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A comparative study on growth and survival performance of swordtail fish, *Xiphophorus helleri*, fed with *Artemia* and fairy shrimp nauplii as supplementary food

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ABSTRACT

A feeding experiment was conducted on larvae of swordtail fish, *Xiphophorus helleri*, to evaluate the effect of two different live feed on growth and survival rate of the fish. Larval were fed thrice a day with Asian star feed powder and twice a day (morning and evening) with either *Artemia* or fairy shrimp nauplii as a supplementary feed for 45 days. Tests were run in triplicate and initial and final weights were recorded for all the treatments. Results indicated that there was a significant difference between fish fed with fairy shrimp nauplii and *Artemia* nauplii ($P<0.01$). The survival of the fish was not affected by the dietary treatments.

Introduction

In aquaculture, production of fish to market size within a short period is of highest importance (Bulkley, 1972). But, the success in the hatchery production of fish fingerlings for stocking in the grow-out production system is largely dependent on the availability of suitable live food organisms for feeding fish larvae, fry and fingerlings. Live feeds also help restore the water quality of the culture system and are more easily accepted by cultured organisms (Pushparaj & Ambika, 2010). Dry feed formulations have been tried as substitutes for live food for edible and ornamental fishes (Khan & Jafri, 1994; Lochmann & Phillips, 1994; James & Sampath, 2002). Common food source for ornamental species are live organisms such as *Artemia* and Daphnia (Godin & Dugatkin, 1996).

The industrial development of freshwater ornamental fish culture has been hampered by the lack of suitable live feeds for feeding the fish at the various production stages (Lian et al., 2003). Many freshwater ornamental fish farmers have shifted from *Moina* to the cleaner *Artemia* nauplii for feeding their young fish. Due to their convenience as an off-the-shelf feed and requiring only 24 h of incubation from cysts, *Artemia* nauplii are the most widely used live food organism for the fry production of marine as well as freshwater fish and crustaceans (Van Stappen, 1996). But major drawback in feeding *Artemia* nauplii to freshwater fish is that the nauplii die after 30– 60 min in freshwater, and must therefore be fed to the fish intermittently every 2–3 h (Merchie, 1996). Furthermore, the high price of *Artemia* cysts has increased the fish cost, and cheaper alternative diets with comparable nutritional quality are needed to maintain the cost competitiveness of ornamental fish in the global market (Lian et al., 2003).

Fairy shrimps are freshwater relatives of brine shrimps, which its nauplii closely resemble brine shrimp nauplii and are similar in size and inhabit temporary ponds that lack fish because they are eaten by fish in natural waters (Munuswamy, 2005). Fairy shrimp have the potential to be used as a feed item for fish such as ornamental fishes that benefit from live food (Prasath et al., 1994) and their cysts and nauplii may be useful in larval culture. In recent years, fairy shrimps and their nauplii have been used as live food for freshwater fish and as test organisms in ecotoxicological tests (Brendonck et al., 1990).

This study was focused on the use of fairy shrimp as live food for swordtail fish, *Xiphophorus helleri*, form an economically important group of ornamental fishes to document the growth performance of this fishes fed with fairy shrimp nauplii as compare to *Artemia* nauplii.

Experimental design

Larvae of swordtail fish, *Xiphophorus helleri*, produced from the ornamental fish hatchery site of the Persian Gulf University, Iran, were used for the experiment. After the birth larvae were graded to a uniform size, with a mean total weight and length of 0.013 g and 0.93 mm, respectively. Sixty larvae were distributed between two treatment and three replicates. Asian star feed were powdered and same amount were fed to all the larvae three times a day. Larvae were also provided with freshly hatched artemia (*Artemia urmiana*) for the first treatment (T1) and fairy shrimp nauplii (*Branchinella thailandensis*) for the second treatment (T2) twice a day. Introduction of nauplii was done after morning and evening feed siphoning so there was around 12 hrs time for fishes to feed on the nauplii. All the survived fishes per each tank were measured for their total weight and length after 45 days. Mean growth rates (GR) specific growth rate (SGR) and condition factor (CF) were calculated from average increments in size and weight according to the following formula:

GR = (Final weight - Initial weight)/Initial weight

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SGR= 100*(ln W2- lnW1)/T; where W1 and W2 are the initial and final weights of the larvae and T is the time in days).
CF= 100*W L_T^{-3} where W is the weight of the fish and L_T the corresponding total length.

The number of dead individuals in each treatment was recorded and average survival rate was calculated.

Survival rate = No- Nt / No*100; where No - initial total number of larvae, and Nt - total number of larvae at the end of 45 days of experiment.

All statistical analyses were performed using the SPSS System. Differences in GR, SGR, CF and survival of all treatments were determined through a one-way analysis of variance (ANOVA) and Duncan test to determine significant differences among treatment means.

Results and Discussions

At the end of experiment, the mean values for wet body weight in T1 and T2 were 0.034±0.003 and 0.36±0.002 g, and for total length were 2.04±0.03 and 2.25±0.01 cm, respectively. The studied parameters were growth rate, specific growth rate and condition factor of the fishes. Analysis of variance on growth parameters of fish explains that there is a highly significant differences between the treatments in term of GR (p=0/001<0/01), SGR (p=0/001<0/01) and CF (p=0/001<0/01) (Table 1). The data presented in table 2 shows comparison of means for the said parameters which well shows the difference between GR SGR and CF of the two treatments.

Over the period of experiment, survival exceeded 83.3% for fairy shrimp and 70% for *Artemia* treatments but did not appear to be affected by live feeds diet. With respect to the calculated chi-square which is smaller than critical chi-square in 0.05 alpha level and degree of freedom it can be concluded that there is no significant difference between the fish survival and treatments (X^2=1.49<3.84, df=1, p=0.22>0.05).

The present investigation assessed the nutritive efficiency of fairy shrimp nauplii, *B. thailandensis* as a potential candidate for replacing *Artemia* in ornamental fish culture. Based on the present data, it is demonstrated that larvae fed on the fairy shrimp nauplii produced good results in growth (weight gain and length increment), which are higher to those fed with the *Artemia* nauplii. Having 40% protein content, the brine shrimp is considered as an important criterion as live feed (Rasawo & Radull, 1986). Adult fairy shrimp (*B. thailandensis*) also has high protein (64.65%), lipid (7.57%), carbohydrates (16.24%) content and has all essential amino and fatty acids (Wipawee et al., 2012). Similar finding was reported by Velu & Munuswamy (2007) when they fed adult fairy shrimp, *S. dichotomus*, and *Artemia* to *C. auratus* and found that the biochemical analyses of the whole tissue of the fish fed with fairy shrimps showed efficient utilization as observed in the gain in weight of fish. Improved growth and condition factor with increasing dietary protein levels are well documented with other species (Sirputhorn & Sanoamuang, 2011: Ali and Dumont, 1995: Prasath et al., 1994). Although fish fed on live feed showed a higher weight gain as compared with fish fed with other types of feeds, but there was no survival difference between the fish fed fairy shrimp or *Artemia* nauplii.

Conclusion

This study suggests that the fairy shrimp nauplii is considered to be a suitable live feed for rearing jewel fish larvae due to its ready acceptance, high nutritional value and longer survival time of fairy shrimp nauplii in freshwater. Although fresh-live diet forms have high nutritive value, harvested fairy shrimp can also be frozen, freeze-dried or acid preserved for later use or made into flakes or other forms of formulated feeds like *Artemia*, and will increase their utility and initiate a new approach in using these fairy shrimps in aquaculture (Velu and Munuswamy, 2007). This can also help the freshwater ornamental fish industry to overcome the high price and survival time of *Artemia*.

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Table 1. One way ANOVA performance of growth parameters for swordtail fish (*Xiphophorus helleri*) larvae fed on *Artemia* and fairy shrimp

	Source	Sum square	df	Mean square	f	sig.
GR	Between group	38	1	38	34.68	0.001
	within group	50.40	46	1.09		
	Total	88.40	47			
SGR	Between group	0.266	1	0.266	34.36	0.001
	within group	0.357	46	0.008		
	Total	0.623	47			
CF	Between group	8.678	1	8.678	30.37	0.001
	within group	13.142	46	0.286		
	Total	21.82	47			

Table 2. Descriptive statistics for GR, SGR and CF of swordtail fish (*Xiphophorus helleri*) fed with *Artemia* and fairy shrimp

	Artemia		Fairy shrimp	
	Mean	SD	Mean	SD
GR	24.85	1.15	26.63	0.94
SGR	7.23	0.099	7.37	0.076
CF	4.02	0.74	3.17	0.23

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