

Influence of protein feeding when growing carp in ecological conditions

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Abstract. The article describes the results of a study on increasing the proportion of protein in feed for Parsi carp by adding rapeseed meal. In order to determine the effect of rapeseed meal as a source of additional protein for carp, it was added to the feed of the experimental group, followed by comparison of growth results with the control group, where it was not added. As a result of the research, it was established that the experimental group was ahead of the control group in terms of average weight gain by 14.61% by the end of the study. The fish selected for the study had the same weight at the beginning of the experiment, but during the experiment, individuals receiving food with a protein content of 45% at each weighing were ahead in growth of their counterparts from the control group, receiving food with 35% protein. The average weights of fish from group I were more than those from group II by 2.29, 4.98, 7.57, 9.92, 11.52, 14.13, 14.61%, respectively.

1 Introduction

In 2023, there are still certain problems with protein feeding in the fish farming industry in the Russian Federation. One of them is the insufficient production capacity for protein feed in the country. This results in the proportion of imported protein feeds remaining high, which poses a challenge when there are trade or policy restrictions on the import of feed ingredients into the country. There is also a problem with the affordability of protein feed. High production and transportation costs of feed affect the cost, which becomes a problem for small and medium-sized fish farms. To solve these problems, it is necessary to increase the production capacity of protein feed in the country. It is also important to invest in research and development of new protein sources, such as alternative plant protein sources or synthetic protein analogues. This will help expand the list of available protein sources for fish, reducing dependence on imports. In addition, it is important to develop and implement effective feed control and management systems that optimize the use of protein feeds and improve the nutritional value of fish feed. Developments in the field of fish feeding help reduce import dependence and increase the country's food security [4,7].

The Parsi breed of carp is one of the varieties of carp bred during breeding work. It gets its name from its place of origin - Parsk, which is a region in Iran. The Parsi breed of carp is often characterized by its characteristics, such as color, size, body shape, etc. Like other varieties of carp, Parsi carp can be bred for a variety of purposes, including commercial

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farming or aquarium farming. It is important to take into account the characteristics of the breed when developing a feeding program and ensuring optimal housing conditions to achieve the best results [3].

Research shows that protein feeding can significantly affect the growth rate of carp. Protein is an important nutritional component for the growth and development of fish. Protein-rich food can help fish gain weight faster and improve overall health. However, the effectiveness of protein supplements may depend on several factors, including their composition, quality and correct dosage. It is also important to consider the balance of all nutritional components in the carp diet to avoid undesirable consequences such as deficiency or excess of certain nutrients. For optimal results, it is recommended to consult with experienced professionals or research scientific research to determine the best feeding practices for carp based on your specific husbandry conditions and breeding goals [6].

2 Materials and methods

Studying the effectiveness of protein supplements on the growth rate of carp is relevant in modern aquaculture for reasons such as:

1. Increase fish production: Protein supplements can improve the nutritional value of carp's diet and speed up their growth. This allows fish producers to increase production and achieve higher yields.
2. Economic Significance: Protein supplements can improve the efficiency of nutrient utilization from feed. This reduces feeding costs and increases the economic efficiency of the aquaculture enterprise.
3. Improvement of product quality: Protein supplements can promote the accumulation of protein in the body mass of carp, which can improve their quality. High quality, high protein fish may be more marketable.
4. Fish Health: Protein supplements can also affect fish health, strengthening their immune system and increasing their resistance to disease. This can reduce the incidence of carp disease and improve their survival rate.
5. Research and Development: Studying the effectiveness of protein supplements on the growth rate of carp helps to improve existing feeding methods and develop new innovative supplements. This is especially important given the growing demand for aquaculture products and constantly changing market demands.

Thus, studying the effectiveness of protein supplements on the growth rate of carp has practical and scientific significance and is an urgent task in the field of aquaculture.

The purpose of our study was to evaluate the effectiveness of increasing the mass fraction of protein in carp feed in order to increase productivity by adding rapeseed meal to the diet. The objectives of the study were: determining the relationship between the amount of protein in the feed and the productive qualities of carp, studying the growth dynamics of carp on a high-protein diet [1].

3 Results and discussion

The experiment was carried out on the basis of the farm of SPECRYBZAVOD LLC. 120 individuals of Parsi carp were selected to form two equal groups. Experimental fish were kept in fiberglass pools measuring 0.5×2×2 m, the volume of each pool was 1000 l, water exchange was 420 l/h (Fig. 1). The light regime of the ponds met the standards and was uniform. Before stocking, the pools were thoroughly washed and disinfected [2,5].

At the beginning of the experiment, the fish were weighed. During the studies, fish were fed 3 times a day. Feeding times: 6:00, 12:00, 16:00. At the same time, the water temperature

was measured. Carp were weighed every week until the end of the experiment. It was found that the water temperature did not fall below 18 °C and did not rise above 23 °C. Every day at 12:00 the physicochemical parameters of the pool were measured, which on average were: oxygen - 8.7 mg/l, pH - 7.7.

For 7 weeks (49 days), the carps of the experimental group received feed with a high protein content. Its composition included: wheat, soybean meal, soybean cake, rapeseed meal and blood meal, BMVK. The feed of the control group did not contain rapeseed meal, but was identical in other components. The mass fraction of protein in the control group was 35%, in the experimental group it was 45% of the dry matter of the diet; it was increased by adding rapeseed meal to the feed. The chemical composition of the feed is presented in Tables 1 and 2.

Table 1. Chemical composition of feed in control groups.

Index	Content
Crude Protein (CP)	45.00 %
Crude fat (CF)	8.00 %
Crude fiber (CF)	2.79 %
Lysine	2.89 %
Methionine + cystine	1.44 %
Calcium	1.44 %
Phosphorus	1.12 %
Vitamin A, IU	6250
Vitamin D3, ME	11250
Vitamin E, IU	125

Table 2. Chemical composition of feed for experimental groups.

Index	Content
Crude protein	35.00 %
Crude fat	2.00 %
Crude fiber	4.00 %
Lysine	1.50 %
Methionine+cystine	0.70 %
Calcium	1.12 %
Phosphorus	0.8 %
Vitamin A, IU	6250
Vitamin D ₃ , ME	11250
Vitamin E, IU	125

The use of feed with a high protein content in feeding fish helps to accelerate their growth [8]. The data obtained during the study are presented in Table 3. The fish selected for the study at the beginning of the experiment had the same weight, however, during the experiment, individuals receiving food with a protein content of 45% at each weighing were ahead in growth of their counterparts from the control group who received the food with 35% protein. The experiment was carried out for 7 weeks, the average mass of fish from group I was more than that of group II by 2.29, 4.98, 7.57, 9.92, 11.52, 14.13, 14.61%, according to the week number.

Table 3. Growth dynamics of carp.

Period cultivation, a week	Groups	
	Experienced	Test
	Average weight	
Beginning of experience	162.0±1.0	162.0±1.7
1	173.39±1.8	169.5±1.9
2	185.40±1.3	176.6±1.7
3	197.4±1.5	183.5±1.5
4	209.4±1.8	190.5±1.6
5	220.4±1.0	197.5±1.4
6	233.4±1.3	204.5±1.6
7	242.4±1.2	211.5±1.3

In addition to feeding, an extremely important criterion for obtaining good live weight gains in fish farming is the physicochemical properties of water. All physiological processes in the body of fish occur under the direct influence of the aquatic environment. In this regard, the water quality in the reservoir must meet standards that can ensure optimal growth and development of fish, and must also exclude the possibility of diseases. One of the most important indicators in this study is the digestibility of feed nutrients, which also depends on the physicochemical parameters of water (Table 4) [2].

Table 4. Chemical composition of water in swimming pools

Index	Actual level	Level required according to requirements
pH	6.8 -7	-
Oxygen, mg/l	7.5–10.0	> 6.0
Color, gr.	25	thirty
Nitrogen of ammonium compounds, mg/l	0.3	0.5
Nitrites, mg/l	0.01	0.02
Nitrates, mg/l	0.9	1.0
Phosphates, mg/l	0.3	0.4
Total hardness, mEq/l	3.5	3.8–4.1
Chlorides, mg/l	0.26	0.2–0.3
Manganese, mg/l	0.02	0.03
Iron, mg/l	0.5	0.6

At the same time, while determining the chemical composition of the water, the temperature, oxygen concentration and pH of the water were also measured daily at 12:00. Temperature fluctuations during the entire growing period did not go beyond 18–23 °C, which does not exceed normal values. The oxygen content and pH level were within acceptable physiological limits.

Table 5. Number of feed units required by one individual per day depending on water temperature and fish weight.

t water, °C	Weight of fish, g										
	>150	150	200	250	300	350	400	450	500	600	700
11	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5
12	1.2	1.1	1.1	1.1	1.1	1.2	1.0	1.0	1.0	0.9	0.8
13	1.8	1.8	1.7	1.7	1.7	1.8	1.7	1.7	2,6	2.5	2.4
14	2.4	2.3	2.2	2.2	2.2	2.2	2.2	2.1	2.1	1.9	1.6
15	2.1	2.9	2.7	2.8	2.7	2.7	2.7	2.7	2.6	2.4	2.0
16	3.6	3.4	3.4	3.3	3.3	3.2	3.2	3.2	3.1	2.8	2.4
17	4.2	4.0	3.9	3.9	3.9	3.8	3.8	3.7	3.7	3.3	2.9
18	4.7	4.6	4.5	4.4	4.5	4.3	4.3	4.2	4.2	3.8	3.2
19	5.3	5.1	5.0	5.0	5.0	4.8	4.8	4.8	4.7	4.2	3.6
20<	5.9	5.7	5.6	5.5	5.6	5.4	5.4	5.3	4.6	4.7	4.0

Based on Table 5, we can conclude that, regardless of the weight of the fish, the number of feed units consumed by fish per day has a positive correlation with temperature, having the highest indicators at temperatures above 20 °C. Due to the inhibitory effect of low water temperature on the chemical processes in the body of cyprinids, the fish's appetite decreases and can disappear completely at t = 8 °C.

4 Conclusion

Increasing the mass fraction of protein in the feed by adding rapeseed meal helps accelerate the growth of Parsi carp. Rapeseed meal contains about 35% crude protein and is rich in minerals. In addition, anti-nutrients in rapeseed meal are found in small quantities, which makes it possible to use it as an alternative source of cheap protein in fish diets. It is important to understand that high protein feeding is not the only aspect for increasing productivity in aquaculture. Ensuring the optimal hydrochemical composition and water temperature directly affects the well-being and activity of fish and indirectly affects the food intake and digestibility. It is recommended to use feed with an increased protein content of up to 45 % due to rapeseed meal in fish farming enterprises specializing in carp in order to accelerate the growth of fish.

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