FEEDING STRATEGY OPTIMIZATION OF STARRY STURGEON (*ACIPENSER STELLATUS*, PALLAS 1771) WITH ARTEMIA NAUPLII

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Abstract

The importance of feeding live food in the first stages of fish life is crucial, because the organism is not fully developed, the accessory glands and the enzymatic equipment of the digestive tract are also insufficiently developed. Natural food brings a supply of vitamins, enzymes, and hormones with a major role in the process of digestion and absorption of the food, very important in the ontogenetic development and in increasing the immunity of fish in the larval and postlarval stages. Internationally, over the years, numerous studies have been carried out on the feeding of fish with Artemia, but the present study aims to optimize the process of feeding Artemia nauplii to freshwater fish reared in a recirculating system. This brine shrimp can survive a limited amount of time in fresh water, after which it rapidly decomposes and, due to its high protein content, becomes a water pollutant for the recirculating system. From the point of view of the costs for cyst decapsulating and the energy costs for hatching, they are too costly to afford feeding "ad libitum" with nauplii the fish larvae. The use of the minimum amount of live Artemia nauplii depends on the resistance of the nauplii in fresh water, expressed in a maximum time interval of 3.5 hours, after which vital activity and very low survival are recorded. The optimal Artemia nauplii feeding requirement of starry sturgeon with an average weight of 0.26±0.15 g and an average length of 3.78±0.8 cm is about 2.26% B.W. representing a maximum of 4.5 g wet mass of nauplii administered per 1,000 of larvae daily.

Key words: *starry sturgeon, feeding, Artemia nauplii*

INTRODUCTION

Artemia salina (Linnaeus, 1758) is a brine shrimp with a high nutritional value (Millan-Alamaraz et al. 2021) and an increased protein content varying between 40-60% (Zarei, 2013) used on a large scale as food in fish and shrimp larviculture (Herawati et al. 2014). The usage of Artemia as live food in the first stages of fish development is timely to cover the enzyme requirement of the digestive tract which is not fully developed, and to provide nutrients, vitamins, and hormones (Maldonado-Montiel et al. 2005).

Usage of Artemia cysts has the advantage of allowing to obtain live food as freshly hatched nauplii with a high nutritional value in a short period, depending on necessities (Chebanov, 2013). The use of artemia nauplii for large-scale feeding of marine fish (Armugam et al. 2013) and crustaceans (Sanders, 2008) in their early life stages has been practiced for several decades worldwide, with feed rations set according to the long survival time of nauplii in salt water.

The time during which the nauplii are active in freshwater is short and it represents a limiting factor for feeding freshwater fish because the feed ration must be dosed efficiently. In the case of sturgeons (Lazu et al. 2008) and other fish with high economic value, raised in a recirculation system (Bura, 2010) it is necessary to optimize the feed

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The manuscript was received: 03.10.2022
Accepted for publication: 15.11.2022

ration (Patriche, 2001) because the decomposition of the nauplii with high protein content leads to an increase in water pollution with nitrogen compounds (Talpeș et al. 2005).

This experiment aims to determine the time interval in which Artemia nauplii are active in fresh water and the amount of nauplii consumed by starry sturgeon in the post larval to fingerlings stage reared in recirculating system (Cristea et al. 2012).

MATERIAL AND METHOD

The experiment for feeding optimization was carried out in triplicate, in the period between 02.07-18.02.2022 and was 90 starry surgeon specimens were used, (aged 52 days after hatching), from three size categories, with an average weight of 0.26± 0.15 g and an average length of 3.78± 0.8 cm, obtained because of artificial reproduction and reared in the Recirculating System of the Institute of Research and Development of Aquatic Ecology Fishing and Aquaculture Galați.

The experiment was carried out in two phases, in the first one the optimal time interval in which Artemia nauplii survive in fresh water was established, and in the second phase the average consumption of nauplii for each starry sturgeon specimen (depending on its size) was quantified.

To complete the study, a 3.5 L bottom aerated cylindroconical incubation unit was used, Ocean Nutrition cysts with 230,000 cysts per gram, decapsulated (using the method presented by Treece, G.D. (2000) were incubated with a density of 1.5 $g \cdot l^{-1}$, in a saline solution with a concentration of 15 ppt, with a constant temperature of 28oC and with an illumination intensity of 2000 lux.

The nauplii were harvested after 19 h of incubation, filtered through a 125-micron sieve and weighed, then transferred to a Berzelius beaker and 100 ml of dechlorinated tap water was added. Three samples of 1 ml each (of water with well-homogenized nauplii) were taken and the nauplii were counted under microscope, and by extrapolation the value of 57.333 nauplii per gram of wet mass was obtained.

Because in the case of determining the survival rate it is not possible to fixate the nauplii with Lugol solution, they were kept for 5-6 hours in the fridge in a temperature of 2-4ºC to slow down vital activities, aiming to facilitate their counting. After a prior homogenization, a milliliter of solution was collected with an automatic pipette and transferred on a Kolkwitz camera to count the nauplii and the unhatched cysts with the aim of establishing the hatching ratio and survival rate of the nauplii in fresh water. The samples were collected every half an hour for three hours and a half (12:00-15:30).

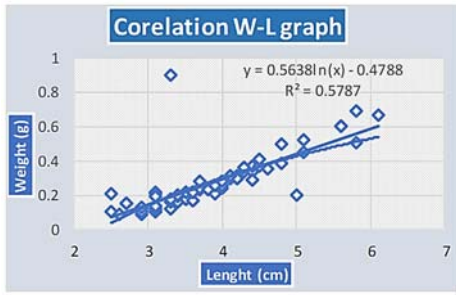
During the period selected for analysis five samples were counted using an Oxion Euromex microscope, equipped with a 3MP video camera, with a total magnification of 400x (with a 10x eyepiece and a 40x objective) under minimal light conditions, in order not to speed up the fast-swimming movements of Artemia nauplii, which exhibit a strong positive phototropic reaction.

In order to quantify the number of Artemia nauplii consumed, each fish specimen was transferred to a Petri dish (with a diameter of 10 centimeters and a volume of approx. 10 ml, on the outside of which a grid with a waterproof marker was previously created to count with a stereomicroscope the nauplii that remained unconsumed after the three hours of feeding), with water at room temperature (24ºC) and Artemia nauplii which were previously counted on the Kolkwitz chamber (Sellami et al. 2020), that were added on the Petri dish through repeated rinsing with water using a syringe of the chamber. The starry sturgeon specimens used were fasted for 14 hours. At the end of the three hours of feeding, the fish were removed from the Petri dishes and anesthetized with a clove oil solution at a concentration of 0.1 ml l^{-1} for a few seconds, to be measured and weighed each specimen, to calculate the correlation between the amount of food consumed and the size of each specimen.

The statistical analysis and graphical processing of the data was carried out with the help of the Excel software.

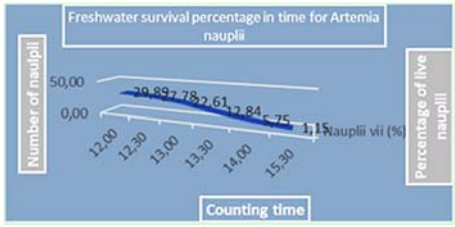
RESULTS AND DISCUSSIONS

In graph 1 the relation between mass and length of the starry sturgeon specimens used in the experiment for feeding optimization with Artemia nauplii is presented.



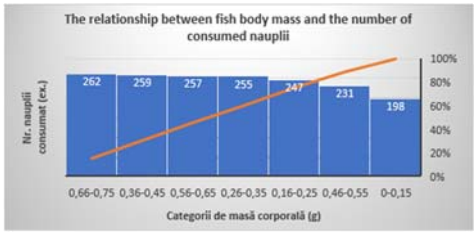
Graph no. 1

In graph 2, shown below, the nauplii activity and their survival rate in freshwater (for a period of 3,5 hours) is presented. The amount of time Artemia nauplii can be active in freshwater, mentioned in the scientific literature, varies from 30-60 minutes (Sserwadda, 2018) to 5 hours (Anonnymus, 2019). The result experiment establishes the survival rate of Artemia nauplii in fresh water accompanied by the maximum reduction of vital activity to a percentage of 1.15% after 3.5 hours. After this time interval feeding is no longer carried out in optimal parameters, because the fish no longer consider the Artemia nauplii as prey, due to the reduction of their vital activity.



Graph no. 2

The number of Artemia nauplii consumed by the starry sturgeon specimens grouped in categories based on the body mass, is presented in graph 3.



Graph no. 3

The results highlight an average consumption of 262 Artemia nauplii per starry sturgeon specimen in the category that most frequently has the average body mass in the interval 0.66-0.75 g.

Data on feeding fish in the post-larval stages are missing from the specialized literature, but the results obtained in this experiment (with an average value of 262 nauplii/specimen of trout with an average body weight of 0.705 g) can be related to a consumption of 40- 45 nauplii per fish larva, (Mal, 2021). Fish larvae, depending on the species, can have an average body mass of around 0.47 ± 0.22 mg like in the case of *Sparus aurata* (Ribeiro, 2022). For shrimp feeding during the post larvae development stage 100 nauplii/day are necessary (Alune, 2021), a stage characterized by a body mass of 1.000 specimens/g (Limuswan, 2013).

CONCLUSIONS

1-Establishing the period during which Artemia nauplii survive and swim freely in fresh water is beneficial for optimizing the feeding process, reducing the cost of feeding "ad libitum" in the early life stages of fish and avoiding the decomposition of unconsumed nauplii that can increase the level of water pollution in the recirculation system.

2-Establishing an average consumption of nauplii for starry sturgeon in the early life stages is beneficial by reducing production costs, due to minimizing losses caused by unconsumed food, and estimating through an extrapolation calculation the amount of food required for large-scale fish production in recirculating system.

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