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The Use of a Vitamin B Preparation in The Diet of Turkeys and Its Effect on Their Growth and Development and The Biochemical Composition of Blood and The Biological Value of Meat

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Abstract: The article discusses the effect of adding riboflavin to the diet of turkeys on their biological and

economic indicators. The use of a yeast-based riboflavin preparation has shown a significant improvement in the growth and development of turkeys, expressed in an increase in the biological value of proteins, an improvement in the biochemical composition of the liver, an increase in live weight, growth rate and meat yield, as well as a decrease in feed consumption. Studies have shown that Rhodotorula glutinis yeast is a highly effective source of riboflavin. The optimal dosage of 4 mg per 1 kg of feed has a positive effect on the metabolism and development of poultry. Production tests have confirmed that the use of riboflavin in the diet of turkeys increases live weight by 8.5%, survivability by 4.0%, average daily gain by 8.5%, and slaughter yield by 6%.

Keywords: Vitamin B, riboflavin, turkeys, growth, development, meat quality, feed efficiency, yeast, nutrient medium, tryptophan, oxyproline, grape must, biochemical composition except.

Introduction: The growth and development of meat turkeys play an important role in agriculture. Adding nutrients such as vitamin B to the diet of turkeys plays an important role in improving their growth and increasing resistance to diseases [1-3]. The purpose of this article is to study the effect of adding vitamin B (in particular, riboflavin) to the diet of turkeys on their growth, development and economic indicators. According to research results, the use of yeast producing riboflavin (vitamin B2) gives positive results in the growth and development of turkeys. In recent years, the use of vitamin preparations produced by the chemical and microbiological industries has become increasingly widespread in animal husbandry [4-7]. Increasing the nutritional value of feed, adding vitamin preparations to them helps to increase the production of basic livestock and poultry products (meat, milk, butter, eggs) and reduce their cost [8-11].

The source of vitamins in poultry farming is natural feed, processed products, complex feed vitamin concentrates and industrially produced synthetic preparations [12-14]. The most important complex vitamin concentrates used in poultry diets include naturally dried grass meal, feed yeast and feed concentrates of microbiological synthesis [15-16]. Many researchers have found that vitamins and microelements play a major role in the vital activity of the animal organism [17-19]. In this case, gastrointestinal, skin diseases, leg paralysis and other problems are observed [20-22]. But among all physiological groups of microorganisms, yeast was valued not only as a high-quality protein feed, but also as vitamin preparations that can ensure the normal development of animals and poultry, increase productivity and protect them from many diseases [22-25].

METHOD

The study involved turkey poults, divided into several experimental groups. The control group was provided with a standard diet, while the experimental groups had a yeast-based riboflavin preparation added to their diet in various doses. During the study, the growth rate of the turkey poults, the survival rate, the average daily weight gain, and meat quality were recorded. The content of biochemical substances in blood, meat, and liver, as well as the content of tryptophan and hydroxyproline, were analyzed. Various types of yeast were used to obtain the yeast-based riboflavin preparation: Rhodotorula glutinis, Brettanomyces vini, and Saccharomyces vini. Different media were used for yeast cultivation, from grape must to a simple medium “bard + salts + water”. Optimal conditions for yeast growth and riboflavin production: temperature 28±2°C, pH 4.5-5.0, shaking at 200 rpm, a medium-to-flask volume ratio of 1:7.5. The most active riboflavin producer was found to be the yeast Rhodotorula glutinis. For yeast cultivation in laboratory and semi-production conditions, the following parameters were established: temperature 28-30°C, pH 4.5-5.0, aeration 1.2-1.3 L/L/min, mixing 220-300 rpm, and cultivation time 72-80 hours. During the experiments, turkey poults were fed a diet supplemented with 4 mg/kg of riboflavin. The subjects of our research were yeasts: Rhodotorula glutinis, Brettanomyces vini, Saccharomyces vini, obtained by us from the Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan.

In laboratory conditions, yeast was cultivated on a shaker at 180-200 rpm in 750 ml Erlenmeyer flasks with 100 and 300 ml of medium at a temperature of 28-30°C. The pH of the initial nutrient medium did not exceed 4.5-5.0. To achieve maximum accumulation of biomass and vitamin, the following nutrient media were used: Grape must, Reader’s medium. K_2SO_4 - 0.2 g, $(NH_4)_2HPO_4$ - 0.2 g, $(NH_4)H_2PO_4$ - 2.0 g, $MgSO_4$ - 0.1 g, $CaCl_2$ - 0.1 g, yeast autolysate - 10 ml, tap water - 1 L, medium pH 5.0-5.5. Sterilization at 0.5 atm. for 10 min. We conducted studies on the cultivation of Rhodotorula glutinis, Brettanomyces vini, and Saccharomyces vini yeasts on hydrolysate, which is a waste product from the Yangiyul Biochemical Plant.

In order to obtain a sufficient amount of biomass and, consequently, a preparation of vitamin B2, for its use in poultry farming, we carried out the cultivation of yeast

in semi-production conditions in 5-, 30-, and 100-liter fermenters with a working volume of nutrient medium of 3, 18, and 50 liters, respectively. We studied the growth rate of the culture and the dynamics of accumulation of vitamin B2 (riboflavin) in biomass and culture fluid. The microbial preparation (vitamin B2) obtained by us in semi-production conditions from yeast was used as a vitamin supplement in the diet of turkey poults. The studies were conducted at the turkey farm of the experimental base "Krasny Vodopad" of the UzRIAS. For the experiments, 150 turkey poults, averaging 70 g each, at 5 days of age were taken. The turkey poults were kept for 30 days in cage facilities, where a temperature of 30-33°C was constantly maintained, then they were transferred to acclimatizers, where they were kept until 95 days of age. The turkey poults were divided into five groups, with 30 poults in each group. The birds were fed with compound feed, balanced in terms of metabolizable energy, protein, minerals, and vitamins, recommended by VNIITIP and the Department of Poultry Science of TSAA.

The housing conditions complied with zootechnical standards and were the same for all groups. During the biological experiment, the weight of the turkey poults was determined by individual weighing at 30-60-90 days of age, as well as the preservation of the livestock. Daily records of feed intake were kept. Mathematical processing was carried out according to Plokhinsky.

RESULTS AND DISCUSSION

The obtained results showed that the inclusion of a yeast-based riboflavin preparation in the diet of turkey poults has a significant effect on their growth and development. In particular, the following positive results were noted in the groups that received the riboflavin preparation: Changes in meat composition: A slight decrease in fat content in the meat was noted, as well as an increase in protein and water content. It was also found that the experimental groups had higher levels of calories, calcium, and phosphorus than the control group. Biological value of proteins: In the groups that received the riboflavin preparation, the biological value of proteins increased, the tryptophan content increased, and the hydroxyproline content decreased. This, in turn, improved the quality of the proteins. Changes in the liver: Under the influence of the preparation, an increase in the content of vitamins A and B2 in the liver was observed, as well as phosphonucleic acids, such as RNA and DNA. General indicators: In the groups that received the preparation, the live weight of the turkey poults increased by 8.5%, survival rate by 4.0%, average daily gain by 8.5%, and meat yield by 6%. Feed costs decreased by 12.4% per 1 kg of gain. Economic calculations showed that a profit of 0.99 rubles per head and an annual income of 140 thousand rubles could be obtained.

In Uzbekistan, compound feeds enriched with microelements, vitamins, and amino acids are usually used for raising chickens. Nevertheless, feed costs per 1 kg of live weight gain remain high in many farms in the republic. The use of various microbial metabolites in the feeding of farm animals reduces feed costs, accelerates animal growth, and also reduces morbidity and mortality of young animals by 2-3 times. In this connection, the task of our further research was to study the stimulating effect of the microbial preparation (B2) obtained from yeast at the Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan on the growth, development, and preservation of turkey poults, as well as their influence on some biochemical indicators of blood, liver, and meat quality.

Microbiological preparations contain a complex of biologically active substances (B vitamins, amino acids, antibiotics, enzymes, lipids, etc.). In this regard, it became necessary to establish the optimal doses of the preparation (B2) in the diet of turkey poults, depending on the content of biologically active substances. We studied the effect of riboflavin preparation, obtained by microbiological synthesis from local yeast strains, on the growth and development of turkey poults. We used Uzbek bronze turkey poults for our studies, which were selected and raised in the poultry department of the Institute of Animal Husbandry of the Ministry of Agriculture of the Republic of Uzbekistan. For the experiments, 50 turkey poults were taken in each group at five days of age (the average live weight of the poults was 70 g). The experiment lasted for three months (from May to August). The poults up to the age of one month were kept in KBE-1 cage batteries, in which the air temperature was maintained according to recommended standards. Then they were transferred to acclimatizers, where they were kept until 95 days of age. The turkey poults were divided into five groups, with 30 poults in each group. The birds were fed with compound feed, balanced in terms of metabolizable energy, protein, minerals, and vitamins, recommended by VNIITIP and the Department of Poultry Science of TSAA. The experiments on the use of the B preparation in the diet of turkey poults were carried out according to the scheme (see the chapter "Objects and Methods of Research"). According to the experimental scheme, the control group of turkey poults was kept only on a farm diet without any additional additives (basic diet). The diet of the second and third groups of turkey poults was supplemented with riboflavin obtained at the Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan at the rate of 4 and 6 mg per

1 kg of feed. The turkey poults of the fourth and fifth groups were fed riboflavin, obtained chemically, also at the rate of 4 and 6 mg per 1 kg of feed.

The highest live weight and average daily gain of this live weight were in the second experimental group, 8.6% higher than in the control, in which the poults received 4 mg of the preparation (Bp) obtained from yeast. The lowest live weight and average daily gain of live weight were in the group receiving 6 mg of riboflavin.

Table 1.
Changes in the composition of the diet of turkey poults depending on age

Component	Age, days	
	May-60	**60-90**
Corn	38,5	35
Barley	0	3
Wheat	20	30,5
Millet	10	-
Bran	-	5
Cottonseed meal	-	6,3
Sunflower meal	11,5	-
Fish meal	9,5	9,7
Meat and bone meal	2	3
Yeast	6	6
Defluorinated phosphate	1	-
Limestone	1,5	1,5
Total	**100**	100
Crude protein, %	22,2	22
Metabolizable energy, kcal	301	290

Table 2.
Standards for the Introduction of Vitamins, Micro- and Macroelements, Antibiotics, and Amino Acids into the Diet of Turkey Poults

Additive	Unit of Measure	Start (g/ton)	Growth (g/ton)
Vitamins			
Vitamin A	g/ton	20-Oct	20-Oct
Vitamin B2 (microbiological)	g/ton	3	56
Vitamin B12 (microbiological)	g/ton	3	96
Vitamin B3	g/ton	10	10
Microelements			
Copper (Cu)	g/ton	10	10
Cobalt (Co)	g/ton	8	8
Manganese (Mn)	g/ton	5	5
Zinc (Zn)	g/ton	5	5
Iron (Fe)	g/ton	100	100
Macroelements			
Calcium (Ca)	%	1.3	0.8
Phosphorus (P)	%	1.8	1.1
Sodium (Na)	%	0.3	
Antibiotics			
Biovit	g/ton	80	125
Bacilichin	g/ton	30-13	
Amino Acids			
Lysine	%	1.2	1.1

Methionine-Cystine	%	0.76	
Methionine	g/ton	200	900

At the end of the experiment, to study the meat qualities of 3-month-old turkey poults, as well as to examine the internal organs of young birds from different groups, a control slaughter was performed with anatomical carcass dissection (3 heads from each group). The results of the carcass dissection are presented in Table 4, which shows that the highest live weight before slaughter and a slightly higher muscle yield were in the second group of turkey poults, whose diet included the B preparation (4 mg per 1 kg of feed). Increasing the dose of the preparation, as well as chemical riboflavin, reduces the carcass weight.

Table 3.

Influence of Vitamin B and Other Additives on the Growth and Development of Turkey Poults

Groups	I-Month			II-Month		
	Heads	Опредняяживая масса, Г, M±m	P	Heads	Average Live Weight (g) M±m	P
I-Control	26	325 ± 23.1	0.95	24	1195± 73,3	0.95
II-Experimental	28	428 ± 30.0	0.95	27	1382± 47,6	0.95
III-Experimental	27	407 ± 16.6	0.99	26	1261± 77,2	0.95
IV-Experimental	27	400 ± 29.2	0.95	26	1251± 56,1	0.95
V-Experimental	26	360 ± 27.2	0.95	24	1200± 62,0	0.95

Groups	III- Month					
	Heads	Average Live Weight (g) M±m	P	Live weight % control group	Average daily gain, g	Preservation %
I-Control	26	2784 ± 169.4	0.95	24	100	76,6
II-Experimental	28	3026 ± 83.5	0.95	27	108,7	90,0
III-Experimental	27	2933 ± 104.9	0.95	26	105,3	86,6
IV-Experimental	27	2908 ± 120.4	0.95	26	104,4	86,6
V-Experimental	26	2800 ± 107.5	0.95	24	100,6	80,0

Table 4.

Results of control slaughter of young animals, g

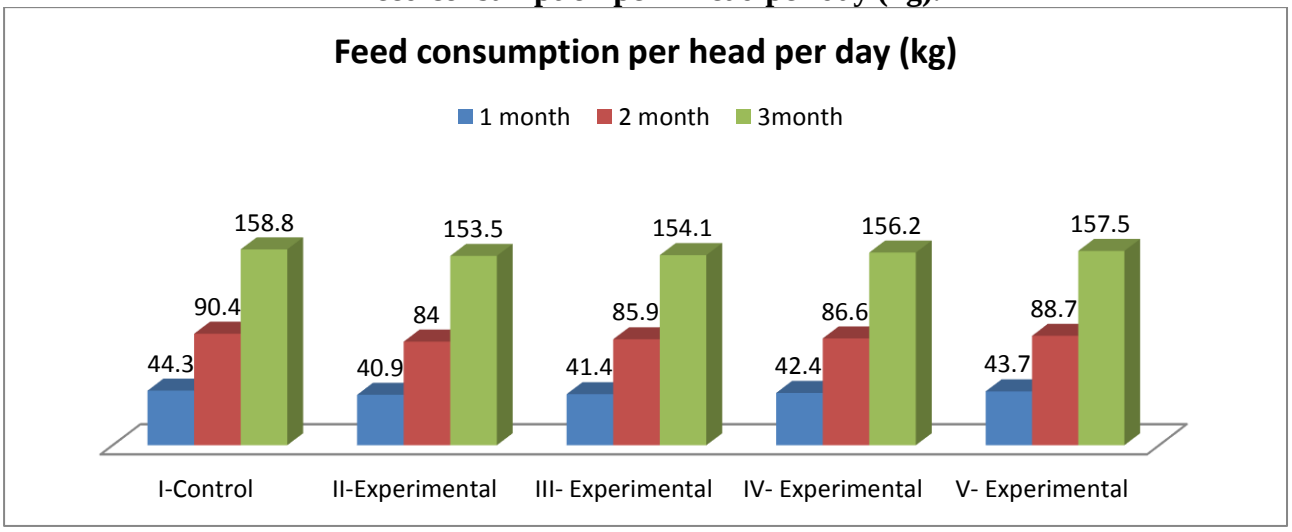
Показатель	Control group	Experienced groups			
	I	II	III	IV	V
Live weight before slaughter	2766,6	3000	2933,3	2900	2800
Live weight without blood, feathers and down	2433,3	2733	2633,3	2566,6	2466,6
Head	92,6	96,6	93,3	89	86,3
Legs	112,3	125,3	117,3	115,3	111,6
Heart	11,7	14	12,7	12,9	12,4

Lungs and trachea	19,7	20,6	20,4	20,1	19,3
Liver	57,3	65,6	61,3	65	62,3
Kidneys	17	20,7	18,6	15,9	13
Spleen	2,5	3,3	3,7	2,6	2,6
Gizzard with contents	101,3	128,6	109,3	103,3	105,6
Gizzard without contents	64,3	75	66,3	75	65
Glandular stomach	10,3	10,6	9,2	10,3	9,8
Intestines	122,3	145,6	122,6	131,6	140
Crop with contents	32	97,3	86,3	46,3	40
Average carcass weight	1800	2118	1991	1960	1875
Slaughter yield, %	65	70,6	67,2	67,6	66,9

Table 4 shows that the pre-slaughter weight and slaughter yield of meat in the P experimental group exceed those in the other groups. Feed consumption per 1 head of turkeys per day showed the following results (1,2,3-graph)

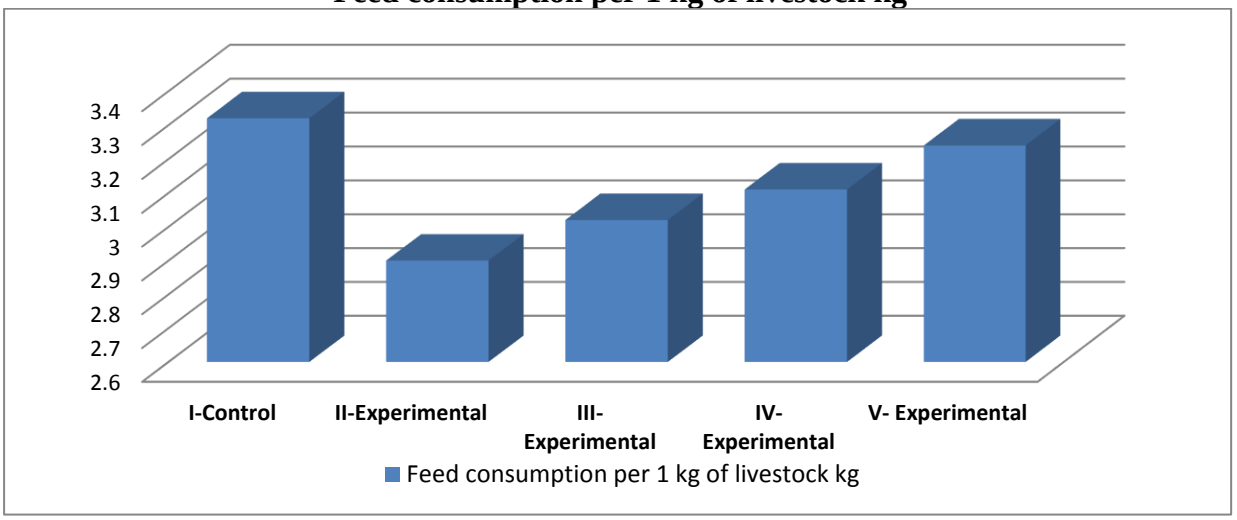
1-graph

Feed consumption per 1 head per day (kg).

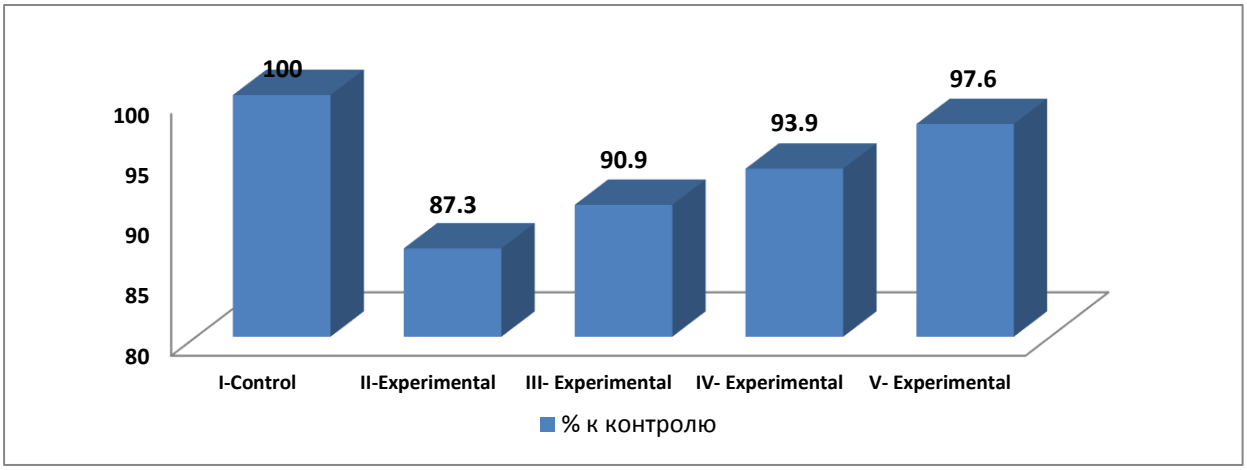


2-graph.

Feed consumption per 1 kg of livestock kg



3-graph,
% to control



In three-month-old turkey poults, feed consumption per 1 kg of gain in the second experimental group was lower compared to the control and other experimental groups by 12.7%, 9.1%, 6.1%, and 2.4%, respectively. Studying the influence of vitamins on the morphological and biochemical composition of the blood of turkey poults is of great importance for understanding the processes of growth and development of birds, as well as for improving productivity in agriculture. Vitamins and minerals play a key role in metabolic processes and the functioning of the bird's body. One of the important components of the biochemical composition of blood is protein. Proteins perform vital functions in the body, including participation in metabolic processes, maintaining the structure of cells and tissues, as well as in immune defense. Studies, such as the works of Rynch et al, E.C. Savron et al., P.E. Ladan et al., and others, show that the protein content in the blood of birds is related to their productivity and physiological state. For example, Galperi et al. found that chickens with increased serum protein levels at an early age show improved meat precocity and egg-laying rates.

In addition, mineral substances, especially calcium and phosphorus, are necessary for the normal functioning of a bird. A deficiency of these elements in the diet can significantly affect growth, development, and blood composition. Studies by Klier, Piescak, Babicheva, and other scientists confirm the importance of calcium and phosphorus for normal metabolism and the development of the skeletal system. The process of mineral metabolism in the bird's body affects the biochemical composition of the blood. For example, studies conducted on 95-day-old turkey poults showed that the level of hemoglobin in the blood depended on the diet. A low hemoglobin content is associated with a deficiency of proteins and vitamins in the diet. During the experiment, in the group of turkey poults that received vitamin and mineral supplements, the hemoglobin level increased by 6%, and the number of erythrocytes and leukocytes also increased. The use of riboflavin obtained by microbiological synthesis also affected the biochemical composition of the blood. The levels of calcium and phosphorus in the blood increased by 3% and 4%, respectively, and the amount of total protein increased slightly. An increase in the content of vitamins A and B in the blood by 6 and 2 µg% was also noted. Thus, the biochemical composition of the blood of turkey poults is influenced by various factors, including diet, vitamin, and mineral supplements. These changes, in turn, affect the growth, development, and productivity of the bird.

5-таблица.
Биохимический состав крови индюшат

Indicator	Группы				
	Контрол	Опытная			
	Control I	Experimental II	Experimental III	Experimental IV	Experimental V
Hemoglobin, g%	9,8	10,4	10	10,2	10,1
Leukocytes (thousand/mm3)	3000	4200	3900	3800	3500
Erythrocytes (million/mm3)	1,94	2,38	2,16	2,11	2,05

Total protein, g%	5,23	6,18	5,24	5,45	5,23
Calcium, mg%	14	17	14	16	15
Phosphorus, mg%	16,8	20,8	20,1	18,8	18,6
Vitamin A, mcg%	23	25	25	25	25
Vitamin B2, mcg%	3,4	5,3	4,4	4,1	4,2

Group I stands out in most indicators: a higher level of hemoglobin, leukocytes, erythrocytes, total protein, phosphorus, and vitamin B2, which may indicate a specific effect on this group. Perhaps this group was affected by substances or conditions that promote hematopoiesis, activation of the immune system, and improved metabolism. Group II stands out for the maximum value of calcium level. Groups III and IV have indicators that are closer to the control values than those of groups I and II. Turkey meat is distinguished by its high nutritional qualities, combining low fat content (1.5-9%) and high protein content. However, with age, the fat content of the meat increases, while the protein content decreases. To improve the quality of meat, in particular to control its chemical composition, the effect of various additives, including vitamin B, is being studied. Studies show that vitamin B, along with antibiotics and enzymes, can alter the content of fat, water, ash, protein, calcium, and phosphorus in turkey meat. In the control group, the content of water, protein, and ash in the meat decreased slightly, but the fat content increased from 1.24% to 2.15%. In experimental group II, an increase in the caloric content of the meat from 141.3% to 148.1% was observed. The content of calcium and phosphorus in the meat of turkey poults in experimental group II was higher than in the control group. This contributed to the normal growth, development, and increase in live weight of the turkey poults.

The nutritional value of meat is primarily determined by the content of complete and incomplete proteins. Sarcoplasmic and myofibrillar proteins are complete and easily digestible, since they contain all the essential amino acids necessary for humans. To assess the nutritional value of meat, it is necessary to take into account not only its morphological and chemical composition, but also the ratio of complete and incomplete proteins. The biological completeness of meat is determined by the content of tryptophan and hydroxyproline. The ratio of tryptophan to hydroxyproline content (T/O coefficient) serves as an indicator of meat quality: the higher the coefficient, the higher the quality.

6-table.

The effect of the drug B2 on the content of tryptophan and oxyproline in the muscle tissue of turkeys, mg %

Index	Control	I	II	III	IV
Tryptophan (mg%)	408,04	416,14	400,51	377,19	402,57
Hydroxyproline (mg%)	69,96	67,62	66,52	62,29	69,65
Tryptophan to hydroxyproline ratio (T/O)	5,83	6,15	6,02	6,06	5,86

The results presented in Table 6 show that the turkeys that received the vitamin B2 preparation at a dosage of 4 mg per 1 kg of feed had an increased biological value of proteins compared to the control group. In the other experimental groups, an increase in the T/O (tryptophan/hydroxyproline) coefficient was also observed, significantly exceeding the control value. These data indicate that adding the microbial preparation of riboflavin (vitamin B2) to the diet increases the biological value of protein in turkey meat.

CONCLUSION

The study showed that the most active riboflavin producer was the yeast Rhodotorula glutinis, which synthesizes endogenous riboflavin from 80 to 120 µg/g of dry substrate, and exogenous riboflavin from 5.6 to 11.0 µg/ml of medium.

The effectiveness of the yeast riboflavin preparation (B_2) as a vitamin supplement in the diet of turkey poults was studied. In particular, a positive effect of the feed riboflavin preparation at a rate of 4 mg per 1 kg of feed was established, mainly on protein and vitamin metabolism, as well as on the function of hematopoietic organs, growth, and development.

It has been practically confirmed that the use of microbial riboflavin preparation as a biological stimulant increases the live weight of turkey poults by 8.5%, survival rate by 4.0%, and average daily gain by 8.5%, and slaughter yield by 6%, as well as reduces feed costs per 1 kg of gain by 12.4%.

When using riboflavin preparation (B_2) in production conditions for 3 months of feeding turkey poults (at 4 mg per 1 kg of feed), a profit per head was obtained.

Thus, the inclusion of a yeast-based riboflavin preparation in the diet of turkey poults has a positive effect on their growth and development. The preparation increases the biological value of proteins, improves the biochemical composition of the liver, increases live weight, growth rate, and meat yield, while reducing feed consumption. The results of this study show that the use of riboflavin preparations in the diet of turkey poults is a promising approach for optimizing their growth and development.

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