The effectiveness of the protective action of mineral adaptogen in respiratory diseases of broilers

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Abstract. There has been unrelenting interest of poultry farmers in feed additives that help to increase the viability of poultry, reduce mortality, and increase the absorption of feed. Adaptogens are such feed additives. Adaptogens increase nonspecific resistance, which has led to their use in poultry farming. However, their use in broiler feeding is limited. The reasons for the mortality of young animals are not only infections and violations in the technology of breeding, but also an increased concentration of harmful gases that can take the life of many chickens. Therefore, the search for new and effective means of protecting broilers is urgent. The aim of the study was: to determine the effectiveness of the pulmo-protective action of adaptogens in broiler feeding. Studies were carried out on arbor acres broilers to determine the effectiveness of the adaptogen as a protective drug, and to determine the efficiency of feeding and the safety of the broiler population when feeding the adaptogen. Micromorphological studies of the respiratory organs were carried out, features of the microstructure of the lungs were revealed with and without adaptogens. For the first time, the pulmo-protective effect of the fodder adaptogen against the background of disturbed microclimate parameters in the poultry house was histologically confirmed.

1 Introduction

Currently, interest in drugs that affect the maintenance of the natural resistance of the bird's body is not weakening. This is especially important in agricultural production due to the large concentration of poultry in limited areas, which increases the influence of external unfavorable environmental factors: microclimate, crowding of poultry, insufficient feeding front, competition, the use of antibiotics, a large number of vaccines, etc. In this regard, the question of finding a means of leveling the negative influence of negative microclimate parameters on the health and feeding of broilers becomes urgent. Adaptogens become one of such agents.

Adaptogens are substances of organic, mineral, plant or microbial origin that can bind toxic substances or other metabolic products that adversely affect the life and health of

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fattening chickens.

In this regard, the aim of our research was: to determine the effectiveness of an mineral adaptogen as a prophylactic agent for the prevention of respiratory diseases in poultry.

To achieve the goal of the study, we set the following objectives:

- assess the state of the microclimate in poultry houses;
- to determine the effect of mineral adaptogen on the absorption of feed and an increase in the live weight of broilers during the feeding period;
- to evaluate the effect of mineral adaptogen on the morbidity of broilers and the structure of the morbidity based on the results of postmortem examination;
- to determine the frequency of occurrence of respiratory pathology against the background of vaccination carried out at the enterprise;
- to determine the pathomorphological changes in the respiratory organs when using an mineral adaptogen.

2 Literature review

In modern scientific articles, a significant place is given to the influence of adaptogens of various origins on the nonspecific immunity of poultry. [1,3,7,9] Many studies have noted the effect of adaptogens on the binding of toxins and their elimination from the body of birds, because mineral adaptogens were originally used as mineral supplements and enterosorbents [1, 3, 7, 9]. More in-depth studies have shown that adaptogens affect the immunity of poultry. [1, 3, 7, 9]

Mineral adaptogens of natural origin - zeolites are a rich source of micro and macro-elements that have a positive effect on metabolism and immunogenesis, at the same time strengthen the musculoskeletal system, affect the formation of bone and cartilage tissue [7, 8, 9, 10], which is vital for rapid body weight gain. Mineral adaptogens-artificial zeolites contain, in addition to natural macro-and microelements, artificially introduced into their composition, substances necessary for the body. The complex of macro-and microelements in this case has a constant chemical composition, while natural zeolites have a non-constant composition, which depends on the depth of the formation during the extraction of zeolite. [1-33]

Adaptogens of microbial origin are pronounced antagonists of pathogenic and conditionally pathogenic microflora in the body of broiler chickens. [26, 27]

Adaptogens of organic origin contain biologically active substances represented by simple peptides of different structures, which also stimulate an active immune response in the body. [5, 6]

Adaptogens of plant origin contain vitamins and bioflavonoids that actively affect the nonspecific immunity of poultry.

The complex use of various adaptogens also enhances the positive effect of their use. [2, 4, 5, 14, 23, 24, 27]

Compliance with the requirements for the conditions of keeping and technology of growing broilers can save the life and health of birds. But the modern conditions of keeping poultry in huge poultry farms leave an imprint on the health of chickens, equipment failures are also a trigger for the development of respiratory and other pathologies in broilers.

Previously used adaptogens on other animal species showed similar results in the prevention of metabolic pathology, as well as increasing the immune response and nonspecific resistance.

The use of mineral adaptogens in deep-bed cows prevented the development of ketosis and other liver dysfunctions in calving cows, as well as the development of early postnatal pathology in newborn calves. When feeding cows with feed of low sanitary quality, organic adaptogens were also prescribed, which had a positive sorption effect on enterotoxins in the

body of cows and improved milk quality and increased the number of dairy products received. [8,13,15,16]

Often adaptogens are prescribed as a source of macro- and microelements, as well as an enterosorbent for mycotoxins in poultry and animal husbandry. [15,16,19,20] In the available literature, we have not found information about the protective effect of adaptogens on the state of the respiratory system, despite the fact that with a large crowding of broilers and failures in ventilation, mass diseases and poultry withdrawal are observed.

3 Materials and methods

The research was carried out at one of the poultry enterprises of the meat sector of the Sverdlovsk region. For the production experiment, day-old broiler chickens of the Arbor Acres cross were selected and divided into two groups of 2000 heads per group.

Before the start of the experiment, day-old chickens were randomly weighed, 25 heads of cockerels and hens, a total of 50 heads from each group, a clinical examination was carried out, and chickens with deformities were removed. During the study period, the technological process of keeping and feeding was the same, the scheme of preventive measures was followed and was identical. The birds were fed a diet from one of the trusted feed mills in accordance to the age of the chickens. Organoleptic control of the microclimate in the poultry houses was carried out daily, monitoring the operation of ventilation, the speed of air movement and the presence of harmful gases of ammonia, hydrogen sulfide, carbon dioxide. Drinking was ad-libitum. The control group received only a basic diet according to the farm scheme. The experimental group, in addition to similar additives according to the farm scheme, additionally received a mineral adaptogen with feed, by mixing at the rate of 2 g per head. (Table 1).

Table 1. Experiment plan

Group	Feed and vitamin-mineral supplements (Basic diet)	Mineral adaptogen with feed
Control	+	–
Experimental	+	+

Throughout the study period, the body weight gain of broilers was monitored every 7 days, the results were recorded in the observation diary. The average daily weight gain was calculated and entered into tables. In addition, the conversion rates and feed intake were calculated.

After a daily clinical examination of the chickens, the dead were removed and postmortem autopsy was performed, the changes were described, special attention was paid to the state of the respiratory system, photographs were taken, and specimens were obtained for histological examination. The selected material was fixed in a 10% solution of neutral formalin, then according to conventional methods: they were dehydrated in alcohols, embedded in paraffin, and histological sections were prepared, which were stained with hematoxylin and eosin. The obtained histological sections were examined under a Micromed-1R light microscope, and photo-fixation was performed with a Levenhuk Series C 300 camera. The obtained digital material was statistically processed.

4 Results research

As a result of the studies, it was found that broiler chickens receiving, in addition to the main diet and supplements used on the farm, various adaptogens better digested and

assimilated the feed, which was reflected in an increase in live weight at each weighing interval. (Table 3.1).

Table 2. Live weight growth dynamics in broilers during the period of experiment

Study days	Control	Experimental, g	%, %
Day 1	0.045±0.003	0.045±0.003	0
Day 7	0.181±0.013	0.201±0.008	11
Day 14	0.467±0.023	0.527±0.018	12.8
Day 21	0.801±0.010	0.883±0.011	10.2
Day 28	1.264±0.012	1.420±0.016	12.3
Day 35	1.439±0.024	1.712±0.005**	19
42 days	1.848±0.015	2.208±0.003*	19.5

*P≤0.05; **P≤0.01

Accordingly, the average daily weight gain was also higher in the experimental groups (Table 3), which is also clearly seen in Figures 1, 2.

Table 3. Dynamics of average daily weights in broilers during the Experiment

Study days	Control	Experimental	
	g	g	%
Day 7	0.019±0.001	0.022±0.002	15.8
Day 14	0.041±0.008	0.048±0.005	17.1
Day 21	0.048±0.010	0.054±0.009	12.5
Day 28	0.066±0.005	0.060±0.011	-9.1
Day 35	0.025±0.013	0.076±0.011**	204
42 days	0.058±0.003	0.050±0.011**	13.8

*R≤0.05; **R≤0.01; g - grams

When analyzing the weighing results during the entire feeding period of broilers in the experimental group, the increase in live weight was higher than in the control group.

Figure 3.1 clearly shows that in the experimental group the increase in live weight was higher than in the control and at the time of slaughter significantly exceeded the live weight and slaughter yield from broilers in the control group.

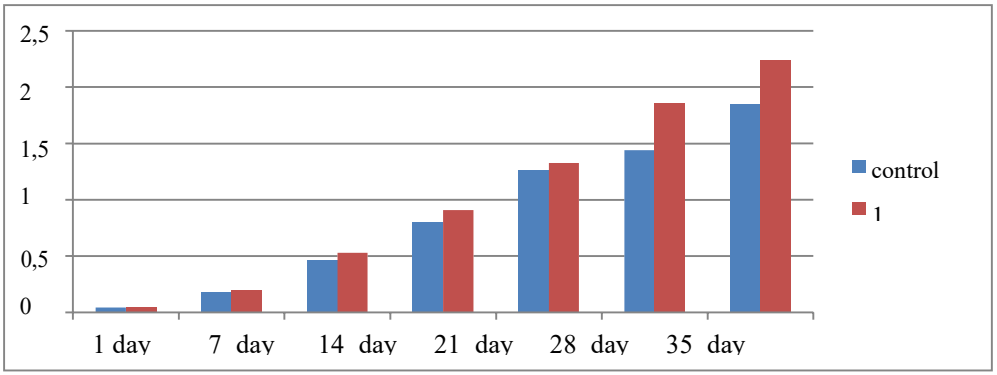

Fig. 1. Live Mass Growth Dynamics

When assessing the uniformity of live weight gain, one can notice wave-like

changes, probably associated with physiological changes in the bird's body (Figure 2).

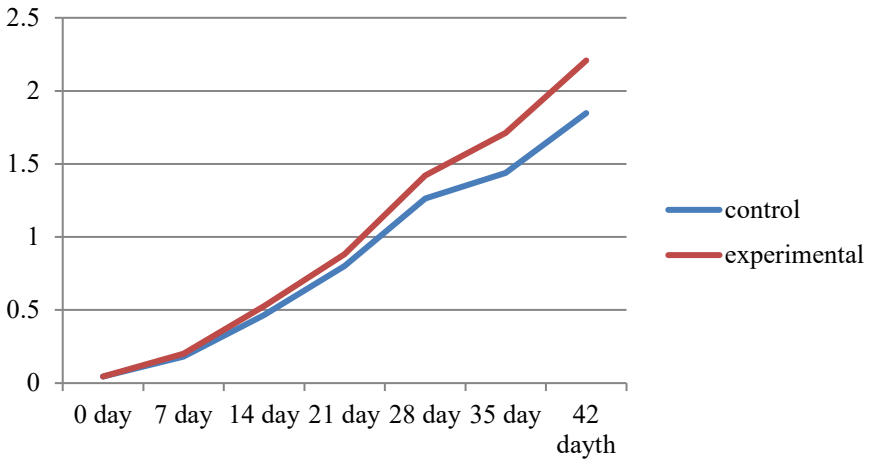

Fig. 2. Growth dynamics of average daily weight gain

The period of decline (failure) in weight gain can be explained by the fact that in the period from the 14th day there is a change in the diet from chick starter to feed grower, and at the same time, according to the technology, it coincides with the vaccination against infectious bronchitis of chickens.

In the period from 17 to 24 days, it coincides with vaccination against infectious bursal disease with a change in diet from grower to finish and, accordingly, with the removal of antibiotics. After that, a relatively sharp increase in live weight is noticeable in the experimental group.

When analyzing the state of the microclimate in the poultry house, deficiencies in the operation of ventilation were noted, due to this, the speed of air movement decreased, and the humidity and concentration of harmful gases (ammonia, hydrogen sulfide and carbon dioxide) increased accordingly.

In addition, on some days the air temperature inside the house also slightly exceeded the maximum permissible values.

During the daily clinical examination, the dead chickens were removed and a postmortem examination was performed. In a macroscopic study, the cause of mortality was determined, and at the end of the experiment, the structure of morbidity and mortality in poultry, as well as changes in the safety of the livestock when using an mineral adaptogen, were determined. (Table 4, Figures 3, 4).

When assessing the safety of poultry while using an mineral adaptogen (Table 4), it can be seen that in the experimental group the safety of birds increased, which was 12%, (Figure 3).

In terms of the number of chickens that died during the entire study period, the number of deaths in the experimental group was 5 times less than in the control group.

Table 4. Poultry safety and the reasons for the death of broilers

Causes of death	Control		Experimental	
	Number	%	Number	%
Airsacculitis	30	1.5	3	0.6
asphyxia	26	1.3	11	0.25

Respiratory organs-related diseases	35	1.75	6	0.45
hepatitis	76	3.8	1	0.05
peritonitis	18	0.9	1	0.1
GI tract-related diseases	45	2.25	30	1.95
dystrophy	40	2	3	0.15
dehydration	17	0.85	3	0.4
Colibacteriosis	23	1.15	3	0.25
Total Mortality	310	15.5	61	4.2
Preservation, %	84,5	-	95.8	-

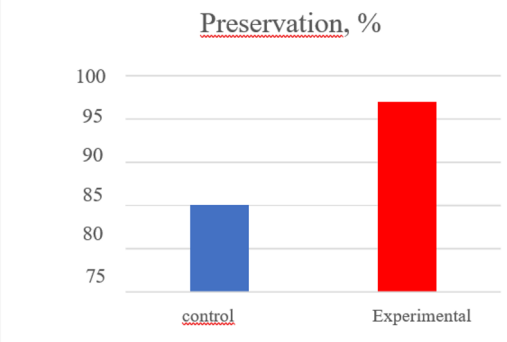

Fig. 3. Preservation of broiler chickens in the experiment

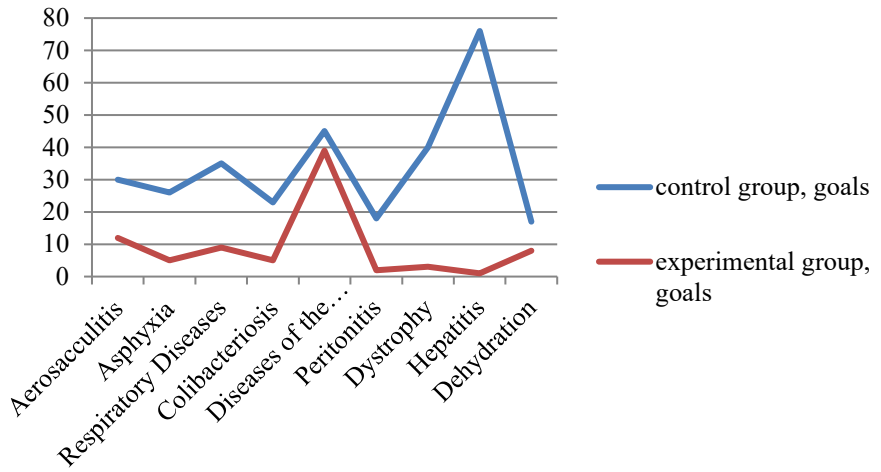

Fig. 4. Mortality rates and causes

When assessing the structure of the case when using mineral adaptogen, it is seen that inflammatory diseases of the respiratory system occur less frequently in the experimental group than in the control group.

For other non-communicable diseases, a decrease in the incidence rate in the experimental group was also noted, compared with the control group.

In general, the case rate in the experimental group decreased by 3.7 times compared to the control group.

The morbidity structure when using mineral adaptogen is shown in the figures. 5, 6

At postmortem examination, macroscopic examination most often revealed tracheal lesions, less often lung lesions and inflammation of the air sacs. Pathological lesions of the respiratory system in broilers (Fig. 7 - 9)

A qualitative assessment of pathological changes in the respiratory organs in the experimental group showed that lung lesions were insignificant (Fig. 11), compared with the control group.

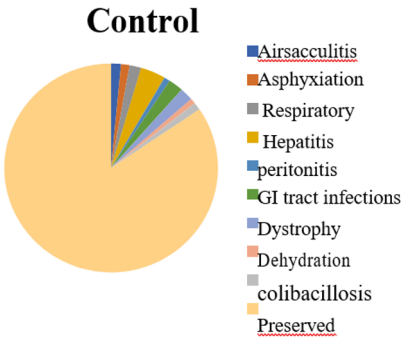

Fig. 5. Structure of disease and mortality of broilers in the control group

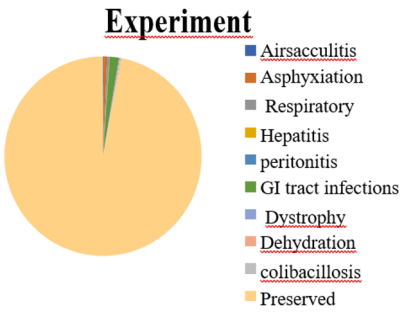

Fig. 6. Structure of disease and mortality of broilers in the experimental group

Fig. 7. Tracheitis

Fig. 8. Pneumonia

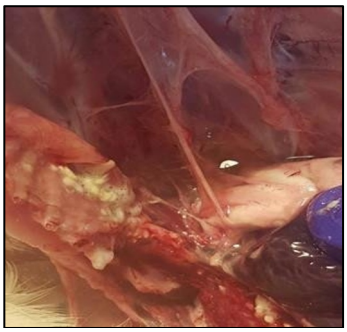

Fig. 9. Aerosaculitis

Most of the dead broilers from the control group had fibrin deposits in the trachea and bronchi (Figure 7), accumulation of exudate and the development of airsacculitis (Figure 9), congestive hyperemia and pulmonary edema (Figure 8), less often pleuropneumonia. Also, during histological examination, pathomorphological changes at the cellular level were noted to an insignificant degree in the chickens of the experimental group and more gross changes we observed in the chickens of the control group.

Histological examination of macroscopically unchanged lungs most often revealed alveolitis, microbronchitis or peribronchitis, perivascular and peribronchial edema; lymphoid cell infiltrates and hemosiderin deposition were noted in the lung tissue (Fig. 10)

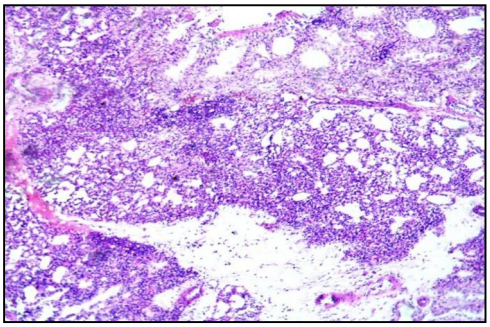

Fig. 10. Histologic structure of the lungs from the control group. Areas with lymphoid cell infiltration are well visible. Coloration hematoxylin and eosin. Y.x100

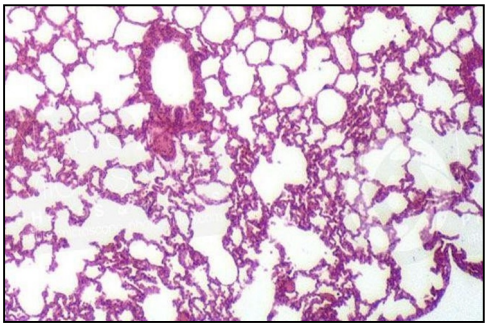

Fig. 11. Histologic structure lay in the experimental group. Coloration hematoxylin and eosin. Y.x100.

5 Economic efficiency of the use of adaptogens in the prevention of respiratory diseases in broilers

When calculating the economic efficiency of using an adaptogen of organic origin in the prevention of respiratory diseases in broilers, the following data were obtained, which are shown in Table 5

Table 5. Economic efficiency with mineral adaptogen in broiler diet

Indicators	Control group farm scheme	Experimental group (mineral adaptogen)
Number of birds at the end Growing	1690	1916
Additional costs for cultivation, ruble.	-	6400.00
Additional profit, rubles	-	71738.69
Economic efficiency per 1 ruble of costs	-	11.71

6 Discussion

As a result of the studies carried out to assess the effectiveness of the mineral adaptogen in the prevention of respiratory diseases in broilers, positive changes were obtained in improving the quality of feeding with an organic adaptogen.

In comparison with the control group, the results obtained by adding an organic adaptogen to feed were 19.5%.

According to the structure of the reasons for the mortality of poultry in the experimental group, the number of deaths due to respiratory diseases decreased. The mortality by asphyxiation resulting from disturbances in the microclimate in the control group was 2.5 times greater than in the experimental group.

When analyzing the causes of mortality, for almost all diseases that caused the mortality of poultry, mortality decreased compared to the control. When analyzing the data of postmortem autopsy, less pronounced changes were noted in the dead broilers in the experimental group than those of the control group.

Similar changes were observed in the histological examination of the lungs in broilers of the experimental group, they had less pronounced pathomorphological changes.

7 Conclusions

After analyzing the results obtained, the following conclusions could be drawn:

1. Resulting from microclimate disturbances in poultry houses, an increase in the mortality of birds due to asphyxia was noted, while in the experimental group the mortality was lower than in the control group, where the bird did not receive adaptogens.
2. When using an mineral adaptogen, the feed conversion increases and broiler chickens gain live weight more intensively: in the experimental group it is 19.5% more than in the control group.
3. When analyzing the mortality and the results of the pathological autopsy of broilers that received the adaptogen, the number of deaths decreased: in the experimental group - by 11,3%.
4. In the pathomorphological assessment of respiratory diseases, the revealed pathology of the respiratory organs was associated with violations of the microclimate in poultry houses.
5. During the pathomorphological and histological examination of the dead broilers, changes in the respiratory system were noted, but their severity was different: pronounced, gross changes were noted from broilers from the control group and less pronounced changes from broilers from the experimental group, which indicates the protective effectiveness of the use of mineral adaptogen in diseases of the respiratory system in poultry.
6. The economic efficiency of using the mineral adaptogen was 11.71 rubles per 1 ruble of costs.

Recommendations

For the prevention of technological stress in broilers associated with microclimate errors with errors in the microclimate, it is advisable to use a mineral adaptogen – artificial zeolite as a feed additive.

Conflict of interest

The authors of the article confirm that the data provided by them does not contain a conflict of interest.

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