Horizons - International Scientific Journal | Volume I · Number I · 2024 | ISSN: 2955-2303
Published by the University "St. Kliment Ohridski" - Bitola (www.uklo.edu.mk)

(*) Corresponding author
Peer review method: Double-blind
Original research article
DOI: 10.20544/HORIZONS.1.1.24.P13
Section B

THE IMPACT OF THE ZEOLITE ON THE GROWTH OF THE COMMERCIALLY GROWN RAINBOW TROUT

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Abstract

This study evaluates the impact of zeolite supplementation in feed on the growth and condition of commercially grown rainbow trout. Over 12 weeks, 600 rainbow trout were divided into three groups (200 fish per group) and reared under standardized conditions. Group A received only commercial feed, while Groups B and C were supplemented with 1% and 2% zeolite, respectively. Growth performance and Fulton's condition factor were assessed biweekly on eight occasions.
The greatest growth was observed in Group B, followed by Group C, with the lowest growth in Group A. Fulton's condition factor decreased as fish mass and length increased, ranging from 1.34 to 0.91 in Group A, 1.34 to 0.84 in Group B, and 1.12 to 0.96 in Group C. Notably, Group C demonstrated the best final condition factor (0.96) and feed conversion efficiency.
Zeolite supplementation, particularly at 1%, significantly enhances growth performance in rainbow trout, while 2% supplementation improves condition factor and feed efficiency. These findings highlight zeolite's potential as a beneficial feed additive in aquaculture systems. Further research is recommended to optimize dosage and evaluate long-term effects.

Keywords: fisheries, rainbow trout, zeolite, conditioning factor, growth factor.

INTRODUCTION

Zeolite is natural, safe and absolutely non-toxic minerals used in industry and agriculture with multiple purposes. It does not cause any negative effects or contraindications, which is confirmed by the results obtained from the chemical and toxicological analyzes carried out by numerous professional and eminent experts.

The morphological and structural characteristics of zeolite confirm that it is an aluminosilicate mineral of volcanic origin. Its crystal lattice is negatively charged and functions as an ion exchanger.

The literature indicates that the main and fundamental role of zeolites in everyday life is their application in aquaculture. It has been proven that they realize this role through:

- ensuring pollution control in swimming pools
- removal of N-compounds from the water of hatcheries, fish transport and aquariums.

Zeolites increase the concentration of oxygen in the aquarium. Thanks to the nutritional supplement, the values of the fish growth parameters increase (Alp, 2005;Tepe et al., 2005; Aybal, 2001; Mumpton, 1999; Pond, 1984; Watten, 1985; Dryden, 1989; Peyghan et al., 2002; Ravendra et al., 2004; Kaiser et al., 2006; Torre, 2006; Kanyilmaz, 2010).

The main objective of this research is to determine the influence of the mineral zeolite added to feed on the production parameters of commercially reared rainbow trout.

Tasks of the research are:

• To determine the growth of trout;
• To determine the condition factor

MATERIAL AND METHODS

The research was conducted with an experiment that was carried out in the registered production for raising rainbow trout of Ribo export Ltd. In Gorna Banjica, Gostivar. Three pools were involved in the performance of the procedure, which were named numerically, i.e. pool no. 22(group A), no. 23(group B) and no. 24(group C).

The experiment was conducted in standardized conditions, each of the pools had dimensions: length 4m, width 1m and depth 45 cm, with a total water capacity of 1.8 m3, temperature of 11°C at an oxygen concentration of 9-11 mg/l.

In each of the three pools, 200 juvenile rainbow trout with an initial weight of 46-48 g and a length of 15-16 cm were monitored for 12 weeks.

The mass, length and width of the fish were measured for each individual in the three pools. The measurements were carried out on 6 occasions, every 14 days.

Photo 1 – Implementing fishes in pool

For all species of rainbow trout we used commercial food from the company Skretting, Italy. Which according to the instructions for use in feeding is used 1 to 2% of the biomass per day. The feed had a granulation of 4 mm and contains protein 44%, Ca 1.1%, crude fat 22%, wheat, blood products, fish oil, animal fats from poultry, mono-ammonium phosphate, wheat gluten, hydrolyzed feather meal, poultry protein, fish meal, permeate whey powder, beet oil and wheat flour.

The zeolite is a product of the company Zeo-Medic D.o.o from Belgrade, Republic of Serbia, produced in 2022.

Feed preparation

22.3 g of zeolite in powder form was added to heated water. By mixing it, a suspension was obtained in a liquid aggregate state. This suspension was then added to 2,419 kg of commercial food. The whole mixture was mixed by hand for 2-3 minutes.

The experimental procedure began with the breeding of rainbow trout samples in group A (control group), groupB (experimental group 1) and groupC (experimental group 2). In group Acommercial food without addition of Zeolite was used, in groupB, 1% zeolite was added to the commercial fish feed.In groupC, zeolite was added in a concentration of 2%.

The following parameters were monitored in all groups:

- growth of fish,
- condition factor,

Fish growth was determined by the difference in mass in two consecutive measurement times.

The condition factor was determined according to Fulton's formula (F=W(g)/L(cm)x100).

The following statistical methods were applied for the realization of the research:

- descriptive statistics of mean values for mass, length and width of fish and dispersion values (variance, standard deviation and coefficient of variation)
- universal analysis of variance (ANOVA).

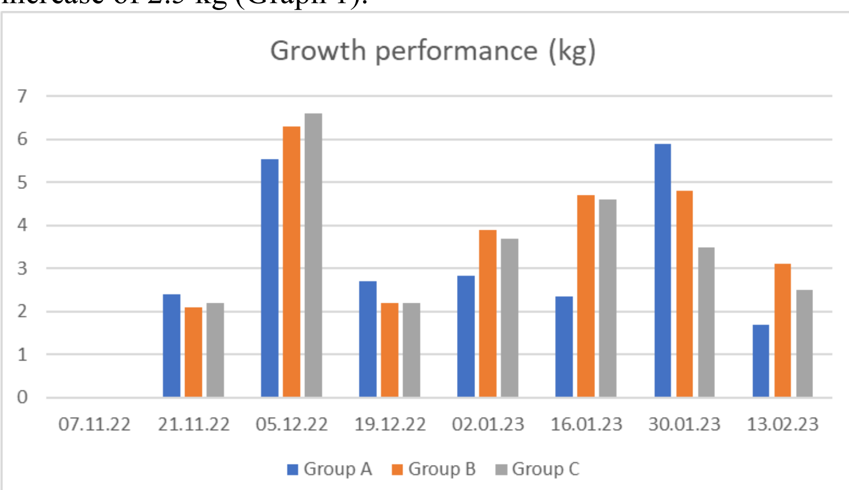
RESULTS AND DISCUSSION

GROWTH PERFORMANCE

The growth of fish during the period of measurements in group A in the first two weeks (from the first to the second measurement) is 2.4 kg, in the following two weeks (from the second to the third measurement) it is 5.53 kg, in the subsequent intervals it is 2.7 kg, 2.84 kg and 2.36kg, while in the next it is the largest of 5.9 kg. The last interval has the smallest increase in the measurement period of only 1.7 kg.

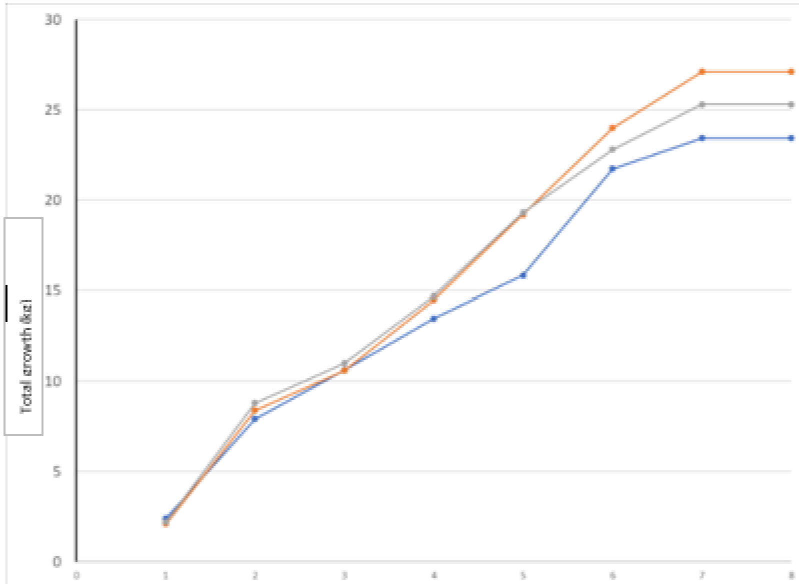
The growth of fish during the period of measurements in group B in the first two weeks (from the first to the second measurement) is 2.1 kg, in the following two weeks (from the second to the third measurement) it is 6.3 kg (the largest increase), in the subsequent intervals it is 2.2 kg, 3.9 kg and 4.7 kg, while in the next it is 4.7 kg. The last interval in the measurement period is with an increase of 3.1 kg.

The growth of fish during the period of measurements in group C in the first two weeks (from the first to the second measurement) is 2.1 kg (the smallest increase), the following two weeks (from the second to the third measurement) is 6.6 kg (the largest increase), in the subsequent intervals it is 2.2kg, 3.7 kg and 4.6 kg, while in the next it is 3.5 kg. The last interval is with an increase of 2.5 kg (Graph 1).



Graph 1: Growth performance gr. A, B and C

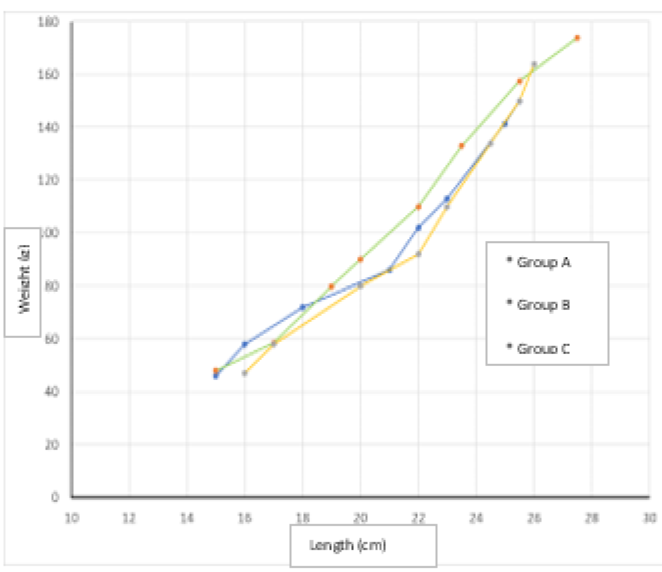
The total increase in group A is B.43 kg, in group B is 27.1 kg, while in group C is 25.3 kg. It can be noted that the fish that have the greatest increase have an addition of 1% zeolite, that is, in group B, while the fish that are fed only with commercial food have the lowest increase (graph 2).



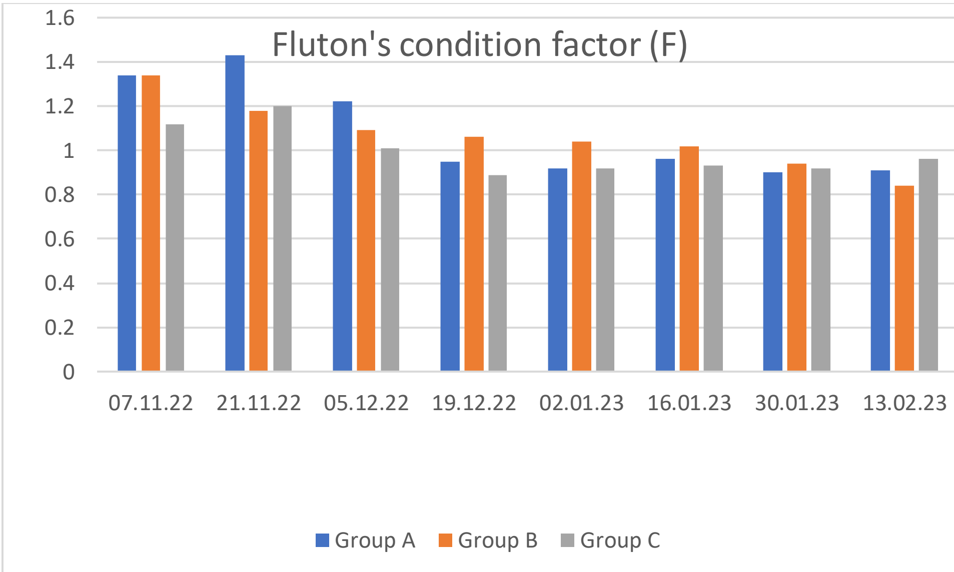
Graph 2: Total growth of fish gr. A, B and C

CONDITIONING FACTOR

The dependence between the mass and the length of the fish shows that with an increase in the mass of the fish, their length also increases, Graph 3.

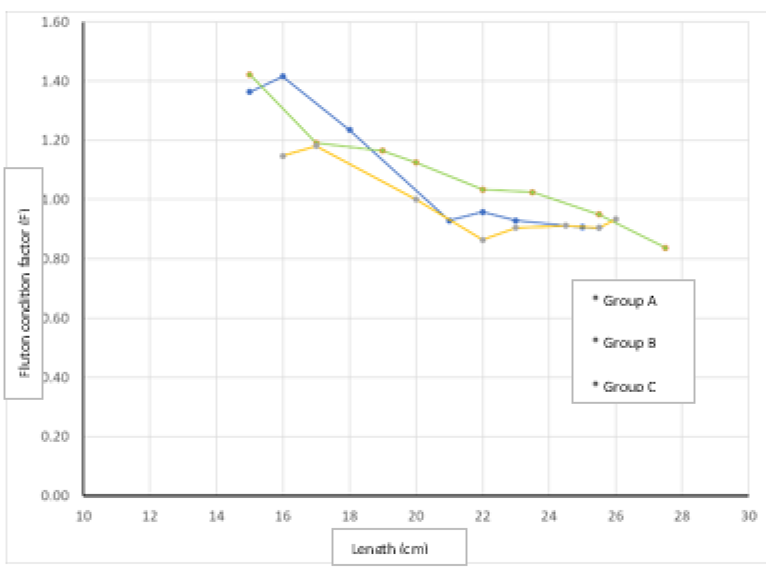


Graph 3: Dependence of mass and length of the fish

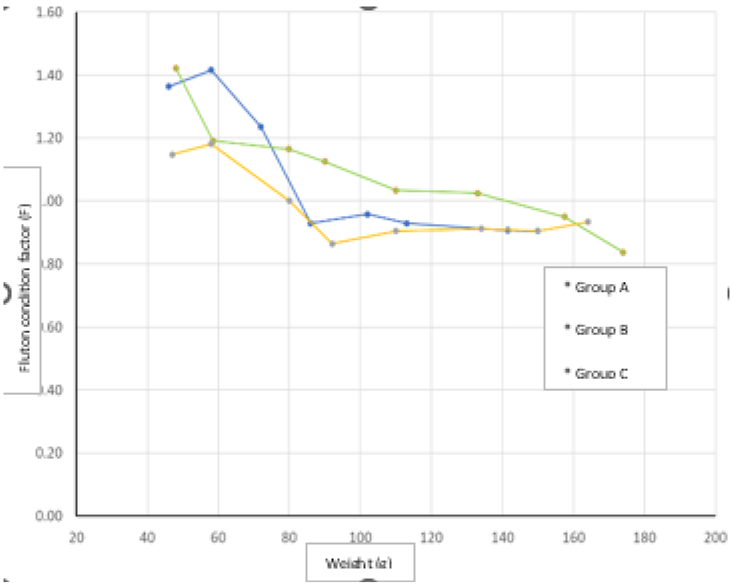


Graph 4: Comparative graph of the Fulton at all groups

The relationship between fish mass, length and Fulton's coefficient shows that as fish mass and length increases, Fulton's coefficient decreases.



Graph 5: Dependence of fish length and Fluton's coefficient



Graph 6: Dependence of fish weight and Fluton's coefficient

The growth of fish during the period of measurements in group A in the first two weeks it was 2.4 kg, the next two weeks it was 5.53 kg, the next intervals were 2.7 kg, 2.84 kg and 2.36 kg, while in the next it is the largest of 5.9 kg. The last interval has the smallest increase in the measurement period of only 1.7 kg.

The growth of fish during the period of measurements in group B in the first two weeks is 2.1 kg, in the following two weeks it is 6.3 kg in the subsequent intervals it is 2.2 kg, 3.9 kg and 4.7 kg, while in the next it is 4.7 kg. The last interval in the measurement period is with an increase of 3.1 kg.

According to the monitored dynamics, the growth of rainbow trout in group B and C showed the highest values from the second to the third measurement. In group A, the largest increase was registered in the seventh measuring interval, which was 5.6 kg. The greatest increase was measured in group C, i.e. 6.6 kg, then in group B with close values of 6.3 kg.

In the paper of Güler et al., 2018, it is indicated that zeolite positively affects many physiological parameters of fish growth. To arrive at these findings, rainbow trout (Oncorhynchus mykiss) were fed food containing zeolite at different rates (1%, 3% and 5%) for a period of three months. Also the hematological findings were analyzed by monitoring the total number of erythrocytes (RBC), total number of leukocytes (WBC),hemoglobin (Hb), hematocrit (Hct), total platelet count (PLT), erythrocyte sedimentation rate (SR), mean cell hemoglobin concentration (MCHC), mean cell hemoglobin (MCH), and mean cell volume (MCV).

At the end of the study, changes in growth parameters were determined, but the only parameter where a statistically significant difference ($p<0.05$) was detected after the applied zeolite was the fitness factor. Using of zeolite caused a change in blood indices, of which WBC, SR and MCV values were statistically significant ($p<0.05$).

Dias et al., 1998 studied the influence of dietary regimen using cellulose and natural zeolite. In their article, they monitored protein digestibility, growth, feed intake and feed conversion time in aquaculture. Effects of zeolite in preventing acute ammonia toxicity was studied in common carp by Peyghan and Takamy, (2002) and in rainbow trout by Erguen et al. (2008). Danbas (2011) studied the fatty acid levels of rainbow trout fed zeolite. Danbas and Altun (2011) investigated the effects of zeolite on some growth parameters of rainbow trout.

The obtained results indicate the fact that after the application of zeolite, advanced growth and development of the rainbow trout and correction of the biochemical and hematological parameters of the rainbow trout were registered.

The condition factor during the period of measurements in group A ranges from 1.34 (at first measurement) to 0.91 (last measurement). It is noticeable that the factor decreases with increasing mass and length of fish. In group B ranges from 1.34 (at the first measurement) to 0.84 (the last measurement). It is noticeable that the factor decreases with an increase in the mass and length of the fish, while in group C ranges from 1.12 (at first measurement) to 0.96 (last measurement). It is noticeable that the factor decreases with increasing mass and length of fish.

This result can be explained in the following way. This study from the beginning had several limitations and that is, the food was prepared for a period of 14 days and not every day, the food was applied manually and not through automatic feeders. I believe if these limitations are changed that the fitness factor would also be different.

From the research carried out regarding the food conversion coefficient, it is evident that in group A it is 0.89 (with a total of 20.9 kg of food consumed, the increase is 23.43 kg, in group B it is 0.845 (with a total of 22.9 kg of food consumed, the increase is 27.10 kg), and in group C it is 0.896 (with a total of 22.68 kg of food consumed, the increase is 25.30 kg).

Regarding the influence of zeolite on parameters important for the growth and development of rainbow trout, we found certain data in the literature. Shalaby et al. (2009) reported that the addition of zeolite at different concentrations of 1% and 2% to tilapia Zilli during 45 days resulted in an increase in body weight, an increase in specific growth rate and better efficiency in aquaculture individuals. Mostafa et al. (2010) registered that by adding 20, 40, 80 and 120 mg/l. zeolite in carp had a positive effect on growth parameters and water quality criteria. Also, Shalaby et al. (2009) reported that zeolite used as feed additive improved growth parameters, feed evaluation coefficient and water quality criteria of tilapia fish. Stetca and Morea (2013) conducted research to determine the physiological effects of natural zeolites in fish feeding and found that 3% and 7% of zeolite as a feed supplement did not change the physiological status. and 43% Ghiasai and Jasour (2012) in their study confirmed that feed conversion rate and specific growth rate increased significantly as a result of zeolite application in fish.

Danbas and Altun (2011) monitored the effect of adding zeolite to rainbow trout reared water. After applying different zeolite concentrations of 1, 2, and 3 mg/l, they observed numerous positive statistical parameters in the growth of the sample.

In the studies that follow, a series of data relating to other investigated parameters are attached. First of all, it refers to the hematological status. Namely, a low hemoglobin level indicates that the iron synthesis mechanism in the fish is damaged. This is thought to be due to the anemia present in the fish. The registered low hemoglobin values are caused by the presence of hemolysis and limited aerobic glycolysis, which stops hemoglobin synthesis.

Changes in dehydration, diet, erythrocyte synthesis, and membrane permeability cause changes in hematocrit levels. Stress in fish causes low blood pH values, increase in erythrocyte volume and a subsequent increase in hematocrit percentage (Saravanan et al., 2011). In this study, the hematocrit values obtained were higher than in the control group. (Alak et al., 2018)

From the obtained results of the conducted study and the consulted literature, the positive influence of zeolite on several parameters responsible for the growth of the examined individuals in aquaculture is evident.

CONCLUSION

The study demonstrates that the addition of 1% zeolite to commercial fish feed significantly enhances the growth of rainbow trout compared to feeding with commercial feed alone. Group A, with the zeolite supplement, achieved the highest total growth of 43.43 kg, surpassing Group B (27.1 kg) and Group C (25.3 kg). This result highlights the efficacy of zeolite as a growth-enhancing additive in aquaculture.

The condition factor analysis further supports these findings, with values in Group A showing a decreasing trend from 1.34 at the first measurement to 0.91 at the last, consistent with increasing fish mass and length. Groups B and C exhibited similar declining trends but with less significant initial and final values, emphasizing the superior growth dynamics observed in the zeolite-supplemented group.

These findings underscore the potential of zeolite as a practical and cost-effective feed additive to improve growth performance in aquaculture. Further research is encouraged to explore the long-term effects of zeolite on fish health, water quality, and its applicability across other species and aquaculture systems.

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