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Study of the effect of different levels of arginine in feed on broiler chickens

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ABSTRACT

Amino acids are the basic structural units of protein molecules in the body. Currently, about 300 amino acids are known, of which 26 are studied best. Amino acids or their derivatives (for example, immune bodies) are part of enzymes, hormones, pigments, and other specific substances that play a crucial role in digestive and metabolic processes. In the process of metabolism, many amino acids are synthesized in the body from other amino acids or compounds, and therefore they are called interchangeable. Amino acids that are not synthesized in the body or are formed in insufficient quantities are called indispensable. According to the content and ratio of essential amino acids, feed proteins are subdivided into full and inferior. Deficiency, absence, or imbalance of essential amino acids in animal diets is accompanied by a deterioration in protein use, metabolic disorders, and decreased productivity. The following amino acids are indispensable; arginine, viburnum, histidine, isoleucine, leucine, lysine, methionine, threonine, tryptophan, phenylalanine. Among the essential amino acids, especially important ones, are those called critical. These are lysine, methionine + cystia, threonine, and tryptophan. A deficiency, absence, or imbalance of essential amino acids in animal diets is accompanied by a deterioration in protein use, metabolic disorders, and decreased productivity. The effective level of arginine in compound feed for broilers of the Cobb-500 cross was experimentally determined. The use of compound feed with arginine levels in the first rearing period (1 to 10 days) - 1.28%, in the second (11 to 22 days) - 1.15% and in the third (23 to 42 days) - 1.11% gives the opportunity to get broiler chickens at the age of 42 days, weighing 2.654 kg, at a feed expenditure of 1.78 kg per 1 kg of gain.

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INTRODUCTION

Poultry, unlike mammals, is not able to synthesize the arginine amino acid in the body. Arginine, by turning into ornithine, takes part in the neutralization of the final products of nitrogen metabolism, which are formed during the breakdown of amino acids and other nitrogenous substances in the body (Oka *et al.*, 1989; Brabander *et al.*, 2009). Ornithine is also used to neutralize benzoic acid. Arginine, in large quantities, is part of the proteins of protamines and histones, as well as plumage proteins. It actively participates in the activity of the parathyroid glands, in the formation of creatine, which plays an important role in energy metabolism (Viñas *et al.*, 2004).

There is antagonism between arginine and lysine in the body. With an increase in lysine in the diet, the arginine content in the body decreases due to an increase in arginase activity in kidneys (Cristina *et al.*, 2012; Zai *et al.*, 2013; Singh *et al.*, 2015). With a one-sided increase in arginine in the diet, absorption of lysine in the intestine and reabsorption in the kidneys decrease. Arginine inhibits the conversion of methionine to homocysteine (Udalova *et al.*, 2015).

The levels of arginine in compound feeds for broiler chickens recommended by scientists from different countries differ among themselves in a wide range (Singh *et al.*, 2015). Therefore, given the important role of arginine in ensuring high bird productivity, the studies to determine the optimal content of this amino acid in compound feeds of broiler chickens of different ages are relevant.

MATERIALS AND METHODS

Studies to determine the optimal levels of arginine in compound feed for broiler chickens of different ages were conducted at Olenka Poultry Factory LLC and in the problematic research laboratory of feed additives of the Department of Animal Feeding and Feed Technology named after P. D. Pshenichny at the National University of Life and Environmental Sciences.

The object of research was the Cobb-500 cross broiler chickens. The studies were conducted by the method of groups. In the main period, which lasted 42 days, given the age of the chickens, three subperiods were distinguished: 1 to 10; 11 to 22; 23 to 42 days, according to the experimental design (Table 1).

For research, 400 heads of broilers of daily age were selected, of which 4 groups were formed according to the analogue principle, 100 animals each. When selecting analogues, the age and live weight of the chickens were taken into account.

Broiler chickens were kept in one room on the floor at a density of 12 animals per 1 m^2. The scope of feeding was 2.5 cm, watering – 1.5 cm. Indices of the indoor microclimate were the same for birds of all groups and corresponded to established hygiene standards (Carrasco-Pancorbo *et al.*, 2008; Mahmoudi *et al.*, 2014; Rama *et al.*, 2015).

The level of arginine in poultry diets was regulated by the introduction of a synthetic preparation of this amino acid into the feed composition.

Chickens' eating the feed was counted daily, for each week of rearing and for the entire period of research. At the end of the experiment, feed expenditures per 1 kg of live weight gain were calculated.

The live weight of broiler chickens was determined by weighing on an AXIS A 5000 IV class cell scale.

According to the experimental design, broiler chickens during the experiment were fed compound feeds balanced by exchange energy (OE) and all nutrients, according to the standards recommended by Cobb. The set and quantity of the main ingredients in the compound feed was regulated depending on the period of chickens rearing (1 to 10, 11 to 22, and 23 to 42 days) and the required arginine content in them. The composition of the compound feeds fed to the birds is shown in Table 2.

The chemical composition of the compound feed, which was fed to broiler chickens of the control and experimental groups, was the same and differed only in the arginine content according to the experimental design.

The indicators obtained in the research process are processed by generally accepted methods of mathematical and variational statistics.

RESULTS AND DISCUSSION

Different levels of arginine in the diets of experimental broiler chickens did not cause a significant difference in the amount of feeds eaten. But over the entire period of the experiment, 4.63 kg of compound feed was eaten by the chickens of the control group, while group 2 birds ate 4.66 kg, and the birds of groups 3 and 4 ate 4.65 kg each (Table 3). Therefore, the largest amount of feed was eaten by the birds of the experimental group 2. Indicators of the live weight of experimental broiler chickens are shown in Table 4.

The data of Table 4 shows that the change in live weight of chickens was observed as early as on the 7th day of rearing. With an increase in the arginine level in the mixed feed of broilers of group 3, their live weight increased by 0.7% ($p < 0.05$) compared to the control. A further increase in the level of arginine in the diet contributed to a decrease in the live weight of poultry of the group 4 by 0.7% compared with the control one and by 1.3% compared with the analogues of the group 3. From this, it follows that the optimum in this period was the arginine content of 1.28% in the compound feed.

Weighing on day 14 of rearing showed that the live weight of broiler chickens of different groups was almost the same. But in the following weeks of research, a clear trend can be traced: an increase in

Table 1: Scheme of scientific and economic experience

Group	Age of chickens, days		
	1 to 10	11 to 22	23 to 42
	arginine content in 100 g of feed, %		
1 – control	1.26	1.17	1.13
experimental 2	1.24	1.15	1.11
experimental 3	1.28	1.19	1.15
experimental 4	1.30	1.21	1.17

Table 2: Composition of animal feed for experimental broiler chickens, %

Component	Bird age, days		
	1 – 10	11 – 22	36 – 42
Wheat	8.38	11.10	0.00
Corn	44.00	43.00	51.71
Peas	10.01	10.50	10.00
Soy	13.70	15.00	20.00
Soybean meal	12.00	10.00	11.00
Fishmeal	7.00	5.00	0.00
Vegetable oil	2.00	2.30	3.40
Common salt	0.18	0.17	0.34
Limestone	1.73	1.83	2.10
Monocalcium phosphate	0.00	0.10	0.45
Premix	1.00	1.00	1.00

Table 3: Eating and expenditures of compound feed in experimental broilers

Indicator	Groups			
	1	2	3	4
Combined feed eaten for the entire period of the experiment, kg	4.63	4.66	4.65	4.65
Compound feed expenditures per 1 kg of gain, kg	1.78	1.78	1.80	1.81

Table 4: Live weight of experimental broiler chickens, g

Age of chickens, days	Groups			
	1	2	3	4
1	52.21±0.65	52.20±0.80	52.23±0.81	52.18±0.70
7	166.11±1.62	165.15±2.15*	167.19±1.98*	164.94±1.77**
14	432.80±16.47	439.92±19.33	429.63±19.82	424.60±18.79
21	846.33±24.37	858.13±20.85*	835.23±26.28	832.76±24.90*
28	1407.33±30.96	1422.42±26.87*	1394.43±29.06	1387.44±31.13*
35	2023.49±34.12	2040.15±30.33*	2013.66±30.00	2006.04±28.08*
42	2637.37±33.66	2654.79±29.30*	2621.10±29.18*	2615.38±34.14*

*p < 0.05; ** p < 0.01 in comparison with the control group the live weight of broiler chickens with a decrease in the arginine content in the compound feed, and its decrease with an increase in the level of the studied amino acids in the diet. In particular, the live weight of group 2 poultry was higher than the control one by 0.7 - 1.4% ($p < 0.05$). This indicator in chickens of groups 3 and 4 was lower than in the control one by 0.6 - 1.9%.

Thus, analyzing live weight indicators, we can conclude that the most effective level of arginine in the compound feed of broiler chickens at the age of 11 to 22 days is 1.15%, and 1.11% at the age of 23 to 42 days.

These findings are also confirmed by the data of daily average gains of experimental broiler chickens (Figure 1).

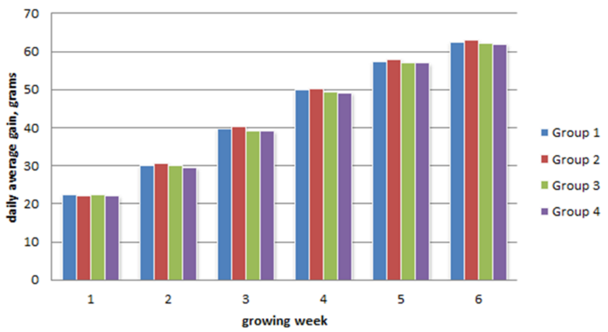

Figure 1: Average daily gains of experimental broiler chickens

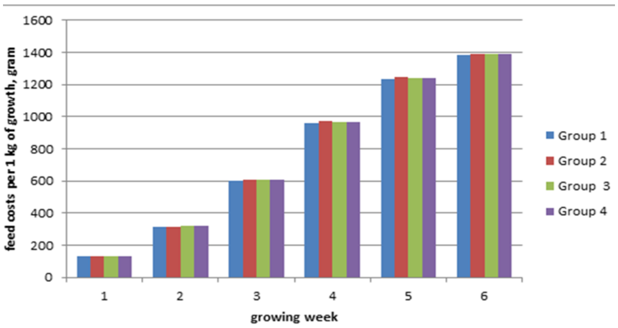

Figure 2: The expenditure of feed per 1 kg of gain in live weight, g

The figure shows that the largest average daily gains were in group 3 birds in the first period of rearing. In the second and the third age periods, the gain was the greatest in chickens of group 2. Under this indicator, they exceeded the control group by 0.6-1.5%.

The expenditure of feed per 1 kg of increase in live weight is one of the main indicators that determine the efficiency of production (Figure 2).

From the figure, you can see that the bird, which had a large live weight, used more feed per 1 kg of gain. But the difference in this indicator between broiler chickens of different groups was not significant.

Table 4 shows the data on the expenditure of compound feed per 1 kg of gain for the entire rearing period. The lowest indicator of the compound feed expenditure per 1 kg of gain in live weight was in broiler chickens of groups 1 and 2. The birds of groups 3 and 4, which ate food with increased levels of arginine, used 1.1–1.4% more compound feed per 1 kg of gain than the control group analogues.

Thus, in our experiments, the most effective levels of arginine in feed for broiler chickens were determined. But it will be relevant to study the effects on the productivity of birds of arginine in combination with other essential amino acids, taking into account the phenomena of synergism and antagonism.

CONCLUSIONS

An increase in the arginine level in the broiler chickens compound feed in the first rearing period to 1.28% contributed to an increase in poultry live weight by 0.7% ($p<0.05$).

An increase in the arginine content in the diet of broiler chickens to 1.30% in the first growing period and to 1.21 and 1.17%, respectively in 2 and 3, contributed to a decrease in the live weight of birds.

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