International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Effects of Spirulina Platensis on Reproductive Rates of Earthworm (Eisenia Fetida) in Ver-Micomposting

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Abstract

The purpose of the present study was to determine how adding *Spirulina platensis* to the diet would affect the growth and reproduction of Earthworm *Eisenia fetida*, in the process of vermicomposting. In the current study, vermicompost was prepared using cow dung. Total three setup were prepared for the both the treatment and control vermicomposting. Development and reproduction of *Eisenia fetida* in cow dung feed supplemented with *Spirulina platensis* (in powdered form) were monitored weekly by counting the number of hatchlings and number of cocoons. When the vermicompost gets matured, cocoons, hatchlings and earthworm were removed to calculate the total change in biomass of Earthworm *Eisenia fetida* after the treatment.

It was observed that *Eisenia fetida* fed with *Spirulina platensis* in vermicomposting had higher rates of reproduction than that of controlled vermicomposting. After the second week of treatment, premature worms formed clitella, and after the third week, cocoons were seen.

Keywords: Vermicomposting, Earthworm, *Eisenia fetida*, *Spirulina platensis*, Vermicompost.

Introduction

Vermicompost is a finely divided peat-like material with a high water-holding capacity, porosity, and aeration. It is low-cost, renewable, and environmentally friendly, with no adverse effects on the functionality of the soil. It has the macro- and microelements that is required by the plants, along with nitrogen, phosphorus, and potassium (Edwards et al., 1997). Vermicomposting involves the bio-oxidation and stabilization of organic material by the joint action of earthworm and microorganisms (Dominguez et al., 1997).

For current study, Earthworm *Eisenia fetida* is used in vermicomposting. It has been used for the vermicomposting of both domestic and industrial organic waste (Albanell et al., 1988).

It is a North European litter-dwelling species inhabiting the soil surface, living primarily in sites rich in organic matter (Garg et al., 2006).

Spirulina platensis is a multicellular, photosynthetic prokaryote (algae) that contains high amount of proteins, vitamins, and minerals superior to many foods, e.g., soybeans. Thus, *S. platensis* was recognized as a nutritious food by the United Nations World Food Conference. Due to the presence of a high amount of nutritive ingredients, Spirulina has a long history as a dietary supplement. The versatile utilization of the alga can be explained on the one hand by its nutrient levels and, on the other hand, by its

recognized effects as an anti-viral, anti-bacterial, anti-oxidant, anti-diabetic, anti-cancer, and anti-inflammatory substance. Therefore, this alga is named "super food" (Jung et al., 2019).
In the current study, *S. platensis* was added as a feed supplement for earthworm *E. fetida* during vermicomposting.

Materials and Methodology

1. Experimental animal - Earthworm: *Eisenia fetida*

Classification of *Eisenia fetida* (Savingy, 1826)

Domain: Eukaryota
Kingdom: Animalia
Phylum: Annelida
Class: Clitellata
Order: Opisthopora
Family: Lumbricidae
Genus: *Eisenia*
Species: *E. fetida*
Binomial name
Eisenia fetida (Savigny, 1826)

The earthworms are classified within the phylum Annelida which consists of around 36 families worldwide. Earthworm are hermaphrodites, with each individual carrying a male and a female reproductive organ (Smolders et al., 2003).Earthworm species can be classified into three morph-ecological groupings: epigeic, endogenic, and anegeic (Aira et al., 2007). *Eisenia fetida* is a type of epigeic species that is commonly used in vermicomposting. Most studies of vermicomposting focus on the species *E. fetida* (Reinecke and Reinecke, 2007). It is available throughout the year. It can be easily maintained under laboratory conditions. It has a higher rate of survival as compared to other earthworm species.

2. Experimental algae - *Spirulina platensis*

Classification of *Spirulina platensis* by Systema nature 2000
Phylum- Cyanobacteria
Class- Cyanophyceae
Subclass- Oscillatoriophycideae
Order- Chroococcales
Family- Spirulinaceae
Genus- *Spirulina*
Species- *platensis*

Spirulina platensis is a type of microalgae. It is used as a feed supplement in aquaculture, poultry, and many other industries. It survives at a pH of around 8.5 and a temperature of around 30°C. It is used in powder form as well as tablet in dietary supplement. Nowadays, natural products derived from *S. platensis* have attracted the attention of new researchers for their health implications related to blood cholesterol, diabetes, and the prevention of aging problems. This healthy food contains protein, carbohydrates, and huge amounts of minerals, including vitamin B_{12} (Roman et al., 2019).

Figure: *Spirulina platensis* (powder)

Experimental setup -

The different phases adopted during vermicomposting are as follows-

A. Collection of cow dung and Earthworm *Eisenia fetida*-

To avoid bacterial growth in vermicompost, 4 to 5 months sun dried cow dung was collected from local cowsheds for preparing vermicompost. For present study, *E. fetida* was procured from breeding stocks of Krishi Vigyan Kendra, Dhar.

B. Initial pre-composting phases-

The cow dung was first pre-composted for 10 days and then it was utilized in vermicomposting.

C. Mesophilic phase-

Earthworm has been placed into containers filled with pre-composted cow dung manure. Cow dung was broken down by *E. fetida* in this container. Water was sprinkled regularly at this container to keep it moist and suitable for earthworm. *S. platensis* powder is provided to *E. fetida* every 15th day during the process of vermicomposting. The container was left undisturbed for a period of 30 days. Excess water which runs out of the container is known as Vermiwash, which has been collected in a bowl. The changes in reproductive rates of earthworm were reported after 30th day of treatment for about a period of 6 months.

D. Maturing and stabilization phase:

It takes between 80-90 days for complete maturation of Vermicompost. When matured, Vermicompost is harvested and sieved with a 4.0 mm sieving tool.

The effects of *Spirulina platensis* as a dietary supplement to earthworm *Eisenia fetida* were observed on the reproductive rates.

First, Increase or decrease in number of cocoons and juveniles were counted. The total number of births and deaths of *E. fetida* have been noted down during the process of vermicomposting and used for further calculations of net reproductive rate of *E. fetida.*

Net reproductive rate (NRR) =

(Number of births - number of deaths) X 100

Population size

In this formula, the number of births represents the total number of live births that occurred in the population during a specific period. The number of death represents the total number of deaths occurred in

the population during the same period. The population size indicates the total number of individuals in the population at the beginning or end of the experiment. The result obtained represents the net reproductive rate as a percentage.

Statistical analysis-

The experimental data was expressed as mean +S.E. A one way analysis (ANOVA) of variance was used. A significant level of $p<0.05$ was considered throughout the study.

Result

The use of *Spirulina platensis* (powder) as a dietary supplement for *E. fetida* was the most important factor in the entire research work. When the Vermicompost gets matured, it is separated with a 4.0 mm sieving tool. The change in the quantity of earthworm was reported by counting and weighing.

The reproductive rate of *E. fetida* cultured in Control vermicomposting (EF/CD) is compared with Experimental vermicomposting (EF/CD/S) is presented in Table 1.

Table 1: Increase in Number, Reproductive rate and change in Biomass of *E. fetida* in EF/CD & EF/CD/S

DAY	PARAMETERS	CONTROL EF/CD	EXPERIMENTAL EF/CD/S
1	Number of alive worms	**110**	**110**
	Biomass of alive worms(grams)	**500**	**500**
30	Number of alive worms	**210**	**235**
	Biomass of alive worms(grams)	**725**	**762**
60	Number of alive worms	**312**	**366**
	Biomass of alive worms(grams)	**955**	**1040**
90	Number of alive worms	**430**	**558**
	Biomass of alive worms(grams)	**1220**	**1620**
120	Number of alive worms	**620**	**710**
	Biomass of alive worms(grams)	**1450**	**1980**
180	Number of alive worms	**760**	**890**
	Biomass of alive worms(grams)	**1780**	**2290**

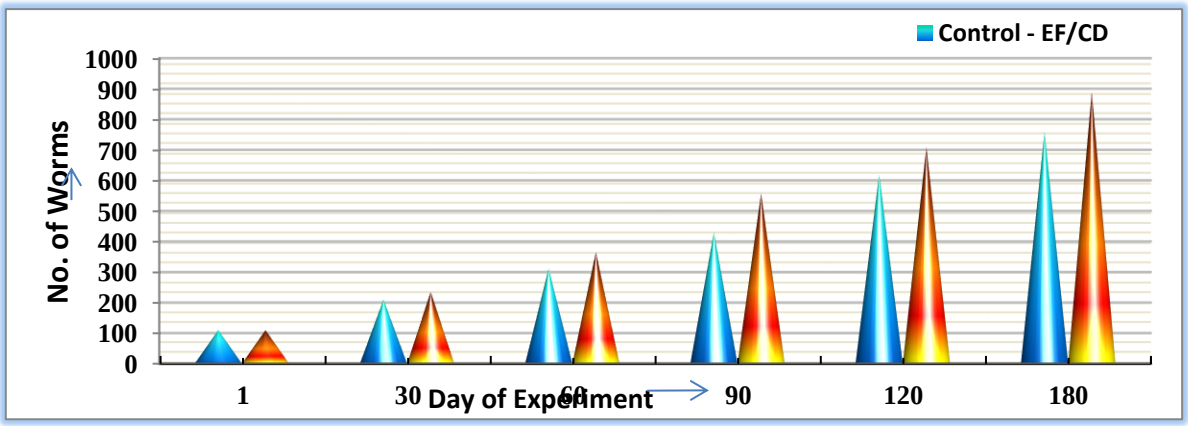

Figure 1: Increase in Number and Reproductive rate of *E. fetida* in EF/CD & EF/CD/S.

Cocoon production - The development of clitellum and cocoon production by earthworm *E. fetida* in control and experimental setup is shown in Table 1. Clitellum development in earthworm individuals was observed from the 2nd week of the experiment, and cocoon production started from the 2nd week of the experiment. At that time worm pairs attained the average weight up to 2.10 gram.

In the present study, the highly significant ($p < 0.05$) cocoon production was observed in experimental vermicomposting.

Success of cocoon hatching - A significant variation in the hatching success of earthworm *E. fetida* cocoons under control (EF/CD) and in experimental (EF/CD/S) vermicomposting. The experimental setup (EF/CD/S) had the greatest number of hatchlings recorded, while the control setup (EF/CD) had just a few hatchlings.

Hatching success of cocoons and fecundity: 100% hatching success was observed in cocoons placed in experimental vermibed setup. In the present study 2.7 hatchlings emerged per cocoon hatched in *Spirulina platensis* feed Vermicompost.

Reproductive rate -

Increase/decrease in number of cocoons and juveniles were counted before and after the treatment.

- **Control (EF/CD)** = 46%
- **Experimental (EF/CD/S)** = 60%

Conclusion

The research findings indicate a notable positive impact of *Spirulina platensis* as a dietary supplement in the vermicomposting process, specifically in enhancing the reproductive rates of *E. fetida*, commonly known as red worms. Here's a breakdown of the key conclusions drawn from the study:

1. Cocoon Production: Cocoon production, a vital aspect of earthworm reproduction, was significantly higher in the experimental vermicomposting setup where *S. platensis* was used as a dietary supplement. This indicates that the presence of *S. platensis* contributed to the stimulation of cocoon formation, crucial for the proliferation of earthworm populations.
2. Hatching Success: The experimental Vermibed setup, enriched with *S. platensis*, exhibited a significantly higher hatching success rate compared to the control setup.
3. This suggests that the presence of *S. platensis* positively influenced the viability and successful hatching of earthworm cocoons, leading to a greater number of hatchlings.
4. Reproductive Rate: The reproductive rate, measured in terms of the increase or decrease in the number of cocoons and juveniles before and after treatment, showed a substantial improvement in the experimental setup. The experimental vermicomposting with *Spirulina platensis* supplementation demonstrated a 60% increase in reproductive rate, while the control setup exhibited a 46% increase. This indicates that *Spirulina platensis* supplementation had a more pronounced positive effect on the reproductive capacity of E. fetida compared to traditional vermicomposting methods.

Overall, these findings highlight the significant role of *Spirulina platensis* as a dietary supplement in enhancing the reproductive rates of *Eisenia fetida* in vermicomposting systems. The use of *Spirulina platensis* not only stimulated cocoon production and hatching success but also led to a substantial increase in the overall reproductive rate of earthworms. This suggests that integrating *S. platensis* into vermicomposting practices could offer sustainable solutions for improving soil fertility and organic waste management while promoting earthworm population growth and biodiversity.

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