

THE EFFECTS OF ADMINISTERING ZEOLITES ON GROWTH PERFORMANCES IN A JUVENILE CARP POLYCULTURE (*Cyprinus carpio*) WITH SILVER CARP (*Hypophthalmichthys molitrix*) AND BIGHEAD CARP (*Hypophthalmichthys nobilis*)

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Abstract

Volcanic tuffs contain a type of minerals, called zeolites, that function as "molecular sifts" in the treatment of wastewater.

This study evaluated the influence of zeolite administration on carp brood growth in the 1st summer, it increased in polyculture with Silver Carp and Bighead Carp. The results have shown that the use of zeolite has slightly influenced the soil and water quality and has resulted in a better assimilation of feed in basin B2 than in control B1. The overall growth rate was higher in B2 than in B1 (2.346 kg versus 2.226 kg). Biological material has grown normally, without the development of pathological conditions that could influence the conduct of the experiment. The physical-chemical parameters of the water, with few exceptions, fell within the optimal range for carp growth.

Implementing this method of natural zeolite filtering would improve fish microclimate factors and increase the production of fish biomass and would obtain production increases in ecological conditions, and ensure the quality of technological water and stimulate better food assimilation.

Trough the application of carp growth technology (*Cyprinus carpio*) in summer I in polyculture using zeolites involved the administration of organic fertilizers, the use of fodder as close to ecological standards as possible and the use of zeolites to ensure the quality of technological water as to stimulate better food assimilation

The real growth gain in experiments had the highest value in B2 (conventional technology and zeolite utilization) with 2.346 kg / ha followed by B1 (conventional technology) with 2.226 kg / ha, indicating that the use of zeolite ensures both Physical-chemical parameters of the water but also contributes to a better assimilation of the food.

Key words: carp, polyculture, zeolites, growth performance

INTRODUCTION

Aquaculture is the world's fastest growing area of all branches of agriculture contributing to the overall effort to ensure healthy nutrition through intake of easily assimilable protein, unsaturated fatty acids, vitamins and minerals. The strategic objectives of medium-term aquaculture are mainly to achieve productions that meet the needs of quantitative and qualitative consumption by creating

nutritionally safe, food-safe or environmentally-friendly products. The quantifiable target is that, by 2020, aquaculture will provide a minimum consumption of 12 kg / year for every inhabitant of the planet. The study of new methods of improvement of the microclimate factors in the systematic and semi-systemic fishing units, under the conditions of applying an improved method of conservation of natural and artificial aquatic bioresources, can lead to an increase in the production of aquatic biomass, turnover, profit.

The need to carry out additional treatments with organic natural substances adsorbing /

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adsorbing water from the fish ponds in order to contain the nitrogen and phosphorus, the main eutrophication triggering agents, represents a potential solution for the application of sustainable fish farming in Romania, together with the application of methods to improve the process of water oxygenation, thus eliminating the phenomenon of "blooming with blue algae" and other pathogens that lead to the suppression of populations of invertebrates and present fish. Synthesis and uses of zeolites have become the objectives of scientific research for almost all countries of the world. Solid microporous zeolite and zeolite-type materials, due to the selective adsorption of molecules in a gaseous or liquid mixture, based on differences in size and shape, have also been called molecular sites. The zeolite molecular sieves possess negative charge networks compensated by the presence of exchangeable cations (by reversible ion exchange) and the zeolite-type molecular sieves exhibit electrically neutral networks and have no ion exchange properties.

The use of natural zeolites is a viable and efficient alternative to conventional wastewater decontamination as both cost-effective and especially because of the high ion exchange capacity (Alvarez-Ayuso et al., 2003; Vaca Mier et al., 2001; Cerjan-Stefanovici et al., 1996; Inglezakis et al., 2005). The paper presents the results of the administration of zeolite on the growth performance of carp brood (*Cyprinus carpio*) in summer I a, increased in polyculture with silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Hypophthalmichthys nobilis*). The experiment was carried out in 2016 in the Experimental Base BRATEȘ of the Research and Development Institute for Aquatic Ecology, Fisheries and Aquaculture Galati. Elements that justified this choice:

- sustainable development of aquatic bioresources using new sources of water quality;

- the attempt to introduce and use, on a larger scale in Romanian aquaculture, mineral additives such as aluminosilicates as absorbents / adsorbents, to maintain water quality and to achieve maximum biological and economic effects;

- the restoration of natural and artificial media factors using new technologies.

MATERIAL AND METHOD

The biological material under experimentation was represented by carp (*Cyprinus carpio*) in summer I, obtained in the Experimental Base Brateș, Galați and silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Hypophthalmichthys nobilis*) of the same age. Experimental lots were increased in summer I in two experimental basins - B1, B2, each having a surface of 1 ha and an average depth of 1.8 m.



Foto 1 The experimental basin B1



Foto 2 The experimental basin B2

At the basis of the organization of the experiments, the following main elements were taken into account: ensuring a habitat corresponding to the biological requirements of the fish species, to be included in the following landmarks: the surface of the basins of 1 ha; a minimum depth of 1.5 m, the growing basins have independent water supply and drainage facilities, the basins provide a complete vacuum, and the basins

are not invaded by vegetation. The popular formula was the following: 50% carp (*Cyprinus carpio*); 25% silver carp (*Hypophthalmichthys molitrix*); 25% bighead carp (*Hypophthalmichthys nobilis*).

Experimental Basin B1 (BR21) - 80,000 ex./ha in the formula: 40,000 *Cyprinus carpio* specimens, 20,000 ex./ha *Hypophthalmichthys molitrix* and 20,000 ex./ha *Hypophthalmichthys nobilis* (control basin). The experimental basin B2 - 80,000 ex./ha in the formula: 40,000 exemplars of *Cyprinus carpio*, 20,000 exemplars of *Hypophthalmichthys molitrix* și 20,000 exemplars *Hypophthalmichthys nobilis*. The mean mean body mass of the biological material was 0.3 g / ex..

The two basins were prepared, populated and fed identically. In addition, in basin B2, zeolite was acquired from SC Minerals Zeo Srl Cluj-Napoca, Cluj County. The distribution in the basin B2 was accomplished with 2 tons of natural zeolite scattered throughout the basin. A zeolite with a minimum of 60% clinoptilolite was used in the experiment and having the following chemical composition: SiO_2 ; TiO_2 ; Al_2O_3 ; CaO ; MgO ; Na_2O și K_2O . The granulation of the distributed zeolite was 1-3 mm.



Foto 3 Zeolite prepared on the shore

The methodology used to study applied growth targeted the following aspects: preparation and maintenance of basins for exploitation in polyculture; populating basins with the established popular formula; recording, studying and interpreting habitat and biotope data, based on periodic analysis; performing and recording biometrics on lots of fish harvested by control fishing during the vegetative period; statistical processing of technological indicators in order to determine the growth parameters.



Foto 4 Zeolite distributed in the basin B2

The water parameters monitored during the research were those that directly or indirectly influence the changes in the water mass, with implications for the biological material's welfare, namely: pH, temperature, dissolved oxygen, concentration of organic substances, hardness, concentration of nitrogen compounds, calcium Ca^{2+} , magnesium Mg^{2+} , report $\text{Ca}^{2+} / \text{Mg}^{2+}$, alkalinity, carbonates and bicarbonates, sulphates, phosphates and chlorides, water being classified in different quality classes according to order 161/2006. Qualitative and quantitative analysis of phytoplankton and zooplankton was performed at species level using numerical and gravimetric assessment of species.

During the experiments, control fishing was performed periodically to determine the following: mean body mass (g); growth rate (g); the health status of the biological material.

In order for the results obtained from the control fishing to be as conclusive but not to stress the biological material, the following rules have been taken into account:

fishing was done once a month; the harvesting of the juveniles was carried out in different areas of the basin; the number of chicks sampled ranged between 50-100 exemplars. Technological indicators are absolutely necessary in order to obtain information on the performance of the applied technology and the growing system used. *The real increase in growth* – (S_r) – was determined gravimetrically, and consisted of weighing two samples at the time of population, determining the initial mass and two samples at the end of the growth period, determining the final mass. It was calculated with the formula:

$S_r = B_f - B_i$ [kg] where, B_f , B_i – final biomass and initial batch [kg].

Individual growth boost – was determined by the formula:

$(W_f - W_i) / N [g/ex.]$ where,

W_f, W_i – the final and initial average mass of the lot [g];

N – number of exemplars [ex.].

Daily growth rate - (GR) - was determined by applying the formula:

$(W_f - W_i) / T [g/day]$

where,

W_f, W_i – the final and initial average mass of the lot [g];

T – cycle growth time [days].

Specific growth rate - (SGR) – was determined by the formula:

$SGR = (\ln W_f - \ln W_i) * 100 / T [\%/day]$

where,

W_f, W_i – the final and initial average mass of the lot [g];

T – cycle growth time [days].

Conversion factor of feed - (FCR) – is the amount of feed consumed to obtain one kilogram of growth. It was calculated with the formula:

$FCR = F / (B_f - B_i) [kg/kg]$

where, F - the quantity of feed administered [kg]; B_f, B_i - final biomass and initial lot [kg].

Percentage of survival - (%) - was determined by the formula:

$N_f / N_i \times 100 [\%]$

where, N_f, N_i – number of final exemplars.

The biometric method for fish is based on the comparison of different measurements with each other (reports or indices expressed as non-dimensional or percentage). The experiment duration amounted to 103 days.

The feed of the biological material was originally composed of a combined granulated feed R 60-1, with a crude protein content of 31% and a grain size of 0.2 mm to 2 mm, of Romanian origin. The biochemical composition of the feed is shown in Table 1.

Starting August, besides compound feed R 60-1, a FeedEx C 30/07 Standard Soprophish extruded feed was also given. with a crude protein content of 30% and a grain size of 2 mm, this type of feed is of Serbian origin, being imported from ECO FEED D.O.O., Serbia (importer Krallex Food Solutions Technology Co., Romania). Feeding is floating and its biochemical composition is shown in Table 1.

Table 1 Biochemical composition of food

Fodder	P %	L %	CP %	A %	PH %
R 60-1	31	12	-	6	-
FeedEx	30	7	5	8	0,8

Legend: P-protein; L-lipids; CP - Crude pulp; A-ash; PH-phosphorus

RESULTS AND DISCUSSIONS

Following the analysis of the collected data, at the end of the experiment (harvesting) in the 2 experimental basins, yields of 2.250 kg were obtained in the B1 basin (without the addition of zeolitic) to 2.370 kg in basin B2, where both supplementary feeding and, zeolite administration. The biotechnological indicators obtained are presented in Table 2.

Table 2 Bioproductive indicators obtained in experimental basins

Parameters	B1	B2
Popular		
No. exemplars	80.000	80.000
Carp	40.000	40.000
Silver carp	20.000	20.000
Bighead carp	20.000	20.000
Initial biomass – kg -	24	24
Individual weight – g -	0.3	0.3
Initial Density - kg/ha -	24	24
Harvesting		
No. exemplars		
Carp	13.520	16.268
Silver carp	8.135	9.200
Bighead carp	3.415	3.890
Final Biomass – kg-	2.250	2.370
Growth parameters		
Final individual weight - g -		
Carp	117,6	98,6
Silver carp	70,8	72,6
Bighead carp	24,6	25,2
Final Density - kg/ha -	2.250	2.370
Number of growing days	103	103
Individual growth boost - g -		
Carp	117,3	98,3
Silver carp	70,5	72,3
Bighead carp	24,3	24,9
Total increase in growth – kg -	2.226	2.346
Total distributed food - kg -	6.678	6.678
Daily growth rate g/day		
Carp	1,14	0,95
Silver carp	0,68	0,7
Bighead carp	0,24	0,24
Specific Growth Rate SGR - % zi		
Carp	6.15	5.97
Silver carp	4.39	5.65
Bighead carp	2.13	4.56

The variation of the individual growth during the whole experimental period is shown in the graphs below (fig. 1 - 2), for each experimental basins. In almost all cases, the biggest gains in weight were achieved in August from the point of view of the quantitative biomass.

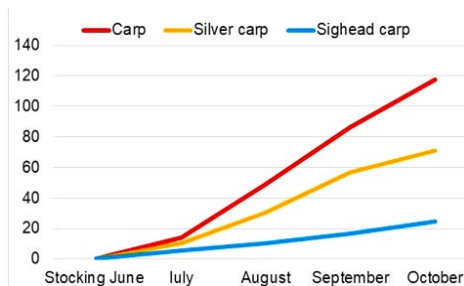


Fig. 1 Growth gain registered in B1

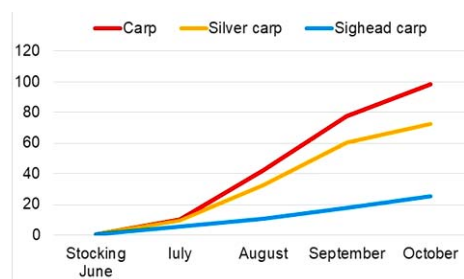


Fig. 2 The growth rate recorded in B2

Although the bighead carp has the lowest average body mass with the lowest growth rates, its growth is linear to carp and silver carp.

The dynamics of the daily growth rate and the specific growth rate are shown in the graphs below (Figures 3 and 4) where it can be seen that the highest daily growth rate for carp was 2.07 g/day in B1 in October, while the lowest was recorded in July with B2 with 0.36 g/day.



Fig. 3 Dynamics of daily growth rate in B1



Fig. 4 Dynamics of daily growth rate in B2

Growth rate dynamics follow a normal line, with higher breeds in the juvenile stage, where the highest values of 11-14% were recorded in the experimental pools. These values did not differ greatly between the two variants because in the first stage the brood better uses the natural food available in the basin.

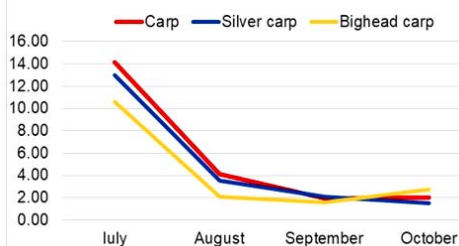


Fig. 5 Dynamics of the specific growth rate in B1



Fig. 6 Dynamics of the specific growth rate in B2

The smallest values were registered at the end of the period where there were many variations, mainly due to the variation in water temperature but also due to food assimilation in preparation for the wintering period.

CONCLUSIONS

The application of eco-efficient technologies has meant the growth of fish in polyculture, with species that can use the whole spectrum of food in a fish pond, given that at this moment in all Romanian aquaculture all carp farms use this increase in polyculture. Thus, the experiments used the growth in polyculture of the species of carp, silver carp and bighead.

The highest production, both by total and by species, was in experimental basin B2 where zeolite was administered to improve water quality and to stimulate fish appetite. Statistically, there are no significant differences ($p < 0.05$) between the results obtained in the case of silver carp and bighead carp. Considering that in B2 the production of silver carp and bighead carp was higher by 16-17% than in B1, it can be said that the use of zeolite especially favors the growth of planktonofage species, but the carp remains dependent on the use of supplementary feed to obtain superior yields. The best survival was obtained in B2, with the exception of the bighead that, having a very small average mass compared to the other species, fell more easily to the birds of prey, especially cormorants and gulls. The real growth gain gained from the experiments had the highest value in B2 (convection technology and zeolite utilization) with 2.346 kg / ha followed

by B1 (conventional technology) with 2.226 kg / ha, indicating that the use of zeolite ensures both physical-chemical parameters of the water, but it also contributes to a better assimilation of the food.

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