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An Experimental Study of the Effect of Natural Zeolite of Chankanay Deposits on Fish-Breeding and Biological and Hematological Parameters of the Body of Fish

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Abstract: This paper presents the fish-breeding and biological and hematological substantiation for the use of natural zeolites of Chankanay deposits of the Almaty region as a component of mixed production fodder for trout. As a result of studies we have determined the possibility of application of natural zeolite in the amount of 1 and 3 % as part of mixed production feed for trout. It has been also found out that the introduction of zeolite into mixed fodder had a positive effect on the growth of two-year-old trout and its physiological state. Absolute growth of trout in case of adding zeolite in the amount of 1 and 3% compared with to the control was equal to 116 and 105 % respectively. Average daily gain in the first version was higher than those of the control and the second experimental group by 0.32 and 0.15 g. The survival rate in all cases was 100%. The hemoglobin content in the blood of rainbow trout in experimental samples increased slightly and equaled 9.8 ± 0.36 (with addition of 1% of zeolite) and 9.6 ± 0.39 g/l (at 3% addition of zeolite), respectively; in the control this figure was-8.7 ± 0.57 g/l. In the numbers of leukocytes as well as the numbers of immature erythrocytes, there have been no differences between the samples. Monocytes and lymphocytes also remained within normal limits.

Key words: Rainbow trout · Zeolite · Mixed fodder · Hematology · Ration · Fodder

INTRODUCTION

With the development of marketable fish-breeding when the fish is deprived of natural food [1], its metabolism is under the control of the human and depends on the quality of feed [2]. It is feed that provides many opportunities for increasing the efficiency of all processes of fish breeding (increasing the rate of fish growth at a minimum cost of feed, reducing mortality and improving the quality of producers and their offspring) [3].

Fodder under the conditions of commercial fish farming must ensure rapid growth and development of fish, have the optimal balance of essential nutrients [4], particularly protein and fat [5] and must also contain a complex of minerals and bioactive substances, vitamins and other elements [6].

To increase the productivity of fish it is of paramount importance to improve the system of feeding. High productivity, efficient use of feed nutrients and the body's resistance to diseases at intensive fish breeding in the conditions of ponds are impossible without the use of various additives in feeding, providing the necessary level of complex nutrition of fish [7]. A search of feed and additives, which by their biological value could replace expensive feed, is performed everywhere [8]. Using the accessible and cheap natural minerals as feed additives in the diets of fish is an important reserve for increasing the efficiency of production of fishery products [9].

The usage of zeolites in mixed fodder for fish was first described in the works of A. Taratukhin and L.K. Shimulskaya (1984) [10]. Zeolites were used as feed additives for growing carp in ponds and farms in the waste waters of the thermal power station, as well as for rainbow trout [11].

The aim of investigation was fish breeding and biological and physiological grounding of the use of natural zeolites of Chankanay deposit of Almaty region in the mixed production fodder for trout by the example of two-year-olds. The goal identified the need to address the

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following objectives: to study the effect of natural zeolite on the growth, development and physiological condition of two-year-old trout and to examine hematological effects on fish at zeolite introduction into their diet.

MATERIALS AND METHODS

The studies were conducted at the Department of Veterinary and sanitary inspection and hygiene of the Kazakh National Agrarian University, in the laboratory of the Kazakhstan-Japan Center and at a trout farm in Turgen village.

To accomplish the tasks we have carried out scientific experiments on young rainbow trout breeding in the trout farm of Turgen village in Almaty region.

The experiments were conducted in accordance with the scheme of studies presented in the Table 1.

The conditions, hydrological regimes and water temperature were the same for all the experimental and control groups of trout.

The object of study was young rainbow trout. In the experimental and control groups, the initial weight of fish at stocking was 341, 348 and 333 respectively. The experimental and control groups of trout were grown in pools with sizes 2 x 2 x 0.7 m with a straight-through water supply. The water temperature in the pools at the beginning of experiments was 11.5°C and by the end of the experiments increased to 19.9°C. This temperature was above the optimum temperature for the growth of trout, therefore the experiment was terminated. Duration of the experiment was 61 days (from 21.05 till 20.07.2012). The average temperature for the whole period of experiment was 16.9°. The oxygen content was 5.5-7.2 mg/l and pH-6.6-7.2.

For the research work the authors used zeolite-a natural absorption material of Chankanay deposit of Taldykorgan district of Almaty region. Its chemical composition, in %, includes silicon oxides-55.90, aluminum-15.60, iron-5.90, Ti-0.45, K-2.15, calcium-5.57, sodium-to 3.05, magnesium-2.54, phosphorus-0.22, ion silicate-to 0.72 and other elements-3.47.

Determining the norm of zeolites input in mixed fodder we relied on the previously published data obtained during the growth of trout [11] and carp [10]. The effectiveness of diets was assessed on the fish breeding and biological (growth rate, rate of mass gain, survival, etc.) and hematological parameters (red and white blood).

Feeding was carried out manually three times a day. Feeds were added in portions and eating was monitored.

Technique for Taking Blood from Fish: Blood samples were taken with a Pasteur pipette from the tail vein of a hungry fish, contained in well-aerated water for 5-10 minutes after the capture.

Determination of Hematological Parameters in Fish: To conduct hematological studies of fish we used automatic hematology analyzer "SysmexF-820"

Table 1: The experimental scheme

No. of group	Number of fishes	Conditions of experiment
Control	50	100% BD
1 experimental	50	99% BD + 1% of zeolite of Chankanay deposit
2 experimental	50	97% BD + 3% of zeolite of Chankanay deposit

Note: abbreviation: BD-basic diet

Table 2: Results of two-year-old trout growing which diet was added with zeolite

	Average mass, g		Gain		
Group	Initial	Final	Absolute growth, g	Relative gain, %	Daily average gain, g
I experimental	341±19.6	457±21.63	116	34.01	1.9
II experimental	348±19.9	453±19.5	105	30.17	1.75
Control	333±20.1	428±17.9	95	28.52	1.58

Table 3: Hematological parameters of trout growing

Indicator	Value in 1 experimental group	Value in 2 experimental group	Value in control	Indicator in the norm
Hemoglobin content in blood, g%	9.8±0.36	9.6±0.39	8.7±0.57	8-10
Number of immature erythrocytes, %	6.2±0.22	6.1±0.31	6.7±0.35	5-10
Number of leucocytes, thousand/mm^3	59.3±0.27	60.2±0.45	60.0±0.56	50-60
Lymphocytes,%	88.3±1.54	87.3±1.51	89.2±1.43	86-90
Monocytes, %	6.5±0.72	6.3±0.69	6.1±0.67	6-9

fordiagnostic testing of whole blood samples with internal dilution and use of special disposable systems with EDTA (disodium salt of ethylenediaminetetraacetic acid).

Main Part: The next stage of research work after the experiment with fish and feed additives for trout was the study of their impact on all life processes of fish. First assessed were fish-breeding and biological indicators of two-year-old trout breeding and then the physiological state of the fish was assessed.

The results of studies on the effectiveness of natural zeolites of Chankanay deposit of Almaty region as an additive to production mixed fodder for growing young rainbow trout are shown below in Table 2.

The final weight of two-year-old trout in all experimental variants was higher compared with the results of fish cultivation in the control groups.

During the study, it was found out that the introduction of zeolite into the feed had a positive effect on the growth of young trout and its physiological state.

Absolute growth of young fish for 61 days in the experimental pools at the addition of zeolite in the amount of 1 and 3% relative to the control was equal to 116 and 105% respectively.

Average daily gain in the first case (1%) exceeded the ones of the control group and the second experimental group by 0.32 and 0.15. The survival rate in all cases was 100%.

The influence of zeolite on the physiological properties of rainbow trout can be characterized by such a measure, as the composition of blood. Feed, including zeolite, had no significant effect on the physiological state of the fish. The hemoglobin content in the blood of young rainbow trout in the experimental variants was 9.8±0.36 (1% zeolite) and 9.6 ± 0.39 g/l (3% zeolite), respectively; in the control this figure was-8.7±0.57 g/l (the differences are reliable at $p = 0.01$). As it can be seen from Table 3, in the experiments and control the differences were small. According to the results of obtained hematological data it was possible to conclude about the good physiological state of the farmed fish.

There have been no differences between the variants on other hematological indicators-the number of leukocytes, as well as the number of immature erythrocytes. All of them were included in the scope of standard values. At a norm of 50-60 thousand/mm^3 the level of white blood cells in fish of experimental groups was 59.3 ± 0.27 thousand/mm^3 and 60.2 ± 0.45 thousand mm^3 compared to 60.0 ± 0.56 thousand/mm^3 for the fish in the control. The bulk of the white blood cells was represented by lymphocytes (88.3 ± 1.54), that proves the absence of deviations from the physiological norm in the trout body. Monocytes also remained within the normal limit and there were no significant deviations during the test period.

CONCLUSION

The physiological state of the two-year-old trout at adding the natural mineral zeolite in the mixed fodder in the amount of 1 and 3% in the end of growing complied with the norm both in the experimental and control groups.

Findings: As a result of research of fish breeding and biological and hematological parameters of the two-year-old trout which feed was added with 1 % and 3 % natural mineral zeolite we have obtained the following data: the absolute growth of young fish for 61 days of cultivation in the experimental pools with the addition of 1 and 3 % of zeolite relative to the control was equal to 116 and 105 %, respectively. Average daily gain in the first case (1%) exceeded those of the control group and the second experimental group by 0.32 and 0.15. The survival rate in all cases was 100%.

The hemoglobin content in the blood of rainbow trout in the experimental variants was 9.8±0.36 (1% zeolite) and 9.6 ± 0.39 g/l (3% zeolite), respectively and in the control it was-8.7±0.57 g/l. On other hematological parameters, the number of white blood cells as well as the number of immature red blood cells, there were minor differences.

Thus, the introduction of 1 and 3 % of the natural mineral zeolite into the feed of a two-year-old rainbow trout did not have a negative impact on fish-breeding and biological and hematological parameters of fish body. According to the obtained results we can conclude about a good physiological condition of two-year-old rainbow trout.

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