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The quality of gosling meat depending on the level of lithium in mixed fodders

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Abstract

Micronutrients are an important component of a complete poultry feeding. Current detailed feeding standards provide guaranteed feed additives for farm poultry of the microelement complex. Among the normalized microelements there is no lithium, which according to the classification based on biological role for living organisms belongs to the group of conditionally essential elements. The purpose of the study was to investigate the effect of various doses of lithium in compound feed on the chemical composition and toxicological and biological parameters of caterpillar meat. The effect of additives of different doses of lithium (0.05 mg/kg, 0.10 and 0.15 mg/kg) in compound forages on the quality and safety of the products of slaughter of 70-day gosling was studied. The studies were conducted on gosling of the Legart breed. Feeding of gosling from day to 70 days of age was carried out by full-feed compound feeds. The birds of the experimental groups were additionally injected with lithium in the feed, mg/kg: the second group was 0.05; third – 0.10 and fourth – 0.15. The gosling of the control group did not receive lithium. Analysis of the results of the studies revealed differences between the control and experimental groups in the chemical composition of the muscular tissue of the gosling in favor of the latter. It was found that the introduction of lithium compound feed had a positive effect on the deposition of dry matter, protein and fat in the gosling of the experimental groups, which contributed to its increased energy and biological value. The best indicators of meat quality were in young animals, which during the growing period were fed compound feeds enriched with lithium at the rate of 0.1 and 0.15 mg/kg.

Key words: lithium, compound feed, gosling, dose, meat, chemical composition, energy and biological value.

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1. Introduction

In recent years, there has been a tendency in Ukraine to revive one of the traditional poultry industries – the gosling breeding. At the same time, the increase in the number of gosling in industrial complexes is accompanied by the improvement of production technologies.

The efficiency of production of gosling products depends to a great extent on the full feeding of the poultry, which involves providing the body with all the nutrients.

Micronutrients are an important component of a complete poultry feeding. Current detailed feeding standards provide guaranteed feed additives for farm poultry of the micro element complex (Bratishko et al., 2013). However, among the micro elements, there is no lithium, which according to the biological role-based classification for living organisms belongs to the group of conditionally essential elements (Prashanth et al., 2015).

In Ukraine, lithium has not been widely used in poultry feeding due to the lack of differentiated feed rates (Sobolev et al., 2019).

In this regard, the development, theoretical and experimental justification of the optimum standards and the most effective ways of introducing lithium in compound feed for different species of poultry is a pressing task.

Lithium is an element with a wide range of biological effects. It has anti-stress, adaptogenic (Miftahutdinov & Terman, 2014), antiviral (Cui et al., 2015), antibacterial (Stachelska, 2015) and radioprotective properties (Antushevich et al., 2013), plays an important role in functioning of the immune system (Lukicheva, 2011).

The discovery of the biological properties of lithium was the basis for its use in zootechnical practice, including poultry.

Today, there is evidence that the use of lithium as a feed additive stimulates the growth and development of the bird, increases its conservation, reduces feed costs per unit weight gain (Homchenko et al., 2005; Preobrazhenskij & Evtinov, 2006), contributes to the increase in the weight of half-eaten carcasses and their edible parts (Grybanova et al., 2013), and improves the quality of meat products (Lukicheva, 2011).

At the same time, the issue of veterinary-sanitary evaluation of poultry products for the use of lithium supplements in their diets has not been sufficiently studied and only on broiler chickens (Bachinskaja, 2009).

Due to the limited amount of scientific work on the effect of lithium additives in compound feeds on the nutritional and biological value of poultry meat, additional research has become necessary.

The purpose and objectives of the study. The purpose of the study was to investigate the effect of various doses of lithium in compound feed on the chemical composition and toxicological and biological parameters of gosling meat.

2. Materials and methods

The studies were conducted on gosling of the Legart breed. Feeding of gosling from day to 70 days of age was carried out by full-feed compound feeds. Poultry of the experimental groups were additionally injected with lithium in the feed, mg/kg: the second group was 0.05; third – 0.10 and fourth – 0.15. The gosling of the control group did not receive lithium.

At the end of cultivation, the control slaughter of poultry was carried out, 3 heads from each group, the most common by live weight. Medium muscle tissue sampling was performed during anatomical disassembly of gosling.

The chemical composition of muscle tissue was determined by conventional methods of zootechnical analysis: total moisture by the arbitration method at a temperature of 103 ± 2 °C; protein – biuret method; fat – by binary mixtures; ash – by the method of dry ashing at a temperature of 525 ± 25 °C.

Toxicological and biological examination and determination of the relative biological value of the muscular tissue of the gosling was performed by micromethods using the tetrahymic pyriformis ciliated infusion.The energy value of meat was calculated by the formula:

$$X = [C – (Ж + 3)] × 4,1 + (Ж × 9,3),$$

where X is the energy value of 100 g of meat, kcal; C – content of dry matter in meat, %; Ж – meat fat content, %; 3 – the ash content of meat, %.

3. Results and discussion

An analysis of the results of the studies revealed differences between the groups in the chemical composition of the muscular tissue of the gosling, which, in our opinion, are caused by the inclusion in the composition of lithium feed. Better meat quality indicators were found in experimental groups (Tables 1, 2).

Table 1

The chemical composition and biological value of the gosling breast muscles ($X \pm S_x$, n = 3)

Indicator	Group			
	1 control	2 research	3 research	4 research
Content of, %:				
Dry matter	25.2 ± 0.32	26,4 ± 0,44	26.8 ± 0.48*	26.7 ± 0.43*
Protein	19.6 ± 0.41	20,3 ± 0,43	20.4 ± 0.40	20.6 ± 0.42
Fat	3.9 ± 0.32	4,1 ± 0,33	4.5 ± 0.34	4.0 ± 0.35
Ash	1.2 ± 0.19	1,0 ± 0,24	1.2 ± 0.19	1.3 ± 0.18
Energetic value kcal /100 g	118.4 ± 3.37	125,7 ± 2,94	128.0 ± 3.25	124.8 ± 3.89
The number of infusions grown, pcs / ml	5.29 ± 0.233 ×10^4	5.45 ± 0.229 ×10^4	5.47 ± 0.232 ×10^4	5.51 ± 0.228 ×10^4
Relative biological value,%	100	103.0	103.4	104.1

Note: the probability of difference between control and study groups: * – P < 0.05

In the breast muscles, the gosling of the experimental groups observed an increase in dry matter content. Thus, if in the young of the control group this figure was 25.2 %, in the poultry of the second experimental group it was higher by 1.2 %, of the third – by 1.6 (P < 0.05) and of the fourth - by 1.5 % (P < 0.05). The increase in dry matter content in the breast muscles was due to the increase in protein and fat.

It is noteworthy that in this group of experimental gosling muscle protein content tended to increase (20.3 %, 20.4 and 20.6 %, respectively, compared to 19.6 % in the control group) with increasing dose of lithium in forage.

The fat levels in the muscles of the breasts of the experimental groups increased slightly. The difference between the control group was 0.2–0.6 %.No significant differences were found in the ash content between the groups. In the breast muscles of the control and third experimental groups, the amount of ash was equal to 1.2 %. Meanwhile, their peers from the second experimental group, it was 0.1 % lower and the fourth – 0.1 % higher.

The caloric content of the chest muscles was largely determined by the protein and fat content of the muscles, therefore, it was highest in the gosling of the experimental groups. Calculations showed that the energy value of 100 g of breast muscle in young animals of the second experimental group was 125.7 kcal, the third – 128.0 and the fourth – 124.8 kcal, which is 6.1 %, 8.1 and 5.4 % respectively higher than in the young of the control group.

Among the criteria recommended for evaluating the quality of meat, the most objective is the indicator of its biological value, which determines the degree of compliance of the food product to the optimal needs of the person and

guarantees its harmless use according to physiological standards.

Micromethods, based on the use of tetrachyme pyriformis as a test organism of the ciliated tetrachyme infusion, have established the higher relative biological value of gosling fed with forage with lithium addition.

The criterion of the relative biological value of the meat was the number (expressed as a percentage) of the infusions in the experimental samples that grew in 3 days relative to the number of cells grown in the control samples.

The results show that the relative biological value of the breast muscles of the young in the study groups was 3.0–4.1 % higher than the control group.

Analysis of the average samples of the thigh muscles and shins of the experimental gosling showed that they were different in chemical composition from the thoracic muscles. The nature of the deposition of dry matter, protein, fat and ash in the leg muscles of the study groups indicates a positive effect of lithium supplements (Table 2).

Table 2

The chemical composition and biological value of the thigh muscles and tibia ($X \pm S_x$, n = 3)

Indicator	Group			
	1 control	2 research	3 research	4 research
Content of, %:				
Dry matter	25.7 ± 0.41	27.5 ± 0.46*	28.6 ± 0.44**	28.4 ± 0.41**
protein	18.5 ± 0.17	19.0 ± 0.13	19.2 ± 0.14*	19.5 ± 0.16**
fat	5.8 ± 0.30	7.0 ± 0.17*	7.9 ± 0.21**	6.9 ± 0.22*
ash	1.1 ± 0.19	0.9 ± 0.17	1.0 ± 0.18	1.1 ± 0.14
Energetic value, kcal/100g	131.0 ± 2.12	145.0 ± 2.35*	153.6 ± 0.95***	147.9 ± 3.24*
The number of infusions grown, pcs / ml	7.09 ± 0.230 $\times 10^4$	7.17 ± 0.220 $\times 10^4$	7.23 ± 0.236 $\times 10^4$	7.22 ± 0.241 $\times 10^4$
Relative biological value, %	100	101.2	102.1	101.9

Note: the probability of difference between control and study groups: * – $P < 0.05$; ** – $P < 0.01$; *** – $P < 0.001$

As can be seen from Table 2, the gosling of the study groups were likely to have increased dry matter content in the thigh and leg muscles. The difference in this indicator between the control and the second study groups was 1.8 % ($P < 0.05$), the third – 2.9 ($P < 0.01$) and the fourth – 2.7 % ($P < 0.01$).

Protein content in the muscles of the thighs and shins of young animals of the second experimental group was 0.5 %, the third – 0.7 % ($P < 0.05$) and the fourth – 1.0 % ($P < 0.01$) higher than the gosling of the control group, where the same indicator was 18.5 %. However, in this group of muscle tissue the nature of fat deposition has significantly changed. Its content in the leg muscles of the second experimental group probably increased by 1.2 % ($P < 0.05$), the third – by 2.1 ($P < 0.01$) and the fourth – by 1.1 % ($P < 0.05$) compared with the control group. However, the differences in this indicator did not have a regular relationship with the level of lithium in the feed.

In the thigh and leg muscles of the control and fourth experimental groups, the ash content was the same, accounting for 1.1 %. The young of the second and third experimental groups gave the control group birds 0.2 and 0.1 %, respectively.

Significant differences between the control and experimental groups were determined by the energy value of the hip and leg muscles. The difference was in favor of the latter and equaled to 10.7 % ($P < 0.05$), 17.2 ($P < 0.001$) and 12.9 % ($P < 0.05$), respectively.

In comparison with the control group, the gosling of the experimental groups were found to be higher (by 1.2–2.1 %) and the relative biological value of the thigh and leg muscles.

The evidence of gosling meat non-toxicity was the absence in all test specimens of the lost infusions and any pathological changes of the Tetrachymena pyriformis during the incubation period.

4. Conclusions

The introduction of lithium compound feed had a positive effect on the deposition of solids, protein and fat in the gosling meat, which increased its energy and biological value.

The best meat quality indicators were in young animals, which were fed 0.1 % lithium-enriched compound feeds during the growing period and 0.15 mg/kg.

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