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Biological Performance of *Pterophyllum scalare* larvae Fed on *Artemia* and Artificial Diet

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Abstract: The effect of a dietary inclusion of *Artemia* nauplii on growth and survival of *Pterophyllum scalare* fry with comparison of a commercial diet during 27 days was investigated. *Artemia* culture experiment was conducted in a conditioned culture at 25±0.5°C at pH 8.0±0.5. As artificial medium, saline solution (6%NaCl) was used for *Artemia* cyst Hatchery. Three fish groups (I, II and III) were evaluated under experiment conditions. The First group of fish was exclusively fed only with artificial diet. The second group (II) was fed with the artificial diet and *Artemia* nauplii. The group (III) was fed only with *Artemia* nauplii.There were differences in daily fish weight gain and growth rate of the evaluated fish groups. The condition factor values were calculated to reflect, the physiological state of the fish groups under the treatment conditions for each evaluated fish group. The average values of condition factors were variable among evaluated fish groups. Comparatively, the higher length and weight values were detected in fish group (II). In addition, minor differences were calculated between the other evaluated fish groups (Iand III).

Key words: *Pterophyllum scalare* · Nutrition · Growth · Survival · *Artemia* cysts and diet

INTRODUCTION

Pterophyllum scalare (popular ornamental freshwater fish in the aquarium trade industry) as a fish fry [1 & 2] needs nutritional factors such as essential amino acids and fatty acids for growth and survival while it can not be synthesized by fish and often remain inadequate [3]. Adding the fish meal to the diet can overcome this problem but it is very expensive. In addition, fish meal has high lipid content and therefore rancidity can be a problem if foods are not properly stored [4].

Using of some plant origin as feed stuffs is limited due to presence of some bad compounds such as alkaloids, protease inhibitors and glycosides [5]. So, using of non-conventional feed stuffs [4] as a live feed stuff will save good growth and low cost benefit values.

The use of live feed such as rotifers, copepods, cladocerans and *Artemia* in fish culture, is good decision in countries where fish culture industry is developed well [6].

In aquaculture, among the live diets used in the aquaculture of fish, brine shrimp (*Artemia*) nauplii are the most widely used food item (due to its convenience and availability). So, *Artemia* is suitable and convenient larval food source for farmed and ornamental fish [7].

It is an important to use live feed during the first days of hatching to decrease the mortality of larva. Dry artificial feeds are inadequate to nourish small larvae during the first stages of feeding. Fish larvae fed with live feed (zooplanktons such as rotifera, copepoda, cladocera, Daphnia, Monia and *Artemia*) had lower mortality rate than those fed with artificial feeds [8 & 9].

Many fish require live food when they are hatched [4 & 6]. Mouth of *Pterophyllum scalar*. (ornamental fish) fry is large enough to eat live diets as their first food, especially if this food is newly.

Knowledge on the dietary requirements and feeding practices of ornamental fishes such as *Pterophyllum scalare* is not saturated and limited [2 & 10].

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The main objective of this study is to evaluate the biological performance of *Pterophyllum scalare* fish fry under different feeding components (*Artemia*, artificial diet with *Artemia* and only artificial diet).

MATERIAL AND METHODS

Fish samples: The larvae of the *Pterophyllum scalare* (average of initial weight 0.373 ±0.01) were bought from the ornamental fish market and they were acclimatized to the culture condition in thelaboratory.

Design of Experiment: Fish larvae were introduced randomly into 9 glass tanks (in special Lab.), each of 10 L water capacity by three groups (I, II and III). Each group (6 individuals X 3 replicates) was maintained in glass tanks.Each rearing tank was includinga good recirculation system whereas water was continuously recirculated by air water lift (as described by Milad *et al*. [2] with some modifications).

Accumulated feed and fecal waste were removed from ponds three times a week. The fish in each aquarium were collected and weighed every 9 days.Each group was sampled, whereas all fish larvae from every replicate were taken to measure the weight and length. Based on the measurements and survival rate, the feed are adjusted for the next 9 days.

The first group (I) of the experiment, larvae was exclusively fed only with artificial diet at 8 AM and 16 PM. The second group (II) was fed on the artificial diet (at 8 AM and 16 PM) and *Artemia* nauplii (at 14 PM). The group (III) was fed only with *Artemia* nauplii (8 AM and 14 PM). The water temperature and pH were checked regularly.

The Artificial Diet: The artificial diet (38% crude protein, 3% crude fat, 5%crude fiber and 8% moisture) was bought from the ornamental fish market.

***Artemia* Culture:** *Artemia* cysts were bought from ornamental fish market (originof these *Artemia*cysts isGreat Salt Lake, USA).

Incubation of Cysts: *Artemia* culture was conducted in a conditioned culture at 25±0.5°C and pH 8.0±0.5 as described by Tamaru, *et al*., [11] with some modifications. As artificial medium, saline solution (6%NaCl) was used for cyst Hatchery. Dry*Artemia* cysts (0.5g) are hatched in plastic culture bottles (1.5L). The *Artemia* larvae were cultured with vigorous aeration by air bubbling. The air was supplied by an air pump which was manually switched on/off.

Separation of *Artemia* cysts and Nauplii: After *Artemia* have hatched, the aeration was stopped. The unhatched eggs and empty cysts were floated to the surface of the water. The percentage of newly hatched nauplii was calculated [11].

Newly hatched *Artemia* were placed in a plastic container, moderately aerated to keep them evenly suspended. Newly hatched *Artemia* were introduced to fish as a live feeding for fish groups (I and II).

Data Analysis: The Relative Growth was calculated according to Utne [12] as following:

RG = [(W2-W1)/W1] X 100. Relative growth [13 & 14] rate (%RGR) = [(W2 –W1) / (W1 xT)] x 100. The W1 is the initial weight at the start of the studied period (g). The W2isfinal weight at the end of the studied period (g). T is time of the studied period.Specific growth rate (SGR) = [(ln W2 – ln W1) / T] x100.

Where W1 and W2 are the initial and final weight,respectively and T is the number of days of the feeding period.

Condition Factor (K): The "K values in this study indicates the relationship between fish length and weight. It can be used within the limitations of the scales on the chart to assess the approximate K value of fish. Condition factor (K) which is measure of fatness is calculated from the relationship: $K= (100W)/ L^3$, Where K= condition factor, W= Total fish weight (g) and L= Total length of fish (cm)

Data analysis was carried out as described by Milad *et al*., [2].

RESULTS

Biological Performance of Fish under Different Feedings: The total length, weight percentage of mortality and condition factor were calculated for each studied fish groups (I, II and III) for inferencing biological performance of fish (under treatment conditions).

The biological performance (wet weight, length, relative growth rate, survival and mortality) of applied fish species was evaluated.

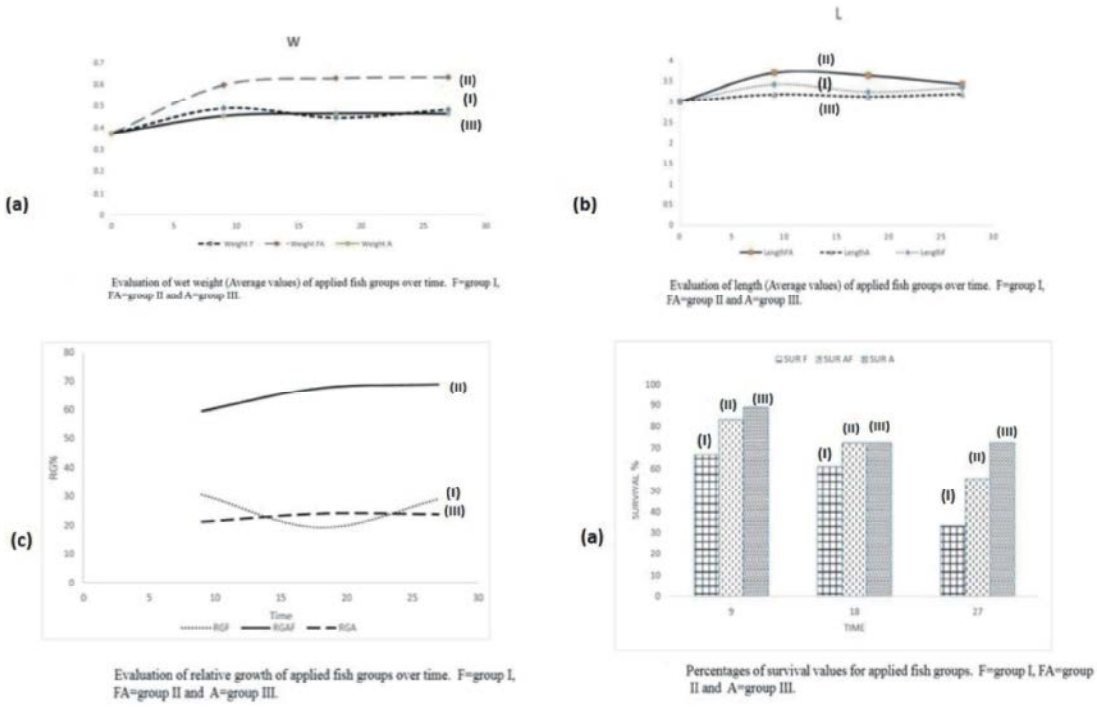

Fig. 1: Evaluation of wet weight (a), length (b), relative growth (c) and percentage of Survival values (d) of the applied fish groups (I=F, II= FA and III=A) fed with different feeding regimes.

Evaluation of Wet Weight of Applied Fish Groups over Time: The wet weights of applied fish groups over time were evaluated. The averages of wet weight values were calculated and presented as a diagram in Figure (1a). Comparatively, the higher wet weight values were detected in fish group (II). In addition, minor differences were calculated between the other two evaluated fish groups (I and III).A temporary decrease in average of weight rate was observed in all evaluated fish groups (I, II and III) between days 9 and 18. In addition, between the second and last period increase in wet weight rates were recorded in all evaluated fish groups (Figure 1a).

Evaluation of Length of Applied Fish Groups over Time: The lengths of applied fish groups over time were evaluated. The averages of length values were calculated and presented as a diagram in Figure (1b). Comparatively, the higher length values were detected in fish group (II). In addition, minor differences were calculated between the other two evaluated fish groups (I and III). A temporary decrease in average of length rate was observed in all evaluated fish groups (I, II and III) between days 9-18. In addition, between the second and last period increase in length rates were recorded in all evaluated fish groups (Figure 1b).

Relative Growth (RG) of Applied Fish Groups: The relative growth of applied fish groups were evaluated and presented as a diagram in Figure (1c). The RG of applied fish values of the different estimated fish groups were different.

The lowest RG value (19.259%) was detected at day 18 (group I) while the lowest RG values for groups II and III were 59.56% and 21.27% respectively (at day 9 for both groups). The highest RG values (30.51%, 68.93% and 24.18%) were detected at days 9 (Group I), 27(Group II) and 18(Group III) respectively.

Relative Growth (RGR %) of Applied Fish Groups: The relative growth rate of applied fish groups was evaluated. The RGR values per fish for each evaluated fish group were calculated and presented in Table (1). These values were 1.07, 2.55 and 0.88 (per fish) in (fish Groups I, II and 18 respectively.

Percentage of Survival Values: No mortality was observed during the first three days of fish acclimatization before treatments.

In the period between days 18 and 27, mortality increased in all groups especially in fish group (I). The percentages of survival were calculated for each

Table 1: Averages of condition factor (K), weight (W) and length (L) values within each evaluated fish group through time (D9, D18 and D27), Weight gain (g), Relative growth (%), Relative growth rate (%) andSpecific growth rate.

Fish groups	GroupI	GroupII	Group III
Aver. K for D9	1.26±0.10	1.18±0.01	1.39±0.06
Aver. K for D18	1.28±0.04	1.32±0.07	1.51±0.06
Aver.K . for D27	1.26±0.06	1.57±0.05	1.43± 0.05
Aver. W. D9	0.48±0.03	0.59±0.004	0.45±0.03
Aver. W. for D18	0.44±0.04	0.62±0.02	0.46±0.02
Aver. W. for D27	0.48±0.06	0.63±0.03	0.46±0.02
Aver. L. for D9	3.41±0.15	3.69±0.15	3.18±0.15
Aver. L. D18	3.24±0.15	3.63±0.15	3.13±
Aver. L. for D27	3.35±0.15	3.42±0.15	3.19±0.15
Final Mean (W)	0.48±0.06	0.63±0.03	0.46±0.02
Weight gain (g)	0.107	0.257	0.087
Relative growth (%RG)	28.95 (per fish)	68.93(per fish)	23.97(per fish)
Relative growth rate (%RGR)	1.07 (per fish)	2.55 (per fish)	0.88 (per fish)
Specific growth rate (SGR)	0.94% (per day)	1. 94% (per day)	0.79%(per day)

Condition factor=(K), weight=(W) and length =(L) and Day= (D)

evaluated fish group (Figure 1d). The fish group (III) (fed on *Artemia* only) has the highest percentages of survival values (88.88%, 72.22% and 72.22%) during the period (9, 18 and 27days) of treatment. In this group (III), no moralities Occurred from from day 18 to day 27. On the other hand, the lowest percentages of survival values (66.66%, 61.11% and 33.33%) were recorded for fish group (I). The percentages of survival values for fish group (II) were 83.33%, 72.22% and 55.55% in days 9, 18, 72 respectively.

Condition Factor: The condition factor (CF) values were calculated for each estimated fish individual in each evaluated fish group (I, II and III). The ranges of these values were (ranged from 0.83 to 1.97), (ranged from 0.87 to 1.77) and (ranged from 0.97 to 1.83) in Fish groups I, II and III respectively.

The averages of these values were calculated. In fish group (I) the average of condition factor values were 1.266, 1.286 and 1.260 in day 9, 18 and 27 respectively. In fish group (II) the average of condition factor values were 1.18, 1.32 and 1.57 in day 9, 18 and 27 respectively. In fish group (III) the average of condition factor values were 1.39, 1.51 and 1.43 in day 9, 18 and 27 respectively (Table 1).

Specific growth rate (SGR), Relative growth rate (% RGR) and Relative growth (%RG) were calculated and presented in Table (1).The highest values of these parameters were calculated in fish group (II).

DISCUSSION

Fish production operation in aquaculture industry aims to increase quantity and quality of aquaculture products. In addition, more effort is needed to estimate the optimum feeding rates, frequencies [2] and decreasing the mortality reasons especially in ornamental fish production. Knowledge on the dietary requirements and feeding practices of ornamental fishes such as *Pterophyllum scalar* is not saturated and limited [2 & 10].

In aquaculture industry, nutrition cost accounts about 60 % of the operating costs especially in intensive fish culture [2 & 15].

In the present study, the feeding schedules (two meals per day) were carried out for 27 days. The suitable and optimum feeding programs may vary with species, size and age of fish [2 & 16]. On the other hand, the increasing of feeding frequency had bad effects on fish performance because it will decrease feed efficiency in fish in certain conditions [17]. Milad *et al.* [2] noted that feeding frequency had a significant effect on feed conversation ratio and growth in the angelfish. Feeding of angel fish (*Pterophyllum scalare*) two meals per day or four meals per day was recommended by Milad *et al.* [2]. They obtained a good fish performance especially in feed conversion ratio and growth using both of the previous feeding programs.

In the present study, the higher length and weight values were detected in fish group (II). In addition, minor differences were calculated between the other two

evaluated fish groups (I and III). This may be due to the effect of feeding with *Artemia* nauplii on FCR (Feed conversion ratio).

The effects of different feeding levels on growth performance and survival of (*Clarias gariepinus*) larvae with the newly hatched *Artemia* nauplii and artificial feed was investigated by Faruque, *et al*. [18]. They found that, the growth of different larvae groups was different. In addition, the higher amount of feed lead to higher growth of these fish under certain condition. The low amount of food with better FCR can be obtained from *Artemia* than the artificial feed.

Regarding the survival ratio of the applied fish under the condition of treatments, the lowest percentages of survival values (66.66%, 61.11% and 33.33%) were recorded for fish group (I). This group fed on artificial diet only. On the other hand the other fish groups (II, III) were fed on *Artemia* nauplii. The survival rates were high in these two groups relatively may be due to the essential factors that including with *Artemia* feeding (sources of metabolic energy or adenosine triphosphate). As described by Tamaru *et al*. [11] the freshly hatched *Artemia* nauplii has a high value feed for fish and crustacean larvae and fry.

In the present study, the fish (group II and III) were fed on Artemia nauplii (according the program that described before) within 24 h after hatching. Because the dry weight and caloric content of *Artemia*nauplii can decrease as much as 25% within 24 h after hatching [11, 19& 20]. In the present study the fish larvae performance was improved by the feeding of enriched *Artemia* nauplii.

The length-weight relationship of fish is an important tool for fish management [21& 22]. Condition factor (K) values were calculated in the present study to evaluate the effect of environmental changes [14 & 23] on the applied fish performance. The condition factor values were (ranged from 0.83 to 1.97), (ranged from 0.87 to 1.77) and (ranged from 0.97 to 1.83) in Fish groups I, II and III respectively. The average values of condition factors were variable among evaluated fish groups. The variability in (K) values reflected the fish health condition.Condition factor compares the well being of a fish and is based on the hypothesis that heavier fish of a given length are in better condition [24].

Generally, the Condition factor values were varied from species to species and from condition to other condition [22]. The value obtained from the study showed that all evaluated fish groups (I, II and III) were in good condition.

More studies are needed to detect the optimum feeding rates and frequencies for *Pterophyllum scalar*. feeding.

Condition factor was a good index of growth, feeding intensity and reflect the fish performance under certain condition.Fish larvae prefer to use live food (*Artemia*) more efficiently than artificial diet. The fish larvae performance was improved by the feeding of enriched *Artemia* nauplii. Due to easy *Artemia* culturing, we expect that, *Artemia* will be widely used as a nonconventional feed staff in the fish farms in the future.

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