Morphostructure of the broiler liver when using adaptogens during growth and fattening

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Abstract. The effectiveness of modern poultry farming depends on many factors, the main of which is the food supply. In addition, preventive work, including vaccination and preventive measures that increase the resistance of chickens and their survival, is an important factor. The article presents comparative results on the use of various adaptogens. The aim of the study was to evaluate the macro-microstructure of the broiler liver when using adaptogens of various origins during growth and fattening. The objectives of the study were: to evaluate changes in the macro- and microstructure of the liver after fattening broilers, when feeding adaptogens of various origins, while comparing the preventive effectiveness of adaptogens in diseases of the digestive system, the effectiveness of fattening and the safety of livestock. For the first time, an organoleptic veterinary and sanitary assessment of the quality of giblets was carried out in comparison with microscopic changes after feeding various feed additives of domestic production with the properties of adaptogens. An adaptogen has been identified that maximally reduces the incidence of broilers in diseases of the digestive system and liver, the main organ responsible for metabolic processes in the body. In addition, an adaptogen has been identified that allows maximizing the efficiency of using the feed base for growing and fattening broilers. Such an adaptogen is an organic adaptogen – peat-sapropel concentrate. The effectiveness of the used domestic feed additives, which are adaptogens, depends on the composition of these additives, it is mainly determined by the mineral composition and biologically active additives included in their composition. The used feed additives have organoprotective properties, increase the nonspecific resistance of the bird's body, increase the efficiency of using the feed base, and increase the survival rate of chickens. Accordingly, they increase the efficiency of meat and poultry farming.

1 Introduction

Modern poultry farming is the most efficient branch of agricultural production, but nevertheless it does not have one hundred percent economic efficiency. What is the reason for the losses in poultry farming? Economic losses are primarily associated with the death of chickens, a decrease in fattening rates, the cost of preventive and therapeutic measures,

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technological losses of products, insufficient use of by-products, and the cost of overcoming unforeseen losses. In this regard, the search for effective means to reduce losses from mortality, increase fattening rates and natural resistance in broilers is an urgent task at the present stage of poultry farming development. Many achievements have already been made in the safety of poultry in production, but so far there are unresolved issues to increase the survival rate of poultry. Due to the fact that ideal conditions cannot be achieved, this is due to problems of equipment wear, changes in the quality of the feed base, insufficient response to vaccination associated with a decrease in the natural resistance of chickens, the search for effective means that increase natural resistance remains relevant to this day. The use of vitamin-enriched feed additives effectively increases survival, and well-known mineral supplements also have a positive effect on poultry health. But as practice has shown, this was not enough. The use of sorbents reduced the poultry's withdrawal from mycotoxin poisoning. For these purposes, zeolites of natural origin were used, they increased survival. The disadvantage of natural zeolites is not a constant chemical composition, which requires additional costs for monitoring the chemical composition of each batch. The most effective and stable in terms of chemical composition are artificial zeolites, which appear as a result of technological processing of by-products of the metallurgical industry, in particular, aluminum production. Previous studies have revealed the positive effect of mineral feed additives made from artificial zeolites as an effective enterosorbent, as a source of macro- and microelements and a means of increasing the natural resistance of broiler chickens, restoring mineral metabolism and a positive effect on the musculoskeletal system as a whole. The use of a feed mineral supplement on the body of broiler chickens has shown that, according to the variety of effectiveness of this additive, it can be attributed to the group of mineral adaptogens. The search for adaptogens of similar action will increase the efficiency of survival and fattening of broilers. The main organ regulating metabolic processes is the liver. The liver detoxifies endotoxins coming from the digestive products from the intestine, in addition, carbohydrate and fat metabolism is regulated, B vitamins accumulate, which is important both for the bird itself and in the future, as a dietary food product for humans. Steroid hormones are synthesized in the liver and homeostasis in the body is maintained. If self-regulation occurs in the process of vital activity and the body regulating metabolic processes copes with endo-loading, then after slaughter the liver as a by-product is sent to sale. If the liver works with overstrain, then irreversible changes occur in the organ and after slaughter such an organ is disposed of. An increase in the percentage of sales of full-fledged poultry products increases the efficiency of poultry farming [1-7]. Therefore, it is necessary to search for a variety of means that have a multifaceted effect on the bird's body. In this regard, the aim of the study was to evaluate the morphological changes in the liver of broilers when using adaptogens of various origins during growth and fattening. The objectives of the study were: - to assess the macrostructure of the liver at the end of fattening and slaughter of broilers after feeding adaptogens of various origins; - to evaluate changes in the microstructure of the liver after fattening and slaughter of broilers after feeding adaptogens of various origins; - to compare the preventive effectiveness of adaptogens in diseases of the digestive system; - compare the safety of the broiler stock and the feed conversion rate when using various adaptogens.

2 Research material and methods

The research was carried out in one of the poultry enterprises of the meat sector, in the Ural State Agrarian University in the laboratory of the Department of Infectious and Non-Infectious Pathology, in the licensed pathomorphological laboratory of the Yekaterinburg Cardiology Center. The studies were conducted on chickens of the Arbor Acres cross. 10,000 heads of chickens were selected for the study, which were divided into 5 groups. One control

group and 4 experimental groups. The groups were selected according to the principle of analogues, with 2,000 heads each. The chickens were selected from the age of one day, kept in one poultry house, i.e. the parameters of feeding, watering and microclimate were identical. All technological processes were the same. The chickens of the control group received feed and vitamin and mineral supplements according to the diets developed at the enterprise, the chickens of the experimental groups received various adaptogens in addition to the diet and basic vitamin and mineral supplements. To assess the preventive effect on the body of chickens of feed additives with adaptogenic, sorption properties and being a source of minerals, the following were selected: mineral (feed mineral additive – FMA "WS- VIT"), organomineral (lump additive "Diagum"), organic additives (liquid peat sapropel concentrate (TSK) – "HumiTorf"), and organic additives enriched with microorganisms having probiotic properties (liquid peat sapropel concentrate enriched with probiotic "HumiTorf-Phyto"). The scheme of the study is shown in Table 1.

Table 1. The scheme of the study

Group number	feed and additives according to the farm scheme	FMA "WS-VIT" in a dose of 2 g / kg of feed	«Diagum» in a dose of 2 g / kg of feed	"HumiTorf" in a dose of 2 liters / 1 m^3 of water, except for vaccination days	"HumiTorf-Phyto" in a dose of 2 liters / 1 m^3 of water, except for vaccination days
1- control, n=2000	+	-	-	-	-
2- experienced,n=2000	+	+	-	-	-
3- experienced,n=2000	+	-	+	-	-
4- experienced,n=2000	+	-	-	+	-
5- experienced,n=2000	+	-	-	-	+

Every 7 days of fattening, chickens were randomly weighed to assess the quality of fattening. In addition, the safety of the livestock and the causes of chicken deaths were regularly assessed, taking into account the microclimate parameter, feed quality, water and the use of antibacterial drugs and preventive technological vaccination of the chicken population. The microclimate parameters were monitored using special sensors reflecting the temperature inside the poultry house, air velocity, humidity and concentration of harmful gases (ammonia, hydrogen sulfide, carbon dioxide). The licensed regional veterinary laboratory of the Sverdlovsk region determined the quality of the feed used and the quality of the water. After the fattening period, a post-slaughter veterinary and sanitary examination of carcasses and giblets was carried out in order to cull low-quality products. At the same time, samples were taken for histological examination, followed by fixation by dehydration and staining according to generally accepted methods. Then histological studies were performed using a light microscope and a digital photo and video camera. The results of the clinical observation were recorded in the observation log. The resulting digital material was subjected to statistical processing. At the same time, the feed conversion rate was calculated and the average daily feed consumption was determined by groups.

3 Results and discussion

During the research period, daily monitoring of the microclimate parameters was carried out. There were no equipment failures. Drinking water from an artesian well, the concentration of heavy metal salts does not exceed acceptable values. No critical concentrations of mycotoxins were detected in compound feeds. However, the presence of mycotoxins in small concentrations was noted.

Table 2. Feed conversion rate

1 group – control, n=2000	2 group FMA "WS-VIT", n=2000	3 group– «Diagum», n=2000	4 group – "HumiTorf"),n=2000	5 group – 'HumiTorf-Phyto", n=2000
1.84	1.77	1.78	1.66	1.88

The lower the feed conversion rate, the more efficient poultry fattening is. According to Table 2, the most effective feed additive is an organic adaptogen (TSK – "HumitTorf"), the average value for the efficiency of using the feed base in broilers receiving (KMD "BSH-VIT" and "Diagum") mineral and organomineral adaptogens.

Table 3. Average daily feed intake

1 group – control, n=2000	2 group FMA "WS-VIT", n=2000	3 group– «Diagum», n=2000	4 group – "HumiTorf"),n=2000	5 group – 'HumiTorf-Phyto", n=2000
42.51	47.45	46.03	51.30	43.54

According to Table 3, the maximum feed consumption of broilers is in groups 4 and, respectively, the average values in groups 2 and 3. In the fifth group, which received an organic adaptogen enriched with probiotic, feed intake approached the values of the control group. The data in Tables 2 and 3 indicate the effective use of poultry feed, which contributed to better fattening, assimilation of feed and better preservation of broiler livestock in the experimental groups. In addition, an analysis of the structure of poultry mortality due to diseases of the digestive system and liver was carried out, the results are presented in Table 4.

Table 4. Structure of causes of death of broiler chickens when using various adaptogens

Causes of the case	Group, number of goals									
	1 control		2 experienced		3 experienced		4 experienced		5 experienced	
	heads	%	heads	%	heads	%	heads	%	heads	%
Hepatitis	76	3.8	1	0.05	1	0.05	1	0.05	1	0.05
Peritonitis	18	0.9	2	0.1	2	0.1	1	0.05	1	0.05
Other diseases of the digestive system	45	2.25	29	1.45	41	2.05	30	1.5	17	0.85
Dystrophy	40	2	3	0.15	3	0.15	3	0.15	1	0.05
Dehydration	17	0.85	8	0.4	8	0.4	3	0.15	2	0.1
Colibacteriosis	23	1.15	5	0.25	5	0.25	3	0.15	11	0.55
Other reasons	91	4.55	36	1.8	26	1.3	20	1	97	4.85

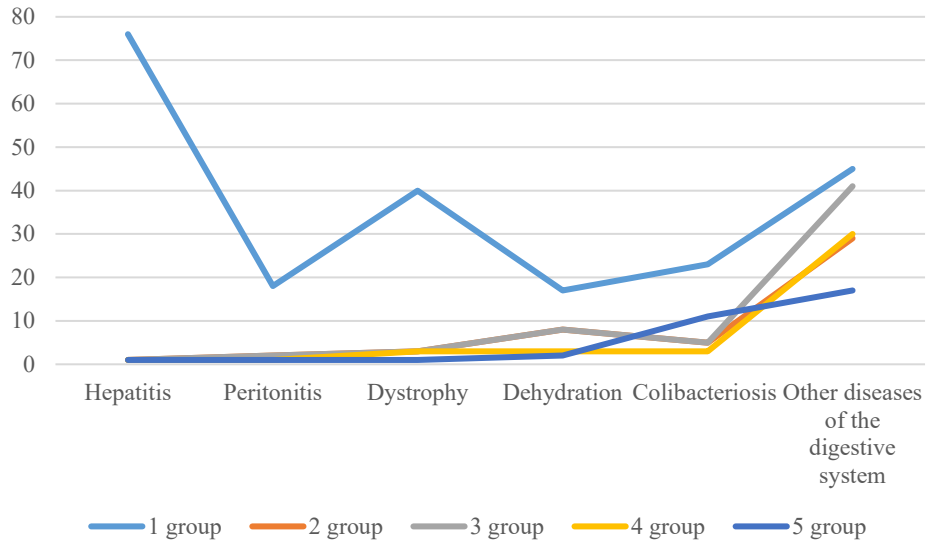

Fig. 1. The safety of livestock depending on the causes of death

From the data in Table 4 and Fig.1, it can be seen that the highest incidence was observed in chickens of the control group and the lowest, in diseases of the digestive system, in the group receiving an organic adaptogen enriched with probiotic. In other pathologies that caused the death of broilers treated with organic, organo-mineral and mineral adaptogens, the values were similar with minor variations, but less than in the control group. The use of any adaptogens in broiler feed reduces their susceptibility to adverse factors related to feed, water and disorders of the digestive system. With liver damage, peritonitis, dystrophy, dehydration and colibacteriosis, the control group has the highest percentage of deaths and in all experimental groups it is the lowest.

In addition, it can be seen that with other problems, the percentage of deaths in the experimental groups is lower than in the control group, which confirms the increase in natural immunity when using adaptogens in broiler feed. The maximum preventive effect in diseases of the digestive system and liver was observed when using an organic adaptogen enriched with a probiotic - "HumiTorf-Phyto". Due to the introduction of Bacillus subtilis into the TSC, the adaptogen has a pronounced local effect, i.e. it maximally reduces the influence of negative factors on the digestive organs and the peripheral intraorgan immune system, and when other systems are affected, for example, with changes in the microclimate, the effect is observed, but it is minimal. Therefore, depending on the prevailing problems in production, various adaptogens can be used or a combined scheme of their application can be developed. Table 5 shows the results of the preservation of the broiler chicken population by group. According to the table, it can be seen that the minimum percentage in the control group is 85% and higher rates in the experimental groups are 8.5% higher in group 5, 10.8% higher in group 2, 10.7% higher in group 3 and 11.95% higher in group 4. Therefore, the use of adaptogens in broiler feed increases the efficiency of meat poultry farming.

Table 5. Safety of broiler chickens when using various adaptogens

Causes of the case	Group, number of goals									
	1 control		1 control		1 control		1 control		1 control	
	heads	heads	heads	heads	heads	heads	heads	heads	heads	heads

At the beginning of the experience	2000	100	2000	100	2000	100	2000	100	2000	100
Everything has fallen	300	15	84	4.2	86	4.3	61	3.05	130	6.5
Safety	1700	85	1916	95.8	1914	95.7	1939	96.95	1870	93.5

During the veterinary and sanitary examination of the giblets on the conveyor, external changes in the liver were determined by color, the condition of the organ surface and on the incision. During the examination of the liver from the broilers of the control group, 20% of the studied giblets revealed a significant color change instead of dark cherry color to yellow-brown or yellow clay color, while there was a change in density from collapsing from low pressure to uneven density with areas of compaction and increased density. Accordingly, uneven coloration with areas of hyperemia and the formation of nodules of different sizes: from millet grain to the size of a pea was also observed on the organ section. (Fig. 2, 3, 4, 5, 6)

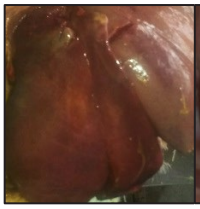

Fig. 2. Changing the color to yellow-brick

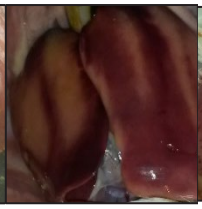

Fig. 3. Color change "variegated striped" coloring

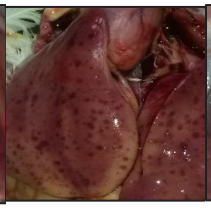

Fig. 4. "Spotted" liver coloration

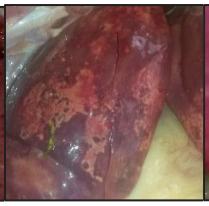

Fig. 5. Zonal liver coloration

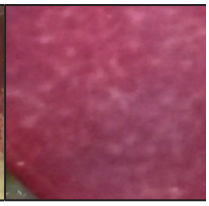

Fig. 6. "Spotted" coloring

Giblets with obvious changes were discarded for disposal, the rest without pronounced macroscopic changes in color, shape and consistency were released without restrictions for sale in accordance with the requirements of GOST. During the study of powders from broilers of experimental groups, the liver macroscopically had the usual appearance: color, shape, consistency, in some cases, slight lightening of the organ was noted (Fig. 7, 8, 9).

Fig. 7. Normal liver color

Fig. 8. Enlightened liver

Fig. 9. Normal liver color of broilers for sale

During the study of the liver microstructure with obvious signs of damage and with a change in the color of the organ, the liver microstructure showed signs of fatty hepatosis (Fig. 12, 13), degenerative-dystrophic changes and necrosis (Fig.10, 11). In the microstructure of the liver from broilers of the experimental groups, a physiological structure with a preserved structure of beams, hepatocytes in a functionally active form were noted (Fig. 14, 15). In isolated cases, the deposition of lipid granules in the cytoplasm of hepatocytes was noted, with the preserved beam structure of the organ.

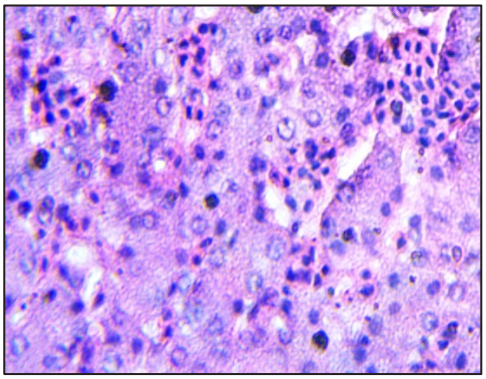

Fig. 10. The control group. Necrosis of hepatocytes on the background of congestive hyperemia. The staining is hematoxylin and eosin. Increase of 1000

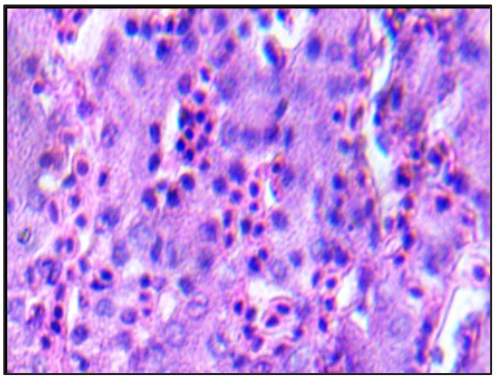

Fig. 11. The control group. Congestive hyperemia. The staining is hematoxylin and eosin. Increase of 1000

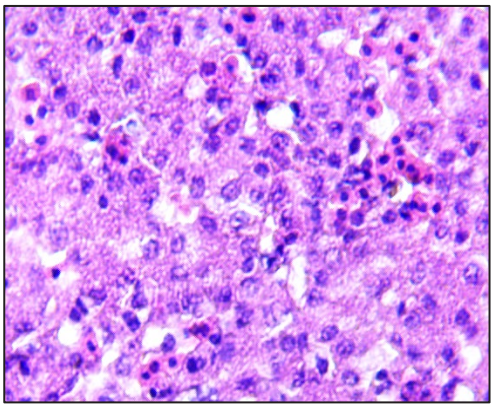

Fig. 12. The control group. Small-drop fatty liver dystrophy. Hyperemia of the liver. The staining is hematoxylin and eosin. Increase of 1000

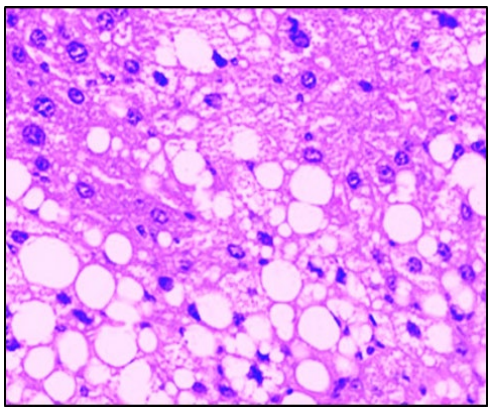

Fig. 13. The control group. Fatty hepatosis. The staining is hematoxylin and eosin. Increase of 1000

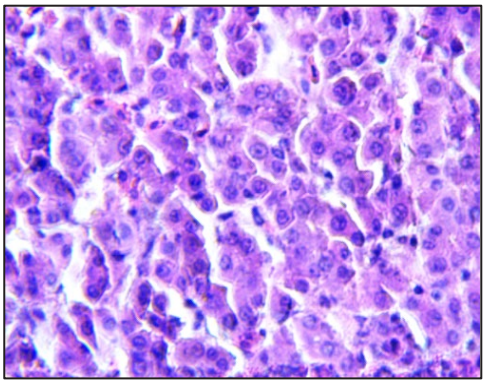

Fig. 14. Preserved functional structure of the liver. Broilers have experienced groups. The staining is hematoxylin and eosin. Increase of 1000

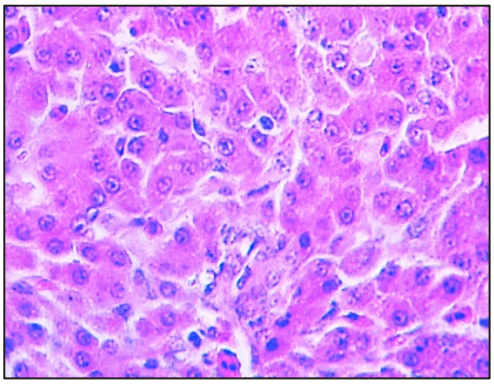

Fig. 15. Preserved functional structure of the liver. Broilers have experienced groups. The staining is hematoxylin and eosin. Increase of 1000

The results obtained made it possible to calculate the economic effect of the use of feed additives of various origin, which are adaptogens. The results are presented in table 6.

Table 6. Economic efficiency when using adaptogens

Indicators	1 group – control	2 group FMA "WS-VIT"	3 group– «Diagum»	4 group – "HumiTorf")	5 group – "HumiTorf-Phyto"
Goals at the end of the experience	1690	1916	1914	1939	1870
Additional costs, rub.	-	6400.00	5008.00	19416,00	47160,00
Additional profit, rub.	-	71738.69	506460	514740	500710
Economic efficiency per 1 ruble of costs	-	11.71	96.78	25.7	9.93

The data in table 6 show that the use of adaptogens makes a profit of at least 9.93 rubles per 1 ruble of costs in the fifth group, and at most 96.79 rubles per ruble of costs in the second group.

4 Conclusions

After analyzing the results obtained on the use of adaptogens of various origins, we noted changes in the restoration of the liver structure, both at the macroscopic and microstructural levels. The increase in livestock safety, depending on the composition of adaptogens, had slight differences in the experimental groups. In addition, an increase in natural resistance was noted, but depending on the etiological factor, the percentage of organoprotection varies. The data obtained allow us to draw the following conclusions:

1. The macrostructure of the liver during the veterinary and sanitary examination of giblets from broilers of the control group does not comply with GOST by 20% and is being disposed of, and from broilers of experimental groups does not exceed 10%, which confirms the preventive organoprotective effect of the used adaptogens.

2. The microstructure of the liver when feeding adaptogens corresponds to the preserved functional activity of the liver and the prevention of early aging of cellular structures.

3. Feeding adaptogens during the fattening period significantly reduces the incidence of diseases of the digestive system, the most effective in this regard is an organic adaptogen enriched with the probiotic "HumiTorf-Phyto".

4. When using any adaptogens, the safety of the broiler population increases from 8.5 to 11.95%. The maximum safety of the broiler population is observed when the organic adaptogen "HumiTorf" is introduced into the diet.

5. When analyzing the effectiveness of fattening, maximum efficiency is noted when using the organic adaptogen "HumiTorfa" (group 4), while the feed conversion rate was 1.66, and in the control group – 1.84.

6. The use of adaptogens allows to increase the efficiency of meat poultry farming by a minimum of 9.93 and a maximum of 96.79 rubles per ruble of costs.

7. Depending on the prevailing problems in production, various adaptogens can be used or a combined scheme of their application can be developed.

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