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RESEARCH ARTICLE

Effectiveness of Chironomid Larvae in Compare to Other Fish Foods on Growth Parameters and Body Protein of Two Economically Important Fishes

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ABSTRACT

With the increasing human population, the demand for healthy, nutritious but cheap food also increasing day by day. The product of aquaculture mainly fish is more efficient to improve global food security. Along with the seafood, the effort is going on for more production of freshwater fish. For that reason, proper growth and sufficient proximate principles in fish are essential with a low-cost but healthy fish diet. *Trichogaster fasciata* and, *Heteropneustes fossilis* were fed with fourth instar larvae of *Chironomus striatipennis* (F1), dry Tubifex (F2), and granular floating type aquarium fish food (F3) respectively to observe the nutritional effect of different fish meal. Fish fed with F1 showed effective food conversion ratio and specific growth rate in comparison to fish fed on F2 and F3 respectively. The average daily gain was 214.3 % and 47.61% respectively in two fish when fed with F1. Percent gain weight increased from 1.12 (7th day) to 15.03 (28th day) in *T. fasciata* and 1.497 (7th day) to 8.21 (28th day) in *H. fossilis* when fed on F1. The result also showed that the protein level was increased steadily in both fishes when fed with F1 in comparison to other foods. It may be concluded that live larvae of *Chironomus striatipennis* were more effective fish food than dry Tubifex and aquarium fish food. It is a natural organic fish food with a negligible wastage used for fish and keeps the culture medium clean and debris-free with an ecofriendly environment.

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Introduction

Chironomids or non-biting midges are Dipteran insects, whose adults are terrestrial and larvae live in aquatic habitat. Most of the chironomids have pollution tolerance ability and used as biomonitoring agents of aquatic pollution (Wright and Burgin, 2009; Carew et al., 2011). This insect is also used for standard sediment toxicity tests (OECD,2004).

This insect can compete with other benthic macroorganisms for habitat and food and can tolerate the changing environment (Kuvngkadilok, 1994; Taenzler et al. 2007; Howarth and Oishi 2013). This dipteran insect performs a significant role in the aquatic trophic chain by making connections between producer and secondary consumer (Tokeshi, 1995). Larvae of these insects have benthic habitats and use benthic sediments and debris like food and in tube buildings. Chironomus larvae are considered as natural food for different freshwater fishes (Broyer and Curtet,2011; Medeiros and Arthington, 2008). Due to high protein content, this larva is very nutritious,

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though the amount of protein varies with the changing physicochemical parameters of aquatic habitats of this insect (Thipkonglars et al. 2010; Nath et al. 2017). It was reported that the growth rate of some aquarium fish was faster and spawned early when fed with Chironomus larvae. With the increasing global population, the demand for more nutritious food is increasing regularly. Moreover, it is essential to use low-cost and readily available fish meals for increasing fish production. At the same time augmenting the nutritional quality of farm fish also important (Bhilave and Nalawade, 2011). Long-standing measures of animal production efficiency are used to increase the production of aquaculture animals to improve worldwide food securities.

Feed conversion ratio (FCR) is the widely used measurement (Fry et al., 2018). Aquatic animals are more efficient i.e. lower feed conversion ratio (FCR) than large terrestrial animals. Such low FCR is due to expending less energy for movement and at the same time most are ectothermic (Naylor *et al.* 2009; Torrissen et al., 2011). FCR, specific growth rate (SGR), and food conversion efficiency are closely related and they found interrelated when the growth of fish was a concern. These measures varied with the composition of the fish diet, hydrogen, and mineral ion concentration of the culture medium, etc. (Bethke et al., 2013; Ariyati et al.; 2018 and Besson et al., 2016). SGR again depends on the weight gain or loss of the fish. Length and weight two important morphometric parameters of the fish used for taxonomic study and analyze the growth pattern. Proteins contribute a crucial role in growth, development and at the same time maintains and repairs worn-out tissues of the body. Proteins also produce enzymes and hormones essential for different physiological processes. Fish also provides an excellent source of easily digestible high-quality proteins and essential amino acids with immense biological value (Meena, 2021; Pal et al., 2018). Efforts are going on to increase the production of fish by maintaining the proper growth and protein level in fishes. For that reason, fish meal is the basis of good fish growth, protein quality and palatableness. A low-cost fish feed is of great concern because it has an impact directly on the cost of fish productions (Siddiqui et al., 2014). Keeping all these views in mind, here an attempt has been made to compare three fish meal namely, chironomid larvae, dry Tubifex, and aquarium fish food to study different growth parameters as well as variation of protein constituent in *Trichogaster fasciata* and *Heteropneustes fossilis*. This study may give an idea about the most effective fish meal for growth.

Materials and Method

Selection of Fish

Live banded gourami (*Trichogaster fasciata,* Bloch and Schneider, 1801) and, *Heteropneustes fossilis* (Bloch, 1794) were obtained from the local fish market at Singur, Hooghly, West Bengal, India. These two fish were selected due to their omnivorous habit and both are used as food and *T. fasciata* also consider as ornamental aquarium fish. Two different fishes were taken for the comparative study in different food mediums.

Two fishes used in the experiment, *Trichogaster fasciata* and *Heteropneustes fossilis are Least Concern (IUCN3.1) as Conservation Status.* For this type of study, formal consent is not required.

Selection of Fish Meal

Fishes fed with fourth instar larvae of *Chironomus striatipennis* from the laboratory stock culture(F1), dry *Tubifex* (available in the market) (F2), and granular floating type aquarium fish food (commercially available) (F3) respectively. Fish fed on F3 was considered as a control for this experiment.

Experimental Set-up and Method

Fishes were acclimatized in laboratory conditions for 7 days before the experiment. During this period fishes are supplied with aquarium fish food once a day. Fishes were kept under starvation for 24 hours before the experiment started. Two different experimental sets were arranged for two different fishes for respective 7 days, 14 days, 21 days, and 28 days experimental study. Twelve fishes were reared for each 7, 14, 21and 28 days of the experiment to avoid any death or damage of fish during the experiment. For *T. fasciata*, each fish was kept in a 1000ml beaker, containing 800ml water, covered with a mosquito net and gravel at the base for the experiment. Each *H. fossilis*, due to its large size, kept in a polypropylene tray (TARSONS) measuring 12"x10"x4" containing 6 litres of water covered by mosquito net and gravel at the base. Aeration in the beaker water was maintained by a mini pump where required. Before start, the experiment, the initial length (from snout to tip of the tail fin), initial breadth, and weight were measured. The length, breadth, and weight of the selected fishes were 6.06 cm.±0.231 (length), 1.86cm±0.03 (breadth) and 4.06gm.±0.304 (weight) for *T. fasciata* and 13.32 cm.±0.666 (length), 1.8 cm.±0.129 (breadth) and 10.02 gm.±0.976 (weight) for *H. fossilis* respectively. The food was provided 2 times a day at 5% of the bodyweight of fish (Yaji and Auta, 2007) according to experimental duration. The water of the rearing beakers was changed every two days to maintain a healthy environment in the experimental medium. After the experiment, length, breadth, and weight were measured. Body length(cm) of the used fish was measured by using a geometric scale and weight (g) was measured by using an electronic balance (WENSER).

Recorded data of length, breadth, and weight were used to measure the following parameters to determine the growth response of the fish to diets (Nadaf et al., 2010; Priya et al., 2018):

Food conversion ratio (FCR) = Dry food intake/ Wet body weight gain.

Specific growth rate (SGR) = ln (Final live weight) – ln (Initial live weight)/ Experimental Duration x 100

Average daily gain (ADG) = Growth (live weight)/ Experimental Duration.

Food conversion efficiency (FCE) = Growth (live weight)/ consumption x 100

Percent gain weight (PGW) = (Average final weight - Average initial weight)/ Average initial weight x 100

Percent gain length (PGL) = (Average final length- Average initial length)/ Average initial length x 100

Chemical Analysis

Body muscle of experimented fish was used to estimate total protein by spectrophotometer (LABMAN) at 750 nm wavelength of visible light (Lowry et al.,1951).

Statistical Analysis

Regression and coefficient of determination (R^2) were analysed by using Microsoft excel. One way ANOVA was also calculated ($\alpha = 0.05$).

Results

The experiment was done to observe the effect of different food namely, live larvae of *Chironomus striatipennis* (F1), dry Tubifex(F2) available in the market, and commercially available aquarium fish food(F3). Fish fed on aquarium fish food was considered as control. *Trichogaster fasciata* and *Heteropneustes fossilis* were considered for this experiment. Fishes were fed for 28 days continuously and data were recorded after 7, 14, 21, and 28 days respectively. The length, breadth, and weight of the fishes were measured during this experiment. Different growth parameters like Food conversion ratio (FCR), Specific growth rate (SGR), Average daily gain (ADG), Food conversion efficiency (FCE), Percent gain weight (PGW), and Percent gain length (PGL) were determined and considered as energy budget. The result was presented separately for *Trichogaster fasciata* and *Heteropneustes fossilis*. The total protein was also estimated from the fish muscle (Lowry et al., 1951) to understand the pattern of change in the level of protein in fish fed on different diets for various days.

The result of one way ANOVA showed that all three foods have effects on the weight of both the fishes (Table 1).

Table 1. Effect of different food on weight of fish

Name of fish	Weight (F-value)
Trichogaster fasciata	4.20*
Heteropneustes fossilis	4.803*

*Significant ($F=4.07$; $df=3,8$; $p<0.05$)

The study revealed that different feed types had a noticeable effect on the feeding parameters. The food conversion ratio (FCR) for *Trichogaster* sp fed on F1 came down to 59.61 on the 28th day from 185.6 on the 7th day (Table 2). On the other hand, the ratio decreased from 230.89 to 128.43 in the case of fish fed with F3. The rate of decrease was 32.1 % and 44.37% respectively. Whereas, FCR was increased by 125 % in the case of fish fed on F2.

Table 2. Growth Performances of *Trichogaster sp.* fed on different Food

Food	Days	FCR	SGR	ADG	FCE	PGW	PGL
Chironomus	7	185.6	0.175	0.007	0.17	1.2	1.155
	14	113.45	0.278	0.012	0.28	3.95	2.63
	21	91.59	0.342	0.015	0.34	7.34	3.86
	28	59.61	0.5	0.022	0.54	15.03	4.88
Tubifex	7	81.95	0.385	0.017	0.39	2.73	1.34
	14	181.33	0.174	0.008	0.176	2.46	0.85
	21	170.56	0.184	0.01	0.18	3.94	2.22
	28	190.11	0.164	0.008	0.17	4.71	4.08
Aquarium Fish Food	7	230.89	0.141	0.005	0.14	0.97	0.16
	14	159.68	0.198	0.01	0.2	2.8	1.4
	21	229.18	0.134	0.006	0.14	2.81	2.36
	28	128.43	0.248	0.011	0.25	6.98	3.4

FCR: Food conversion ratio; SGR: Specific growth rate; ADG: Average daily gain
FCE: Food conversion efficiency; PGW: Percent gain weight; PGL: Percent gain length

An increase in SGR (Specific growth rate) 0.175 (7th day) to 0.5 (28th day) was observed when *Trichogaster* sp was fed on F1, which was highest (185.7%) in comparison to the fish fed on F2 (decrease by 57.4%) and F3(increase by 75.8 %).

ADG (Average daily gain) increased (214.3 %) from 0.007 (7th day) to 0.022 (28th day) in fish fed on F1, decreased (52.94%) from 0.017 to 0.008 in fish fed on F2, and increased (120%) from 0.005 (7th day) to 0.011(28th day) in fish fed on F3.

FCE (Food conversion efficiency) increased (217.64 %) from 0.17 (7th day) to 0.54 (28th day) in fish fed on F1, decreased (56.4%) from 0.39 to 0.17 in fish fed on F2, and increased (78.57%) from 0.14 (7th day) to 0.25(28th day) in fish fed on F3.

Percent gain weight (PGW) increased from 1.12 (7th day) to 15.03 (28th day) in fish fed on F1, increased from 2.73 to 4.71 in fish fed on F2, and increased from 0.97 (7th day) to 6.98(28th day) in fish fed on F3. PGW was highest in fish fed on F1 in comparison to the fish fed on F2 and F3 respectively.

Percent gain length (PGL) in *Trichogaster* sp increased from 1.155 (7th day) to 4.88 (28th day) in fish fed on F1, increased from 1.34 to 4.08 in fish fed on F2 and increased from 0.16(7th day) to 3.4(28th day) in fish fed on F3. PGL was highest in fish fed on F1 in comparison to the fish fed on F2 and F3 respectively.

The food conversion ratio (FCR) for *Heteropneustes fossilis* fed on F1 came down (15.73%) to126.09 on the 28th day from 149.63 on the 7th day (Table 3). On the other hand, the ratio decreased (18.38%) from 277.8 to 226.72 in the case of fish fed on F2. The rate of decrease was 27.89 % in fish (244.49 to 176.3) in the case of fish fed on F3.

Table 3. Growth Performances of *Heteropneustes fossilis* fed on different Food

Food	Days	FCR	SGR	ADG	FCE	PGW	PGL
Chironomus	7	149.63	0.212	0.021	0.213	1.497	0.825
	14	145.13	0.217	0.025	0.22	3.09	1.84
	21	137.19	0.228	0.03	0.233	4.89	2.58
	28	126.09	0.282	0.031	0.293	8.21	3.19
Tubifex	7	277.8	0.115	0.014	0.115	0.8	0.516
	14	215.93	0.147	0.015	0.148	2.07	0.815
	21	243.62	0.13	0.015	0.131	2.758	1.09
	28	226.72	0.138	0.016	0.141	3.95	1.86
Aquarium Fish Food	7	244.49	0.13	0.015	0.13	0.916	0.631
	14	207.19	0.153	0.016	0.154	2.162	0.971
	21	204.68	0.154	0.017	0.156	3.28	1.697
	28	176.3	0.177	0.019	0.181	5.08	2.355

FCR: Food conversion ratio; SGR: Specific growth rate; ADG: Average daily gain
FCE: Food conversion efficiency; PGW: Percent gain weight; PGL: Percent gain length

An increase in SGR (Specific growth rate) 0.212 (7th day) to 0.282 (28th day) was observed when *Heteropneustes* sp was fed on F1, which was (33.02%) in comparison to the fish fed on F2 (increased from 0.115 to 0.138 i.e. 20 %) and F3 (increased from 0.13 to 0.177 i.e.36.15 %).

ADG (Average daily gain) increased (47.61%) from 0.021 (7th day) to 0.031 (28th day) in fish fed on F1, increased (14.28%) from 0.014 to 0.016 in fish fed on F2, and increased (26.66%) from 0.015 (7th day) to 0.019(28th day) in fish fed on F3.

FCE (Food conversion efficiency) increased (37.5 %) from 0.213 (7th day) to 0.293 (28th day) in fish fed on F1, increased (22.6%) from 0.115 to 0.141 in fish fed on F2 and increased (39.2 %) from 0.13 (7th day) to 0.181(28th day) in fish fed on F3.

Percent gain weight (PGW) increased from 1.497 (7th day) to 8.21 (28th day) in fish fed on F1, increased from 0.8 to 3.95 in fish fed on F2 and increased from 0.916 (7th day) to 5.08 (28th day) in fish fed on F3. PGW was highest in fish fed on F1 in comparison to the fish fed on F2 and F3 respectively.

Percent gain length (PGL) in *Heteropneustes* sp increased from 0.825 (7th day) to 3.19 (28th day) in fish fed on F1, increased from 0.516 to 1.86 in fish fed on F2 and increased from 0.631 (7th day) to 2.355 (28th day) in fish fed on F3. PGL was highest in fish fed on F1 in comparison to the fish fed on F2 and F3 respectively.

The highest increased in length was found when *Trichogaster* sp. fed with F1 (12.525cm) and minimum in F3 (7.32cm), whereas, highest and minimum increased in length in *Heteropneustes* sp were 8.435cm and 4.281cm when fed with F1 and F2 respectively. The highest increased in weight was found when *Trichogaster* sp fed with F1(27.52g) and minimum in F3 (13.56g), whereas, highest and minimum increased in weight in *Heteropneustes* sp were 17.687g and 9.578g when fed with F1 and F2 respectively.

Regression equations were calculated and corresponding curves were plotted to understand the length-weight relations in both the fishes fed on a different diet. The result showed that the regression equation for *Trichogaster* sp fed on F1 is y = 1.873x - 0.876; R^2 = 0.898 (Figure 1), fed on F2 is y = 1.109x - 2.699; R^2 = 0.918 (Figure 2) and fed on F3 is y = 1.093x - 2.720; R^2 = 0.898 (Figure 3) respectively. At the same time, the regression equation for *Heteropneustes* sp fed on F1 is y = 1.676x-12.72; R^2 = 0.754 (Figure 4), fed on F2 is y = 1.849x - 15.36 R^2 = 0.799; (Figure 5) and fed on F3 is y = 1.093x - 2.720; R^2 = 0.898 (Figure 6) respectively. The curves revealed that there was a positive and significant relation between length and weight of both the fishes fed on all three types of diets.

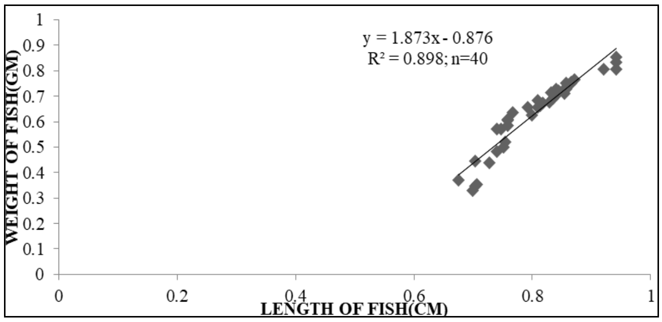

Figure 1. Regression line of length and weight of *Tricogaster* sp fed on *Chironomous*.

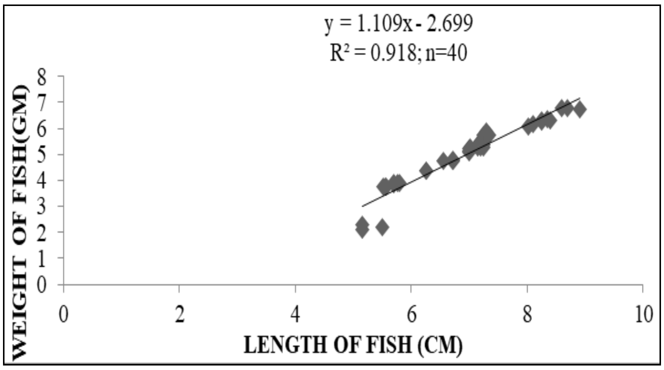

Figure 2. Regression line of length and weight of *Tricogaster* sp fed on dry *Tubifex*

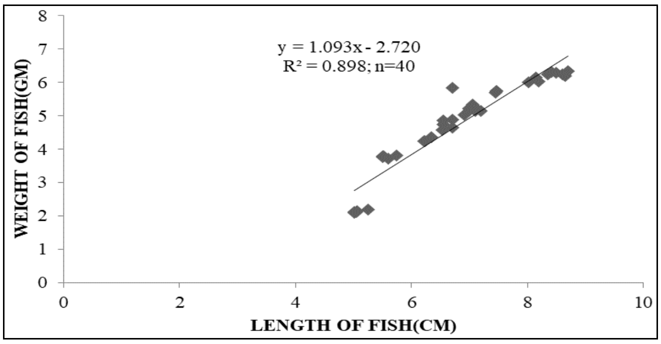

Figure 3. Regresion line of length and weight of *Tricogaster* sp fed on Fish food.

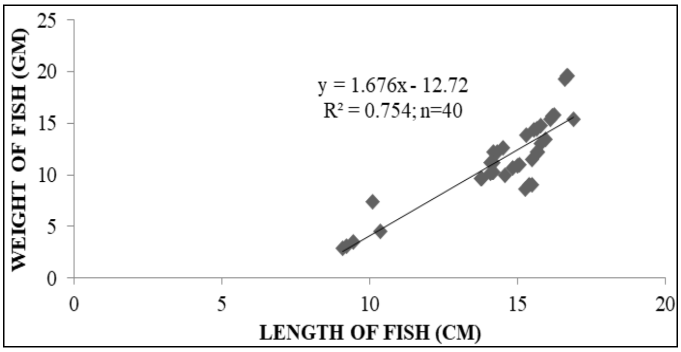

Figure 4. Regresion line of length and weight of *Heteropneustes* sp fed on *Chironomous*

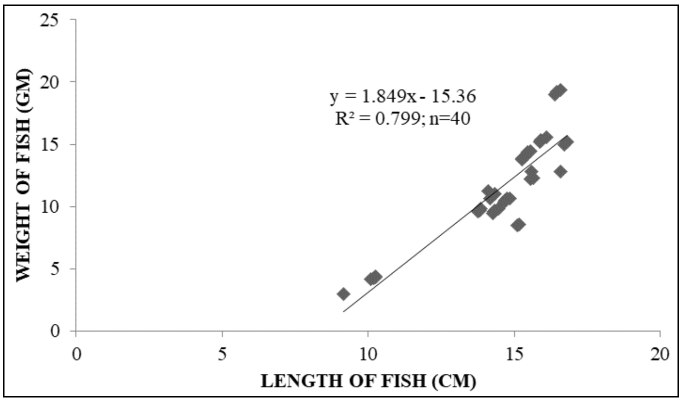

Figure 5. Regresion line of length and weight of *Heteropneustes* sp fed on *Tubifex*

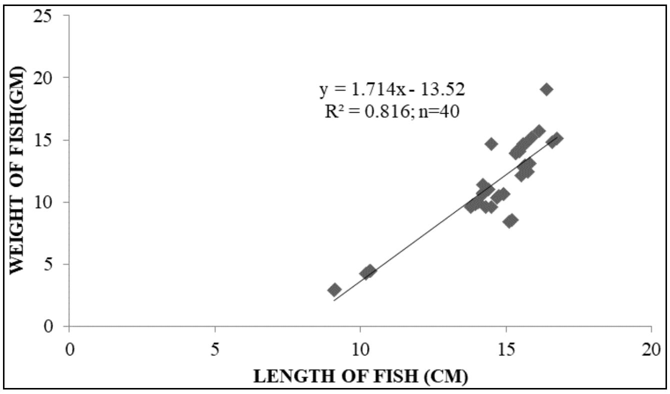

Figure 6. Regresion line of length and weight of *Heteropneustes* sp fed on Fish food

A relation was considered between FCR and SGR. Regression equations and their corresponding curves were plotted to understand the FCR-SGR relations in both the fishes fed on a different diet. The result showed that the regression equation for *Trichogaster* sp fed with F1 is y = -0.002x + 0.*594*, R^2 = *0.891* (Figure 7), fed on F2 is y = -0.002x + 0.555, R^2 = 0.993 (Figure 8) and fed on F3 is y = -0.001x + 0.373, R^2 = 0.976 (Figure 9) respectively.

The regression equation for *Heteropneustes* sp fed on F1 is y = -0.003x + 0.648, R^2 = 0.905 (Figure 10), fed on F2 is y = -0.000x + 0.252, R^2 = 0.984 (Figure 11) and fed on F3 is y = -0.000x + 0.295, R^2 = 0.991 (Figure 12) respectively. The curves revealed that there was a significant relation between FCR and SGR of both the fishes fed on all three types of diets.

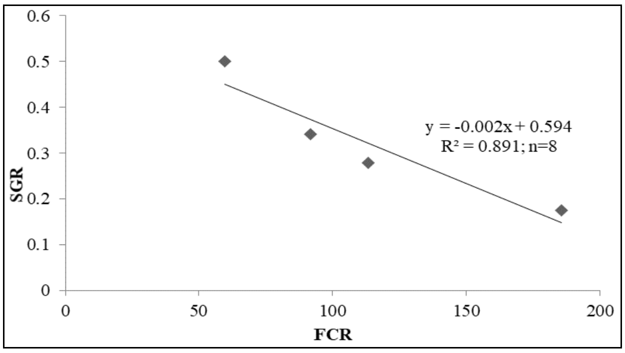

Figure 7. Relation between FCR and SGR of *Trichogaster* sp. fed on Chironomus.

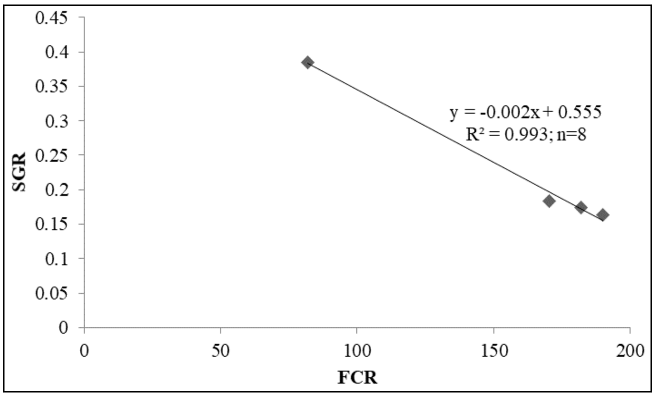

Figure 8. Relation between FCR and SGR of *Trichogaster* sp. fed on Tubifex.

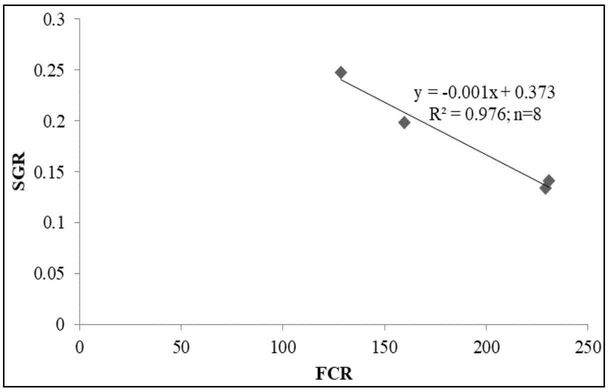

Figure 9. Relation between FCR and SGR of *Trichogaster* sp. fed on Fish Food.

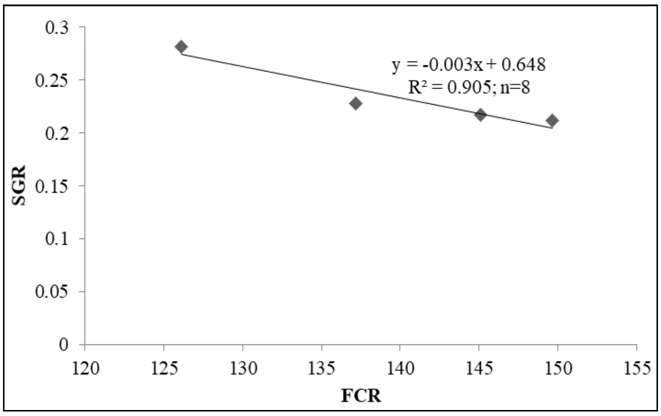

Figure 10. Relation between FCR and SGR of *Heteropneustes* sp. fed on Chironomus

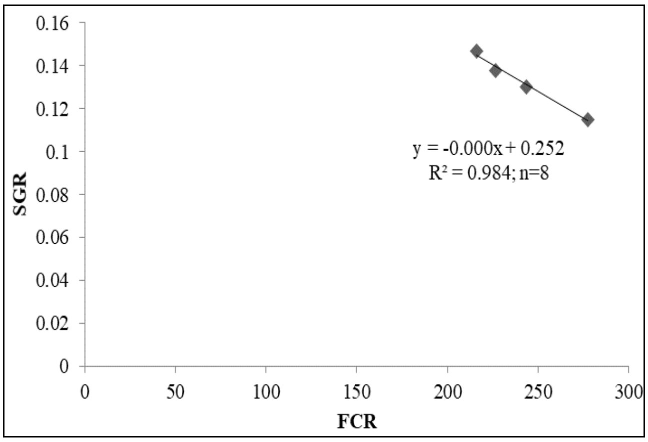

Figure 11. Relation between FCR and SGR of *Heteropneustes* sp. fed on Tubifex

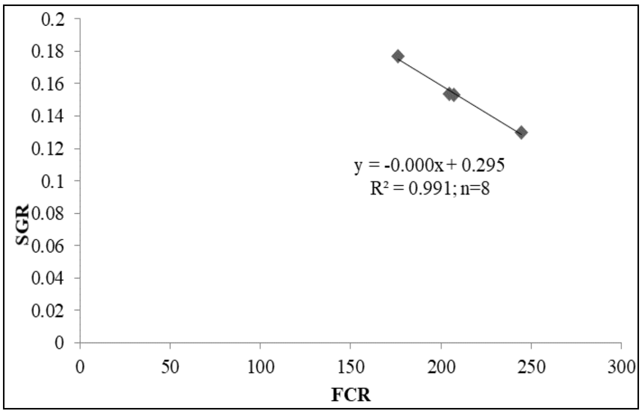

Figure 12. Relation between FCR and SGR of *Heteropneustes* sp. fed on Fish Food.

Body protein was estimated from the muscle of the fish. The result showed that the protein level was increased steadily in *Trichogaster* sp. fed on *Chironomus* larva in comparison to other diets. It was 1.28 mg/ml on the 7th day, which was increased to 2.65mg/ml on the 28th day as depicted in Figure 13. A similar trend was observed for protein in the case of *Heteropneustes* sp fed on *Chironomus* larva. It was 0.7mg/ml on the 7th day, which was increased to 1.68 mg/ml on the 28th day of the experiment (Figure 14). The rate of increase was almost double in both fish. Results also indicated that the protein level gradually decreases in fish fed on dry *Tubifex* and aquarium fish food respectively.

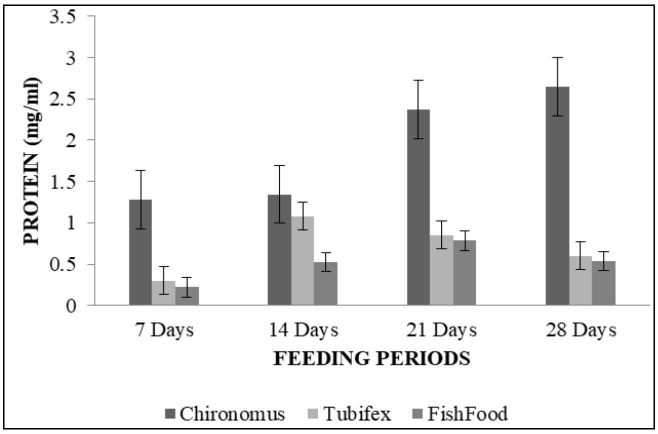

Figure 13. Protein level in *Trichogaster* sp fed on different diets for different feeding periods (Mean±SE)

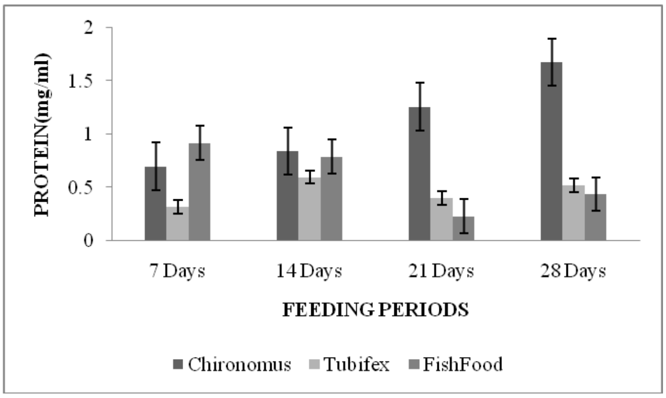

Figure 14. Protein level in *Heteropneustes* sp fed on different diets for different feeding periods (Mean±SE)

Results also showed an inverse relation between FCR and the protein level of fish. The regression equation for *Trichogaster* sp and *Heteropneustes* sp are y=-0.008x+2.380 (R^2 = 0.386; n=12) and y=-0.001x+0.990 (R^2=0.065; n= 12) when calculation was done with pooled data.

Discussion

Various catfish, rainbow trout, and carp were obtained a proper amount of nutrients when fed on *Chironomus plumosus* (Bogut 1995; Robinson 1984). *Chironomid* larvae enriched with protein makes it one of the preferred food of freshwater fish in comparison to other conventional food (Thipkonglars et al., 2010). Chironomid larva is a good source of fat and iron. Chironomid larva is treated as "living capsules of nutrition" as these larvae contain important proximate principles and vitamins, essential for the growth of fingerlings (Maleknejad et al., 2014; Zivic et al., 2013).

Considering the energy budget of *T. fasciata* it was observed that Feed Conversion Ratio (FCR) was 59.61 in the case of fish fed on Chironomus larvae(F1) and highest in the case of commercial fish food, 230.89. FCR also lowest in *H. fossilis* fed on F1. As the protein in the fish diet increases, the FCR gets smaller. This indicates that the fish takes less feed to produce a kilogram of fish. This can be important because while fed with higher levels of protein might be more expensive per kilogram because it is possible to use less feed, it may be the cheapest way to feed fish (USAID HERVEST, 2011). Priya et al. (2018) has been revealed that chironomid larvae with basal supplementary feed increased the weight and length of *Catla catla*. It was also estimated that more protein and calories were available for human nutrition from aquatic species as food than terrestrial animal and lower FCRs of any animal use as a food of human with low production cost, maybe the cheapest and healthy food for human (Fry et al., 2018).

FCR is an important factor for culture fish. Results revealed that specific growth rate (SGR) was highest in fish fed on *Chironomus* larvae and FCR-SGR has an inverse relation for all three feeds. The rate of decrease of FCR range between 32.1% to 44.37% for F1 and F3 in the case of *Trichogaster* sp. But SGR increased by 185.7% in the case of fish fed on F1 compared to F3(75.8%) i.e. control of this experiment. Whereas, FCR increased and SGR decreased by 20.46% in fish fed on F2. Whereas FCR decreased by 15.73% and SGR increased by 42.52% for F1, and FCR decreased by 27.89%, and SGR increased by 33.01% for F1 in *Heteropneustes* sp. FCR decreased with time of exposure in both *Trichogaster* sp and *Heteropneustes* sp. but, the growth rate was high in both fish fed on *Chironomus* larvae. It is beneficial when a low quantity of feed is required for the high unit weight gain of a fish (Nadaf et al., 2010). The present study also revealed that FCR was lowest for *Chironomus* larvae(F1) in comparing F2 and F3. This indicates that F1feed requires the lowest quantity for the unit weight gain of the fish, whereas, F2 and F3 require in greater quantity.

Body protein level increased gradually with time in both the fishes fed with F1. The study also revealed an inverse relation between FCR and protein both *Trichogaster*sp. ($y = -0.008x+2.380$; $R^2=0.386$) and *Heteropneustes* sp. ($y = -0.001x+0.990$; $R^2=0.386$). So a decrease in FCR resulted in the rise of protein level in the body of fish fed on *Chironomus*. It was reported that the nutritional value of farm raised fish mainly depended on the chemical constituents of the fish diet and natural food is preferred by the fish due to softness, high digestibility, and much water content (Bogut, 2007).

Both the fish feed with F1 showed better average daily gain (ADG), food conversion efficiency (FCE), percent gain weight (PGW), and percent gain length (PGL) than the fish fed on F2 and F3(control). The highest PGW 15.03 and PGL 4.88 for *Trichogaster*sp. and 8.21 and 3.19 for *Heteropneustes* sp. were observed respectively after 28 days, when fed with *Chironomus* larvae (F1). It has been reported that frozen chironomid larvae mixed with supplementary diet increased the weight and length of *Catla catla* and this larva was a better growth performer (Priya et al., 2018; Mohseni et al., 2012).

From this study, it has appeared that the live *Chironomus* larva has a good impact on farm fish than other commercial supplementary feeds. Most Chironomids contain a respectable amount of omega -3 and other essential fatty acids, required for fish and humans. So, *Chironomus* larva as feed may able to fulfil the need for fatty acids at the same time increase the body protein level (as shown in this experiment) of fish. The rate of wastage is high if the aquarium fish foods are not used in the proper amount. Thus deposited at the base of the culture containers, decay and cause water pollution. This contaminated water deteriorates the condition of the culture medium and causes the death of the fishes. But moveable *Chironomus* larvae are easily attracted by the fish and wastage is less. The remaining live organisms will accumulate at the base of the culture medium. The remaining larvae may help in maintaining the medium clean by using the waste materials in their tube building or later eaten by the fish. Chironomids may use as feed and for habitat restoration at the same time (Samanta et al., 2019). Moreover, a cost effective approach to the production of Chironomids is going on throughout the world due to its high nutritive value as a fish diet (Nath, 2020; Podder et al., 2020). *Chironomus striatipennis* larva is more effective for the growth and development of *Trichogaster fasciata* and *Heteropneustes fossilis*. Both fish have immense economic importance as human diet and *T. fasciata* also uses as ornamental fish. Thus C*hironomus* larva is a proper food source of farm fish. This larva may be used directly as a potential natural condition or may feed with basal supplementary diet to fish to culture the fishes as a nutritious food source for humans.

Conclusion

It has appeared from this study that live larvae of *Chironomus striatipennis* were more effective fish diet than dry *Tubifex* and aquarium fish food. *Chiromonus* larvae diet has a positive impact on different growth parameters with a continuous rise of protein level in both *Trichogaster fasciata* and *Heteropneustes fossilis*. Thus live *Chironomus* larvae can be used as a good alternative to fish meal or may feed with basal supplementary diet to fish as this larva is more effective for the growth and development of these two fishes as a natural fish diet.

Compliance with Ethical Standards

a. **Authors' Contributions:** Susanta Nath designed the study and arrange the experiment, performed statistical analysis, prepared the manuscript.

Shreya Samanta did the experiment under the guidance of S. Nath, wrote the first draft of manuscript.

Sudipta Das manage the literature searches.

b. **Conflict of Interest**: No conflict of interest.
c. **Statement on the Welfare of Animals**: Two fishes used in the experiment *Trichogaster fasciata* and *Heteropneustes fossilis are Least Concern (IUCN3.1) as Conservation Status*. For this type of study, formal consent is not required.
d. **Statement of Human Rights:** Not applicable.

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