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Use of decapsulated artemia cysts for the growth and survival of caspian salmon (*Salmo trutta caspius*) fry

Mehran Javaheri Baboli[1*], Reza Roozbehfar[2], Mehdi biria[3]

[1]*Department of Fisheries Science, Ahvaz Branch, Islamic Azad University- P.O. Box 1915, 61849-8411 Ahvaz, Khuzestan- Iran*

[2]*Islamic Azad University, Abadan Branch, Young Researchers Club, Abadan, Iran and Department of Fisheries, Khorramshahr University of Marine Science and Technology, Khorramshahr, Iran*

[3]*Department of fisheries, Science and Research Branch, Islamic Azad University, Khuzestan-Iran*

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Abstract

Experiments were conducted to evaluate decapsulated *Artemia* cysts as food for *Salmo trutta caspius* fry. Initially, The larvae Mean wet weight 16.1 ± 78 mg were fed on different diets :(T1) dried decapsulated *Artemia* cysts, (T2) decapsulated *Artemia urmiana*, (T3) *Artemia urmiana* nauplii,(T4) artificial feed feeds for 15 days.After this period, all treatments were fed with commercial diets for 20days.At the end of the first period, larval treated fish T2 (feed with Nauplii *Artemia*) of WG, LG, percentage of body weight gain, SGR, dry weight and survival were better than the other treatments ($p < 0.05$). In the end of second stage after 20 days in treatments T2 and T3 had the highest wet weight ($p < 0.05$), the highest dry weight and length were obtained at treatment T3 ($p < 0.05$), The highest percentage increase in body weight in the treatments T1 and T3 respectively ($p < 0.05$). In all treatments there was no significant difference in SGR and survival ($p < 0.05$). This study showed that the larval Caspian Sea salmon have growth and better performance in use of *Artemia* Nauplii.

*Corresponding Author: Mehran Javaheri Baboli ✉ mehranjavaheri@gmail.com

Introduction:

Salmonids (Salmonidae) from around the world are the most important fish species and it is being done for centuries in various communities (Lee and Donaldson, 2011). Among this family, the Caspian Sea salmon importance and great valency in terms of meat quality and economic value (Kazanchof, 1981) and storage of DNA (Abdoli and Naderi. 2007). The larval period is most important in many fish species, Success in larviculture depends on the existence of suitable diets that are easily consumed. The brine shrimp *Artemia* is widely used as a live food organism for many larval fish cultured in intensive systems. However, increased demands for good quality *Artemia* cysts and recent fluctuations in world harvests have sharply increased prices. As a result, attention is again concentrating on new alternative diets to *Artemia* nauplii.

Poor quality *Artemia* cysts might represent a potential alternative to *Artemia* nauplii. The outer layer of the *Artemia* cyst is non-digestible by predator organisms, but this outer layer can be quickly removed with hypochlorite treatment, a procedure called decapsulation. Decapsulated *Artemia* cysts have been successfully fed to fish larvae (Verreth et al., 1987; Vanhaecke *et al.,* 1990; Pector et al., 1994). As decapsulated embryos have more energy content than newly hatched nauplii (Le´ger et al., 1986), they are potentially more nutritious for feeding. Several other advantages of decapsulated *Artemia* cysts are listed in Pector et al. (1994).

Rainbow trout larvae fed with Nauplii *Artemia* after 21 days led to the highest larval growth and the highest standard throughout the rest of the treatments consumed of cysts Decapsulated, commercial food and had to have used a combination of them (Meshkini et al., 2009). Carp larvae fed with decapsulated *Artemia* cyst relieved with better survival were fed *Artemia* Nauplii, but significantly better growth of larvae fed with *Artemia* Nauplii (Vanhaecke et al., 1990).

In another study on larvae *Leuciscus idus*, using larvae of the decapsulated cyst of survival were better than other treatments, and treatments of *Artemia* fed Nauplli longitudinal growth was better than the other treatments (Shiri Harzevili et al., 2004). *Artemia* cysts decapsulated out great properties such as improved cysts hatching capabilities and ease of maintenance and cost less to use laboratory equipment to decapsulated cysts (Bruggeman et al., 1980 ; Van Stappen., 1986). Even low-quality cysts can be used as food sources (Ribeiro and Jones., 1998). The aim of the present study was to investigate the suitability of live food and artificial diet for *Salmo trutta caspius* fry during their early feeding stage.

Materials and methods

Preparation of Artemia cysts

Artemia cysts (*Artemia urmiana*) from *Artemia* and Aquatic Animals Research Institute, Urmia University, with 35 percent humidity and 85% of cysts hatching prepared and according to standard methods decapsulation, isolation and disinfection were conducted (Lavens and Sogreloss., 1996; Vanstappen., 1996). The resulting cysts according to standard procedures at 33 ppt salinity and 28-30 C temperature was hatched (Baronykova., 1999; Lavens and Sogreloss., 1996; Bengston., 1991). After harvest for maintain nutritional value and reduce the metabolism of fatty, Nauplii in salinity 30 per thousand and under aeration at temperatures below 10 degrees (refrigerator) until salmon fed larvae were kept.

Preparation and transport of larvae caspian sea salmon

Larvae Caspian Sea salmon (*Salmo trutta caspius*) that approximately 70% of the yolk sac has been absorbed, from Restocking of Salmonidea Centre of Shahid Bahonar Kelardasht and were transported to the laboratory. To do this, double-walled plastic bags were filled to 25% volume of water and after placing the larvae inside the bag, 75% of the remaining space was filled with pure oxygen and then the bags were tightly closed. Bags placed inside

the box with ice, was evaluated every 2 hours, larval behavior and ambient temperature till reach the destination (Bromage et al., 2002).

Dietary treatments

During this study the effect of 3 dietary treatments for 15 days on the Caspian Sea salmon larvae in actively feeding stage was investigated (Mean wet weight 16.1 ± 78 mg, dry weight averaged 9.5 ± 12.48 mg, 0.6 ± 20.2 mm initial length), With the density 350 larvae per 40-liter tank that was filled with 25 liters of water were kept and was evaluated with three replications. All treatments were prepared with well water at a raceway system. These treatments include:

Treatment one (T1): a commercial concentrate feed used for Caspian Sea salmon larvae actively feeding stage, from the Chineh company Tehran (SFT00)

Treatment two (T2): newly hatched *Artemia* Nauplii.

Treatments three (T3): decapsulated *Artemia Urmiana* cysts.

At the end of first stage (15 days) and start second stage (20 days), conducted compromising nutritional treatments two and three with diet changes to commercial concentrate diet for 3 days. For this purpose, in the treatment two and three were used of newly hatched Nauplii *Artemia* as live food. In three consecutive days with ratios of 75% newly hatched Nauplii *Artemia* + 25% commercial concentrate feed, 50%newly hatched Nauplii *Artemia* + 50% commercial concentrate feed, 25% newly hatched Nauplii *Artemia* + 75% commercial concentrate feed And on the fourth day all the treatments with 100% concentrate diet was fed until the twentieth day. The average amount of daily food, According to the water temperature and fish size was calculated and determined on 12 occasions at an interval of 2 hours, larvae were provided daily. All groups of larvae were fed ad libitum 12 times daily.

Data collection

During this review, from each replicate randomly selected 10 larvae and with precision total larval weight and length were measured. To determine dry weight, the larvae separately for 24 hours at 60 ° C dried and we've weighed them again. Percentage survival larvae at the end of the first and second period (the period fifteen days, and the twenty-day period) in different treatments were studied. Percentage weight gain and SGR were calculated from the following formula:

Percentage weight gain= [final weight – initial weight] ×100

Specific Growth Rate (SGR) = [Ln(final weight) – Ln(initial weight)] ×(number of days)$^{-1}$×100

$$\text{Survival Rate} = \frac{\text{number of fish at beginning of experiment} - \text{number of dead fish at end of experiment}}{\text{number of fish at beginning of experiment}} \times 100$$

The statistical analysis of data

The mean and standard deviation were calculated for all parameters. Results were subjected to one-way analysis of variance followed by Dunken's entire comparison test ($P<0.05$), using a software SPSS 16.0.For all statistical to determine significant differences among treatment means. All data are presented as the mean±SD.

Results

Based on statistical analysis of the maximum weight(213.86gr), length(31.66mm), percentage of body weight gain(145.82), specific growth rate(6.09) at the end of 15 days in treatment fed with Nauplii *Artemia* (T2) was obtained And lowest in the treatment with commercial diet obtained ($p <0.05$) (Table 1). Dry weight between treatments were not significantly different ($p <0.05$) (Table 1). The highest survival rate was obtained in treatment fed Nauplii *Artemia* and the lowest survival rate were obtained in treatment fed with decapsulated *Artemia* cysts ($p <0.05$) (Fig. 1).

Fish larvae at the end of the twentieth day, biometric and data were obtained. Highest wet weight in treatments T3 obtained, but with values

Table 1. Growth parameters of Caspian salmon fry fed with experimental treatments at the end of the fifteenth day.

Treatment Growth Parameters	T1 Commercial feed	T2 Nauplii *Artemia*	T3 Decapsulated cysts
Wet weight(mg)	157.76±17.76^{a}	213.86±8.17^{b}	185.17±10.11^{ab}
Dry weight(mg)	26.3±7.53^{b}	34.4±4.97^{a}	33.2± 0.6^{a}
Length(mm)	28.43± 0.93^{a}	31.66±0.46^{b}	30.53±0.23^{ab}
PWG	81.33±20.41^{a}	145.82±9.39^{b}	111.36±8.36^{ab}
SGR	3.92±0.72 ^{a}	6.09±0.27 ^{b}	5.01±0.26^{ab}

* The numbers in each row have the same coefficients with no significant difference.

Table 2. Growth Indicators of larvae Caspian salmon fed with experimental treatments at the end of 35 day.

treatment Growth parameters	T1 Commercial feed	T2 Nauplii *Artemia*	T3 Decapsulated cysts
Wet weight(mg)	444.26±12.38^{a}	483.66±5.78^{b}	518.69±11.16^{b}
Dry weight(mg)	79.96±2.07^{a}	85.2±0.38^{a}	94.86±2.02^{b}
Length(mm)	37.34±0.65^{a}	39.75±0.12^{b}	40.1±0.22^{b}
PWG	250.54±22.24^{a}	164.63±38.93^{b}	283.34±28.38^{a}
SGR	5.5±0.46^{a}	4.39±0.56^{a}	5.1±0.27^{a}

* The numbers in each row have the same coefficients with no significant difference.

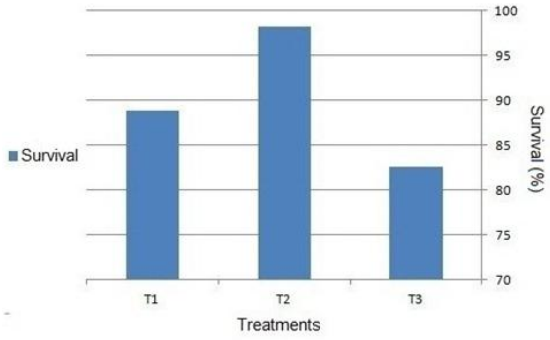

Fig. 1. Survival rate (mean ± SD) for Caspian salmon fry, *Salmo trutta caspius* fed different diet.

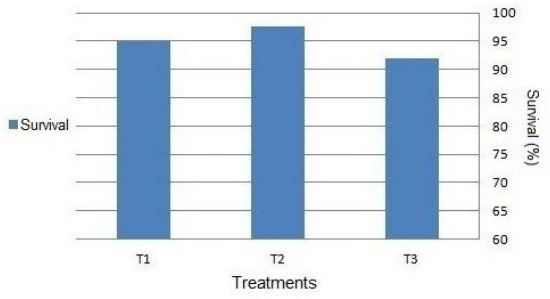

Fig. 2. Survival rate (mean ± SD) for Caspian salmon fry, *Salmo trutta caspius* fed different diet

T2 did not differ significantly, but was significant difference with treatment T1 ($p < 0.05$) (Table 2). Dry weight of T3 treatment had significant differences with other treatments, but there was no significant difference between treatments T1 and T2 ($p < 0.05$) (Table 2). Maximum length was obtained in T3-treated, but no significant difference with treated T2 ($p < 0.05$) (Table 2). The highest percentage increase in body weight were treated T3 obtained, but with T1 treatment had no significant difference ($p < 0.05$) (Table 2). Significant difference in terms of specific growth rate and survival between treatments were not observed ($p < 0.05$) (Table 2) (Fig. 2).

Discussion

According to the research and experience gained in recent years, the most critical growing stage after stage of most aquatic reproduction, larval rearing period. Based on scientific evidence, Salmon fish has the most fragile control mechanisms of environmental stress and much more in need of care and practice are providing the best conditions (Bromage et al. 2002). Today, in addition improve

methods in diets products, use of live foods, very good results in the production of larvae with high resistance (Watanabe et al., 1983). The use of decapsulated *Artemia* cysts as a direct food source in aquatic larviculture has been previously suggested (Verreth et al. 1987; Vanhaecke et al. 1990). The authors concluded that decapsulated cysts were a good alternative to live food and dry food in initial feeding of larval fish. However, direct application of this food item is a fundamental problem that was their fast sedimentation in water and lack of motility (Fleig et al. 2001). According to this experiment, the best growth and nutritional factors in treatments fed with newly hatched nauplii *Artemia* were obtained, because the larvae can be better exploited. The best survival was obtained in treatments fed with nauplii *Artemia*, lowest survival in the treated fed with the decapsulated cysts has been obtained, Slow growth and high mortality of larvae fed on artificial diets may be related to the absence of a stomach and low digestive capacity at the beginning of their development (Ribeiro and Jones, 1998). Similar result was observed with use of nauplii *Artemia* comparison with commercial diets and decapsulated cysts in rainbow trout affect on higher average weight gain, feed conversion ratio and better survival rates (Meshkini et al. 2009). Freshly hatched nauplii are mobile and can remain living and swimming in water column (Celada et al. 2007) while cysts are inert. Similar result was observed with ide larvae, *L.idus* (Shiri harzevili et al. 2004), gold fish, *Carassius auratus* (Kaiser et al. 2003) and tench, *Tinca tinca* (Celada et al. 2008). In a study based on the formulated of Decapsulated *Artemia urmiana* cysts in the newly beginning to feed rainbow trout larvae was conducted; results indicate increased in percentage of survival and rapid growth of larvae fed with decapsulated *Artemia* cysts(Nekoofard., 2000). The interest foods are located on the surface or water column. In this study larvae treated fed with decapsulated cysts in the end of second stage were the best growth factors. Indicating that decapsulated cysts in the early stages of life, can be help to better utilization from the concentrate food. The information obtained in the experiments conducted, this suggests that if our goal in the larval rearing salmon, higher average weight gain, improved feed conversion ratio and survival rates and production meat with better quality and especially with emphasis on economic costs, the use of *Artemia* nauplii to achieve these goals is the best option.

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