

A Comparative Study on the Growth Rate of Persian Sturgeon, *Acipenser persicus*, Larvae Fed with *Artemia urmiana* and *Daphnia* sp.

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Abstract: This study aimed to compare the growth of Persian sturgeon larvae in the utilization of two types live food was performed. In this experiment of nauplii *Artemia urmiana* (*Artemia Urmia*) and *Daphnia* sp (*Daphnia Magna*) was used. Ten-days-old Persian sturgeon larvae with initial weight 43.38 ± 6.75 mg were transferred to 9 circular fiberglass tanks with a volume 50 liters and a density of 2 pieces per liter. Three treatments in this experiment were considered. In treatments 1, 2 and 3, Persian sturgeon larvae with *Artemia urmiana*, *Daphnia* sp., and a mixture of 50% *Artemia*+50% *Daphnia* were fed, respectively. The larvae were fed daily to 30% of their body weight. The obtained results showed that using a mixture of *Artemia urmiana* and *Daphnia* indicated to high efficiency in growth performance and survival rate of *Acipenser persicus* larvae.

Key words: Persian Sturgeon • *Artemia urmiana* • *Daphnia magna* • Live Food • Survival

INTRODUCTION

Sturgeons (Acipenseriformes) are one of the most ancient groups of the Osteichthyes with 25 species distributed in the temperate waters of the Northern Hemisphere, Eurasia and North America [1]. The larviculture of marine fishes in commercial hatcheries still depends on the supply of live preys such as rotifers, *Artemia* and *Daphnia*. Until now, substitution of compound diet for live prey, known as weaning, is only performed some weeks after hatching in marine fish, while freshwater species can be fed compound diets as early as at mouth opening [2]. Rearing of sturgeon larvae has received increasing attention in recent years [3] due mostly to the fact that in several countries the wild stock of these migratory fish is severely depleted or in danger of disappearance. *Artemia* is the most common feed organism for the feeding of larval fish and crustaceans. More than 85% of marine animals cultured are raised with *Artemia* sp. Several artificial diets have been formulated, but none have equaled *Artemia*. Several reasons may play a role in the development of *Artemia* in aquaculture, ease of access, potential for long-term maintenance, ease of transportation, ease of cultivation, and the different size

and its role as a carrier vitamins, pigments and vaccines for aquaculture the main factors led to that is the monopoly selection of *Artemia* as live food in fishes [4, 5]. The results of a study performed that *Artemia urmiana* has a high potential of enrichment with *Bacillus* and bakery yeast probiotic [6]. The unique nature and role of *Artemia* has revolutionized the aquaculture industry particularly the shrimp farming [7]. Rainbow trout larvae fed with nauplii *Artemia* after 21 days led to the highest larval growth and standard length the compared with treatments fed of cysts Decapsulated, commercial food and two mixture (50% concentrated food+50% decapsulated cysts and 50% concentrated food + *Artemia* nauplii) [8]. In previous experiment on larvae *Rutilus frisii kutum* the lowest survival rate was observed in larvae fed artificial dry feed compared with larvae fed *Artemia* nauplii and larvae fed mixed diet (*Artemia* nauplii + artificial dry feed) [9]. *Daphnia magna* is also one of the most important food animals which have attracted the attention by fish nutrition is around the world [10]. In another previous experiment on Persian sturgeon larvae fed with *Daphnia magna* bioencapsulated with probiotic was the best growth and survival [11] and the best resistance in against challenge test obtained [12]. Optimization of

zootechnical, nutritional and microbial factors of live foods can reduce the heavy mortalities of the fish in larviculture. *Artemia urmiana* nauplii and *Daphnia* sp. or their mixture are commonly employed as starting food for the larviculture of sturgeons in Iranian hatcheries. This study aimed to evaluate the effects of feeding the Persian sturgeon, *Acipenser persicus* larvae with either of *A. urmiana* nauplii or *Daphnia magna* or a mixture of these two live foods on their growth performance.

MATERIALS AND METHODS

Experimental Diets: This study was carried out in Shahid Marjani Sturgeon Propagation Center, Golestan, Iran in March 2008. A 25-day feeding experiment was conducted with the Persian sturgeon larvae, using two live foods *A. urmiana* (treatment A), *Daphnia magna* (treatment B) and the mixture of them (50% *Daphnia* + 50% Artemia) (treatment C), with 6 times feeding frequency per day. The *D. magna* was obtained from an intensive production ponds and *A. urmiana* was provided by Artemia and Aquatic Animals Research Institute of Urmia University. *Daphnia* was sieved through a net to get the suitable size for the mouth of fish. Cysts were decapsulated according to the method described by Van Stappen [13]. Freshly hatched nauplii were obtained daily from cysts with 86% hatching rate. After verifying mean hatching rates, which corroborated the data provided by the supplier (250000 nauplii g⁻¹ cysts), feeding ration assessment was performed using known amounts of nauplii hatched in determinate water volumes, and distributing them into the corresponding replicates.

Experimental Design and Maintenance of Fish: The experiment was conducted in a completely randomized design with three treatments, in nine fiberglass tanks (capacity of 50 liters). Each treatment was in triplicate. The tanks were stocked by fish larvae in a density of 2 fish per liter. So, in total, there were 100 fish in each tank. The larvae were fed daily based on 30% of their body weight. The water temperature was 16.8±0.6°C, pH was 7.6-8.3 and water oxygen level was maintained above 7.5 mg/l during the experiment. All tanks were maintained under natural photoperiod (LD 12:12). The initial weight and length of the larvae were 43.38±6.75 mg and 19.48±1.15 mm, respectively.

Analyses and Measurements: After 25 days of the feeding trial, the fish were weighed individually. Some growth and feeding parameters such as weight gain (WG),

specific growth rate (SGR), feed efficiency (FE) and survival of the fish were calculated based on the data biometry of Persian sturgeon larvae. The growth parameters of the studied fish were calculated by using the following formulas:

$$\text{Specific growth rate (SGR)} = \frac{[(\ln \text{BWt}_1 - \ln \text{BWt}_0) / (t_1 - t_0)]}{\times 100}$$

Where ln= natural logarithm, BW=body weight and t₀ and t₁ start and end times of study, respectively.

Food conversion ratio (FCR) = food intake (g) / living weight gain (g)

Food conversion efficiency (FCE) = [living weight gain (g)/food intake (g)]

Protein efficiency ratio (PER) = living weight gain (g)/ protein intake (g)

Lipid efficiency ratio (LER) = living weight gain (g) / lipid intake (g)

Energy efficiency ratio (EER) = living weight gain (g)/ energy intake (kcal)

Condition factor (CF) = 100×[(g final weight of fish)/(total length of fish- cm)³].

Statistical Analysis: Data were analyzed by one-way ANOVA to test the effects of the dietary treatments. When a significant treatment effect was observed, Duncan's new multiple range test [14] was used to compare means. Treatment effects were considered at *P* < 0.05 level of significance. All statistical tests were performed using the SPSS, statistical package (SPSS, version 12, Chicago, IL).

RESULTS

The values of feeding and growth parameters of Persian sturgeon larvae are presented in Table 1. The best performances of fish in terms of survival and growth rate were recorded at the treatment C (Figs. 1 & 2). The highest final body weight of the larvae obtained in treatment of C, while the final body length obtained in treatment A. The highest SGR (13.44%) was obtained in treatment of C and this had significant difference with treatment of B (*p*<0.05) but no significant difference with treatment of A. The highest PER, LER and EER was observed in the larvae of treatment C and these were significantly different with those of treatment B (*p*<0.05). The lowest FCR (3.77) was obtained in treatment C, while, the FCE was highest (27.30) in the treatments A and C. The maximum condition factor (0.55) obtained in treatment B and this

Table1: The values of growth parameters of Persian sturgeon larvae in different feeding treatments

Growth parameters	Treatment		
	A	B	C
Final body weight (mg)	1205.41± 159.27 ^a	457.33± 85.73 ^b	1264± 122.77 ^a
Final body length (mm)	74.35± 6.90 ^a	43.58± 6.73 ^b	73.66± 3.14 ^a
Specific growth rate	13.27± 0.55 ^a	9.25± 1.22 ^b	13.44± 0.716 ^a
Food conversion ratio	3.91± 0.57 ^b	11.04± 3.21 ^a	3.77± 0.69 ^b
Food conversion efficiency	26.03± 3.44 ^a	9.87± 3.16 ^b	27.30± 4.81 ^a
Protein efficiency ratio	4.02± 0.55 ^a	1.43± 0.51 ^b	4.22± 0.77 ^a
Lipid efficiency ratio	10.76± 1.47 ^a	3.83± 1.35 ^b	11.30± 2.06 ^a
Energy efficiency ratio	0.53± 0.07 ^a	0.19± 0.07 ^b	0.56± 0.10 ^a
Condition factor	0.30± 0.07 ^b	0.55± 0.09 ^a	0.32± 0.06 ^b

-Refer to "Materials and Methods" for the definitions of the treatments A, B and C.

-In each column, data having the same alphabetic letter are not significantly different ($p>0.05$)

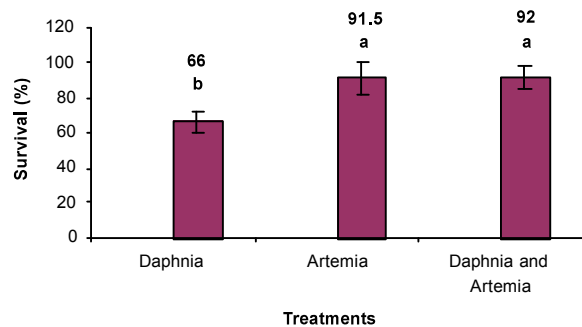


Fig. 1: Mortality rates of Persian sturgeon larvae fed three different diets over a period of 25 days

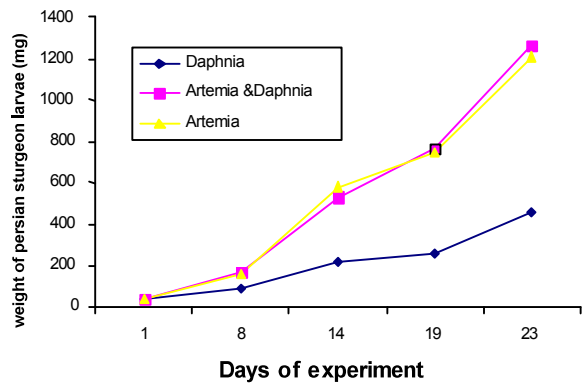


Fig. 2: Growth patterns of Persian sturgeon larvae fed three different diets over a period of 25 days

had significant difference with treatments A and C ($p<0.05$). The maximum and minimum survival rate was in treatments C (92%) and B (66%), respectively (Fig. 1).

DISCUSSION

When decapsulated Artemia cysts are used as direct food instead of live nauplii, it is important to consider the different behavior of nauplii and cysts in water. Freshly

hatched nauplii are mobile and can remain living and swimming for some 12 h in well water [15] while cysts are inert. Feeding by Artemia cysts to young fish larvae is essential as first feeding in hatchery operation of *Acipenser persicus* but Artemia are poor in some essential fatty acid, 20:5n-3 (eicosapentaenoic acid; EPA) and 22:6n-3 (docosahexaenoic acid; DHA) [16]. The *Daphnia magna* is common live food organisms used for the rearing of marine fish larvae. Some authors [17-21] have suggested that fish larvae initially have a low endogenous digestive enzyme production, and that live zooplankton provides an exogenous source of enzymes, which may increase the digestion of food. The result obtained by Pooling *et al.*, [22] showed that the use of Artemia nauplii or zooplankton in larviculture in African catfish (*Clarias gariepinus* Burchell) allowed excellent survival rates. In our trial, acceptance of the formulated diet and performance of fish fed the diet seemed to be relatively low. Periods of food deprivation or inadequate nutrition have been shown to result in abnormal behavior and morphological development such as bending of the spinal cord, hunched back [23] and other nutrition disorders [24, 25]. The mixture of Artemia and Daphnia gave good performance in Persian sturgeon larvae in this trial and there were no abnormal behaviors or morphological development. In this study different result were obtained from using two live food organisms and their mixture. The results of this study highlighted that growth performance and survival rate of Persian sturgeon larvae were highest after using a mixture of *A. urmiana* nauplii and *D. magna* as food. Values of growth parameters were higher in the larvae fed with Artemia than those fed with Daphnia. These results were in accordance with our previous findings from the use of *A. urmiana* nauplii for feeding *A. nudiventris* larvae and the larviculture of Persian sturgeon larvae [26].

The *A. persicus* larvae showed a high potential and growth performance by using a mixture of two live foods of *A. urmiana* nauplii and *Daphnia* sp., suggesting that using this mixture could be an effective and more economical method in the sturgeon larviculture.

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