



Effect of carbohydrate nutrient as potato peel on growth activity of earthworm (*Eudrillus Euginaea*) on vermibed

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Abstract

Demand of eco-friendly environment, sustainable agriculture and economy brought recycling of organic wastes into enriched nutrient supplement for soil as well as plant. High amount of starch, proteins contained potato peel (PP) waste can be degraded by activity of earthworm to enrich the nitrogen content of manure by vermicomposting. A small scale experimental study report on growth activity of earthworm that is *Eudrillus euginaea* was conducted in different proportion of potato peel in Centurion University and Technology Management, Bhubaneswar, Odisha, India. Earthworms respire through their skin, so they are highly reactive to any change in their environment. Earthworms act in the soil as aerators, grinders, crushers, chemical degraders and biological stimulators. They secrete enzymes, proteases, lipases, amylases, celluloses and chitinases which bring about rapid biochemical conversion of cellulosic and the proteinaceous materials in the variety of organic wastes which is originate from homes, gardens, farms, industries and other food production factories. As organic waste, Potato is being largely used as different products like French fries, potato chips, potato starch, potato powder and potato protein etc. During the processing operations reasonable amount of potato solids remove as waste especially the potato peel, which may be a good source of bioactive compounds. In this experimental study different proportion of potato peel that is 0, 20, 40, 60, 80 and 100 percentage is used to know the growth and other reaction activity of earthworm *Eudrillus euginaea* during the process vermicomposting. The growth rate and other parameter like moisture, pH, temperature and electrical conductivity was being measured in time interval to known the reason of growth and death of earthworm.

Keywords: Potato peel (PP), *Eudrillus euginaea*, Vermicomposting

1. Introduction

With advancement in green revolution and increase in population the need for food and food production has increased. Therefore, surplus quantity of food has induced in human, the attitude of generating food waste. This leads to increase in waste generation rate, high collection cost and dwindling financial resources. These problems are now seen in most of the developing countries. So, waste disposal has become one of the greatest global concerns, since it causes environmental pollution. In some cities the organic waste from market, municipality or households are dumped indiscriminately or littered on the streets causing environmental deterioration (Bhumi Patel, 2015) ^[5]. So, it has become essential that we device and materialize certain environmentally friendly disposal methods and ultimately try to utilize these wastes. Biological processes such as Vermiculture and Vermicompost utilises earthworms like *Eisenia fetida*, *Lumbricus rubellus*, *Eudrillus euginaea*, *Perionyx excavates* etc. which help in converting organic wastes such as vegetable wastes into organic fertilizer having great benefit.

One of the organic wastes which are generated in large quantity in commercial as well as in domestic kitchens and industries is the potato peel. Potatoes are used in large quantities for making chips, French fries and other packaged food material. Potato has become a common vegetable use in different places like Institutes, hotels and house as a food source. This vegetable is also used in beauty products. As the increase or use of potato is high, the waste production i.e., potato peel is also high. It contains fibre, dietary fibre and other carbohydrates that can be further hydrolysed to

produce insulin, oligo fructose, lactose and resistant starch etc. (Shinawar Waseem Ali^{1*}). Since the safe disposal and environment friendly management of these wastes become a global priority. So, the biological treatment of these wastes appears to be most cost effective and carry a less negative environmental impact (Jadia and Fulekar, 2008). Under the present condition of environmental degradation vermiculturing and vermicomposting technology offers recovery of valuable resources like manure from these biodegradable wastes.

Vermiculture is a biological process for the mass production of earthworms with the multiple objectives of waste management, detoxification and improvement of soil fertility (RAJIV K. SINHA, 2002). It is basically the science of breeding and raising earthworms. The practice was started in the middle of 20th century and the first serious experiments were established in Holland in 1970, and subsequently in England, and Canada. Later vermiculture practices were followed in USA, Italy, Philippines, Thailand, China, Korea, Japan, Brazil, France, Australia and Israel (Edward, 1988). India has yet to appreciate the full importance of vermiculture despite the potential for the production of 400 million tonnes of vermicomposting annually from waste degradation (Sinha, 1996).

2. Materials and Methods

2.1 Collection of Soil and Cow dung

Soil and cow dung were collected from the Centurion University and Technology Management, Bhubaneswar, Odisha, India. After collection, the soil and cow dung were sun dried, then crushed and seized into tiny particles in

2.36mm sieving tray. The collection, drying and sieving process takes about 12- 14 days.

2.2 Collection of Earthworm

In this experiment earthworms *Eudrillus euginaea* were collected from the vermicomposting unit of Centurion University and Technology Management, Bhubaneswar, Odisha, India. These earthworms were propagated and maintained at room temperature in the mixture of soil and cow dung at Centurion University and Technology Management laboratory, Bhubaneswar, Odisha, India. Digested slurry was supplied to the surface as a food source. These earthworms were kept in control medium for 4-5 days then introduced into the experimental medium.

2.3 Collection of Organic Waste

Potato peel (PP) was collected from the canteen of Centurion University and Technology Management, Bhubaneswar, Odisha, India. This organic waste that is potato peel was grounded into small piece in paste form for easy mixing and easy intake of earthworm. Substrates were mixed with soil, cow dung and digested slurry, which are favourable substrate for earthworms. The chemical characterization of all the compost materials, that is potato peel, soil and cow dung is done.

2.4 Proportional Setup of vermibed

Proportional setup was done in six different containers. The collected soil, cow dung and potato peel were measured and setup in six different rectangular shaped plastic bins of length 28 cm, breadth 16 cm and height 6cm. The experimental bins were used as culturing beds maintained by adding digested slurry and water for maintaining moisture and a proper environment for the earthworm (*Eudrillus euginaea*). In this setup the proportion of soil and cow dung always remain same that is in 1:1 ratio and organic waste that is potato peel varies, so the ratio of soil and cow dung with potato peel are kept in different proportion with in different container obtained with vermibed and the growth of these earthworms in these different ratio was observed. The setup was maintained for 4-5 days

2.5 Application of Vermiculture

After the different proportions were setup, the cultured area was fully prepared for the introduction of earthworms. Earthworms were first measured by different parameter like length, perimeter and diameter for knowing the growth after 15 days of introduction into different proportion of potato peel. Before the introduction of the earthworms in the experimental area, layering of culture bed was done by alternative pouring of digested slurry and the prepared compost of soil, cow dung and potato peel. Different chemical parameter was also tested that is moisture contain, pH and electrical conductivity of the compost before and after vermiculture process. In each container 4 earthworms were introduced. Water and digestive slurry was given in regular interval for moisture and nutrient which help in proper growth of earthworms. The plastic bin was kept in room temperature and covered for darkness and protection from other predators. After earthworm's introduction within 4-5 days brownish or blackish worm cast were produced in the plastic bin due to the degradation of residues. Observation of earthworm's growth was done after 15-20

days of introduction in regular interval of time. Death and survival of the earthworm was also analysed and recorded in tabulated form.

2.6 Analytical method

Different analytical method was carried out for measuring the difference in the chemical composition of soil before and after adding of earthworms in different proportion of potato peel. Methods like moisture, pH, temperature and electrical conductivity (EC) of the compost both in initial and final stage of culturing process was measured. pH and temperature was measured by digital pH and temperature meter, moisture was determined by keeping the compost in oven for 1hr in 50°C where the initial and final weight of compost is measured and electrical conductivity by a digital conductivity meter. Composition of soil, cow dung and potato peel was done by XRF analysis method. Individual parameter of soil, cow dung and potato peel was also measured.

3. Result and Discussion

The organic waste potato peel was converted by the action of *E. euginaea* into stabilized nutrient-rich material in the process of precomposting and then application of vermicomposting. Activities like metabolism, growth and respiration are greatly influenced by temperature. Temperature is important factor influence the growth and survival of earthworms (Hou *et al.*, 2005; Qiao *et al.*, 2003). The vermiculture and vermicomposting process requires 40-50% moisture which favour the microbial activity and it make easy to feed by earthworm (Sharma *et al.*, 2005). The low percentage of moisture content reduces microbial biodegradation (Ahn *et al.*, 2007) while at higher percentage; the water displaces much of the air in the pore of composting bed leading to anaerobic condition (Rynk, 2000), hence it is obvious to maintain perfectly.

The observation of the experiment was carried out by studying different parameter of each proportion with tables and plotting graphs. Table-1 and Table-2 explained about the setup of different proportional setups as vermibed and the physical parameters pH, temp, moisture and EC of individual materials was measured. Biomass of earthworm has also been calculated in tabulated form. Survival rate of earthworm has been calculated in an interval of 15 days up to 3 months by measuring length of body and diameter of annules shown in Table-3. The survival rate with earthworm growth was plotted in Graph-1 and Graph -3 presenting that it was possible in very low percentage of potato peel like in set-1 and set-2. The death of earthworm occurred only during initial treatment in experimental set contained whole PP and in Set-4 it only survived for 2days which estimated for 4 times of the experiment. The growth of earthworm is reciprocal to it's survival but the biomass is reduced except set-1 and set-2. The physical parameters of different sets was measured during precomposting and different time interval of vermicomposting. The electroconductivity was reduced as compared to final except experimental and control which contain alkalinity more in soil. Similarly, pH was increased except set 1 and 2 where slightly changed towards acidic. The temperature is almost increased in all sets except in control set where it slightly less occurred due to the heat generated during composting and vermicomposting shown in Table-4 and plotted in Graph-2.

Table 1: Proportional setup table of different container

Proportional Setups	Ratio / Percentage of Potato Peel
Control	1:0 / 0%
Set-1	4:1 / 20%
Set-2	3:2 / 40%
Set-3	2:3 / 60%
Set-4	1:4 / 80%
Experimental	0:1 / 100%

Table 2: Measurement of physical parameters of individual material

Parameters	Soil	Cow Dung	Potato Peel
pH	6.58	6.83	7.88
Temperature	23.8°C	23.8°C	25.9°C
Electrical Conductivity	32.9µ	0.647µ	132.11µ

Table 3: (Growth rate of earthworm in each proportion of potato peel)

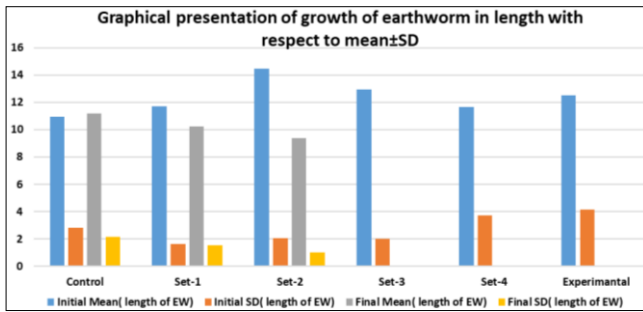
	Initial					FINAL				
	Length (cm)	Diameter (cm)	Perimeter (gm)	Mean	SD	Length (cm)	Diameter (cm)	Perimeter (gm)	Mean	SD
Control	14.5	0.4	1.5			15.2	0.5	1.6		
	11.7	0.5	1.6	10.93	2.83	12.1	0.5	1.6		
	9.5	0.2	0.9			10.8	0.2	0.9	11.17	2.14
	8	0.2	0.8			9.4	0.3	1.8		
Set-1	13.3	0.4	1.5			-	-	-		
	11.6	0.4	1.4			10.5	0.3	1.2		
	12.5	0.3	1.2	11.73	1.64	11.6	0.3	1	10.24	1.52
	9.5	0.2	0.9			8.6	0.1	0.5		
Set-2	11.8	0.4	1.5			8.7	0.1	0.5		
	17.8	0.5	1.6			-	-	-		
	13.2	0.3	1.2	14.45	2.05	10.1	0.2	0.9	9.4	0.98
	15	0.3	1.1			-	-	-		
Set-3	15.4	0.4	1.5			-	-	-		
	12.7	0.5	1.6			-	-	-		
	10.5	0.6	2	12.95	2.02	-	-	-		
	13.2	0.3	1.2			-	-	-		
Set-4	16.2	0.4	1.4			-	-	-		
	11.3	0.4	1.5	11.68	3.69	-	-	-		
	12	0.3	1.1			-	-	-		
	7.2	0.2	0.7			-	-	-		
Experimental	11.4	0.3	1.2			-	-	-		
	14.9	0.5	1.7			-	-	-		
	16.5	0.4	1.3	12.5	4.13	-	-	-		
	7.2	0.2	0.8			-	-	-		

Table 4: (Measurement of physical parameters of different set ups)

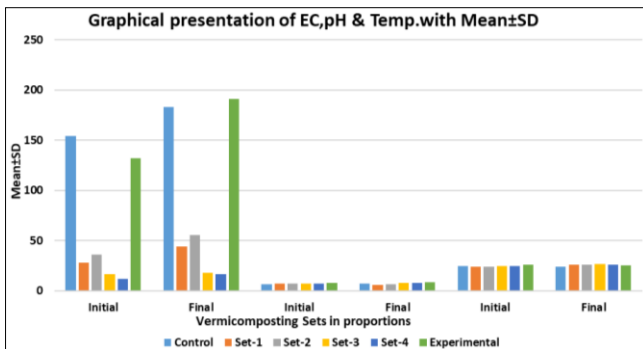
Observation	Electro Conductivity in S/m		pH		Temperature	
	Initial	Final	Initial	Final	Initial	Final
Control	154.4	183.34	6.64	7.11	24.8°C	24.3°C
Set-1	0.779	44.3	7.28	6.23	24.2°C	26.3°C
Set-2	0.588	55.3	7.19	6.47	24.2°C	26.1°C
Set-3	0.364	8.3	7.24	7.94	24.4°C	26.6°C
Set-4	0.584	16.8	7.34	7.97	24.4°C	26.1°C
Experimental	132.11	191.2	7.98	8.5	25.9°C	25.5°C

Table 5: (Survival and death of earthworm within interval of 15 days)

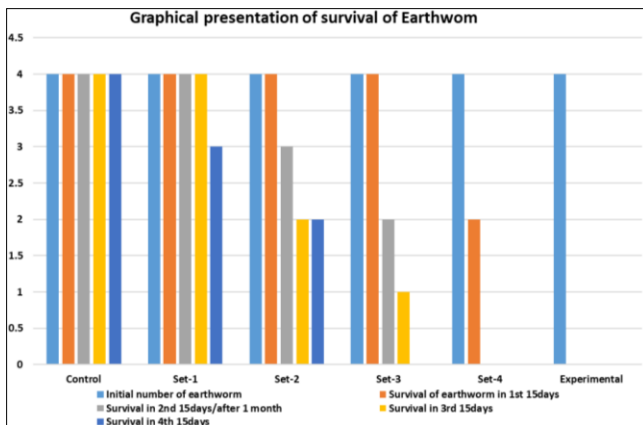
Sl. No.	Proportional setup	Initial number of earthworms	Survival of earthworm in 1 st 15days	Survival in 2 nd 15days/after 1 month	Survival in 3 rd 15days	Survival in 4 th 15days
1	Control	4	4	4	4	4
2	SET-1	4	4	4	4	3
3	SET-2	4	4	3	2	2
4	SET-3	4	4	2	1	Death
5	SET-4	4	2	Death	Death	Death
6	Experimental	4	Death	Death	Death	Death



Graph 1: (Growth rate of earthworm in various proportion of PP waste)



Graph 2: (Physical parameters of various proportion of PP waste)



Graph 3: (Graph of survival rate of time interval 15 days)

4. Conclusion

From the above result and discussion a small conclusion can be made that in more or large amount of potato peel the pH, temperature, moisture and EC value is more than in less amount potato peel quantity. According to the biomass of earthworm the size of earthworm is comparatively reducing. Death of earthworm (*Eudrillus eugineae*) is also seen in more amount of potato peel, which may be due to basic effect of the soil. During vermicomposting the alkalinity is reduced, temperature increased due to composting and microbial action which was mostly unfavourable for surviving of earthworm Thus, less amount of potato peel must be used while culturing or composting. But a clear conclusion can be drawn after a large-scale analysis on this topic.

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