Growing Broiler Chickens Using Compound Feed Enriched with Antioxidant “Bisphenol-5”

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Abstract. The article consider the use of the antioxidant "Bisphenol-5" in compound feed, as it can stabilize lipids, vitamins and other unsaturated compounds in feed used for growing broiler chickens; chemotherapeutic protection of young poultry against oxidative stress can be provided by selecting the optimal doses of the preparation in the diet. The research is based on the scientific and production experiment, as well as on the physiological experiment to study the digestibility and daily balance of nitrogen in experimental chickens. It is shown that reasonable doses of the preparation ensure the regulated lipid-protein metabolism, the increase in live weight; feed conversion and the economic efficiency of growing broiler chickens are significantly increased.

1. Introduction

At present, the poultry industry in Russia, being an innovative branch of agriculture, is growing fast. Increase in the production of poultry meat and the highest level of genetic potential use is mainly considered to be a result of complete and balanced feeding [1, 2]. Poultry rations should be balanced not only in regards to nitrogen-containing and nitrogen-free substances, but also to essential amino acids, minerals, vitamins, biologically active substances and other compounds [3, 4, 5, 6]. The compound feed gradients, containing fats, fat-soluble vitamins and other nutrients, under the influence of oxygen undergo oxidation accompanied with appearance and accumulation of such toxic products as aldehydes, ketones, and peroxides, leading not only to a decrease in the nutritional value and quality of feed, but also to pathological changes in the poultry liver, blood, kidneys if the poultry consumes such compound feed, the poultry can also lag behind in growth and development. Therefore, to stabilize lipids, vitamins and other unsaturated compounds contained in feed, antioxidants are added during the feed procurement, preparation and storage [7].

In addition, under stress, free radicals are released in the animal's body; lipid-cholesterol metabolism is disrupted. Antioxidants are used to prevent these consequences and suppress free radical oxidation [8, 9, 10, 11, 12, 13, 14]. Domestic and foreign manufacturers of antioxidants offer a wide range of these preparations to consumers. At the same time, consumers set a task for developers to increase the products' efficiency. One of these preparations is an innovative antioxidant "Bisphenol-5".

The research purpose was to substantiate the use of the fat-soluble antioxidant "Bisphenol-5" when growing broiler chickens.

2. Objects and methods of research

The research objects were 15-day-old broiler chickens of the Cobb 500 cross with a live weight of 486 to 506 g. The experiment was carried out in the laboratory of the Scientific and Technical Center "Akhmadulliny" in Kazan. To carry out research work on the principle of analogous groups, 10 chickens were selected in each of the five groups. Broilers of the control and experimental groups were kept in the same conditions, corresponding to the recommendations of VNITIP. According to the age, the experimental chickens were fed with "Rost" or "Finish" complete feed. Compound feed for poultry of the experimental groups was enriched in different doses with a fat-soluble antioxidant "Bisphenol-5", previously dissolved in oil, – table 1.

Table 1. Experiment scheme.

Group	Livestock in a group, head.	Experimental conditions
Control	10	Basic diet (BD)
Experimental1	10	BD + Bisphenol -5 (0.0002 % to weight)
Experimental 2	10	BD + Bisphenol -5 (0.0004 % to weight)
Experimental 3	10	BD + Bisphenol -5 (0.0008 % to weight)
Experimental 4	10	BD + Bisphenol -5 (0.0015 % to weight)

In addition, for feeding broilers of the first experimental group, a compound feed enriched with "Bisphenol-5" at a dosage of 0.0002% to the feed weight was prepared. Individuals of the 2nd experimental group received a mixture of concentrated feed containing the studied preparation in an amount of 0.0004%. For peers of the 3rd experimental group, compound feed was prepared with the addition of an antioxidant to it at a dose of 0.0008%. For feeding the poultry of the 4th experimental group, the compound feed contained "Bisphenol-5" in an amount of 0.0015%. The feeding of broilers in the experimental and control groups was organized without restrictions.

In order to study the feed additive "Bisphenol-5" and its effect on the amount of nutrients absorbed through the wall of the gastrointestinal tract and nitrogen retention by the body of the bird, five groups of 34-day-old broilers were formed, four individuals in each of them kept in individual cages with free access to food and water. In the course of the experience, preliminary and accounting periods were identified. For feeding the chickens, we used the "Finish" compound feed No. PK brand-6-2-619.

To determine the nutritional value of feed and the chemical composition of the droppings, the generally accepted research methods [15] and the method of M.I. Dyakov [16] were used.

Broiler chickens were slaughtered at the age of 41 days.

3. Results and discussion

The absolute gain in live weight of broiler chickens (table 2) is one of the indicators characterizing the growth rate of farm animals.

The data presented in table 2 indicate that during the experiment, the growth rate of broiler chickens participating in the study was not the same both in groups and in the periods of registration. The growth rate of the experimental chicks increased with age. If in the first 15 days of the study the increase in live weight of broilers ranged from 380.6 to 388.0 g, then from 32 to 38 days of life their growth was within 610.8–766.4 g.

The growth rate of poultry in the experimental groups receiving compound feed enriched with the antioxidant "Bisphenol-5" in an amount from 0.0002 to 0.0015% to the feed weight was 1.5–25.5% ($p \leq 0.01$) more than in the control group. Broiler chickens of the 3rd group, which were fed with the preparation under study in an amount of 0.0015% to the feed weight, had an increase in live weight of 2215.4 g, which is 13.6% ($p \leq 0.001$) more than in the control group. Also, according to this indicator, they exceeded by 4.6–10.9% ($p \leq 0.001$) their peers in other experimental groups, where the poultry

received compound feed containing a fat-soluble antioxidant in a dosage of 0.0002–0.0008% to the feed weight.

Table 2. The absolute gain in live weight of broiler chickens, g.

Research period, days	Group				
	control	experimental			
		1	2	3	4
15–21	380.6±7.65	383.8±8.74	386.4±6.06	386.5±8.69	388.0±3.22
22–26	338.8±10.29	341.5±12.24	343.6±5.26	368.5±21.13	374.3±3.67
27–31	485.1±6.98	497.7±3.66	509.5±4.41	524.8±8.90	527.2±1.67
32–38	610.8±8.46	634.0±6.29	695.3±12.28	766.4±8.64	620.0±6.35
39–41	135.3±7.29	140.4±4.64	183.2±5.87	169.2±6.34	127.8±3.99
15–41	1950.6±20.84	1997.4±16.0	2118.0±20.55	2215.4±23.99	2037.3±12.76

Note * - P ≤ 0.05; ** - P ≤ 0.01; *** - P ≤ 0.001

Thus, the introduction of the antioxidant “Bisphenol-5” into the compound feed in an amount of 0.0002–0.0015% to the feed weight contributed to an increase in the growth rate of broiler chickens by 2.4–13.6% compared to the control group.

To find out the reasons for the increase in the growth rate, we carried out a physiological experiment (table 2 and table 3).

Table 3. Results of the study of compound feed nutrients digestibility in experimental broiler chickens, %.

Indicator	Group				
	control	experimental			
		1	2	3	4
Dry matter	70.19± 0.67	72.01± 0.15*	73.80± 0.17**	74.94± 0.25***	73.09± 0.29**
Organic matter	72.84± 0.61	74.67± 0.13*	76.53± 0.15**	77.12± 0.23***	75.76± 0.26**
Protein	89.98± 0.22	90.14± 0.71	91.35± 0.06**	91.74± 0.08***	90.53± 0.10
Cellulose tissue	37.83± 1.38	40.89± 2.18	43.31± 0.38**	46.01± 0.55***	41.54± 0.63*
Fat	89.26± 0.24	93.66± 0,03***	92.19± 0.05***	93.21± 0.07***	90.70± 0.10**
Nitrogen-free extractive substances	66.44± 0.75	68.33± 0.17*	71,07± 0.19***	71.40± 0.28***	70.60± 0.31**

Note * - P ≤ 0.05; ** - P ≤ 0.01; *** - P ≤ 0.001

During digesting, under the influence of enzymes contained in the gastrointestinal tract, the specificity of organic compounds found in feed is lost; they decompose into monomers available for absorption with which the bulk of energy and structural compounds enter a living organism. We have found that in experimental broiler chickens, the substance “Bisphenol-5” has a positive effect on their digestibility of nutrients.

The largest amount of absorbed nutrients was noted when an antioxidant was added to the feed in an amount of 0.0008%. In broilers of the 3rd experimental group, the digestibility of dry matter was 4.75% ($p < 0.001$) higher than in the control group. A decrease in the antioxidant to 0.0002% to the feed weight in chickens of the 1st group led to an increase in the absorption of all nutrients in comparison with the

control group individuals. At the same time, the difference in this indicator between the groups was insignificant, and the difference in the content of fiber and protein was unreliable.

A fat-soluble antioxidant at a concentration of 0.0015% to the feed weight added to the compound feed led to an increase in the amount of absorbed nutrients in the gastrointestinal tract of broiler chickens compared to the control group. However, the content of assimilated nutrients in poultry of the 4th experimental group was at the level of the 2nd group.

An increase in the digestibility of nutrients through the wall of the gastrointestinal tract with an optimal amount of added antioxidant in a complete feed for broiler chickens of the 3rd experimental group, in our opinion, is caused with the activation of digestive juices secretion, an increase in enzymatic activity, which contributed to the intensification of growth processes in poultry.

Nitrogen-containing feed substances entering the gastrointestinal tract of a bird, under the action of enzymes, break down into free amino acids, which are absorbed through the wall and are used for restoring worn-out tissues, growth and development of a growing organism. Therefore, the effectiveness of the use of nitrogen-containing feed substances in poultry at different age periods is judged by the nitrogen balance in the bodies of chickens (table 4).

Table 4. The balance of nitrogen in the bodies of experimental chickens (day, g).

Indicator	Group				
	control	experimental			
		1	2	3	4
Nitrogen received in feed	5.00±0.05	5.18±0.08	5.41±0.03***	6.10±0.03***	5.35±0.01***
Nitrogen released in feces	0.50±0.05	0.51±0.01	0.47±0.01*	0.50±0.01	0.51±0.01
Digested	4.50±0.05	4.67±0.07	4.94±0.03***	5.59±0.02***	4.84±0.01***
Nitrogen released in urine	1.33±0.01	1.39±0.01**	1.46±0.02***	1.36±0.02	1.2±0.02*
Nitrogen retention in the body	3.17±0.05	3.28±0.06	3.48±0.02**	4.24±0.01***	3.59±0.01***
Utilization ratio to the received, %	63.40±0.48	63.28±0.19	64.28±0.23	69.50±0.31***	67.09±035***
Utilization ratio to they digested, %	70.46±0.38	70.20±0.17	70.36±0.21	75.76±0.26***	74.11±0.31***

Note* - $p \leq 0.05$; ** - $p \leq 0.01$; *** - $p \leq 0.001$

The results of our studies (Table 4) show that the nitrogen balance in the experimental chickens was positive. These data indicate that feeding broilers with compound feed enriched with “Bisphenol-5” had a positive effect on nitrogen assimilation. The optimal introduction of the preparation “Bisphenol-5” into the compound feed was reflected in the retention of 4.24 g of nitrogen in the bird’s body per day, which amounted to 69.50% to the received or 75.76% ($p \leq 0.001$) to the digested.

Adding antioxidant to the compound feed had a positive effect on poultry appetite and feed intake. According to our observations, the excretion of nitrogen with feces of poultry from the control and experimental groups ranged from 0.47 to 0.51 g per day. However, the percentage of this element to the received differs.

An increase in the concentration of the studied substance to 0.0015% to the feed weight contributed to an increase in nitrogen retention in the body of chickens by 13.2% ($p \leq 0.001$) compared with the control group.

The results of the study convincingly proved that in order to improve the digestibility of dietary nitrogen, to increase its retention, and, consequently, to enlarge the growth rate of broilers, it is necessary to add antioxidant “Bisphenol-5” to the complete feed at a dose of 0.0008% to the feed weight. We proceed from the fact that, as a rule, any technology used for intensive cultivation of meat poultry is focused on reducing the feeding period. At the same time, stimulation of poultry appetite and metabolic rate, high average daily gains and weight gain of poultry in the shortest calendar period are economically justified as long as the rapid growth of poultry makes it possible to reduce the cost of feed consumption per kilogram of the product obtained with its high taste and consumer value. This pattern becomes evident when an increase in the nutritional value of diets, and, therefore, a rapid growth of poultry, is accompanied by a decrease in feed costs due to a shorter feeding period. This is easily confirmed by comparing the results of the experiment.

Table 5. Economic efficiency of using the antioxidant “Bisphenol-5” in broiler chickens**.**

Indicator	Group (n-10)				
	control	experimental			
		1	2	3	4
The compound feed “Rost” given to the poultry, kg	8.5	8.5	8.5	8.5	8.5
The compound feed “Rost” costs, rbl	216.84	216.84	216.84	216.84	216.84
The compound feed “Finish” given to the poultry, kg	28.5	28.5	28.5	28.5	28.5
The compound feed “Finish” costs, rbl	594.80	594.80	594.80	594.80	594.80
The cost of compound feed, rbl	811.64	811.64	811.64	811.64	811.64
The amount of the preparation fed, g	-	0.07	0.14	0.28	0.57
The cost of the additive used, rub.	-	0.35	0.71	1.43	2.86
Cost of consumed feed, rub.	811.64	811,99	812.35	813.07	814.50
Broiler chickens gain, kg	19.51	19.97	21.18	22.15	20.37
in % to control	100	102.4	108.6	113.6	104.4
Feed conversion per 1 kg gain, kg	1.90	1.85	1.75	1.67	1.82
in% to control	100	97.4	92.1	87.9	95.8
Cost of 1 kg of gain, rbl	59.43	58.09	54.79	52.44	57.12
Slaughter output, %	70.12	71.22	71.31	72.61	71.10
Meat received, kg	13.68	14.22	15.10	16.08	14.48
Cash proceeds from the sale of meat:					
rbl	1368	1422	1510	1608	1448
%	100	103.9	110.4	117.5	105.8
The effect of using the additive, rbl	-	54	142	240	80
Efficiency per 1 ruble of additional costs, rbl	-	154.3	200	167.8	28.0
Efficiency index	1.18	1.23	1.30	1.38	1.24

Analysis of the effectiveness of the use of the additive “Bisphenol-5”, which was included in the feed and given to broiler chickens at the age of 15–41 days (table 5) indicates that the chickens of the experimental and control groups throughout the entire experiment received complete feed in the same amount. And for the entire period of the experiment, they ate 3.7 kg of compound feed per head. The cost of feed (“Rost” and “Finish”), expressed in ruble equivalent in both groups was equal to 594 rubles 80 kopecks.

In addition to the compound feed, broiler chickens of the experimental groups were fed with additive “Bisphenol-5”. Throughout the entire study period, broilers of the first experimental group received 0.07 g of the antioxidant “Bisphenol-5”, the second group – 0.14 g, the third group – 0.28 g, the fourth group – 0.57 g of the studied substance, respectively.

Due to the consumption of compound feed containing an antioxidant in an amount of 0.0002% to the feed weight, there was a 2.4% increase in poultry productivity and a 2.6% decrease in feed costs per unit of production.

Particularly important is that the addition of the substance “Bisphenol-5” in the amount of 0.0004% to the feed weight enlarged by 8.6% the increase in live weight of poultry and reduced by 7.9% feed costs per unit of gain.

The use of the studied preparation at a concentration of 0.0008% to the feed weight increased the growth rate of broilers by 13.6% and reduced feed costs per unit of production by 12.1%.

Replenishment of the main diet of broiler chickens with the studied preparation at a dosage of 0.0015% to the feed weight made it possible to increase poultry productivity by 4.4% and reduce feed costs per unit of production by 4.2%.

All the results of using the preparation “Bisphenol-5” in the experimental groups are similar in one aspect: they led to a decrease in the cost of a unit of production by 2.3 - 11.8% in relative terms and in the range from 1.34 to 6.99 rubles in absolute terms at the cost of 1 kg of live weight gain for chickens of the control group equal to 59.43 rubles at the time of the experiment.

The largest cash proceeds were obtained with the dosage of the preparation in the amount of 0.0008% to the feed weight, which amounted to 1608 rubles, or 17.5% more than in the control group.

4. Conclusion

Thus, the use of the antioxidant “Bisphenol-5” in growing broiler chickens gives the greatest economic effect when the preparation is added to a balanced compound feed at the rate of 0.0008% to the feed weight; it is confirmed by an increase in meat production by 22.8%, a decrease in feed costs per unit of gain by 12.1 %, a decrease in the cost of 1 kg of live weight gain by 6.99 rubles and an increase in the efficiency index by 0.2 points.

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