

Effect of different feed types on growth, spawning, hatching and larval survival in angel fish (*Pterophyllum scalare* Lichtenstein, 1823)

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Abstract. In this study effects of commercial extruder diet (T_1), earthworm (T_2), 50 % commercial extruder diet + 50 % earthworm (T_3) on growth, spawning, hatching and larval survival of angel fish (average weight 4.06 g) (*Pterophyllum scalare* Lichtenstein, 1823) were investigated. The experimental groups were fed for 60 days. According to the results of this study, the best spawning and hatching were found in group T_3 but there was no significant difference with other groups ($p>0.05$). Also larval survival rate in group T_3 showed significant difference with group T_2 ($p<0.05$) and higher than other groups. The best weight gain were found in commercial extruder diet (T_1) as it showed significant difference with group T_2 ($p<0.05$).

Key words: Angel fish (*Pterophyllum scalare*), earth worm, growth, spawning, larval survival.

چکیده. در این مطالعه اثرات جیره تجاری (تیمار اول)، کرم خاکی (تیمار دوم) و 50 درصد جیره تجاری+50 درصد کرم خاکی (تیمار سوم) روی رشد، تخم‌ریزی، تقریب و بقای لارو ماهی آنجل (با میانگین وزن 4.06 گرم) (*Pterophyllum scalare* Lichtenstein, 1823) مورد بررسی قرار گرفت. گروه های آزمایشی به مدت 60 روز تغذیه شدند. مطابق نتایج این مطالعه، بهترین تخم‌ریزی و بقای لاروی در تیمار سوم مشاهده شد ولی اختلاف معنی داری با سایر گروه ها وجود نداشت ($p>0.05$). همچنین میزان بقای لاروی در گروه سوم اختلاف معنی داری را با گروه دوم نشان داد ($p<0.05$) و بالاتر از سایر گروه ها بود. بهترین وزن به دست آمده در جیره تجاری مشاهده شد (تیمار اول) که اختلاف معنی داری را با گروه دوم نشان داد ($p<0.05$).

کلمات کلیدی: ماهی آنجل (*Pterophyllum scalare*), کرم خاکی، رشد، تخم‌ریزی، بقای لاروی

Introduction. Ornamental fish farming is an important primary industry (Lim & Wong 1997). Angel fish is one of the most popular freshwater fish species in the aquarium trade industry (García-Ulloa & Gómez-Romero 2005). Due to its body coloration, shape and economical value the angel fish represents one of the most important ornamental cichlid species (Luna-Figueroa 2003).

The angel fish, *Pterophyllum scalare* (Lichtenstein, 1823) has distinguished itself by the complexity of its reproductive behavior, involving competition for territory and sexual partners, courtship, mating and parental care. In this species, the couple is greatly involved with the offspring, mainly during the initial breeding phase (Cacho et al 1999).

P. scalare is, without question, the most popular and generally more available member of the entire Cichlidae family. Both the silver and a myriad of artificially selected color and finnage varieties are commercially produced. These Cichlids make a magnificent solo display, but there is no practical reason for excluding other fish from their aquarium.

Over the past several years, many people have begun raising earthworms as a source of income or as a means of managing organic waste. Some are drawn to the business by extravagant claims of vast potential markets for earthworms in large waste disposal systems agriculture and as a source of food for animals. Despite these claims, the current major commercial use of earthworms is as bait for freshwater sport fishing (Sherman 2003).

Earthworms are excellent food for cultured fish species. The advantages of earthworms in the diets of cultured fish have been demonstrated. For example, carp fed

dried nightcrawlers supplemented with sardine oil grew better than those fed a fish meal diet (Mason et al 1992).

The potential value of earthworm as a protein source had been established by several authors (Stafford & Tacon 1988, Edwards & Niederer 1988, Orozco et al 1988, Ortega et al 1996). Mattson et al (2002) had also suggested that earthworms provide a substantial nutrition to the animals consuming them. Furthermore, the studies of Albarran (1996), Dynes (2003) and Vielma-Rondon et al (2003) had shown that not only earthworm could serve as a rich protein source but also as a source of essential amino acids, especially lysine which is limited in many basic foodstuffs and that the amino acid composition of earthworm meal is very similar to that of fishmeal and potentially superior to that of meat meal.

The general objective of this study was to determine the effects of commercial extruder diet (T₁), earthworm (T₂), 50 % commercial extruder diet +50 % earthworm (T₃) on growth, spawning, hatching and larval survival of angel fish.

Material and Method. In this study, 18 pairs of 14 months angel fish (average weight of 4.06 g) were randomly stocked into each aquarium with six replications per treatment. Angel fish were obtained from the Institute of Ornamental Fish Hatchery in Babol, Iran and were transferred to the place of experiment and acclimated for 2 weeks. Fish were fed to satiation twice per day. The feeding trials were conducted in 18 (80×30×40 cm) glass aquaria. Gentle aeration was provided by air stones. During the experiment, the water quality parameters were monitored during the trial and average value for temperature, dissolved oxygen, hydrogen ion concentration (pH) and salinity were 26±2 °C, 5.7-7.7 mg l⁻¹, 6.9-7.8 units and 0.1 mg l⁻¹ respectively. Dark cycle of 12:12 h was maintained during the feeding trial. We used three diets which were included commercial extruder diet (T₁), earthworm (T₂), 50 % commercial extruder diet + 50 % earthworm (T₃). Nutrient compositions of experimental diets are given in Table 1. Proximate composition of diets was carried out using the Association of Analytical Chemists (AOAC 2000) methods. Protein was determined by measuring nitrogen (N×6.25) using the Kjeldahl method (Mehrad & Sudagar 2010); Crude fat was determined using petroleum ether (40–60 Bp) extraction method with Soxhlet apparatus and ash by combustion at 550 °C. The experiment was conducted for 60 days with angel fish. All fish from each replicate were individually measured and weighed at the beginning and every two weeks until the end of the experiment. Wet weight (g) was determined at each sampling day, with an electronic balance (0.01 g sensitive) and a scale.

Table 1

Nutrient composition of experimental diets (%)

Diet	Commercial extruder diet	Earthworm
Protein	54	61
Lipid	18	9
Fiber	1.5	-
Ash	10	5
Vitamin	2	-

Reproduction parameters were investigated after 60 days. Breeders after 60 days feeding were spawned during one month. Spawning, hatching and larval survival for each pair of breeders were investigated.

The following variables were calculated:

Weight Gain (WG) = final fish weight–initial fish

Specific growth rate (SGR) = $(\ln W_t - \ln W_0) \times 100 t^{-1}$ (Hevroy et al 2005)

W_t and W₀ were final and initial fish weights (g), respectively and t is time (days) between $\ln W_t$ and $\ln W_0$.

The data obtained from the trial were subjected to one-way analysis of variance (ANOVA) (using SPSS 16.0 programme) to test for effects of dietary treatments. When ANOVA identified significant difference among groups, multiple comparison tests among

means were performed using Duncan's new multiple range test. For each comparison, statistically significant differences were determined by setting the aggregate type I error at 5% ($P < 0.05$).

Results. Results (table 2) showed that the growth of fish fed commercial extruder diet (T_1) was significantly higher than other treatments ($p < 0.05$). There were no significant differences ($p > 0.05$) among the experimental groups in spawning and hatching (%). The percentage of larval survival among commercial extruder diet (T_1) and earthworm (T_2) as well as earthworm (T_2) and 50 % commercial extruder diet + 50 % earthworm (T_3) showed no significant difference ($p > 0.05$), while extruder diet (T_1) and 50 % commercial extruder diet + 50 % earthworm (T_3) significantly showed higher level survival in group T_3 (70.84 ± 6.98) ($p < 0.05$).

Table 2

Growth and reproduction performance of the experimental diets

Parameters	T_1	T_2	T_3
Initial mean weight (g)	4.05 ± 0.52^a	4.03 ± 0.45^a	4.12 ± 0.59^a
Final mean weight (g)	7.85 ± 0.48^a	6.38 ± 0.58^b	7.12 ± 0.45^{ab}
Weight gain (g)	3.80 ± 0.43^a	2.27 ± 0.31^b	3.08 ± 0.32^{ab}
Specific growth ratio (SGR)	1.11 ± 0.17^a	0.74 ± 0.15^b	0.95 ± 0.13^{ab}
Fecundity	502.50 ± 96.38^a	492.67 ± 102.48^a	614.00 ± 119.59^a
Hatching (%)	79.88 ± 6.86^a	77.98 ± 9.55^a	82.25 ± 11.07^a
Larval survival (%)	57.86 ± 6.51^b	62.85 ± 9.06^{ab}	68.93 ± 7.80^a

Groups with different alphabetic superscripts differ significantly at $p < 0.05$ (ANOVA)

Discussion. Producing a diet with high percentage of protein needs abundant sources of protein. Use of live feed in aquaculture increases growth and survival percentage of fish. Moreover, the absorption of protein will be improved. Earthworm is one of live feed with high levels of protein (usually 45-70 %) and suitable fatty acids that can provide aquatic nutritional needs. There are no clear results about protein requirement in some aquarium fish including the angel fish. In carnivorous fish, dietary protein requirement usually accounts approximately 40 to 50 % for fry (Soriano-Salazar & Hernandez-Ocampo 2002).

Earthworm lipid has nutritional and medicinal values and it is believed that due to dissolved substances in its lipid which create a good taste of food can be useful in aquatics (Hoseini & Jalali 2010).

According to some researches, it was declared that angel fish fed with diet containing high protein level was indicated better growth (Degani 1993). Abi-Ayad & Kestemont (1994) were used three different diets for goldfish larvae: D1 (*Artemia* nauplii), D2 (*Artemia* nauplii+50 % dry feed) and D3 (dry feed). At the end of the second week, specific growth rate was higher in the groups fed with diet D1, intermediate in the D2-fed groups and low in the D3-fed groups. During the third week, the best specific growth rate was observed in the groups fed the D2 diet. Soriano-Salazar & Hernandez-Ocampo (2002) indicated that in angel fish fed with live feed was obtained better FCR than angel fish was fed with commercial diets. Kruger et al (2001) observed that fish fed with supplementation of daily *Daphnia* to drum-dried flake feed grew faster and had a better feed conversion ratio (FCR) than those receiving weekly *Daphnia* supplementation or flake feed only. But Zuanon et al (2006) found same FCR in different protein levels. Bahadir Koca et al (2009) showed that the highest weight gain of angelfish was obtained in CED group fed with commercial extruder diet including high protein (49 % protein). Lowest weight gain was found in group fed with commercial flakes including lower crude protein level. In this study the better SGR and highest weight gain (see figure 1) of angelfish was obtained in T_1 group fed with commercial extruder diet including high protein (54 % protein). According to these data, it can be concluded that angel fish can use higher level protein better than lower protein. These findings agree with those of Degani (1993), Soriano-Salazar & Hernandez-Ocampo (2002), and Bahadir Koca et al (2009).

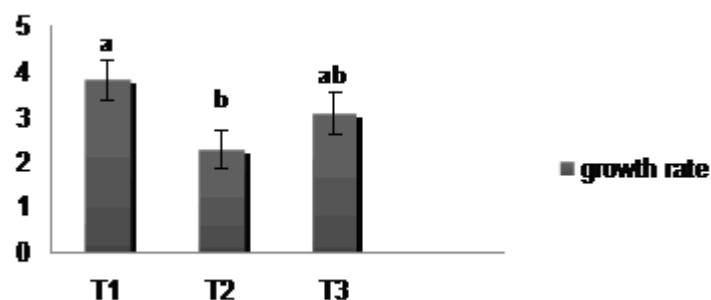


Figure 1. Mean and standard deviation of growth rate in different treatments

Observations were made by Luna-Figueroa (2003) who compared two live foods (*Daphnia pulex* (Leydig, 1860) and *Culex quinquefasciatus* (Say, 1823)) larvae, with 50.15 and 40.18% crude protein, respectively) and three commercial flakes with different protein levels (45, 43 and 27% crude protein) for on-growing angel fish juveniles. In collectively, fish fed with *D. pulex* and *C. quinquefasciatus* showed a higher reproduction and growth influence than with commercial food but the best survival ratio was obtained in commercial extruder feed group as 100 %. In our study, the best spawning, hatching and larval survival were found on T₃ group (50 % commercial extruder diet + 50 % earthworm).

Conclusions. In the present study, angel fish fed with diet including high level protein commercial extruder diet was showed better growth. In addition, it was found that earthworm with commercial extruder diet can improve the reproductive performance of angelfish.

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