ATTEMPTS TO REAR SALMON FRY IN RECIRCULATING AQUACULTURE SYSTEMS

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Abstract

Atlantic salmon (Salmo salar) is raised in aquaculture due to high consumer demand for fresh salmon and salmon semi-finished products. It is a healthy food due to its high content of protein and omega-3 fatty acids, being a good source of minerals and vitamins. Because salmon require special growing conditions, especially in terms of temperature, in our country there are no producers of this species. In this experiment we tried to rear, in a recirculating aquaculture system, Atlantic salmon fry to a weight of 6 g. The results of this study are encouraging regarding the growth of salmon in RAS. The weight gained and survival are comparable to those obtained in countries with experience in raising this species.

Key words: salmon, rearing, fry, recirculating system

INTRODUCTION

Because Atlantic salmon (Salmo salar) easily adapt to conditions outside its natural habitat, it is one of the most commonly cultivated species in the world.

Salmon farming began in Norway and Chile, but has expanded greatly in recent years. About 60% of the world's salmon is from aquaculture. The largest salmon producers are Norway and Chile. Together, they accounted for about 80% of total global salmon production, followed by the United Kingdom with 7.2% and Canada with 5.1% [7].

Because salmon require special growing conditions, especially in terms of temperature, in our country there are no producers of this species. In this experiment, an attempt was made to increase Atlantic salmon fry to a weight of 6 g in a recirculating aquaculture system.

Recirculating aquaculture systems have the advantage of easily controlling water quality parameters. Over time, researchers have studied the growth of salmon in recirculating systems [5; 8; 11].

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MATERIAL AND METHOD

The study took place in 2017 - 2018, for a period of 5 months, within a recirculating aquaculture system of a fish farm in southeastern Romania. 50,000 specimens of Atlantic salmon fry (Salmo salar), from the hatching of eggs in the same farm, were evenly distributed in 4 Ewos basins made of fiberglass, measuring 1.5m x 1.5m x 0.7m. The 4 lots were different by the average individual mass of the specimens and implicitly by the population density.

The water supply of the system was made from a well, drilled to a depth of 200 m, with an operating flow of 21 m3 / hour. The growth system was provided with filtration and sterilization installations, with a role in technological water conditioning. The water temperature inside was kept at 14-16ºC.

The feeding of the fish material was done ad libidum. Biomar feed with a granulation ranging from 0.5 mm and a protein content of 58% to 1.5 mm and a protein content of 54% was used. The transition to larger feed was made gradually, starting with mixing the 2 types of feed in a ratio of 1: 1 [4].

The monitoring of the physico-chemical parameters of the water was performed daily, recording the temperature, pH, and dissolved

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oxygen, using the multiparameter HQ40d Hach Lange with 2 probe connectors

Dead specimens were removed daily from each basin and recorded to assess the survival of the biological material.

In order to highlight the performance of the applied technology and of the growth system used, the technological indicators were determined. ***The weight gain*** (WG) was determined by weighing 2 samples of 100 specimens from each growth basin. It was calculated with the formula: WG = Bf - Bi [kg], where Bf, Bi - final and initial biomass of the lot [kg]. ***The individual weight gain*** represents the difference between the final and initial average mass of the specimens. ***The daily growth rate*** **(**GR**)** was calculated as the ratio between the difference of the final and initial biomass and the number of days of growth. ***The specific growth rate*** (SGR) was calculated according to the formula: SGR = [(ln final weight–ln initial weight) x 100 / time in days. ***The feed conversion ratio*** (FCR) was calculated as the ratio between the amount of feed distributed and the difference between the final and initial biomass of the lot. ***Survival*** (%) was determined by the formula: Nf / Ni x 100 [%], where - Nf, Ni represents the final and initial number of specimens

Statistical analysis

The statistical processing of the obtained data was performed through the Microsoft Excel program (Office 2010) for Windows. Statistical differences between variables were tested by the t test (comparisons between means, significance p <0.05) and the ANOVA One Way test.

RESULTS AND DISCUSSIONS

Attempts to rearing were performed in RAS because this system allows the control of living environment parameters and their treatment to ensure optimal conditions for the development of biological material [1].

The average water temperature ranged from 14.49 to 14.63^{0}C, the dissolved oxygen was maintained between 6.52-6.58 mg / l, with a saturation of 90% and the pH between 6.53-6.59 upH [2].

The technological water quality parameters (mean ± standard deviation) are presented in Table 1. The values obtained were in accordance with the recommended thresholds for raising Atlantic salmon and relatively similar in the 4 basins, the differences being statistically insignificant (P > 0.05).

Table 1 Physico-chemical parameters of technological water (mean ± standard deviation

	Temperature (°C) mean±SD	OD (mg/l) mean±SD	pH (upH) mean±SD
C1	14.63 ± 0.35	6.58 ± 0.17	6.54 ± 0.1
C2	14.49 ± 0.35	6.52 ± 0.17	6.53 ±0.12
C3	14.5 ± 0.34	6.54 ± 0.19	6.59 ± 0.12
C4	14.61 ± 0.40	6.55 ± 0.16	6.54 ±0.18

The weighing of the fish material was performed at the beginning of the experiment, periodically, during the experimental period and at the end of it, in order to follow the growth dynamics of the salmon fry from the four growing basins.

The data regarding the initial and final parameters of the biological material are presented in table 1.1

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Table 1.1 Initial and final parameters of the biological material involved in the experiment

Parameters	C1	C2	C3	C4
Initial parameters				
Number of fish	12.500	12.500	12.500	12.500
Initial individual mass (g)	0,85	0,67	0,51	0,48
Initial biomass (kg)	10,63	8,38	6,38	6,00
Initial density (kg/m³)	6,75	5,32	4,05	3,81
Final parameters				
Number of fish	10.840	10.610	10.371	10.264
Final individual mass (g)	6,53	6,43	6,37	6,35
Final biomass (kg)	70,79	68,22	66,06	65,18
Final density (kg/m³)	44,94	43,32	41,94	41,38

In all variants, it is observed that in the first month there was an increase in average body weight, followed by a decrease in the second month. In the third month of growth, in the basins where the specimens had a higher average initial body weight, a substantial increase was observed, compared to the variants in which the specimens had a lower body weight, following that, in the last two months, the batches C3 and C4 to have a significant increase compared to groups C1 and C2 ($P < 0.05$) (fig.1). In the present experiment, an increase of approximately 700% was obtained in 24 weeks, compared to the results obtained by Maage et al., 1991, which obtained an increase of salmon fry by 700% after 12 weeks [6].

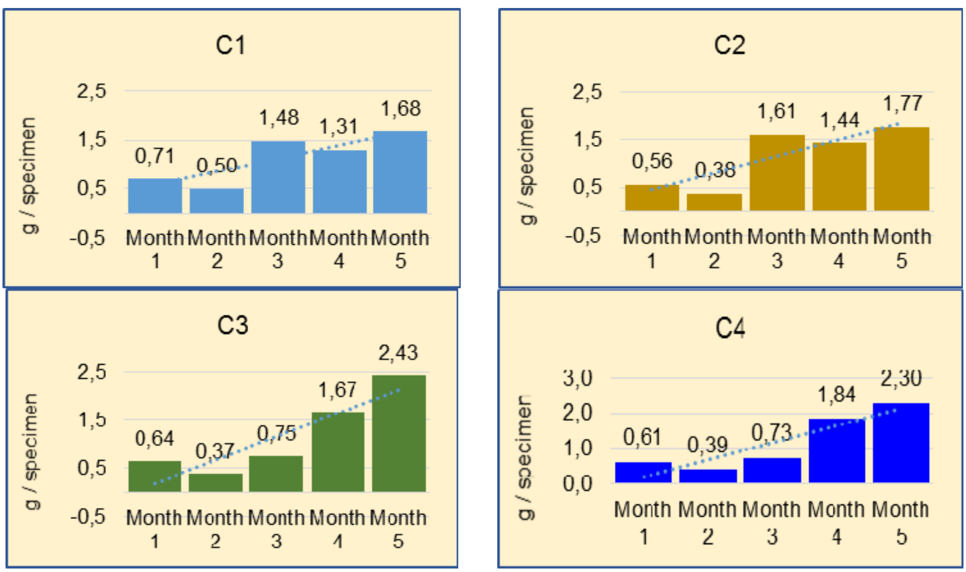

Figure 1. The evolution of the individual weight gain during the experimental period, in the rearing basins

Because the lots were divided so that the individual masses of the specimens were homogeneous in each lot, the biological material did not have to compete for food with larger specimens. The accumulation of biomass was higher in salmon fry that had a lower average weight at the beginning of the experiment. (fig. 2).

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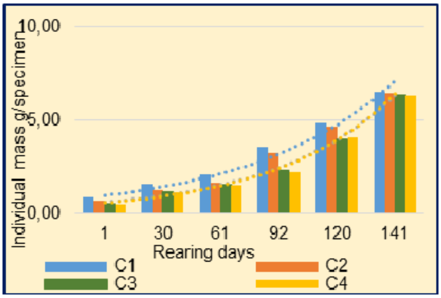

Figure 2. Dynamics of individual average masses during the growth period (Wmed)

The daily growth rate had similar values in all groups (Fig. 3). The increase in the density of biological material in basins has led to a decrease in the daily growth rate. A lower density favors better access of biological material to food. Ytteborg et al., 2016 obtained a daily growth rate of 0.17 g / day in the case of salmon fry raised for 24 weeks [12].

The final density is above that established by Yanfeng W. Et al., 2018, as the maximum, respectively 30 kg / m3 [9].

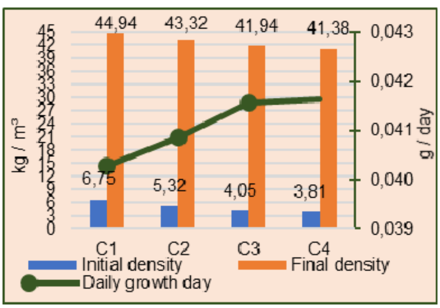

Figure 3. Evolution of stocking density and daily growth rate

The experiment of rearing salmon fry indicated a direct relationship between the evolution of the average mass accumulated during the experiment and the evolution of the density of biological material in basins. At a lower density of 41.3 kg / m3 in C4 the individual growth increase was higher (5.87g / specimen) compared to C1 (5.68 g / specimen), in which the density was of 44.94kg / m3 (Fig. 4).

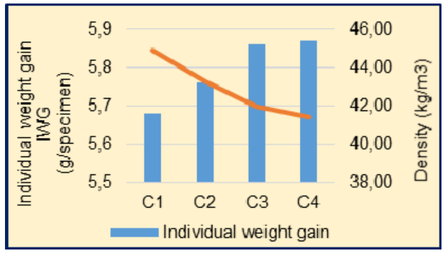

Figure 4. Correlation between storage density and individual weight gained

Survival was decreasing, being 87% lower in C1 and lower in the rest of the variants as follows: 2% lower in C2, 5% lower in C3 and 6% lower in C4 (Fig. 5).

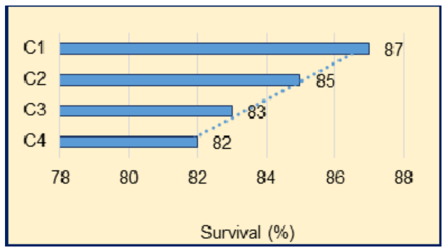

Figure 5. Survival of salmon fry during the experiment

In the present experiment, the mortality rate for salmon fry with an average mass between 6.35 - 6.53 g varied between 13% and 18%, compared to that obtained by Davidson J. et all. 2016, which varied in the analyzed batches between 9.5% -7.5%, in specimens of 340 -750 g [2].

The specific growth rate (SGR), which presents very well the dynamics of the individual growth of the biological material from the experiment, had values of 1.34% in C1, the other lots registering higher values, with 11% in C2, 23% in C3 and with 26 % higher in C4 (fig. 6).

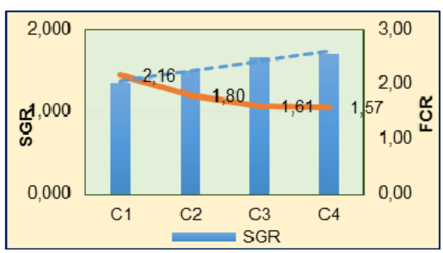

Figure 6. SGR and FCR variation during the experiment

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The specific growth rate (SGR) was similar to that obtained by Handerland in 2008, which obtained an SGR value of 1.53% / day for salmon raised at a temperature of 14°C [3]. In contrast, the values obtained for the feed conversion factor (FCR) were different from those obtained by R Weihe, 2018 for salmon raised and fed with isoenergetic diets [10].

CONCLUSIONS

• The results of this study may be the onset of Atlantic salmon production in the SAR and Romania.

• Studies must be continued in order to obtain a production with specimens of sales size on the market, knowing that the Romanian consumer prefers this species.

• The gain must be seen in the context of the need to diversify the species obtained in Romanian aquaculture.

• The economic value as well as the potential benefits of obtaining salmon in Romanian aquaculture must be a major consideration that must be clearly established before continuing a work program.

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