Influence of sodium dimethylglycinate on environmental safety and meat productivity when growing broiler chickens

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Abstract. The aim of the studies was to evaluate the effect of adding sodium dimethylglycinate in broiler diets, as part of a feed additive to increase the digestibility of feed nutrients, improve health and increase the meat productivity of broilers. During the experiment, the prevalence of live weight was established by 77 g (3.81%) in the experimental group, with a reduction in feed costs per 1 kg of gain by 0.05 kg. Safety in the experimental group was 100%, and in the control - 97.5. The European efficiency index increased by 35.18 points and amounted to 389.35. An increase in the digestibility of nutrients obtained from feed by the body of broilers: dry matter - by 1.44, protein - by 1.25, fat - by 2.74, nitrogen-free extractive substances - by 1.67%. The mass of the pectoral muscles increased by 78 g, which confirms the high digestibility of nutrients in the feed. Sodium dimethylglycinate has also been shown to improve the immune system and reduce oxidative stress in broiler chickens. Activation of enzymes of the antioxidant status was observed under the influence of the studied additive: superoxide dismutase by 8.32%, ceruloplasmin by 9.47%, and the level of malondialdehyde decreased by 5.63%.

1. Introduction
Despite a slight decrease in the level of production of eggs and poultry meat in 2020 by 2.5 and 6.4%, respectively, due to the cessation of supplies of breeding eggs and day-old chickens from a number of European countries, due to the closure of borders due to the pandemic, many enterprises remain production volumes and quality of products at the proper level. To increase productivity, safety of birds, as well as safety and quality indicators of eggs and meat, poultry farmers are increasingly using feed biologically active additives in bird feeding that can stimulate poultry growth, activate metabolic processes, and increase the digestibility of feed nutrients.

One of these additives is sodium dimethylglycinate, a tertiary amino acid that plays an important role in various biological processes, including the cellular metabolism of choline and betaine, being as a source of glycine for the synthesis of glutathione [1, 2].

The body of chickens is practically unable to synthesize glycine. In this regard, at a young age, glycine is considered an essential amino acid in chickens due to the insufficient rate of biosynthesis [3, 4].

The need for glycine by the body of birds is explained by the participation of this acid in the synthesis of purine bases and the structure of heme [5]. Sodium dimethylglycinate can be metabolized in liver mitochondria, converting both of its methyl groups as a result of tetrahydrofolate
transmethylation into free glycine [1, 6]. Sodium dimethylglycinate is completely absorbed in the form of a physiological compound, has antioxidant properties, thereby reducing the effect of oxidative stress and changes in the levels of blood plasma metabolites associated with oxidative stress. In addition, it can increase the ability of digestive enzymes and improve the ability of the intestinal brush border to come into contact with nutrients, which subsequently aids in the digestion and absorption of nutrients [7].

In this regard, in our studies, we studied the effect of a feed additive containing sodium dimethylglycinate as an active ingredient.

2. Materials and methods

The studies were carried out in the conditions of the State Scientific Institution RIPPMMDP and the Research Center of LLC «MegaMix» on broiler chickens of the Ross 308 cross. The experiment involved two groups of chickens, 50 heads each. Broiler chickens from the control group received granulated feed, the experimental group received the studied feed additive as part of the feed in the amount of 1.2 kg/t of feed.

The studied feed additive contains sodium dimethylglycinate as the main component, due to which the feed conversion improves, the safety and productivity of broiler chickens increases.

The containment conditions were the same as recommended by Aviagen®. Live weight was recorded on a weekly basis, and safety was carried out daily. At the end of the experiment, during slaughter and anatomical cutting, the morphological and varietal composition of the carcasses was carried out, according to State Standard R 52702-206 «Chicken meat (carcasses of chickens, chickens, broiler chickens and their parts). Technical conditions».

The digestibility and use of nutrients in feed during the physiological experiment were determined using the methodological recommendations of the Federal Scientific Center “All-Russian Scientific Research and Technological Institute of Poultry Farming” of the Russian Academy of Sciences (2004). The nutritional value of feed and excrement was assessed according to State Standard R-51417-99.

Determination of immunoglobulins in the blood of experimental broiler chickens was carried out according to the Mancini method; superoxide dismutase - on an SF-46 spectrohmatometer; ceruloplasmin - on the Cobas Mira analyzer; malondialdehyde - by the method M. Uchiyama and M. Mihara [8].

3. Results and discussion

Throughout the experiment, broilers of both groups developed in accordance with the standard indicators of the Ross 308 cross (Table 1), however, the chickens of the experimental group significantly prevailed, over their peers from the control group: at 21 days - by 2.60% (P < 0.05), 28 days - by 4.06% (P < 0.01), 35 days - by 77 g (3.81%; P < 0.05).

Feed consumption per 1 kg of gain in the experimental group decreased by 0.05 kg. It should also be noted a high level of safety in both groups: 100% in the experimental group, and 97.5 in the control group. When calculating the European efficiency index, a higher value of this indicator was established in the experimental group - 389.35 units, exceeding the control by 35.18.

The beneficial effect of sodium dimetyl glycinate on the digestibility of feed nutrients, according to Clapés and Infante [9], Cools et al [10], Kalmar et al [11], associated with the surfactant properties of dimethylglycine esters. In our studies, in the experimental group, a high assimilation by the body of broilers of nutrients obtained with feed, in particular fat, was established (Figure 1).
Table 1. Changes in live weight of broiler chickens during rearing (n = 50).

| Age, days | Control       | Experimental  |
|-----------|---------------|---------------|
| 0         | 41.6 ± 1.03   |               |
| 7         | 179.6 ± 1.56  | 181.4 ± 1.25  |
| 14        | 443.8 ± 3.87  | 456.7 ± 4.98  |
| 21        | 885.4 ± 6.68  | 908.4 ± 7.83* |
| 28        | 1402.3 ± 13.23| 1459.2 ± 12.73** |
| 35        | 2021.5 ± 17.46| 2098.6 ± 15.93** |

EIE - European Efficiency Index
Feed costs per 1 kg gain, kg
Safety, %

|                  | Control       | Experimental  |
|------------------|---------------|---------------|
|                  |               |               |
|                  | 354.17        | 389.35        |
|                  | 1.59          | 1.54          |
|                  | 97.5          | 100           |

Figure 1. Digestibility of feed nutrients, % (n = 3).

The fat digestibility of the chickens from the experimental group was 2.74% higher than the control (P < 0.01). The digestibility of protein and nitrogen-free extractive substances was also higher than in the control group by 1.25 (P < 0.05) and 1.67% (P < 0.05), respectively, which is consistent with studies conducted by a number of authors [12, 13, 14, 15].

This positive effect supports the hypothesis that sodium dimethylglycinate acts as an emulsifying agent, as proved by Vanhauteghem et al [16].

Anatomical cutting of carcasses, at the age of 35 days, demonstrated the effectiveness of the studied feed additive. The lethal yield in the experimental group exceeded the control values by 0.8% and amounted to 73.59%. An increase in the mass of pectoral muscles by 78 g (P < 0.05) confirms the high digestibility of feed nutrients and, in particular, protein, which positively affected the yield of 1st grade carcasses in the experimental group, which amounted to 66.8%.

Studies [9, 17] found that sodium dimethylglycinate improves the body’s immune system and reduces oxidative damage by removing free radicals, thereby improving the health and growth performance of animals and birds.

As a result of the experiment, we recorded a significant excess, in the blood of the chickens of the experimental group, the concentration of immunoglobulins by 18.45% (P < 0.01) in relation to the control. The use of the studied feed additive led to the activation of enzymes of the antioxidant status of broiler chickens: superoxide dismutase by 8.32% (P < 0.05), ceruloplasmin by 9.47% (P < 0.05).
The level of substances active to thiobarbituric acid and, in particular, malondialdehyde decreased by 5.63% (P < 0.05) compared with the control.

4. Conclusion
The present study has demonstrated that sodium dimethylglycinate serves as an additive that can activate metabolic processes, improve the absorption of nutrients in feed and increase the meat production of broiler chickens.

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