

The relationship between introducing pancreatic hydrolysate of soy protein into the diet and the amino acid content in the muscle tissue of rainbow trout

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Abstract

The need in protein in the feed is in fact the need in amino acids, their qualitative composition and amount. Naturally, the need for some essential amino acids in various species of fish may be different, thus, the food should contain them in the ratio that best meets the plastic and functional needs of the organism. The article presents a research on the efficiency of combined feeds for the rainbow trout upon the introduction of various dosages of the Abiopeptide feed additive based on pancreatic hydrolysate of soy protein into them. The influence of this feed additive on the amino acid composition of muscle tissue of rainbow trout has been studied.

Keywords: pancreatic hydrolysate of soy protein, combined feed, rainbow trout, amino acid composition, muscle tissue.

INTRODUCTION

The main building materials in the organism of the fish are proteins synthesized mainly from proteinogenic amino acids of the feed. The effect of using protein on the growth largely depends on the balancedness of the diet in terms of all nutrients, primarily protein and essential amino acids, in accordance with the fish needs [1-3].

Usually feeds contain varying amounts of all essential amino acids, but their quality and ratios may not correspond to the optimal level. The most important element of full-fledged nutrition is balancedness of the amino acid composition of the diet in accordance with the needs of the organism, which determine the amount and the kind of essential amino acids that should be in the feed to ensure normal fish growth and activity. Lack of any essential amino acid inevitably limits the use of other amino acids for protein synthesis, which reduces their efficiency. However, quantitative relationship shows that the main mass of the protein is deposited in white muscles. In addition, deposition of protein in white muscle of fish is faster and is more used for growth. Therefore, the quantity and the quality of protein, the degree of its digestibility and assimilation in the animal organism largely determine the nutritional value of the feed [4-6].

The lack of essential amino acids in the diets results in an increased protein consumption, which significantly increases the cost of feed per unit of fish growth [7-9].

Recently, in the industrial aquaculture, increased attention has been paid to biologically active substances based on protein components as sources of diet enrichment with complete protein balanced in terms of the amino acid composition [10-13].

The Abiopeptide feed additive produced by the Scientific Production Company LLC A-BIO from Pushchino, Moscow region, based on the pancreatic hydrolysate of soy protein is in this respect of the greatest interest.

MATERIALS AND METHODS

The research was performed on the basis of the Feeding, Zoohygiene and Aquaculture Department, at the Technologies of Feeding and Growing Fish Research Laboratory, and on the basis of the Training and Research-Testing Laboratory for Determining the Quality of Food and Agricultural Products of the Saratov State Agricultural University.

The research was aimed at improving rainbow trout productivity by enriching the diet with pancreatic hydrolysate of soy protein.

The task of the research was to determine the relationship between introducing pancreatic hydrolysate of soy

protein into the diet and the amino acid content in the muscle tissue of rainbow trout.

The subject of the research was approved by the Council for Grants of the President of the Russian Federation, and was supported by the grant of the Russian Federation President for State Support of Young Russian Scientists (No. MK-6216.2018.11).

For the research, fries of rainbow trout weighing at the beginning of the experiment of 55.3 to 56.7 g were selected and put into an aquarium [14]. By the method of analogues, a reference and 3 experimental groups 10 bions each were formed. The duration of the experiment was 9 weeks.

The reference group received full-fledged sinking pelleted combined feed (MD). Juveniles in experimental groups 1, 2 and 3 received the same feed with the Abiopeptide preparation based on the pancreatic hydrolysate of soy protein in the amount of 0.75, 1.00 and 1.25 ml per 1.0 kg of fish, respectively.

During the anticipated experiment, the rainbow trout was fed 6 times a day at equal intervals.

The granulated combined feed with diameter of the granules in accordance with the weight of the fish was used for feeding. The combined feed composition included fish meal, wheat, wheat gluten, fish oil, and a premix. The nutritional value of 1 kg of the feed was as follows: exchange energy - 22.4 MJ, crude protein - 44%, crude fat - 22%, and fiber - 1.2%. The feed composition and its nutritional value corresponded to the needs of the fish.

The daily feeding rate was calculated with respect to water temperature and fish weight. Daily feed consumption and fish survival rate were determined daily.

For enriching the combined feed with pancreatic hydrolysate of soy protein, the Abiopeptide feed additive was used. The additive was added to the combined feed by spraying in the amount of norm of preparation per 1.0 kg of live weight of the fish.

The amino acid composition of rainbow trout muscle tissue was determined at the end of the research, whereas specimens with the average weight of 147-150 g were chosen.

Amino acids were determined according to GOST R 55569-2013 "Feedstuffs, compound feeds, feed raw materials. Determination of proteinogenic amino acids using capillary electrophoresis".

The essence of the method is in decomposing the sample for analysis by means of acid hydrolysis with amino acids' transformation into free forms, obtaining phenylthiocarbonyl derivatives of amino acids, and their further separation and

quantitative determination by capillary electrophoresis. In the conditions of measurement, leucine and isoleucine are not separated, therefore, their total determination is stipulated.

Tryptophan was determined by method M 04-38-2009 "Feed, combined feed and raw materials for their production", the mass fraction of amino acids was measured by capillary electrophoresis with the use of the "Kapel" FR.1.31.2015.19761 capillary electrophoresis system.

RESULTS

A valuable criterion for assessing the physiological state of fish is the level of protein and amino acid metabolism, and the contents of individual free amino acids in the muscle tissue. At the beginning of the research, amino acids were determined in the experimental feed samples (Table 1).

After analyzing the data, one can say that pancreatic hydrolysate of soy protein may be attributed by the balancedness of the amino acid composition to high-quality protein feed: by the total of essential amino acids, the feed additive is close to high-quality fish meal. The introduction of pancreatic hydrolysate of soy protein increased the content of amino acids in the combined feed according to the norm of consumption. The total content of amino acids in experimental group 1 increased by 17.9%, in

experimental group 2 - by 44.7%, and in experimental group 3 - by 61.1%. With that, the content of crude protein in groups amounted to 44.0% in the reference group, 44.15% in experimental group 1, 44.2% in experimental group 2, and 44.25% in experimental group 3. The obtained amino acid composition of the combined feed in the experimental groups corresponded to the rainbow trout needs in a certain growing period.

At the end of the research, the authors killed the trout and performed analysis to determine the content of amino acids in its muscle tissue; three fish from each group weighing 150.0 g were taken for this purpose (Table 2).

Amino acid analysis of the muscle tissue of the rainbow trout shown in Table 2 leads to the conclusion that its protein contained a set of essential amino acids, and their total mass fraction exceeded 65% in all studied samples. The total content of free amino acids in the muscle tissue was the greatest in experimental group 2, despite the fact that the rate of pancreatic hydrolysate of soy protein introduction into the diet was the highest in experimental group 3. The obtained result indicates an excess of protein in feeding the rainbow trout in experimental group 3, which also deteriorates utilization of nutrients from the feed.

Table 1 – The content of proteinogenic amino acids in the combined feeds, %

Amino acid	Combined feed				Pancreatic hydrolysate of soy protein
	reference	experimental 1	experimental 2	experimental 3	
Essential					
Arginine	2.3±1.4	2.4±1.1	2.7±1.0	2.9±0.7	1.42±0.34
Lysine	2.4±1.2	2.7±0.8	3.3±1.3	4.1±1.1	0.63±0.26
Threonine	1.6±0.5	1.9±0.8	2.5±0.9	2.8±0.7	0.57±0.14
Phenylalanine	2.0±1.1	2.2±0.9	2.7±1.1	2.9±1.2	6.02±0.77
Histidine	0.9±0.4	1.1±0.7	1.6±0.6	1.8±0.5	0.58±0.21
Leucine + Isoleucine	5.0±2.1	5.7±2.3	7.4±2.2	7.8±2.6	6.84±0.86
Methionine	0.7±0.4	0.8±0.3	1.0±0.3	1.3±0.4	0.53±0.11
Valine	1.6±0.3	2.1±1.2	2.9±1.0	3.1±1.5	1.79±0.26
Nonessential					
Tyrosine	0.7±0.3	0.8±0.4	1.0±0.4	1.4±0.5	0.59±0.24
Proline	2.6±0.8	3.0±1.4	3.1±1.2	3.3±1.6	0.16±0.05
Serine	1.9±0.3	2.5±1.0	2.8±0.6	3.3±0.7	0.29±0.08
Alanine	2.0±0.6	2.9±1.1	3.8±1.3	4.2±1.4	0.57±0.18
Glycine	2.5±1.0	2.8±1.2	3.1±1.0	3.3±1.2	0.27±0.14
Total content	26.2	30.9	37.9	42.2	20.26

Table 2 – The content of proteinogenic amino acids in the muscle tissues of the rainbow trout, %

Amino acid	Group			
	reference	experimental 1	experimental 2	experimental 3
Essential				
Arginine	1.07±0.02	1.34±0.09*	1.99±0.05***	2.03±0.04***
Lysine	1.24±0.03	1.89±0.07***	2.23±0.26*	1.77±0.04***
Phenylalanine	0.53±0.01	0.87±0.03***	0.96±0.04***	0.22±0.01***
Histidine	0.12±0.03	0.17±0.08	0.18±0.02	0.09±0.04
Leucine + Isoleucine	1.75±0.06	2.55±0.07***	2.84±0.07***	1.10±0.01***
Methionine	0.32±0.03	0.52±0.20	0.85±0.01***	1.21±0.04**
Valine	0.68±0.01	0.98±0.07*	1.22±0.11**	1.06±0.04**
Tryptophan	1.21±0.01	1.29±0.04	1.21±0.01	1.24±0.02
Nonessential				
Proline	0.39±0.03	0.70±0.06*	0.95±0.05***	1.47±0.03***
Threonine	0.71±0.03	1.07±0.01***	1.24±0.12*	1.73±0.04***
Serine	0.77±0.04	0.99±0.01*	1.48±0.02***	1.83±0.05***
Alanine	1.00±0.04	1.36±0.11	2.18±0.19**	1.33±0.03***
Glycine	0.66±0.04	1.14±0.02***	1.81±0.17**	2.05±0.04***
Tyrosine	0.39±0.02	0.43±0.01	0.63±0.02***	0.37±0.01
Total content	10.85	15.28	19.78	17.50

*P>0.95; **P>0.99; ***P>0.999

In quantitative terms, these figures vary according to the studied groups. The contents of arginine, glycine, serine, threonine, proline and methionine increased in the muscle tissue in direct proportion to the norm of introducing hydrolysate of soy protein into the diet, the content of the remaining proteinogenic amino acids in the 3rd experimental group reduced, indicating the absence of protein balance in the muscle tissue, and the decrease in the nutritional value of the fish in this group.

DISCUSSION

The obtained data allow to draw a conclusion that there is a direct correlation between the total content of free amino acids in the muscle tissue of rainbow trout and the standard norm of introducing the pancreatic hydrolysate of soy protein into the combined feed; however, its excessive content inhibits the metabolism, and the nutritional value of muscle tissues in terms of the amino acid composition reduces. The norm of introducing pancreatic hydrolysate of soy protein into the combined feed of experimental group 2 contributed to amino acids' balance of rainbow trout muscular tissues. The composition is the most optimal for physiologically balanced nutrition of humans, compared to the fish in other experimental groups.

CONCLUSIONS

The introduction of pancreatic hydrolysate of soy protein into the combined feed for rainbow trout in the amount of 1.0 ml per 1.0 kg of the fish weight has a positive effect on the protein and amino acid composition of the muscle tissue.

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