	0.01	0.00	0.00	0.00
		70	0.00	---	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
2	PW	35	**0.19**	0.00	---	0.00	**0.40**	0.00	**0.15**	0.00	0.00	0.00
		70	0.00	0.00	0.00	---	0.00	**0.57**	0.00	**0.35**	0.00	0.00
3	CRW	35	0.03	0.00	**0.40**	0.00	---	0.00	**0.55**	0.00	0.00	0.00
		70	0.00	0.00	0.00	**0.57**	0.00	---	0.00	**0.14**	0.00	0.00
4	LGW	35	0.01	0.03	**0.15**	0.00	**0.55**	0.00	---	0.00	0.00	0.00
		70	0.00	0.00	0.00	**0.35**	0.00	**0.14**	0.00	---	0.00	0.00
5	CM (control)	35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	---	0.00
		70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----

Table 6: Significant variations or difference ($P \leq 0.05$) in Percent vermicompost -PV produced by *p. excavatus* out of different organic wastes at 35 & 70 days' time intervals.

Sl. No.	Organic wastes	Days or time intervals	FAW		PW		CRW		LGW		CM (control)	
			35	70	35	70	35	70	35	70	35	70
1	FAW	35	----	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		70	0.00	----	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	PW	35	0.01	0.00	----	0.00	**0.42**	0.00	0.00	0.00	0.00	0.00
		70	0.00	0.00	0.00	----	0.00	0.02	0.00	0.00	0.00	0.00
3	CRW	35	0.00	0.00	**0.42**	0.00	----	0.00	0.00	0.00	0.00	0.00
		70	0.00	0.00	0.00	0.02	0.00	----	0.00	0.00	0.00	0.00
4	LGW	35	0.00	0.00	0.00	0.00	0.00	0.00	----	0.00	0.00	0.00
		70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----	0.00	0.00
5	CM (control)	35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----	0.00
		70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	----

2. Percent compost and vermicompost production

The percent compost and vermicompost produced out of different organic wastes were gradually increased from 35 days to 75 days time intervals (Table-1). Likewise, the percent compost (without worms) produced out of FAW, PW, CRW, LGW and CM (Control) were 19.91% ±0.58 & 26.22%±0.38 ; 21.57%±0.50 & 31.50%±1.14 ; 22.63%±0.65 & 32.19% ±0.52 ; 23.37% ±0.59 & 30.33%±0.36 and 41.11%±0.63 & 50.76%±1.96 at 35 and 70 days time intervals respectively. Percent vermicompost produced out of FAW, PW, CRW, LGW and CM (Control) were 26.88%±0.46 & 34.73%±0.41 ; 29.43% ±0.40 & 40.48%±0.29 ; 30.20% ±0.42 & 42.80%±1.60 ; 37.64%±0.55 & 52.67%±0.59 and 49.21% ±0.41 &70.38% ±0.46 at 35 and 70 days time intervals respectively (Table-1 & Graph-2).

There is a significant variation was noticed in both percent compost ($F=124.668$ and $P=0.000$) and vermicompost ($F=393.114$ and $P=0.000$) among and between different organic wastes (Table-1, 5 & 6) except between PW-35 and FAW-35; CRW-35 and PW-35; LGW-35 and PW-35; CRW-70 and PW-70; LGW-70 and PW-70; LGW-35and CRW-35;LGW-70 and CRW-70 in compost production without worms (Table-5) and between CRW-35 and PW-35; PW-35 in case of vermicompost production (Table-6). The percent vermicompost production by the *P. excavatus* out of different organic wastes is positively correlated with Gross biomass production and FIWN at 35 and 70 days time interval (Table-7). Further, both compost and vermicompost production was directly proportional to the increase in time intervals from 35 days to 70 days with respect to all organic wastes including cattle manure-control. Comparatively, the production of percent vermicompost is more than that of compost may be due to feeding activity by the earthworms that might enhanced the microbial population in the vermicompost process, that in turn accelerated the vermicompost production. Variations among vermicompost of different organic wastes may be due to difference in the nutrient status, palatability of different organic wastes that influenced both microbial and earthworm activity.

A comparison of vermicomposting efficacy by different earthworms has been carried out by a number of researchers [25,42,20,23]. Vermicomposting accelerates the decomposition process, which further leads to higher nutrient turnover than that of the traditionally prepared compost, which only involves the action of microorganisms alone[28]. Each earthworm species has its own characteristic features on decomposition of organic matter and they are sensitive to fluctuating climatic and environmental conditions too.

SUMMARY AND CONCLUSION

The results of the present study revealed that the biomass of the epigeic earthworm, *Perionyx excavatus* such as Gross worm biomass (GWB), Worm biomass ratio (WBR) and FIWN increased from 35days to 70 days time intervals in all the organic wastes (FAW, PW, CRW, LGW and CM). The maximum Gross worm biomass (GWB), Worm biomass ratio and FIWN was observed in CM and they were minimum in FAW among all the organic wastes used in this study. There is a significant variation in worm biomass production (GWB, WBR, and FIWN) was noticed among and between all the organic wastes except between few organic wastes at 35 and 70 days time intervals. The percent vermicompost is more than that of normal compost in all the organic wastes.

The production of percent compost and vermicompost were more in CM followed by LGW, CRW, PW and minimum in FAW among all organic wastes. Here also, there is a significant difference was observed among and between the production of compost and vermicompost except between few organic wastes.

Based on the results of the present study, it can be concluded that the earthworm, *Perionyx excavatus* is a potential epigeic earthworm species, can be easily used in vermicomposting for biodegradation and bioprocessing of variety of organic wastes in an efficient manner and as well as in vermifarming for the production of worm biomass as vermiprotein that can be utilized as chief protein in pisciculture and poultry. It is also concluded that the production of worm biomass and percent vermicompost depends on nature of organic waste and potential of earthworm species used in the experimental studies.

REFERENCES

[1] Aira, M., Monroy, F., Dominguez, J., and Mato, S. (2002), How earthworm density affects microbial biomass and activity in pig manure. *Eur. J. Soil. Biol.*, 38,7-10.

[2] Albanell, E., Plaixats, J., and Cabrero, T. (1988), Chemical changes during vermicomposting (*Eisenia fetida*) of cheen manure mixed with cotton industrial wastes. *Biology and Fertility of soils,* 6,266-261.

[3] Arumugam, N., Murugan, T., Johnson Rajeswar, J., and Ram Prabu, R. (2015), Applied Zoology, Saras publications, Camp road, Periavilai, Kottar P. O., Nagercoil, Tamil Nadu.
[4] Atiyeh, R. M., Dominguez, J., Subler, S., and Edwards, C. A. (2000), Changes in biochemical properties of cow manure during processing by earthworm, *Eisenia fetida* and the effects on seedling growth. *Pedobiologia*, 44,709-724.
[5] Bansal, S., and Kapoor, K. K. (2000), Vermicomposting of crop residues and cattle dung with *Eisenia fetida. Bioresour. Technol*., 73,95-98.
[6] Chan, P.L. S., and Griffiths, D. A. (1988), The vermicomposting of pre-treated pig manure. *Biological wastes*, 24, 57-69.
[7] Chaudhuri, P.S., and Bhattacharjee, G. (2002), Capacity of various experimental diets to support biomass and reproduction of *Perionyx excavatus*. *Bioresour. Technol*., 82,147-150.
[8] Dominguez, J., Edwards, C.A., and Webster, M. (2000), Vermicomposting of sewage sludge – effect of bulking material on the growth and reproduction of the earthworm, *Eisenia andrei. Pedobiologia* 44(1), 24-32.
[9] Edwards, C.A., and Bohlen, P.J. (1996), Biology and Ecology of Earthworms, 3rd Edition, Chapman and Hall publications, 2-6 Boundary Row, London, UK, pp.202-217.
[10] Edwards, C.A., Dominguez, J., and Neuhauser, E.F. (1998), Growth and reproduction of *Perionyx excavatus* (Perr.) (Megascolecidae) as factors in organic waste management. *Biol. Fert. Soils,* 27, 155-161.
[11] Elvira, C., Sampedro, L., Benitez, E., and Nogales, R. (1998), Vermicomposting of sludges from paper mill and dairy industries with *Eisenia andrei*; A pilot- scale study. *Bioresour.Technol*., 63,205-211.
[12] Evans, A.C., and Guild, C.L. (1948), Studies on the relationship between earthworms and soil fertility. IV on the life cycles of some British Lumbricidae*, Ann. Biol*., 35,471-484.
[13] Garg, V. K., and Kaushik, P. (2005), Vermistabilization of textile mill sludge spiked with poultry droppings by epigeic earthworm, *Eisenia fetida*. *Bioresour. Tech*., 96, 1063-1071.
[14] Garg, V. K., Suthar, S., and Yadav, A. (2012), Management of food industry waste employing vermicomposting technology. *Bioresour. Technol*., 126,437-444.
[15] Hallatt, L., Reinecke A.J., and Viljoen, S.A. (1990), The life cycle of the oriental compost worm, *Perionyx excavatus* (Oligochaeta).*S. Afr.J.Zool.,* 25,41-45.
[16] Hallatt, L., Viljoen, S., and Reinecke, A. J. (1992), Moisture requirements in the life cycle of *Perionyx excavatus* (Oligochaeta). *Soil Biol. Biochem*. 24, 1333-1340.
[17] Ismail, S. A. (1997), Vermicology: The biology of earthworms. *Orient Longman, Ltd.* Chennai, India.
[18] Jaykumar, V., Murugan, S. S., and Manivannan, S. (2018), Biodynamics of epigeic earthworm *Eudrilus eugeniae* and *Eisenia fetida* during recycling of poultry waste amendedwith different organic food sources. *Int. Arch. Appl. Sci. Technol*. 9(4), 46-51.
[19] Kaushik, P., and Garg, V. K. (2003), Vermicomposting of mixed solid textile mill sludge and cow dung with epigeic earthworm, *Eisenia fetida. Bioresour. Technol*., 90,311-316.
[20] Khwairakpam, M., and Bhargava, R. (2009), Vermitechnology for sewage sludge recycling. *J. Hazard Mater*, 161 (2-3),948-954.
[21] Loehr, R.C., Martin, J.H., Neuhauser, E.F., and Malecki, M.R. (1984), Final project report submitted to the National Science Foundation, Department of Agricultural Engineering, Cornell University, New York.
[22] Loh, T. C., Lee, Y. C., Liang, J.B., and Tan, D. (2005), Vermicomposting of cattle and goat manures by *Eisenia foetida* and their growth and reproduction preferences. *Bioresour. Technol.,* 96,111-114.
[23] Lourduraj, C. A., and Joseph, S. (2010), Production of vermicompost from water hyacinth (*Eichhornia crasipes*)-Efficacy of different species and enrichment of N, P, K, Ca, Mg of vermicompost. *Ecol. Environ. Conserv.,* 16(2),187-189.
[24] Maboeta, M.S., and Van Rensburg, L. (2003), Vermicomposting of industrially produced wood chips and sewage sludge utilizing *Eisenia fetida. Ecotoxical Environ. Saf*., 56, 265-270.
[25] Manna, M. C., Jha, S., Ghosh, P.K., and Achrya, C.L. (2003), Comparative efficacy of three epigeic earthworms under different deciduous forest litters decomposition. *Bioresource Tech.,* 88(3),197-206.
[26] Mba, C.C. (1996), Treated- cassava peel vermicompost enhanced earthworm activities and cowpea growth in field plots*. Resources, Conservation and Recycling,* 17,219-226.
[27] Meharaj, I., and Manivannan, S. (2015), Influence of poultry wastes amended with different organic food sources on growth and reproduction performance of indigenous earthworms *Lampito mauritii* (Kinberg) and *Perionyx excavatus* (Perrier). *Eur. J. Exp. Biol.* 5 (6), 1–6.
[28] Mikola, J., and Setala, H. (1998), Productivity and trophic level biomasses in a microbial based soil food. *Oikos* , 82,158-168.
[29] Mitchell, M. J., Hornor, S.G., and Abrams, B. I. (1980), Decomposition of sewage sludge in drying beds and the potential role of the earthworm, *Eisenia fetida*. *Journal of Environmental Quality*, 9,373-378.
[30] Molina, M. J., Soriano M. D., Ingelmo, F., and Llinares, J. (2013), Stabilization of sewage sludge and Vinasse: Bio-wastes by vermicomposting with rabbit manure using *Eisenia fetida*. *Bioresour. Technol*., 137,88-97.
[31] Murchie, W.R. (1960), Biology of oligochaeta biomastos, *Zetekismith and Gittins in Northen Michigan Am. Midl. Nat*, 64,194-215.
[32] Neuhauser, E.F., Kaplan, D.L., and Hartenstein, R.(1979), Life history of the earthworms, *Eudrilus eugeniae* (Kinberg) *Rev. Ecol. Biol. Sol*.,16, 524-534.
[33] Orozco, F. H., Cegarra, J., Trujillo, L.M., and Roig, A. (1996), Vermicomposting of coffee pulp using the earthworm, *Eisenia fetida*: Effects on C and N contents and the availability of nutrients. *Biology and Fertility of Soils,* 22,162-166.
[34] Ranganathan, L. S., and Parthasarathi, K. (1999), Precocious development of *Lampito mauritii* and *Eudrilus eugeniae* reared in pressmud. *Poedobiologia,* 43, 904-908.
[35] Reinecke A.J., Viljoen S.A., and Saayman, R. (1992), The suitability of *Eudrilus eugeniae, Perionyx excavatus* and *Eisenia fetida* (Oligochaeta) for vermicomposting inSouthern Africa in terms of their temperature requirement. *Soil. Biol. Biochem*., 24,1295-1307.
[36] Reinecke, A.J., and Viljoen, S. A. (1990), The influence of feeding patterns on growth and reproduction of the vermicomposting earthworm, *Eisenia foetida* (Oligochaeta) *Biol. Fertil. Soils* 10,184-187.
[37] Reinecke, A.J., and Venter, J.M. (1987), Moisture preferences, growth and reproduction of the compost worm, *Eisenia fetida* (Oligochaeta). *Biol. Fertil. Soils*, 3,135-141.
[38] Shanthi, N. R., Bhoyar, R. V., and Bhide, A.D. (1993), Vermicomposting of vegetable waste. *Compost Science and Utilization,* 1 (4), 27-30.
[39] Singh, N. (2006), Effect of initial substrate pH on vermicomposting using *Perionyx excavatus* (Perrier, 1872). *Appl. Ecol. Environ. Rese*. 4, 85-97.
[40] Suthar, S. (2007), Influence of different food source on growth and reproduction performance of composting epigeics: *Eudrilus eugeniae, Perionyx excavatus* and *Perionyx sansibaricus. Appl. Ecol. Environ. Res*., 5(2),79-92.
[41] Suthar, S., and Ram, S. (2008), Does substrate quality affect earthworm growth and reproduction patterns in vermicomposting systems? A study using these popular composting earthworms. *Int. J. Environ. Waste Manage*, 2, 584-600.
[42] Tripathi, G., and Bhardwaj, P. (2004), Decomposition of kitchen waste amended with cow manure using epigeic species, *Eisenia foetida* and anecic species, *Lampito mauritii Bioresour.Technol*., 92,215-218.
[43] Wilson, D. P., and Carlile W. R. (1989), Plant growth in potting media containing worm-worked duck waste. *Acta Horticulturae,* 238,205-220.
[44] Yadav, A., and Garg, V. K. (2010), Bioconversion of food industry sludge in to value added product (vermicompost) using epigeic earthworm, *Eisenia fetida*. *World Revi. Sci. Technol. Sust. Dev.,* 7(3),225-238.