E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2018; 6(1): 48-51

www.fisheriesjournal.com
Received: 25-11-2017
Accepted: 27-12-2017

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Influence of Earthworm powder as a supplementary feed diet in the growth and gonadal development in the male *C. carpio*

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Abstract
The aim of the present study was to analyse the effect of supplementary feed earthworm powder on the body weight, gonadal development and the Gonado Somatic Index (GSI) in the freshwater fish *C. carpio*. It is well noted that reproduction is sensitive to the state of energy reserves and there is a balance between energy and homeostasis and fertility. In this view the study examined the effect of supplementary diet on growth and reproductive performance of fresh water fish male Common carp *C. carpio.* The Earthworm powder with the composition of (0%, 5%,and 7.5%) were mixed with the normal fish feed diet during the month of June 2015 to December 2015.The body weight and the development of the gonads in the fishes were noted. The significant increase in the weight of the body (903.26 ± 0.08) and gonad (108.53 ± 0.019), GSI was increased during the month of August with the fishes fed with Supplementary feed 2(SF2) compared to the fishes fed with Control feed (CF) and Supplementary feed 1(SF1).

Keywords: *C. carpio*, Earthworm powder, Gonad, GSI

1. Introduction
Fishes are the good source of many vitamins and minerals and are often recommended as a healthy diet by governmental food agencies. Knowledge on fish reproductive cycle is inevitable in aquaculture practices and also in evaluating the commercial potentialities of its stock, life history, culture practice and management of fishes [2]. The major health problems in developing countries are poor nutrition and trace element deficiency. Fish provides protein, polyunsaturated fatty acids and micro nutrients such as Iron, calcium, zinc and vitamin A and D. n-3 polyunsaturated fatty acids (Linolenic acid, 18:3) present in fish [1].
Over past several years, many people have begun raising earthworm as a source of income or as a mean of managing organic waste [3]. Earthworm *Eisenia fetida* is used for the supplementary food and it is an excellent food for cultural fish species. The advantage of earthworm in the fish feed supplemented with sardine oil grew better than those fed a fish meal diet [6]. The potential value of earthworm as a protein source has been established by several authors [7].
Brood stock nutrition has high significant impact on the growth and reproductive potential of fresh water fishes [4]. High percentage of protein in body mass, vitamins, minerals and suitable size in different life stages make it suitable for fish during different growth stages [11]. Not only earthworm could serve as a rich protein source but also as a source of essential amino acid, especially lysine which is limited in many basic foodstuff and that the amino acid composition of earthworm s very similar to that of fishmeal and potentially superior to that of meat meal [9, 10]. The purpose of the study was to examine the effect of earthworm powder as a supplementary feed in the growth and reproductive performance in the fresh water fish Common carp *C. carpio*

2. Materials and Methods
E. foetida fetida (Older Spelling, *foetidaz*) known under various common names.
E. foetida worms are used for vermicomposting and hence it was used for the feed preparation. Earthworm was collected during the month of August 2015 to October 2015 by digging and sorting method.

The collected worms were washed in the running water and it was sacrificed by putting it into the boiling water which is 118°C the boiled worms were stained dried and cut into small pieces dried in the vacuum and after dried allowed to grind into the powder. The powder was stored in an air tight packet. Three types of feed prepared with the proportionate of earthworm powder (0%, 5% and 7.5%) rice bran (40%, 20% and 20%) soy bean meal (15%) tapioca flour (5%) mineral mixture (5%, 2.5% and 2.5%) vitamin E (2.5%, 2.5 ; 2.5), salt (10.5%). The control feed CF contains earthworm powder (0%) and rice bran (40%) and SF1 contains earthworm powder (25%) rice bran (20%) and SF2 contains (40%) of earthworm powder, rice bran (20%).

2.1 Preparation of experimental diet

The experimental diet was prepared at Tamilnadu Fisheries College and Research Institute, Tuticorin, India. Groundnut oil cake (GOC) was the main principal ingredients, soy flour, maize, tapioca, mineral mixture and salt were the other binding agents used for the preparation of the supplementary diet. Water is added to the above ingredients and the resulting paste was steamed for 10 to 12 minutes and cooled at room temperature. After cooling earthworm powder was added in the ratio of (0%, 5%, 7.5%) and mixed well. It was then squeezed as a noodules by using feed pelletizer and they were extruded to sun dry to avoid fungal infection the dried noodules were packed in air tight container and stored in a room temperature.

2.2 Collection of experimental Fish

The experiment was carried out at the Tamil Nadu Fisheries Department Corporation, Aliyar, Pollachi, Coimbatore District, Tamil Nadu, India. The experimental fish, *C. carpio* were collected and subjected to acclimatization in cement tanks under natural photoperiod. The weight of the experimental fishes was about 610 ± 5gms

2.3 Calculation of Gonado – Somatic Index

The Gonado Somatic Index was calculated for each experimental groups separately by the following formula [8].

$$GSI = \frac{\text{weight of the gonad}}{\text{weight of the fish}} \times 100$$

3. Results

The three groups of experimental fishes (feed CF, SF1 and SF2) and its observed body weight is given in table 1. The weight of fishes recorded in the month of June 2015 was 610.17g with fishes fed with CF, 820.18g in fishes fed with SF1 and 830.28 g in fishes fed with SF2. The weight of the fish fed with CF shows 805.25g and 900.20g in fishes fed with SF1 and 1060.17g in fishes fed with SF2 in the month of July 2015. Increased in the fish weight was noticed from the month of August 2015, control feed fish shows 903.26g, SF1 fishes with 1105.23g and SF2 fishes with 1200.38g respectively. Weight slightly decreased to 850.34g, 1000.15g and 1110.20g in the month of September 2015 of fishes feed with CF,SF1 and SF2.In the month October the weight of the fishes noticed was 800.17g in CF,940.90g in SF1and 1060.20g in SF2 fed with the supplementary feed. The gradual increase in the body weight were observed in all the experimental group of fishes. In November the fishes shows 810.21gm, SF2 960.20g and SF3 feed fishes with 1110.28 g of its body weight. The weight of the fish during the month of December 2015 in fishes fed with control feed CF was 860.32g, in fishes fed with SF1 was 1014.20g and fishes fed with SF2 was 1150.278.The maximum fish weight was observed during the month of August 2015 respectively.

3.1 Gonadal weight

The monthly observation of gonadal weight of three groups of experimental fishes is given in the table 2. The gonadal weight observed in the month of June 2015 was 42.33g, 62.13g and 73.80g in feed CF, SF1 and SF2 group of fishes. The experimental fishes fed with CF contain 48.40g, fishes fed with SF1 75.14g and fishes fed with SF2 89.63g was observed in the month of July 2015respectively. The maximum weight of gonads was noticed during the month of August with CF1 60.61g, SF1 with 88.62g and SF2 with 108.53g group of fishes. All experimental fish showed gonad weight of 48.33g, 73.09g and 88.43g in fishes fed with CF, SF1 and SF2 group of fishes during the month of September 2015. In October the gradual increase in the gonadal weight was noted with 83.12g, 68.16g and 54.32g of fishes fed with SF2, SF1 and CF feed. The gonadal weight observed in the month of November 2015 is 59.15g in CF, 72.18g in SF1 and 86.15g in SF2 group of experimental fishes. The fishes fed SF2 showed 98.21g, and with SF1 78.20g and with control CF 62.13g respectively. The weight of the gonad followed regular cyclic changes that were correlated with the reproductive activities of fishes. The weight of the gonad increased from June to August 2015 and it gradually reduced in their size from September to October 2015. And the maximum gonadal weight was observed during the month of August 2015 (60.61g, 88.62g and 108.53g) of fish fed with CF, SF1 and SF2 respectively.

Table 1: Body weight of the *C. carpio* fed with three types of supplementary feed (CF, SF1 and SF2) during the experimental period June 2015 to December 2015

Months	Body weight(gms)		
	CF	SF1	SF2
June 2015	610.17 ± 0.05	820.18 ± 0.06	830.28 ± 0.05
July 2015	805.25 ± 0.05	900.20 ± 0.04	1060.17 ± 0.05
August2015	903.26 ± 0.08	1105.23 ± 0.05	1200.38 ± 0.08
September2015	850.34 ± 0.09	1000.15 ± 0.06	1110.20 ± 0.09
October 2015	800.17 ± 0.05	940.90 ± 0.06	1060.20 ± 0.08
November2015	810.21 ± 0.05	960.20 ± 0.07	1110.20 ± 0.07
December2015	860.32 ± 0.09	1014.20 ± 0.06	1150.27 ± 0.08

Values are mean ± SD; CF – Control Feed, SF1 – Supplementary Feed 1 and SF2 – Supplementary Feed 2.

Table 2: Gonadal weight of *C. carpio* fed with the supplementary feed (CF, SF1 and SF2) during the experimental period January 2015 to December 2015

Months	Gonadal Weight (gms)		
	CF	SF1	SF2
June 2015	42.33 ± 0.02	62.13 ± 0.02	73.80 ± 0.017
July 2015	48.40 ± 0.03	75.14 ± 0.03	89.63 ± 0.015
August 2015	60.61 ± 0.15	88.62 ± 0.02	108.53 ± 0.019
September 2015	48.33 ± 0.07	73.09 ± 0.06	88.43 ± 0.020
October 2015	54.32 ± 0.03	68.16 ± 0.04	83.12 ± 0.020
November 2015	59.15 ± 0.04	72.18 ± 0.02	86.15 ± 0.036
December 2015	62.13 ± 0.02	78.20 ± 0.05	98.21 ± 0.038

Values are mean ± SD; CF – Control Feed, SF1 – Supplementary Feed 1 and SF2 – Supplementary Feed 2.

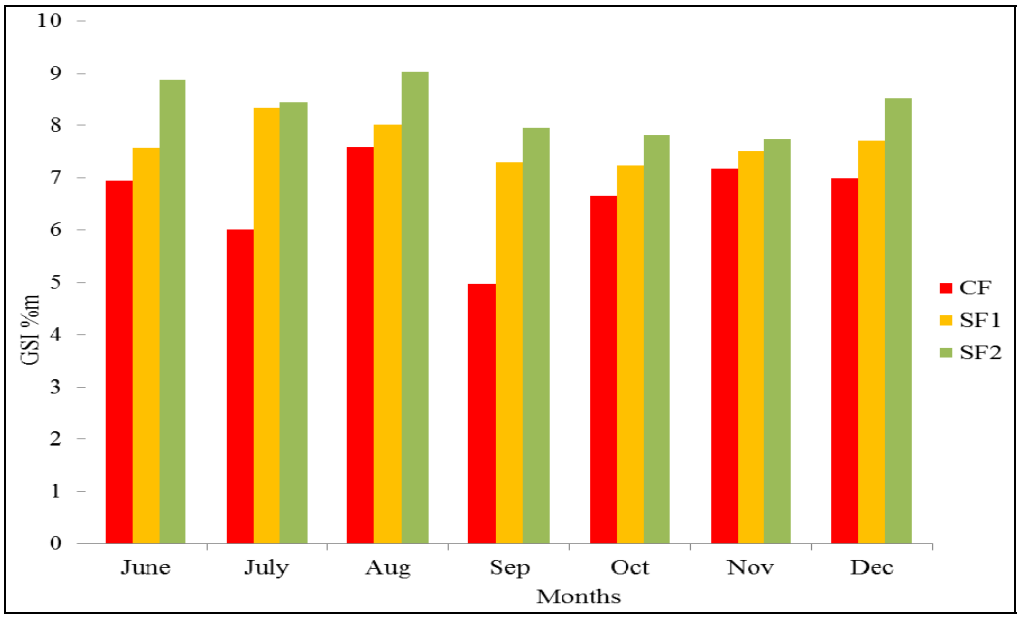

Fig 1: Gonado Somatic Index of *C. carpio* feed with the supplementary feed CF, SF1 and SF2 during the experimental period from January 2015 to December 2015

3.2 GSI (Gonado Somatic Index)

The monthly observation of gonado somatic index was observed during the month of June 2015 of group of fishes fed with CF, SF1 and SF2 are (6.93%, 7.57% and 8.88%). The July month show 6.01g, 8.34g, and 8.45g of group of fishes fed with CF, SF1 and SF2. The maximum GSI was observed in the month of August with (7.59%, 8.01% and 9.04%) fishes fed with CF, SF1and SF2 feeds. The GSI gradually decreased from September to October was noted as (4.97%, 7.30% and 7.96%) of fishes fed with control feed, SF1 feed and SF2 feed and (7.17%, 7.51%, 7.75%) of GSI of fish in the month of November group of fishes fed with CF, SF1 and SF2. The observation in December was gradually increased with (6.98%, 7.71% and 8.53%) fish fed with CF, SF1 and SF2.

4. Discussion

In the present study the experimental fishes fed with SF2 showed higher body and gonadal weight throughout the experimental period from June 2015 to December 2015.The gonad weight recorded was maximum in August, 2015 (108.53 g) in fishes fed with SF2 compared to fishes fed with feed CF (60.61g) and SF1 (88.62 g). The increased gonad weight of the fishes noticed due to the increase of spermatogonia and their active division to form spermatocytes. The gonadal weight was reduced in the month of September and October, 2015. Similar finding was reported by Golam Zauddin, [12] in *Anabas testudineus*. This is mainly due to the release of spermatozoa during breeding season (August, 2015) and the size of the testes was reduced and it was referred as the resting stage [13]. The male gonad attains full maturity during breeding season (July - August) in *L. rohita*. The gonad weight was reduced and GSI value falls in male *L. rohita* in post spawning period [15] was coincide with present study. The reduction in the size and gonad weight of the experimental fishes declined during the month of September and October 2015

The GSI used to indicate spawning period of fishes. The peak value of GSI observed in the present study was August 2015 given in the figure 1.It was declined during the month of September and gradually increased from November to December 2015.GSI of eel fish showed peak value of 2.41% and 1.74% for female and males during breeding season (September) respectively [14].

5. Conclusion

The result of the present study shows that the supplementary feed earthworm powder improved the growth performance, gonad weight which achieved with steam pellet diets. During this study period the increase in body weight and the gonadal weight was higher in the SF2 which has high percentage of earth worm powder compared with CF and SF1 respectively.

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