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Growth of *Mystus montanus* fed with two different Earthworm meal

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ABSTRACT

In this study, earthworm *Eisenia fetida* was cultured for 60 days using the aquatic weed water hyacinth and agricultural waste. Worm meal was prepared and given to the fish *Mystus montanus*. The growth parameters of the fish were analysed after 60 days and compared with the fish fed with pellet diet and two different eartyhworm diets. The fish feed on earthworm meal prepared from water hyacinth showed 51.87% increase in Body weight gain, 22.22% increase in Specific growth rate, 51.43% decrease in Food conversion ratio and 55.29% increase in Protein efficiency ratio than the control group of fish. This eco friendly economical method of fish feed preparation from aquatic weed is certainly a promising one in the aquaculture field.

Key words: Water hyacinth, Agricultural waste, Vermiculture, *Eisenia fetida*, Fish, Growth parameters.

1. Introduction

Aquatic weeds are considered as big menace not only in India but all over the world. About 40 % of 8 lakh/ha of cultivated fishery waters in India are rendered unproductive because of aquatic weeds (Sannigrahi, 2009). Water hyacinth (*Eichhornia crassipes*) is a fast growing perennial aquatic plant found in wetlands and which prefers nutrient-enriched water (Wilson *et al.,* 2005). It can cause infestations over large areas of water surfaces and leads to series of problems such as decrease of biodiversity, blockage of rivers and drainage systems, depletion of dissolved oxygen, alterations in water chemistry, environmental pollution, decreased fish population, restricting access to fishing sites and loss of fishing equipment (Malik, 2007). Gunnarsson and Petersen, (2007) reported the chemical composition of water hyacinth as 83.6% organic matter, 16.3% crude protein and 16.4% crude fiber (on DM basis). Water hyacinth tops the list of most dreaded aquatic weed and now spread to all around the globe. The seeds of the plant will sprout even after 20 years of dormancy due to drought conditions. It has successfully resisted all attempts of eradicating it by chemical, biological, mechanical, or hybrid means (Abbasi and Ramasamy, 1999).

Earthworm has been found to be a good source of protein (Hilton, 1983), it uses as fish bait is well known in fishing. Moreover, it has been used in pharmaceutical as an anticancer, antibiotic, anti-hyperglycemia, anti-diabetes, anti-hypertension and anti-hypotension and also in cosmetic industries. Earthworm contains 60-70% protein and high in essential amino acid (lysine and methionine) compared with meat or fish meal (Sigh *et al*., 1978). Ngyuon and

Yang, (2007) reported that earthworm powder-based diet contains 6-11% of fat, 5-12% of carbohydrate and 2-3% of minerals and various types of vitamins. The protein content in the earthworm powder was reported to improve sexual performance and stimulate the appetite of the fingerling marble goby (*Oxyeleotris marmoratus*) and tra catfish (*Pangasius hypophthalmus*) (Ngyuon and Yang, 2007). Therefore, earthworm is viewed as a potential ingredient and a good source of protein in the fish feed formulation. Aboud *et al*., (2005) reported that water hyacinth could provide large quantities of nutritious feed and was a potential source for ruminant nutrition. Earthworm has great nutritive value as food for both marine and fresh water fishes. In spite of being a good appetizing food for fishes and its easy availability, it is surprising that earthworms are used as feed for fishes. Water hyacinth was also found to enhance the rate of multiplication of earthworms. Composting of water hyacinth biomass was completed in 55 days, whereas the composting of agricultural wastes was completed only in 70 days. Selvaraj, 2006 reported that the number of adult worms was found to be 4,590 (more than three times increase over the initial number of worms introduced) in the water hyacinth compost and 2,610 (less than two times increase over initial population) in the agricultural waste compost and each worm weighed about 1.70gms in the water hyacinth compost and about 1.21gms in the agricultural waste compost. The present project was aimed to prepare earthworm meal by vermiculture of *Eisenia fetida* on water hyacinth and agriculture waste and analysis of its food quality by feeding the fish *Mystus montanus.*

2. Materials and methods

2.1 Vermiculture

Earthworms of Eisenia *foetida* were obtained from a culture bank maintained in Agricultural college and Research centre, Killikulam. Aquatic weed *Eichornia* sps (Water hyacinth) was taken from Thamirabarani River near Eral. Agricultural waste was obtained from a local farmhouse. The earthworm bed was prepared in wooden box of 3feet breadth and 2feet height. The biomass was chopped and heaped under the sun for about 10 days. A layer of small pebbles was placed at the bottom of the box. A thin layer of soil was placed above it. Partially decomposed cow dung was placed over the soil layer. Chopped biomass was spread over the cow dung layer. The biomass and cow dung ratio was 70:30 on dry weight basis. 50 earthworms, *Eisenia fetida* were released over the mixture. The compost mixture was covered with palm leaves. The same bed was prepared for agricultural waste and 50 earthworms, *Eisenia fetida* were released. Vermiculture of *Eisenia fetida* was conducted under laboratory conditions in darkness at an average temperature of 25^0 C $\pm 5^0$C and a substrate moisture content of 70-75 % for 60 days.

2.2 Fish culture

Fish of ***Mystus montanus*** (Jerdon, 1849) with an individual mean weight of about 4.1±0.10g and 11.5 ±0.39 cm length were caught from a stream near Tiruchendur. They were acclimatized in the tank for one week while being fed with control diet. The fish were distributed in nine tanks of 35 liter capacity at a stocking density of 10 fish per tank and divided into 3 groups. The study design is shown in table-1.The fish in the first group served as control and fed with pellet food. The fish in the second (Group I) and third groups (Group II) were fed with earthworm meal prepared from worms cultured on agricultural waste and water hyacinth. The ingredients of the fish feed is seen in table-2. Everyday remaining diets

were collected by siphoning before feeding. Quantity of feed was adjusted weekly according to the weight of fish in each tank. Every two day, each aquarium was cleaned and 50% water change was done. All fish were fed twice in the morning and evening at 3% body weight for 60 days. The experimental fish were weighed individually at the begining and at two week intervals.

Table 1: Experimental Design

sample	Feed	Feeding%	No. of fish
Control	Pellet diet	3%	10
Group I	Earthworm meal prepared from agriculture waste	3%	10
Group II	Earthworm meal prepared from water hyacinth	3%	10

Table 2: Ingredients of diet

S.no	Ingredients	Inclusion%
1.	Rice bran	25
2.	Ground nut oil cake	24
3.	Earthworm meal	40
4.	Tapioca flour	10
5.	Vitamin and mineral mix	1

2.3 Growth parameters

The growth parameters of the fish such as SGR, FCR and PER were calculated using the following formulae.

$$SGR = \frac{InWt - InW_0}{T} \times 100$$

Wt = Final Mean Wet Weight (gm), W_0= Initial Mean Wet Weight (gm),
T= Total Number of Days of Experiment.

FCR = Total dry weight of food offered- Total dry weight of uneaten food/ Final weight of fish – initial weight of fish

PER = Gain in body weight (wet weight) in grams X 100/ Protein intake (dry weight) in grams

2.4 Statistical analysis

Experimental data were expressed as mean ± SD. Differences between groups were evaluated by one way analysis of variance using SigmaPlot Software build version 2011.0. Values of $P<0.05$ were considered statistically significant.

3. Results and Discussions

The growth of the fish ***Mystus montanus*** fed with three different diets were analysed by calculating the BWG, SGR and FCR values after 60 days. The data regarding the growth parameters of the fish is presented in **Table 3.** Growth rate of the fish fed with three different diets was compared and increasing percentage of growth is shown in **Figure-1.**

Table 3: Growth parameters of *Mystus montanus*

S. No	Sample	Initial Weight (g)	BWG (g)	SGR(g)	FCR	PER
1.	Control	3.95± 0.20	4.90±0.10	0.009	3.13±0.299	0.85±0.12
2.	Group I	4.15± 0.46	5.50±0.36	0.0095	2.37±0.21	1.04±0.11
3.	Group II	4. 07 ±0.35	6.80±0.10	0.011	1.52±0.87	1.32±0.07
	F-Value	--	**68.50**	**6.39**	**24.58**	**46.55**

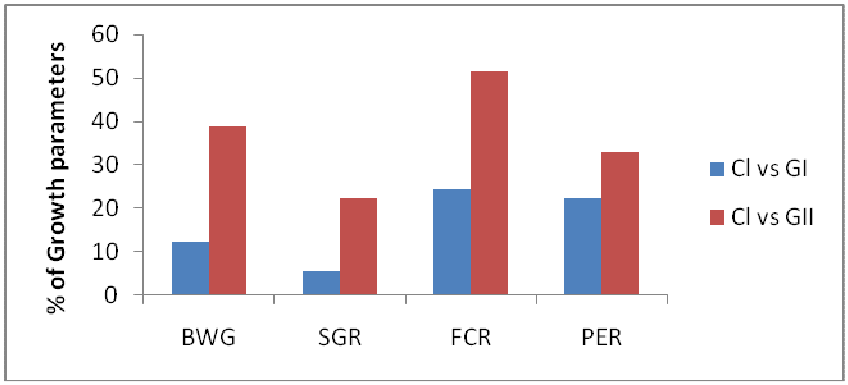

Figure 1: Growth parameters of fish in percentage

3.1 BWG and SGR

The average body weight gain of Control fish was 4.90± 0.10g. The BWG of Group I fish was increased to 5.50±0.36g and Group II fish was increased to 6.80±0.10g. Specific growth rate of control group of fish was 0.009g. The SGR value of group I fish was 0.0095g and it was 0.011 in the group II fish. Significant ($P<0.05$) deviation of BWG and SGR was observed in the fish feed on two different earthworm meal. The results of the present study indicated that fish fed with earthworm meal prepared from agricultural waste showed increased BWG and SGR than the control group of fish but lesser than the fish fed with earthworm meal prepared from water hyacinth. Evaluation of earthworm (*Hyperiodrilus euryaulos*) meal as protein source in diets for *Heterobranchus longifilis* fingerlings under laboratory condition by Sogbesan and Madu, (2008) revealed that 25% replacement of fish meal by earthworm meal supported higher net gain in weight and specific growth rate than fish fed 0 (control), 50, 75 or 100% earthworm meal. In the present project work the BWG was increased to 12.24% in the group I and 38.77% in the group II fish and SGR was

increased to 5.55% in Group I fish and 22.22% in the group II fish than the control group of fish.

3.2 FCR

Food conversion ratio decreased in the experimental groups of fish than the control group. The FCR values were 2.37±0.21 and 1.52± 0.87 respectively in the group I and group II fish.The FCR was statistically significant ($P<0.05$) in the two groups of fish fed with earthworm diet. In the present study decreased FCR was observed in the group II fish**.** Lower FCR indicates more efficient food conversion efficiency of the fish (i.e. better utilization of the feed by the fish). Omoyinmi *et al*., (2012) observed superior growth rate in *Oreochromius niloticus* on fish meal diet compared with those fed maggot, earthworm and garden snail-meal diets. In our results earthworm meal was superior to the pellet diet and earthworm meal prepared from water hyacinth showed decreased FCR in the fish than earthworm meal prepared from agricultural waste. FCR was decreased to 24.28% in group I fish and 51.43% in group II fish. This confirmed the effectiveness of water hyacinth as a better feed for earthworm and its better food quality for fish.

4. PER

The PER value of control fish was 0.85 ± 0.12. The PER values were increased as 1.04 ± 0.11 and 1.32± 0.07 in the group I and group II fish. Statistically significant ($P<0.05$) PER was observed in the fish fed with two different earthworm diets. Protein quality of earthworm has been reported at par with that of fishmeal (Sogbesan *et al.*, 2007). A study to evaluate the influence of feed supplemented with earthworms on the growth and meat quality of broiler chickens indicated that the diets with 2% worms supported the highest live weight at 10 weeks and the highest percentage of breast and leg meat (Vu Dinh Ton *et al*, 2009).Tuan and Focken, (2009) reported that fish fed diets contained 30%, 70% and 100% of fish meal protein, replaced by earthworm meal had higher growth rate, protein efficiency and energy retention than those fed the fish meal based control diet. Earthworm contains 60-70% protein and high in essential amino acid (lysine and methionine) compared with meat or fish meal (Paoletti *et al*., 2003). Earthworm powder-based meal contains 6-11% of fat, 5-12% of carbohydrate and 2-3% of minerals and various types of vitamins. The protein content in the earthworm powder was reported to improve sexual performance and stimulate the appetite of the fingerling marble goby *(Oxyeleotris marmoratus)* and tra catfish *(Pangasius hypophthalmus* (Nhi, 2000). In the present study PER values were increased to 22.35% in group I fish and 55.29% in group II fish.

5. Conclusion

Earthworm has high protein content (about 60% on dry weigh basis), considerable mineral matter and less of fat and fiber and more palatable to fish. A better dietary source of earthworm feed can meet the demand of protein, minerals etc, to feed the fish. Water hyacinth is good source of earthworm feed and the earthworm grown on water hyacinth can be used in fish feed formulations. This is confirmed in the present study by the increasing growth rate of the fish fed with earthworm meal prepared from worms cultured on water hyacinth than fish fed with pellet diet and earthworm meal prepared from worms cultured on agricultural waste. This eco friendly economical method to produce fish food is certainly a promising one in the aquaculture field and also a chance to utilize the aquatic weed to reduce

its menace in the aquatic habitat, more over the vermicompost is an alternate source of chemical fertilizer.

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