Article

Effect of feeding *Artemia urmiana* cysts on performance and survival of Caspian brown trout (*Salmo trutta* caspius) fish at the larva stage

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Received 25 June 2018; Accepted 30 July 2018; Published 1 March 2019

Abstract

This study was conducted to evaluate the effect of feeding different levels of *Artemia urmiana* cysts on performance and survival of Caspian brown trout fish. The treatments included different levels (25, 50, 75 and 100%) of *A. urmiana* cysts to Caspian brown trout fish with an average weight of 120±25 g in active phase of larva stage until the weight of one gram. Feed intake (FI), weight gain (WG), body weight (BW), feed conversion ratio (FCR), specific growth rate (SGR) of the treatments were determine and the survival percentage index was calculated based on the number of remaining larvae in the sites on the total number of larvae. The result of study showed that the higher feed intake was for 25 and the lower feed intake was for 50% of *A. urmiana* cysts treatments. Also the best specific growth rate and feed conversation ratio was related to the 25% of *A. urmiana* cysts groups ($p \leq 0.05$). Additionally the best survival index was for fish that fed by 75% and the worst survival index was for fish that fed by 100% of *A. urmiana* cysts. In conclusion we could demonstrate that feeding *A. urmiana* cysts may have some beneficial effects on the performance and survival of Caspian brown trout (*Salmo trutta caspius*) fish at the larva stage.

Keywords *Artemia urmiana*; Caspian brown trout; performance; larva survival.

Proceedings of the International Academy of Ecology and Environmental Sciences
ISSN 2220-8860
URL: http://www.iaees.org/publications/journals/piaees/online-version.asp
RSS: http://www.iaees.org/publications/journals/piaees/rss.xml
E-mail: piaees@iaees.org
Editor-in-Chief: WenJun Zhang
Publisher: International Academy of Ecology and Environmental Sciences

1 Introduction

Caspian brown trout (*Salmo trutta caspius*) is an endangered anadromous species distributed in southern region of the Caspian Sea and it is one of the rare species of Caspian Sea which migrates to related rivers such as Sefide-Rud and Gorgane-Rud for reproduction (Kiabi et al., 1999; Nazemi et al., 2000). Fish spend initial stages of their lives including parr and smolt infresh water river (Coad, 2000). Artificial propagation fingerlings to natural water is an approach to prevent their extinction, but achieving this goal is faced hard from which feeding and mortality in fry and fingerlings are the most important ones (Halver and Hardy, 2002). In reality in the commercial producing of marine species, rearing of fish larvae is the most important and critical stage. A high nutritional quality diet which is easily accepted and digested is essential for better growth and higher development of the larvae (Saber et al., 2005). The use of Artemia species as live feed for crustacean and fish larvae is widespread in marine and freshwater aquaculture (Bahrekazemi and Yousefi, 2017). Artemia represents an interesting food source for carnivorous larval and juvenile stages of many species which show an absolute requirement for live prey during their early development (Koueta et al., 2002). Hafezieh and Hosseinpour (2010) showed significant differences between length and survival rate of the sturgeon larvae among treatments. Additionally, Achionyenzeh et al. (2012) showed that higher specific growth rate in larvae than post larvae. They also mentioned that *Artemia nauplius* was a good starter live food for the larvae of *Clarias gariepinus*. Akbari et al. (2005) showed that larvae survival after 1 and 4 weeks were significantly higher ($p \leq 0.05$) in trout larvae fed only on *Artemia nauplii* than others. Although many studies have been done on feeding Caspian brown trout (Ramezani, 2009; Sotoudeh et al., 2011) but also the few study has been carried out on its performance and survival parameters (Wang et al., 2005). The present study was conducted to examine the effect of feeding *Artemia urmiana* cysts on performance and survival of Caspian brown trout (*Salmo trutta Caspius fish*) at the larva stage.

2 Material and Methods

2.1 The fish and the diets

Three hundred Caspian brown trout fingerlings have been obtained from the Coldwater Fishes Research Center and transferred to a local fish farm in the Urmia (Khezr Abad), West Azerbaijan, Iran. The water was supplied from a spring with flow rate of 7 L s^{-1}. The water temperature, dissolved oxygen, pH, and electrical conductivity were measured by an oxygen meter (Oxi 300i, Germany) and a pH meter (Metrohm 827, Germany). During the experiment, the temperature ranged from 12.5 -$13^{\cdot c}$, the pH ranged from 6.9 to 7.2 and electrical conductivity ranged from 238.5 to 242.5, and the dissolved oxygen was approximately 9-10 mg L^{-1}. The basal practical diet was formulated which is suitable for the growth of Caspian brown trout fingerlings (Saber et al., 2005). For preparing the experimental diets, different levels of *A. urmiana* de-hulled cysts (25, 50, 75 and 100%) were used respectively. In this study, the treatments included feeding of 5 described diets to Caspian brown trout fish with an average weight of 120 ±25 g in active phase of larva stage until the weight of one gram. The amount of calculated food was given to fish at 8 periods with intervals of two hours daily.

2.2 Performance

Feed intake, Weight gain, Body weight, Feed conversion ratio, Specific growth rate of the treatments were determine by the methods as below:

Weight gain (g per day) = Weight increase per day (Kim et al., 1996)

Weight gain (g) = Final weight – initial weight, (Hevroy, 2005)

Feed conversion ratio (FCR) = Feed fed (g per dry weight) / fish weight gain (g wet weight) (Kim et al., 1996)

Specific Growth Rate (SGR): (% of Body weight per day) = (LnW2–LnW1) x 100/t, where W2 and W1 are respectively, final and initial weight (g) of each fish, t the duration of the experiment in days (Wang et al., 2005).

2.3 Determination of survival rate index

The survival percentage was calculated based on the number of remaining larvae in the sites on the total number of larvae.

2.4 Statistical method

All data were tested for normality to satisfy the assumptions of oneway ANOVA and Duncan test to determine the statistical significance of treatment on performance and comparison of differences in survival of larvae between treatments. Differences were considered significant at the ($p \leq 0.05$) level.

3 Results and Discussion

3.1 Performance

The result of Effect of feeding *A. urmiana* cysts on performance of Caspian brown trout fish at the larva stage are shown in Table 1. The result showed that feed intake was at the highest in the fish were fed by 25% and the weight gain was at the highest in 50% *A. urmiana* cysts respectively ($p \leq 0.05$). As result revealed that the better feed conversion ratio was related to the 25% Artemia groups. Additionally Specific growth rate was 0.55 and 0.50% in the 25% Artemia and control groups ($p \leq 0.05$).

Azimirad and Meshkini (2017) showed that, the enrichment trend of *Artemia franciscana* at different times used in this experiment was different. In terms of the enrichment time, the results showed the capability of Artemia enrichment had significant difference.

Table 1 The average performance index of the treatments.

Treatments	Feed intake (g)	Weight gain (g)	Feed conversion ratio	Specific growth rate
Control	0.39^{b*}	130.85^{a}	0.77^{d}	0.50^{d}
25% Artemia urmiana cysts	0.41^{b}	154.31^{d}	0.64^{a}	0.55^{c}
50% Artemia urmiana cysts	0.36^{ab}	146.62^{d}	0.68^{b}	0.40^{b}
75% Artemia urmiana cysts	0.31^{a}	138.19^{bc}	0.73^{c}	0.34^{a}
100% Artemia urmiana cysts	0.30^{a}	143.10^{cd}	0.70^{bc}	0.36^{ab}
p-value	**	**	**	**

*Letters in front of the row numbers demonstrated the significant differences

Artemia has been widely used in aquaculture due to the high nutritional value, the proper size and the possibility of enrichment. It can be used as the carrier of particles used in aquaculture such as nutrients (fatty acids, vitamins, etc.), antimicrobial substances, vaccines and probiotics. Administration of live, beneficial and non-pathogenic bacteria in the culture medium or Artemia culture can have positive effects on cultured fish species via improvement in the intestinal microbiota, eliminating harmful bacteria and improving the nutritional value of Artemia (Sorgeloos et al., 2000).

3.2 Survival rate index and obesity coefficient

The result of table 2 showed that average survival rate index was at the lowest in the 25 and 50% *A. urmiana* cysts groups and at the highest in the75% *A. urmiana* cysts instead.

Growth and survival data are powerful tools for understanding the effects of experimental diets on feeding fish larvae (Wang et al., 2005; Hoseinifar et al., 2015). In the present study, growth and survival data were evaluated therefore to show the effects of live food and artificial diet on Caspian brown trout fish. The obesity coefficient index of Caspian brown trout fish tended to decrease when the fish fed by higher amount of *A. urmiana* cysts ($p \le 0.05$). Miaolan et al. (2018) showed that there were no significant difference was observed between the average body weight of E-*Artemia* (2.38±0.40 mg) and E-*Artemia* (2.91±0.21) ($p > 0.05$). The EPA of *Artemia* fed with E-flocs was 3.00±0.46%, significantly higher than that of T-*Artemia* (1.57±0.19%).

Table 2 The average survival rate index and obesity coefficient of the treatments.

Treatments	Survival rate index	Obesity coefficient
Control	99.90^{b}	0.95^{b}
25% Artemia urmiana cysts	99.68^{ab}	0.96^{b}
50% Artemia urmiana cysts	99.68^{ab}	0.95^{b}
75% Artemia urmiana cysts	99.91^{b}	0.87^{a}
100% Artemia urmiana cysts	99.62^{a}	0.85^{a}
p-value	**	**

*Letters in front of the row numbers demonstrated the significant differences

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