



Influence of different feeds and feed additives on fish-breeding and biological indicators at rearing rainbow trout

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Abstract

The paper analyzes an influence of various feeds and feed additives on fish-breeding and biological indicators at rearing rainbow trout. Experimental data indicate a positive influence of probiotic "Biocons" in composition of the feed on fish-breeding and biological indicators of both juveniles and commercial trout. As a result of research, the norms for introduction of probiotic action "Biocons" into artificial trout starter and production feed in the amount of 0.5% were tested. With a probiotic effect, the developed feed for trout can improve fish productivity, reduce the cost of feed for production, by increasing weight and increasing survivability. On the basis of obtained data on the positive influence of probiotic preparation "Biocons" on fish-breeding and biological indicators of juvenile and commercial trout, the feasibility of including probiotic in starter and production domestic feeds for trout was confirmed.

Keywords: trout, fish feed, fodder coefficient, fish-breeding and biological indicators, basin technology

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INTRODUCTION

Rainbow trout - a cold-water fish, a pelagic predator with portion feeding. With a lack of favorite objects, it quickly goes on to feed by other forms, it is relatively easily subject to domestication (Scherbina and Gamygin 1980).

Modern trout breeding - a high-intensity farm with concentrated fish rearing while ensuring optimal environment conditions (Brignonet et al. 2018, Grigoriyev and Sedova 2008). Despite the rather complicated rearing technology, trout occupy a leading position in aquaculture (Ward et al. 2018, Vorobiyeva 1999). As an object of fish rearing, it is in demand in most countries of the world, including Kazakhstan (Mente et al. 2018, Yuca et al. 2015). Fast-growing fish, which include trout, is characterized by good feed intake and rapid weight gain. These properties are most often possessed by stocky form fish (Davooabadi and Shahsavari 2013, Molchanova and Khrustalev 2017). The decrease in catch of valuable species of fish from natural reservoirs is compensated by their intensive rearing in artificial conditions. The intensity of growth processes of trout is largely determined by the composition of feed, which is used when it is rearing (Vasilyeva et al. 2015). Moreover, the need of fish varies

depending on the age, size, puberty, hydrochemical properties and water temperature, as well as on the quality characteristics of the nutrients of the feed (Kanidiyev and Gamygin 1977). The method of feeding and the frequency of feeding is essential (Titarev 1980). The frequency of feeding juveniles also depends on the weight of reared fish. The smaller size and weight of fish, the more often it should be fed (Kanidiyev and Gamygin 1977). Feed storage conditions should be strictly followed (Titarev 1980).

Properly selected feed and feeding technologies - fundamental factors for success in trout breeding (Ryzhkov et al. 2014, Ünal et al. 2014). At present, fish breeding in Kazakhstan is based mainly on the use of foreign feed. The active development of aquaculture in Kazakhstan is held back for a number of reasons, the most important of which is the lack of competitive domestic feed. One of the ways to improve the quality of artificial feed is the inclusion of special biologically effective additives, that is, preparations of probiotic action (probiotics). Nutrient feed requirements for

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rearing fish, namely, protein, amino acids, fat, carbohydrates, energy, mineral elements, vitamins, depends on the species composition of fish, their age, and also on combination with natural feeds (Alpeysov 2014). Numerous studies have already proven the effectiveness of probiotics in the fight against pathogens of various bacterial fish infections. The variety of microbial species that have been studied as probiotic preparations for agricultural use is quite large. The use of probiotics has a positive effect on the fish growth rate, contributes to better digestibility of feed. Inclusion, effect of a number of probiotics have been shown to be effective in combating rapid water pollution in low-flow reservoirs. Probiotics designed specifically for the needs of aquaculture are a new direction. One of the biotechnical methods of intensive fish breeding is the feeding of fish with artificial feed, the recipe of which will be balanced for main nutrients and, importantly, will be made from available local raw materials, which will reduce its cost. It should be noted that rainbow trout better assimilate artificial feed than brook (Sabodash 2002). It should be noted that the feeding of trout is carried out in accordance with the standards proposed by the producers of mixed feeds, and the size of the diet is determined according to special tables taking into account the weighed fish and water temperature. At rearing planting material rainbow trout also, the mode of feeding is important. It is necessary to feed the trout carefully, strictly according to the norm, despite the fact that it can eat feed in excess (Galasun 1875). Excessive feeding leads to unproductive feed costs and water pollution, insufficient to incompletely realize the potential growth rate of fish (Pivtorak and Bobel 2017).

At rearing trout in basins, it is necessary to strictly observe the rearing technologies and the planting density, not exceeding it. And not observance of technology and excess of density, lack of sanitary and preventive actions can lead to disease of fishes (Crank et al. 2019).

The effectiveness of feed depends on the physiological value of feed, and on the entire biotechnology of rearing fish (Rusakyavichus et al. 1978).

Today, a variety of feed allows to obtain the best fodder coefficient, rapid growth and minimal impact on the environment in different conditions, as feed fully satisfy the need for fish nutrients (energy, protein, minerals and vitamins).

The reduction of stocks of valuable fish species in fishery reservoirs of republic dictates the need for development of commercial fish breeding. For the dynamic development of fish breeding, it is necessary to develop biotechnical techniques that ensure the profitability of production, food and environmental safety of fish products. Basins are the most productive for rearing trout. Gravity basins are optimal (Isbekov et al. 2016).

MATERIALS AND METHODS

In the process of implementing R&D on "Development and implementation of biotechnical methods of rearing trout using domestic feed with the inclusion of probiotic preparations to improve rearing conditions and increase fish productivity" was carried out jointly by "Kazakh Research Institute of Fisheries" and "Kazakh Research Institute of Processing and Food Industry" tested domestic feed with inclusion of probiotic preparation at rearing rainbow trout in the basins on the base of LLP "Chilik Pond Fish Farm" using water from an artesian well. The task of fish-breeding research included an evaluation of effectiveness of influence of the probiotic preparation "Biocons" included in the composition of artificial starter and production feeds on the fish-breeding and biological indicators of trout in conditions of basin technology. Trout rearing was carried out in basins using water from an artesian well on a direct-flow water supply. To evaluate the quality of artesian water entering the fish-breeding tanks, a general hydrochemical analysis was carried out according to the standard technique. When rearing trout, the regulatory and technical base and guidelines for basin technologies for rearing trout were adopted as the initial technological standards.

During the rearing period, fish were weighed regularly, waste was taken into account daily, observations were made of the physiological state of fish, water temperature and oxygen content.

To establish the shelf life of developed new feed for trout, mixed feed were laid on storage in production conditions in storage of LLP "Kazkorm". Storage of an experimental batch of feed was carried out under naturally occurring conditions and its quality was determined at the beginning of storage and after 2 and 4 months.

RESULTS AND DISCUSSION

According to organoleptic and physico-mechanical indicators of mixed feed for trout must comply with requirements specified in **Table 1**.

The feed included probiotic "Biocons" in the amount of 0.5%. Trout rearing was carried out in 2 stages.

I stage of trout juvenile rearing was divided into two periods:

1st period - Trout juvenile was reared from larvae that switched to external feeding with an average weight of 0.1 g to juvenile with an average weight of 1 g. The experiment lasted 35 days.

2nd period - Trout juvenile was reared from an average weight of 1 g to 5 g. The experiment lasted 35 days.

At I stage, experiments were carried out using three types of artificial starter feed for trout juvenile:

Variant №1 - starter feed of domestic production without the inclusion of probiotic preparation;

Table 1. Technical requirements for the quality of probiotic mixed feed for trout

The name of indicators	Characteristics and norms	
	starter with probiotic "Biocons"	production with probiotic "Biocons"
Appearance, color	grains and granules obtained as a result of extrusion correspond to the appearance and color of the components used in manufacture of trout feed (from light to dark brown).	
Smell	specific, characteristic of mixed feed for fish, but not putrid and not musty	
The residue on the sieve with holes with a diameter of 1 mm, %, not more	5.0	
Size of feed grains (granules), mm	1.0 - 2.5 - 8.0	
Mass fraction of humidity, %, not more	10.0	
Content of probiotic in feed, %, not less	1.0	
Mas. share of crude protein, %, not less	53	45
Mas. share of crude fat, %, not less	13	13
Mas. share of crude fiber, %, not more	2.0	4.0
Mas. share of crude ash, %, not more	10.0	
Lysine, %, not less	3.5	3.0
Methionine, %, not less	0.8	0.8
Methionine + cystine, %, not less	1.0	1.0
Phosphorus, %, not less	0.9	0.9
Calcium, %, not less	1.2	1.2
Peroxide number of fat, % iodine, not more	0.3	
Acid number of fat, mg KOH/g, not more	30.0	
Water resistance, min, not less	120.0	
Swelling of granules, min, not less	15.0	
Friability of granules, %, not more	1.0	
Presence of pathogenic microorganisms	not allowed	
Toxicity	not allowed	

Table 2. Fish-breeding and biological indicators of trout juvenile when fed with various starter feeds

Indicators	Experience variants		
	№ 1	№ 2	№ 3
Type of feed			
Duration of experiment, days	35	35	35
Density of planting, pcs/m ³	10000	10000	10000
Initial mass, g (X±m)	0.13±0.01	0.11±0.01	0.12±0.01
C _v , %	0.18	0.19	0.17
Final mass, g (X±m)	1.21±0.26	1.32±0.21	1.28±0.23
C _v , %	0.36	0.32	0.34
Absolute growth gain, g	1.08	1.21	1.16
Average daily growth gain, mg	30.8	34.5	33.1
Fodder coefficient, units	1.14	1.02	1.06
Survivability, %	84.6	89.7	86.2

Note - №1 - domestic starter feed without probiotic (control); №2 - domestic starter feed with probiotic "Biocons" (0.5%); №3 - starter imported feed "Aller Aqua"

Variant №2 - starter feed of domestic production with the inclusion in the composition of feed of probiotic preparation "Biocons" in the amount of 0.5%;

Variant №3 - starter feed of foreign production (company "Aller Aqua", Denmark).

At II stage, duration of experiment was 55 days. The source material was juvenile rainbow trout with an average weight of 5 g. Three types of artificial feed for trout fingerlings were used for feeding:

Variant №1 - production feed of domestic production without the inclusion of probiotic preparation;

Variant №2 - starter feed of domestic production with the inclusion in the composition of feed of probiotic preparation "Biocons" in the amount of 0.5%;

Variant №3 - production feed of foreign production (company "Aller Aqua", Denmark).

According to the results of experiment at I stage, the influence effectiveness of probiotic preparation "Biocons" included in the composition of artificial domestic starter feed on fish-breeding and biological indicators of trout juvenile reared in basin technology conditions was evaluated and a comparative analysis was performed with other starter feeds. Data on fish-

breeding and biological indicators of trout juvenile when fed with artificial starter feeds at I stage (1st period) are presented in **Table 2**.

The best value of fodder coefficient with probiotics was 1.02 units. The value of this indicator differed slightly from the similar value of imported feed and was only lower by 0.04 units (3.92%), as compared with the control (feed without inclusion of probiotic preparation) - by 0.12 units (11.76%), which is a more significant difference. According to the results of I stage of 1st period, it can be concluded that introduction of probiotic preparation "Biocons" into the starter feed for trout juvenile had a positive influence on the growth and survivability of trout juvenile.

Data of fish-breeding and biological indicators of trout juvenile when fed with starter artificial feeds at I stage (2nd period) are presented in **Table 3**.

The best indicators were observed in trout juvenile, where was used domestic feed with probiotic "Biocons" 0.5% (variant №2), in second place - juvenile, which was fed with foreign feed "Aller Aqua" (variant №3) and in third place - indicators of trout juvenile, which were fed domestic feed without inclusion of probiotic preparation

Table 3. Fish-breeding and biological indicators of trout juvenile when fed with starter artificial feeds at I stage (2nd period)

Indicators	Experience variants		
	№ 1	№ 2	№ 3
Type of feed			
Duration of experiment, days	35	35	35
Density of planting, pcs/m ³	7000	7000	7000
Initial mass, g (X±m)	1.11±0.18	1.12±0.16	1.13±0.17
C _v , %	0.35	0.36	0.34
Final mass, g (X±m)	4.64±0.41	5.67±0.32	5.35±0.36
C _v , %	0.21	0.18	0.19
Absolute growth gain, g	3.53	4.55	4.22
Average daily growth gain, mg	100	130	120
Fodder coefficient, units	1.19	1.04	1.08
Survivability, %	90.5	94.3	92.1

Note - №1 - domestic starter feed without probiotic (control); №2 - domestic starter feed with probiotic "Biocons" (0.5%); №3 - starter imported feed "Aller Aqua"

Table 4. Fish-breeding and biological indicators of trout fingerlings feeding on artificial production feeds when rearing in basins

Indicators	Experience variants		
	№ 1	№ 2	№ 3
Type of feed			
Duration of experiment, days	55	55	55
Density of planting, pcs/m ³	2000	2000	2000
Initial mass, g (X±m)	5.6± 0.26	5.4±0.28	5.5±0.23
C _v , %	0.18	0.19	0.17
Final mass, g (X±m)	25.3±1.37	27.2±1.26	26.8±1.29
C _v , %	0.13	0.11	0.12
Absolute growth gain, g	19.7	22.1	21.3
Average daily growth gain, mg	358	402	387
Fodder coefficient, units	1.2	1.1	1.12
Survivability, pcs.	1702	1750	1726
Survivability, %	85.1	87.5	86.3
Fish productivity, kg/m ³	43.0	47.6	46.2

Note - №1 - domestic starter feed without probiotic (control); №2 - domestic starter feed with probiotic "Biocons" (0.5%); №3 - starter imported feed "Aller Aqua"

(variant №1). The final mass value of trout juvenile in variant №2 (with probiotic) was 5.56 g, and survivability was 85.3%. These indicators were higher than in variant №3 (imported feed) by 0.26 g and 4.1%, respectively, in variant №1 (control) by 1.16 g and 7.7%, respectively. The fodder coefficient with probiotics was 1.04 units and did not differ significantly from imported feed, was lower by 0.04 units; and in control - 0.15 units. The inclusion of probiotic "Biocons" (0.5%) into the artificial starter feed suggests that it has a positive influence on the fish-breeding and biological indicators of trout juvenile.

Data of fish-breeding and biological indicators of trout fingerlings feeding on artificial production feeds are presented in **Table 4**.

The best values were observed in trout fingerlings, where probiotic "Biokons" was used in feed (variant №2), fingerlings, who were fed with foreign food "Aller Aqua" (variant №3), ranked second; in third place are the indicators for trout fingerlings, who were fed with domestic feed without inclusion of a probiotic preparation (variant №1). At the same time, all values of fish-breeding and biological indicators of trout fingerlings differed slightly from the best ones.

The value of fodder coefficient with inclusion of probiotics (1.1 units) differed slightly from the imported feed and was lower only by 0.02 units; lower than in the control - 0.1 units. In all variants of experiment high fish productivity is shown. But the best indicator of fish productivity was noted in variant №2 (food with probiotics), where it was 47.6 kg/m³. This indicator was

higher than in variant №3 (foreign feed) by 1.4 kg/m³ and by 4.6 kg/m³ than in the control. It should also be noted that the values of survivability in all variants of experiment were higher than normative: in variant №1 by 5.1%; in variant №2 - by 7.5%; in variant №3 - by 6.3%. These indicators indicate a good quality of the feed used.

Thus, the inclusion of probiotic "Biocons" in the amount of 0.5% into the composition of artificial production feed had a positive effect on the improvement of fish-breeding and biological indicators of trout fingerlings, which made it possible to reduce fodder coefficient by increasing growth and increasing survivability, resulting in an increase in trout fish productivity when rearing in basins.

CONCLUSIONS

As a result of the research, norms for introduction of probiotic preparation "Biocons" into artificial trout starter and production feed in the amount of 0.5% (in 2015) and 1% (in 2016) were tested.

The inclusion of probiotic "Biocons" (0.5%) into composition of artificial starter and production feed had a positive effect on the improvement of fish-breeding and biological indicators of trout. This made it possible to reduce fodder coefficient by increasing growth and increasing survivability, resulting in an increase in trout fish productivity when rearing in basins.

The presence of probiotics “Biocons” in domestic feeds had a positive effect on the improvement of fish-breeding and biological indicators of both juvenile and commercial trout. The presence of probiotic preparation in domestic feeds has had a positive influence on the survivability of juvenile and commercial trout, and its growth rate, thereby confirming the positive immunostimulating effect of “Biocons” on juvenile and commercial trout.

According to the results of general evaluation of studied artificial feed, domestic feed with probiotic “Biocons” (1%) was recognized as the best, foreign feed

“Aller Aqua” ranked second, and domestic feed without probiotic was third. The differences in data obtained are statistically significant. Domestic starter and production feeds with inclusion of probiotic “Biocons” were not inferior in their properties to foreign feed produced by “Aller Aqua”, which indicates their competitiveness.

On the basis of obtained data on the positive effect of probiotic preparation “Biokons” on the fish-breeding and biological indicators of trout juveniles and fingerlings, the feasibility of including probiotic in starter and production domestic feed for trout was confirmed.

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