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STUDY OF THE INFLUENCE OF BIOLOGICALLY ACTIVE ADDITIVE USING MICROALGAE ON THE GROWTH AND MICROFLORA OF RAINBOW TROUT

Abstract. The aim of this work was to study the effect of biologically active feed additive based on microalgae on the growth parameters and microflora of fish.It was found that the growth rate of fish is directly depended on the amount of chlorella suspension in the feed. Higher length and weight measurements of trout were observed in the variant with the addition of a chlorella suspension in the volume of 10 ml/kg compared to the other variants of our experiment. The variant grown with the addition of chlorella suspension in the amount of 10 ml/kg, had greater increase in weight by 112.7, than the control and experimental variants grown with the addition of chlorella suspension in the amount of 5 and 15 ml/kg, showing indicators of 98.2, 97.5, and 99.6, respectively.The survival of fish during the study period remained at a high level (100 %) in the second experimental variant .Survival rate in the control group was reported 97 % and the first variant showed 97.7 %. Despite a significantly high growth rate, the survival rate of fish was amounted to 96.5% in the third variant, Perhaps this is due to the fact that in conditions of excessive intake of chlorella suspension into the environment and with its incomplete assimilation by fish, there is a high reproduction of microalgae in the aquatic environment. Quantitative and qualitative analysis of rainbow trout microflora was carried out in control and experimental variants.The calculation of TMC (full abbreviation) in the bodies of trout in the control variant showed that the number of bacteria ranging from $2{,}1\times10^5$ to $3{,}8\times10^5$CFU/g in the intestine.Bacterial contamination of the liver was insignificant, and the omch (full abbreviation) index is not more than 1×10^2 KOECFU/g wet weight.Gill contamination ranged from $2{,}1\times10^4$to 3×10^5 CFU/g. In the experimental variants with the addition of *Chlorella vulgaris* suspension, the omch indices of different trout organs did not differ significantly from those of the control variant. In the intestine, the number of bacteria ranges from $3{,}1\times10^5$ to $3{,}8\times10^5$ CFU /g, in the liver no more than $2{,}6\times10^2$CFU /g wet weight. The insemination of gills was reported from 3×10^5 to 5×10^5 CFU /g. The selected associations of microorganisms consist of both saprophytic and opportunistic bacteria. The studies found that the qualitative composition of the microbiocenosis of trout in both control and experimental versions/variants is represented by 4 main genera *Lactobacillus, Aeromonas, Pseudomonas* and *Acinetobacter*. But the numerical ratio of the bacterium of the genus *Lactobacillus* was much higher in the experimental variants, in particular in the second variant of the experiment, compared with the control and other variants of the experiment.In addition to the representatives of these genera, representatives of the genera *Micrococcus, Sarcina, Bacillus, Enterobacter, Escherichia, Serratia, Proteus* and *Vibrio* were alsofound in different proportions in the trout microflora.The results obtained in the course of the studies allow us to recommend the introduction/addition of feed additives based on microalgae *Chlorella vulgaris* to the composition of feed for trout fish, which allows to increase the growth rates and maintain the physiological state of fish at the appropriate level.

Key words: *Chlorella vulgaris*, rainbow trout, biological active additive, microflora.

Nutrition is the basis of life of fish and any other organism. It is known that fish feed with a large variety should be available both from biological and physiological position [1]. From a biological point of view, food should be available structurally and spatially so that fish can consume it without excessive

energy consumption. From a physiological point of view, the food should be acceptable in taste and smell, easily digested and provide all the energy and plastic needs of the body.

High productivity and rational use of feed are possible only when fish farming facilities are fully provided with the necessary amount of protein, fat, carbohydrates, minerals and vitamins and receive enough energy to carry out their vital functions. Abundant and complete feeding, especially at a young age, contributes to an increase in weight, more rapid achievement of puberty, a clear manifestation of the signs of the exterior. Studies have shown that, providing optimal conditions for metabolic processes in the body of fish, you can achieve an increase in their growth rate with a decrease in 2-3 times the feed consumption. Such results can be obtained through proper feeding, which involves the use of diets containing all the necessary substances for the animal body [1].

Currently, the domestic feed industry is experiencing an acute shortage of quality feedstock. To overcome the crisis in domestic feed production, a number of issues are considered, the main of which are: improving feed formulations with the addition of various natural biologically active substances. At the same time, the use of natural biologically active substances is promising, which provide correction of the standard feed diet and composition of the resulting fish products for the missing nutrients [2]. Currently, the use of various microalgae as biologically active additives to feed is of great interest. It is known that microalgae have a unique biochemical composition, contains a wide range of biologically active substances – vitamins, macro-and microelements, amino acids and functional pigments [3]. In this regard, the search for new, non-traditional sources of biologically active substances for feeding fish is one of the most urgent problems of today.

In this regard, the aim of this work was to study the effect of biologically active feed additives based on microalgae on the growth and microflora of fish. Rainbow trout (*Oncorhynchus mykiss)* is selected as the object- the type that is attributed currently to the genus of Pacific salmon (*Oncorhynchus)* of the salmon family *(Salmonidae)*. Rainbow trout meat is provided with easily digestible proteins, unsaturated fatty acids, trace elements and vitamins that are important for human nutrition. Rainbow trout is one of the first places in the world fish market.

Materials and methods of research. The study was conducted on the basis of Turgen trout farm, located in Almaty region, Enbekshikazakh district, Turgen village. For the experiment in the aquarium installation, rainbow trout fry were selected, the average mass of which at the beginning of the experiment was about 50 – 54.1 g. [1, 7]. The control and 3 experimental groups of 10 individuals each were formed by the method of analogues. The juveniles were grown in aquariums with a capacity of 250 l. the duration of the experiment was 10 weeks. The control group received a complete feed Aller silver (Poland). The composition of the feed included: vitamins, premixes and minerals, corn gluten, poultry flour, feather flour, sunflower protein, blood products, wheat gluten, canola, rapeseed oil, fish oil, fish flour, soy protein, soy. The nutritional value of this feed was: crude protein – 45 %, fat – 22 %, carbohydrates -20%, fiber-2%, phosphorus 1%, energy value - 22.3 MJ. As a biologically active additive, *Chlorella vulgaris* suspension and juveniles of the 1st, 2nd and 3rd experimental groups were used, the same compound feed enriched with an additional suspension of *Chlorella vulgaris* microalgae was obtained at the rate of 5, 10 and 15 ml per 1 kg of fish weight, respectively.*Chlorella vulgaris*suspensionin 1 mlcontained 3 million/s. Feeding rainbow trout during the experiment period was performed 6 times a day, in the daytime at regular intervals. Weekly studies were conducted on the growth and development of rainbow trout on the basis of the results of control catches. The weight method was used. According to the results of weighing, the value of the absolute growth of juveniles was calculated. The absolute increase is calculated by the difference between the initial and final weight of the fish for the period. The relative increase was calculated by the formula:(1) where M0, MP – the average weight of fish at the beginning and end of the period, respectively. To characterize the intensity of growth, indicators of fish fatness coefficient were used [3]. At the end of the experiment, control and experimental groups of trout fish planting material were collected for microbiological studies. Microbiological studies of gills, liver and intestines of control and experimental groups of fish planting material were carried out. 3 fish specimens from each variant of the experiment and control were selected for the autopsy. From selected samples made the seeding of the environment General purpose and selective nutrient medium with three replications to determine KMAFAnM and the number of conditionally pathogenic bacteria. To determine the total bacterial contamination of fish organs, primary bacteriological crops were carried out on fish-peptonic and meat-

peptonic agar media. Enterobacteriaceae bacteria were determined by fermentation in a storage medium and were detected by incubation in an Endo medium at a temperature of 37 °C [4]. The study of morphological, cultural, biochemical properties of the isolated microorganisms was carried out according to the General requirements and recommendations for microbiological studies GOST ISO 7218-2011 [5]. The isolated bacteria were screened out for 1 % of simple agar in test tubes, assigned an individual culture code, and then identified to the genus by conducting and determining the morphological, tinctorial, some biochemical properties of the isolated microorganisms. Spent crops on differential nutrient media: Endo, YSA. To determine the number of lactic acid microorganisms in the intestine of fish, the method of deep sowing of the selected sample for cabbage agar was used. The crops were incubated for 5 days at a temperature of 30 °C. the Number of microorganisms was determined from calculations for 1 g. Identification to the genus was carried out by gram staining followed by microscopy, determination of the ability to capsule and sporulation, tests for oxidase and catalase activity and mobility. At the same time, the isolated microorganisms were identified by determinants [7,8]. Tests for oxidase and catalase activity were performed in accordance with GOST 18963-73. Drinking water was used. Methods of sanitary – bacteriological analysis. The resulting digital material was statistically processed using the program Statistica 6.0.

Research results and discussion. As it is known, the rapid growth of fish and high productivity are achieved only if the fish are provided with the necessary amount of nutrients –protein, fat, carbohydrates, minerals, vitamins – and get enough energy to carry out vital functions [9]. Growth processes in hydrobionts depend on a whole complex of external and internal factors, among which one of the most important is trophic, since the composition of food and the degree of its availability largely determine the linear-weight characteristic of fish [10]. In terms of aquaculture, trout are grown on artificial animal feed, the raw material for the production of which should best match the natural food of fish. Introduction of rainbow trout components uncharacteristic for natural nutrition into the feed composition can have a significant impact on fish metabolism and, as a result, lead to changes in their physiological state and growth processes [11]. The study of the dynamics of the mass of rainbow trout fry in our experience showed that the initial mass of the sample of juveniles in all groups was the same about 55.3–56.7 g. Observations of the process of feed intake by rainbow trout showed that when feeding fish in control and experimental containers, the time of feed intake was different. In General, the eating time of both control and experimental fish ranged from 5 to 20 minutes.

According to the study of feeding rainbow trout feed with the addition of suspension of microalgae *Chlorella vulgaris* found that the growth rate of fish was similar in the control and experimental versions with a tendency to increase absolute growth (table 1).

However, between the experimental groups of fish, the weight gain and growth of rainbow trout differed and depended primarily on the composition of the feed, since the other conditions of trout cultivation were the same. It was found that the growth rate of fish directly depended on the amount of Chlorella suspension in the feed. A high increase in the length and weight of the trout was observed in the second variant compared to the other variants of our experiment. At the end of the experiment in the variant with the addition of Chlorella suspension in the amount of 10 ml/kg, the trout weight gain was 112.7, and in the control and experimental variants with the addition of Chlorella suspension in the amount of 5 and 15 ml/kg, these indicators were 98.2, 97.5, and 99.6, respectively. It is shown that in the second variant there is 12.7% more weight gain compared to other variants.

There are a number of indicators to characterize the physiological state of fish. The most common among them are: Fulton fatness coefficient. This indicator makes it possible to determine the effect of feed used on metabolism and to identify the causes of its positive or negative action [3]. During the research period, the determination of the Fulton fatness coefficient, reflecting the relationship between the weight and length of fish, allowed to analyze the physiological state of rainbow trout (table 2).

The analysis of the obtained results shows that the feed enriched with Chlorella suspension used in feeding did not have a negative impact on the physiological state of rainbow trout, which does not contradict the data of other studies [12]. Moreover, it should be noted that the coefficient of fatness of trout increased on average from 3 to 3.2 in the experimental versions.

Table 1 – Growth parameters of rainbow trout

Week	Experiment variant	Weight, g	Length, sm	Increase of weight, g	Increase of length, sm
1	Control	52,3±1,5	10,2	–	–
	1 variant	53,4±1,3	10,1	–	–
	2 variant	51,7±1,2	10,2	–	–
	3 variant	54,1±1,1	10,4	–	–
2	Control	58,1±1,4	11,8	11	15,6
	1 variant	60,2±1,2	11	12,7	8,9
	2 variant	58,6±1,2	11,6	13,3	13,7
	3 variant	60,1±1,1	11,1	11	6,7
4	Control	67,1±2	12,5	28,2	22,5
	1 variant	68,0±1,2	12,5	27,3	23,7
	2 variant	69,1±1,3	12,6	33,6	23,5
	3 variant	69,8±1,1	12,5	29	20,1
6	Control	78,7±1,2	13	50,4	27,4
	1 variant	81,5±1,3	12,8	52,6	26,7
	2 variant	82±1,2	13,2	58,6	29,4
	3 variant	83±2,4	13	53,4	25
8	Control	95±1,3	14,1	81,6	38,2
	1 variant	95,8±1,2	13,8	79,4	36,6
	2 variant	98±1,3	14,2	89,5	39,2
	3 variant	97±1,2	14,4	79,2	38,4
10	Control	103,7±1,2	15,2	98,2	48
	1 variant	105,5±1,3	15	97,5	48,5
	2 variant	110±1,2	15.1	112,7	49
	3 variant	108±2,4	15,1	99,6	45,1

Table 2 – Morpho-physiological characteristics of rainbow trout

Indicators	Control (feed)	Feed+*Chlorellavulgaris* 5 ml	Feed+ *Chlorellavulgaris* 10 ml	Feed+*Chlorellavulgaris* 15 ml
Weight, g	103,7±1,2	105,5±1,3	110±1,2	108±2,4
Length, sm	15,2	15	15.1	15,1
Fatness coefficient	2,9	3,1	3.2	3,1

Thus, according to the results of studies, there was a significant positive effect of the Chlorella suspension Supplement on the morpho-physiological parameters of rainbow trout growth and development. It was found that the most effective was the feed with the addition of Chlorella suspension in the amount of 10 ml/kg. These data indicate a positive effect of feed additive in the form of *Chlorella vulgaris* suspension on the growth of rainbow trout.

Survival of fish during the study period remained at a high level in the second experimental version was 100 %. Survival in the control group was 97 % and in the first variant 97.7 %. In the third variant of the experiment, despite a significantly high growth rate, the survival rate of fish was 96.5%. Perhaps this is due to the fact that in conditions of excessive intake of Chlorella suspension into the environment and with its incomplete assimilation by fish, there is a high reproduction of microalgae in the aquatic environment. As you know, their excessive reproduction in the aquarium can lead to a deterioration in the conditions of growing fish, which can thereby affect their survival [12].

As it is known, the state of the microflora of any living organism, including fish, is a determining factor in the normal functioning of the entire immune system as a whole. The microflora of fish is concentrated mainly in the mucus on the scales, on the surface of the gills and in the digestive tract. At the same time, the digestive system is of the greatest interest, since it is a kind of protective barrier between the internal environment of the body and the foreign environment, a special role in which belongs to the normal intestinal microflora, as well as the liver, where the toxic substances of food are detoxified, not neutralized by its enzymatic cleavage.

In this regard, at the next stage of the study of the effect of biologically active feed additives on the growth and development of fish, the study of the state of the microflora of rainbow trout when feeding feeds enriched with suspension of*Chlorella vulgaris* microalgae.

Quantitative and qualitative analysis of rainbow trout microflora in control and experimental variants was carried out. The calculation of TMN in trout organs in the control variant showed that the number of bacteria in the intestine varies from $2{,}1\times10^5$to $3{,}8\times10^5$CFU /g. Bacterial contamination of the liver was insignificant, the TMN index is not more than 1×10^2 CFUn/gof wet weight. The insemination of gills was from $2{,}1\times10^4$to 3×10^5 CFU /g.

In the experimental variants with the addition of *Chlorella vulgaris* suspension, the TMN values of different trout organs do not differ significantly from those of the control variant. So in the intestine the number of bacteria varies from$3{,}1\times10^5$ to $3{,}8\times10^5$CFU /g, in the liver no more than $2{,}6\times10^2$ CFU /g of wet weight. The insemination of gills was from $3\times10^5$to 5×10^5 CFU /g.

According to the literature, the microbial number on the gills can vary widely from $6x10^2$to $2{,}2x10^6$CFU /g. [13]. It is known that the composition of the microflora of the outer covers is closely related to the conditions of fish [14]. In case of unsatisfactory water condition due to the measures taken to intensify production or damage to the tissues of the Gill epithelium, the level of bacterial contamination in fish increases.

The total number of bacteria in the intestine according to some authors, varies in different species of fish within 10^2 to 10^{12}cl. per 1 gram wet weight. However, most authors point to the 10^5 – 10^8 cl/g [15]. This variation seems to be related not only to the species diversity of the fish studied, their habitat and physiology, but also to the methods of counting bacteria used by different researchers. After all, it should be noted that the methods for studying the attached intestinal microflora of fish are mainly based on the homogenization of the intestine and subsequent crops of homogenates on various selective media, which, as is known, can detect only microorganisms that can grow on specific environments. The intestine also contains anaerobic bacteria, many of which are known to be resistant to cultivation in the laboratory. In this connection, it is possible and there is a slight underestimation of the population of bacteria.

At the end of incubation of cups with crops from various organs of fish in general, 12 isolates of bacteria with different morphotypes of colonies, from trout organs were isolated into a pure culture.

Morphological characters were studied in 12 selected isolates of bacteria (shape, motility, presence of capsule and the ability to spore formation), identified by their Gram – and has explored some of the cultural (the growth pattern of the selected cultures on solid and liquid media) and biochemical properties.

The study of cultural and morphological properties of the detected and isolated cultures of bacteria found that the trout microflora is represented by mobile and non-mobile, gram-positive and gram-negative cocci and sticks. At the same time, it should be noted the dominance of mobile gram-negative bacteria (sticks) in the control variant, which is 67 % of all isolated microorganisms in trout. During the test to determine the oxidase activity revealed 5 oxidase-positive, 5 oxidase-negative strains and 2 cultures with questionable results in trout. The test for catalase activity of bacterial cultures isolated from trout showed 2 catalase-negative, 8 catalase-positive strains and 2 strains showed ambiguous results (table 3).

Bacteriological study of various organs of fish in experimental variants showed that gram-positive sticks and cocci dominated in all variants of the experiment in the incidence.

Determination of isolated isolates of bacteria was carried out before the genus and, in some cases, before the family. Selected association of micro-organisms are composed of both saprophytic and opportunistic bacteria.

Table 3 – Numerical ratio of belonging to the genera of selected microorganisms, %

Taxon (kind)	Numerical ratio of belonging to the genera of selected microorganisms, %			
	Control (feed)	Feed+Chlorellavulgaris 5 ml	Feed+ Chlorellavulgaris 10 ml	Feed+Chlorellavulgaris 15 ml
Sarcina	6 ± 0,5	5 ± 0,5	5,5± 0,5	5 ± 0,5
Micrococcus	5 ± 0,5	6 ± 0,5	5± 0,5	6 ± 0,3
Aeromonas	16 ±1	12±1,5	11±1,5	12± 1
Vibrio	8 ± 0,5	8± 0,5	7±1	8± 0,5
Acinetobacter	10 ± 0,5	9 ± 0,5	10 ± 0,2	10± 0,3
Pseudomonas	12 ±1	11 ± 1	10± 1	12± 1
Enterobacter	6 ± 0,5	5±1	4 ± 0,5	5± 0,5
Escherichia	7± 1	5 ± 0,5	4 ± 0,5	5± 0,5
Serratia	6 ± 1	7 ± 0,5	3 ± 0,5	5 ± 0,5
Bacillus	3± 0,5	3± 0,5	3± 0,5	3± 1
Lactobacillus	11±2,5	18± 2	22± 2,5	17± 1
Proteus	8± 0,5	6± 1	4± 0,5	5 ± 0,5

During researches it is established that the qualitative composition of the microflora of trout in the control and experimental variants are represented by 4 major branches: *Lactobacillus, Aeromonas, Pseudomonas* and *Acinetobacter*. But the numerical ratio of the bacterium of the genus Lactobacillus was much higher in the experimental variants, in particular in the second variant of the experiment, compared with the control and other variants of the experiment.According to literature sources, it is known that the bacteria of the genus *Lactobacillus* are very demanding on food sources and do not grow on simple media. Most bacteria in this family need "arginine, cysteine, glutamic acid, leucine, phenylalanine, tryptophan, tyrosine, valine". The suspension of Chlorella is rich in these substances and getting into the gastrointestinal tract of the macroorganism, first of all, becomes the optimal nutrient medium on which lactic acid bacteria develop rapidly [16]. In addition to representatives of these genera in the microflora of trout in different proportions were also representatives of the genera: *Micrococcus, Sarcina, Bacillus, Enterobacter, Escherichia, Serratia, Proteus* and *Vibrio*.

Despite the fact that Pseudomonas, Vibrio and aeromonad as opportunistic microorganisms under certain conditions, can cause epizootics, they are representatives of normal microflora of fish.

In General, the results correspond to what is known from the literature. According to some authors in the composition of the microflora of the fish in the norm encountered opportunistic microorganisms, among which the representatives of families: *Pseudomonadaceae* (*Pseudomonas* kind), *Vibrionaceae* (*Aeromonas* kind) and *Enterobacteriaceae* [17]. On the skin and gills are common bacteria of the genera: *Aeromonas, Pseudomonas, Citrobacter, Proteus, Enterobacter, Escherichia, Cytophaga, Flavobacterium, Micrococcus, Staphylococcus, Enterococcus* [18].

A balanced diet of fish is an important factor in ensuring their normal functioning and proper metabolism. The correct organization of biologically complete feeding of fish contributes to the maximum manifestation of their genetic potential. The data obtained allow us to conclude about the positive effect of biological feed additives based on microalgae *Chlorella vulgaris* on fish microflora, morphophysiological indicators of growth and development of rainbow trout, with the most effective volume of the Supplement is 10 ml per 1 kg of live weight of fish.

As is known, Chlorella suspension is not only a source of proteins, vitamins, macro-and microelements, but also a source of biologically active substances with a high antagonistic effect in relation to opportunistic microorganisms [19]. It is known that the normal functioning of many systems and organs of animals, including fish, largely depends on the species composition and inter-species ratio of microorganisms that inhabit their intestines.The obtained positive effect of the Supplement on the growth and development of fish can be explained by the fact that the use of feed supplements based on microalgae *Chlorella vulgaris* in the feed for trout increases the contamination of their intestines lactic acid

bacteria, which, in turn, have an antagonistic effect on a wide range of pathogenic and opportunistic microorganisms. Thus, the restoration of the microbiocenosis of the gastrointestinal tract allows to increase the resistance of fish to adverse factors, increase growth rates, improve metabolism, increase the digestibility of nutrients in the diet and increase the survival of fish by stimulating their growth and development [20].

The results obtained in the course of the studies allow us to recommend the introduction of feed additives based on microalgae *Chlorella vulgaris*to the composition of feed for trout fish, which allows to increase growth rates and maintain the physiological state of fish at the appropriate level.

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МИКРОБАЛДЫРЛАР НЕГІЗІНДЕГІ БИОЛОГИЯЛЫҚ БЕЛСЕНДІ ҚОСПАЛАРДЫҢ ҚҰБЫЛМАЛЫ БАХТАХТЫҢ ӨСУІНЕ ЖӘНЕ МИКРОФЛОРАСЫНА ӘСЕРІН ЗЕРТТЕУ

Аннотация. Жұмыстың мақсаты микробалдырлар негізінде алынған биологиялық белсенді қоектік қоспалардың балықтардың микрофлорасы мен өсу параметрлеріне әсерін зерттеу болып табылды. Балықтардың өсу қарқындылығы жемдегі хлорелла суспензиясының мөлшеріне тікелей байланысты екендігі анықталды. Бахтахтың ұзындығы мен массасының өсуінің жоғарғы көрсеткіші экспериментіміздің басқа нұсқаларымен салыстырғанда құрамында 10 мл/кг мөлшерінде хлорелла суспензиясы қосылған нұсқада байқалды. Тәжірибе соңында 10 мл/кг мөлшеріндегі хлорелла суспензиясы қосылған нұсқада бахтах салмағының өсімі 112,7 құрады, ал мөлшері 5 және 15 мл/кг хлорелланың суспензиясы қосылған бақылау және тәжірибелік нұсқалардабұл көрсеткіштер тиісінше 98,2, 97,5 және 99,6 құрады. Зерттеу кезінде балықтардың өміршеңдігі екінші тәжірибелік нұсқада жоғары деңгейде сақталып, 100% құрады. Бақылау нұсқасында өміршеңдік 97% және бірінші нұсқада 97,7% құрады. Тәжірибенің үшінші нұсқасында өсудің айтарлықтай жоғары көрсеткішіне қарамастан, балықтардың өміршеңдігі 96,5% - ды құрады. Бұл хлорелла суспензиясының балықтар мекендейтін ортаға артық мөлшерде түсіп, оны балықтардың толық игере алмағандығынан микробалдырлардың сулы ортада жаппай көбеюімен байланысты болуы мүмкін. Бақылау және тәжірибелік нұсқаларда құбылмалы бахтахтың микрофлорасының сандық және сапалық талдауы жүргізілді. Бахтах органдарында ЖМК есептеу бақылау нұсқасында ішек бактерияларының саны $2{,}1\times10^5$ пен $3{,}8\times10^5$ КТБ /г аралығында ауытқығанын көрсетті. Бауырдың бактериялық тұқымдылығы шамалы, ЖМК көрсеткіші ылғалды салмағының 1×10^2 КТБ бірл./г тең болды. Желбезектеріндегі тұқымдылығы $2{,}1\times10^4$ мен 3×10^5 КТБ /г. аралығын қамтыды. Chlorella vulgaris суспензиясы қосылған тәжірибелі нұсқаларда бахтахтың әр түрлі органдарының ЖМК көрсеткіштері бақылау нұсқасынан айтарлықтай айырмашылығы болмады. Ішегінде бактерия саны $3{,}1\times10^5$ мен $3{,}8\times10^5$ КТБ /г аралығында ауытқыса, бауырында ылғалды салмағынан $2{,}6\times10^2$ КТБ /г-нан асқан жоқ. Желбезектеріндегі бактериялардың тұқымдылығы 3×10^5 пен 5×10^5 КТБ/г. аралығын құрады. Микроорганизмдердің бөлінген ассоциациялары сапрофитті және шартты патогенді бактериялардан тұрады. Зерттеу барысында бахтах микробиоценозының сапалық құрамы бақылау және тәжірибелік нұсқаларда Lactobacillus, Aeromonas, Pseudomonas және Acinetobacter негізгі 4 туысынан құралғаны анықталды. Бірақ Lactobacillus туысының бактерияларының сандық арақатынасы тәжірибелік нұсқаларда, атап айтқанда тәжірибенің екінші нұсқасында, бақылаумен және тәжірибенің басқа нұсқаларымен салыстырғанда әлдеқайда жоғары болды. Бахтах микрофлорасында аталған туыс өкілдерінен басқа Micrococcus, Sarcina, Bacillus, Enterobacter, Escherichia, Serratia, Proteus және Vibrio туыс өкілдері де әртүрлі қатынаста кездесті.Жүргізілген зерттеулер барысында алынған нәтижелер өсу көрсеткіштерін арттыруға және балықтардың физиологиялық жағдайын тиісті деңгейде ұстауға мүмкіндік беретін Chlorella vulgaris микробалдырлар негізінде бахтах балықтары үшін құрама жем құрамына жемдік қоспа ретінде енгізуді ұсынуға мүмкіндік береді.

Түйін сөздер: Chlorella vulgaris, құбылмалы бахтах, биологиялық белсенді қоспа, микрофлора.

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ИССЛЕДОВАНИЕ ВЛИЯНИЯ БИОЛОГИЧЕСКИ АКТИВНОЙ ДОБАВКИ НА ОСНОВЕ МИКРОВОДОРОСЛЕЙ НА РОСТ И МИКРОФЛОРУ РАДУЖНОЙ ФОРЕЛИ

Аннотация. Целью настоящей работы явилось изучение влияния биологически активной кормовой добавки на основе микроводорослей на параметры роста и микрофлору рыб. Выявлено, что темпы роста рыб напрямую зависели от количества суспензии хлореллы в корме. Высокий прирост длины и массы форели наблюдался в варианте с добавлением суспензии хлореллы в объеме 10 мл/кг по сравнению с остальными вариантами нашего эксперимента. В конце опыта в варианте с добавлением суспензии хлореллы в количестве 10 мл/кг прирост массы форели составил 112,7, а в контрольном и в опытных вариантах с добавлением суспензии хлореллы в объеме 5 и 15 мл/кг, эти показатели составили соответственно 98,2, 97,5, и 99,6. Выживаемость рыб в период исследований сохранялась на высоком уровне во втором опытном варианте и составила 100 %. Выживаемость в контрольной группе составила 97 % и в первом варианте – 97,7 %. В третьем варианте опыта, несмотря на значительно высокий прирост роста, выживаемость рыб составила 96,5%. Возможно это связано, с тем что в условиях избыточного поступлении суспензии хлореллы в среду обитания и при не полном ее усвоении рыбами наблюдается высокое размножение микроводорослей в водной среде. Проведен количественный и качественный анализ микрофлоры радужной форели в контрольном и опытных вариантах. Подсчет ОМЧ в органах форели в контрольном варианте показал, что в кишечнике количество бактерий колеблется от $2{,}1\times10^5$ до $3{,}8\times10^5$ КОЕ /г. Бактериальная обсемененность печени была незначительной, показатель ОМЧ равен не более чем 1×10^2 КОЕ ед/г влажного веса. Обсемененность жабр составила от $2{,}1\times10^4$ до 3×10^5 КОЕ /г. В опытных вариантах с добавлением суспензии *Chlorellavulgaris* показатели ОМЧ различных органов форели не существенно отличаются от таковых контрольного варианта. В кишечнике количество бактерий колеблется от $3{,}1\times10^5$ до $3{,}8\times10^5$ КОЕ /г, в печени не более чем $2{,}6\times10^2$ КОЕ /г влажного веса. Обсемененность жабр составила от 3×10^5 до 5×10^5 КОЕ/г. Выделенные ассоциации микроорганизмов состоят как из сапрофитных, так и из условно-патогенных бактерий. В ходе исследований установлено, что качественный состав микробиоценоза форели как в контрольном, так и в опытном вариантах представлен 4 основными родами *Lactobacillus, Aeromonas, Pseudomonas* и *Acinetobacter*. Но численное соотношение бактерии рода *Lactobacillus* было намного выше в опытных вариантах, в частности во втором варианте опыта, по сравнению с контролем и остальными вариантами опыта. Кроме представителей перечисленных родов, в микрофлоре форели в разном соотношении встречались также представители родов *Micrococcus, Sarcina, Bacillus, Enterobacter, Escherichia, Serratia, Proteus*и *Vibrio*. Полученные в ходе проведенных исследований результаты позволяют рекомендовать введение в состав комбикормов для форелевых рыб кормовой добавки на основе микроводорослей *Chlorellavulgaris*, позволяющей повысить показатели роста и поддерживать физиологическое состояние рыб на соответствующем нормам уровне.

Ключевые слова: Chlorella vulgaris, радужная форель, биологическая активная добавка, микрофлора.

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