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PHARMACOLOGICAL REGULATION OF THE DETOXICATION FUNCTION OF POULTRY LIVER IN MYCOTOXICOSIS

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ABSTRACT

The article presents the results of studying the effectiveness of pharmacocorrection of combined poultry mycotoxicosis with polysaccharide and phospholipid substances. In an experimental simulation of mycotoxicosis, quails were fed with feed contaminated with aflatoxin B1 in concentration of 0.019 mg/kg of feed and T-2 toxin in concentration of 0.095 mg/kg of feed for a month. For pharmacocorrection of toxicosis, a complex consisting of beet pulp and rapeseed lecithin in 4:1 ratio was used. Poultry of the first experimental group daily got an antitoxic complex at a dose of 2.5 grams per head. The second group received only toxic feed without treatment; the third group got the main diet. The results of the experiment showed that in the group with the use of the antitoxic complex in poultry, an increase in body weight was noted, whereas in the group without treatment on the background of the development of mycotoxicosis negative dynamics of body weight was recorded with a difference of 18.5%. In the group without treatment on 16th, 21st, and 28th days of the experiment 19% of quail deaths were recorded, while the use of the antitoxic complex ensured 100% safety of the poultry. Laboratory studies have shown an increase in the activity of aminotransferases, indicating damage of the membranes of hepatocytes leading to the release of intracellular substances into the bloodstream during intoxication. This process was accompanied by activation of lipid peroxidation with a dominant increase in malondialdehyde (MDA) in poultry blood serum. The use of the complex of polysaccharide and phospholipid substances in experimental mycotoxicosis has the hepatoprotective effect and improves the lipoperoxidation processes in poultry.

KEY WORDS
liver, detoxification, quails, mycotoxicosis, plant fiber, phospholipids

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INTRODUCTION

Liver functions in the organism are very diverse, since liver is the central organ of chemical homeostasis, where a single energy pool for the metabolism of carbohydrates, proteins, fats, vitamins, microelements and other substances is created. The barrier function of liver is of a great importance, because many toxic substances of endogenous and exogenous origin are delayed or changed and excreted. The most dangerous of the natural toxicants – pollutants of agricultural raw materials and food products – are microscopic fungi and their toxins – mycotoxins. The most common mycotoxins found in feed are produced by three genera of fungi – *Aspergillus, Penicillium and Fusarium*, and often their content in the feed does not exceed the maximum permissible level. Moreover, numerous studies have proved that many of them even in low concentrations have mutagenic, teratogenic, carcinogenic and immunosuppressive properties, and are also able to reduce the body's resistance to infectious and invasive diseases [1-3].

Mycotoxins contaminate food and feed at all stages of their production, transportation, storage, processing and implementation. In this regard, along with the measures aimed at preventing the entry of mycotoxins into the body, finding ways to reduce the toxicity of xenobiotics already in the gastrointestinal tract is important [4, 5].

Among the most promising ways in this area is the use of dietary fiber from recycled plant materials, reinforced with components with hepatoprotective, detoxification and anti-inflammatory activity [6].

For the purpose of primary sorption of toxicants in the gastrointestinal tract, the use of beet pulp, which contains a complex of soluble and insoluble dietary fiber, is proposed. The first include polysaccharides – pectins with the high absorption capacity against heavy metals, mycotoxins and other xenobiotics. The second fraction is represented by insoluble “rough” dietary fiber, which, passing through the gastrointestinal tract, affects intestinal motility and helps to mechanically remove toxic substances from the body [7, 8].

Essential phospholipids are included in compounds obtained from plant resources and possessing high biological activity, including hepatoprotective activity, which led to the inclusion of phospholipid component in the form of rapeseed lecithin in the antitoxic complex [9].

The purpose of the research was to study the pharmacological correction efficiency of combined poultry mycotoxicosis with a complex of polysaccharide and phospholipid substances.

MATERIALS AND METHODS

Studies were carried out on quails of Texas Pharaoh breed with the body weight of 315.7 ± 1.18 g, divided into three groups (two experimental groups and control group) of 16 quails each. In the experiments, quails

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that passed the quarantine regime and did not have external signs of disease were used. To obtain statistically reliable results, groups were formed according to the principle of paired analogues.

The essence of the method of reproducing combined mycotoxicosis: for 30 days the quails of the experimental groups were fed with the feed naturally contaminated with mycotoxins. The concentration of aflatoxin B1 in samples was 0.019 mg/kg, and concentration of T-2 toxin was 0.095 mg/kg. It should be noted that both toxins separately did not exceed the maximum permissible level, but their combined effect on the body for a long time causes the development of toxicosis. The third group served as an intact control.

Pharmacological correction

For pharmacocorrection of mycotoxicosis a complex of polysaccharide (beet pulp) and phospholipid substances (rapeseed lecithin) was used in 4:1 ratio. The presence of the first component – vegetable fibers from the sugar beet, including pectin and cellulose, determines the ability of the preparation to form complexes with xenobiotics and remove them from the body, as well as to improve the functional state of the gastrointestinal tract due to prebiotic properties. The second component of the preparation, represented by rapeseed lecithin, allows restoring the phospholipid skeleton of the hepatocyte membrane, reducing the intensity of lipid peroxidation processes, the generation of active oxygen metabolites, and eliminating the disturbance of cell energy supply.

The poultry of the first experimental group daily got an antitoxic complex *per os* at a dose of 2.5 grams per head. The second group received only toxic feed without treatment, the third group was kept on the main diet, receiving benign compound feed. All quails could freely take water from automatic drinkers.

Clinical observation

All quails were monitored, weighing was carried out on 15th and 30th days of the experiment. In order to study the effect of the antitoxic complex on the detoxification function of poultry liver, blood was taken from 5 quails from each group for biochemical studies (15 days from the beginning of the experiment and one day after the last use of the complex). Laboratory studies were carried out on a Vitalab Flexor automatic biochemical analyzer using aspartate aminotransferase (AST) and alanine aminotransferase (ALT). The intensity of lipid peroxidation (LPO) was evaluated spectrophotometrically by the level of diene conjugates (DC), ketodienes (KD) and malondialdehyde (MDA).

Statistical processing

Statistical processing of the results was carried out using special software packages. The study of quantitative traits was carried out by comparing the average values of two sample sets with the determination of Student's criterion and significance level (p).

RESULTS

As the result of the studies, it was found out that in the group using the antitoxic complex in poultry an increase in the body weight was noted, while in the group without treatment on the background of the development of mycotoxicosis, negative dynamics of body weight was recorded [Table 1].

Table 1: Influence of the antitoxic complex on quail body weight at mycotoxicosis (M±m; n=16)

Groups	Body weight, g		
	Background	On the 15th day of experiment	On the 30th day of experiment
1 experimental	315.2±1.26	323.8±1.09	334.1±0.86*
2experimental	315.1±1.18	298.7±1.76	282.0±0.93
3 control	317.1±0.87	336.3±1.48	358.0±0.97

Note: * p≤0.05 – the differences are significant in relation to the group without treatment

On the 15th day of research, in the 1st group the body weight of quails increased by 2.7%, while in the 2nd group there was a decrease in weight by 5.2%. On the 30th day of the experiment, the body weight of quails of the 1st group increased by 5.9% in relation to the initial data, with a dynamic decrease in body weight of poultry of the 2nd group by 10.8%. The significant difference between the group using the antitoxic complex and the group without treatment was 18.5%. At the same time, an intact poultry had a dynamic increase in body weight, which was 6.1% by the middle of the experiment and 12.9% at the end of the experiment.

Clinical studies determined that the first symptoms of intoxication in quails of the 2nd group (without treatment) were observed already on the 8th day of the experiment (severe inhibition, decreased egg laying,

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narrowing of the palpebral fissure, excretion of serous outflows from the nose and eyes, moderate decrease in appetite).

By the 15th day of the experiment, poultry in this group showed a significant decrease in appetite, increased thirst, watery consistency of greenish droppings, with an admixture of blood, lack of egg laying, as well as egg molding was observed in some quails, and the shell of eggs was soft, deformed and green.

In the group without treatment, on the 16th, 21st and 28th days of the experiment the death of three quails was recorded (18.8% of the total amount). In the group with the use of the antitoxic complex, the safety of quails during the period of the experiment was 100%, and the clinical signs of intoxication (dullness of feathers, decrease in egg laying and weight gain) began to appear only in the middle of the experiment. Moreover, by the end of the experiment, the use of the complex contributed to a significant improvement in the state of the poultry, since there were practically no external signs of intoxication.

Results of biochemical studies

A biochemical blood test found out that with the development of mycotoxicosis, a significant change in the activity of enzymes-markers of the liver condition occurred [Table 2].

In the 2nd group (without treatment), by the middle of the experiment an increase in AST activity by 18.5% was revealed relative to the intact poultry, and at the end of the experiment, the differences between the groups were 28.1%. ALT activity increased more significantly – on the 15th day it increased in 1.7 times and on the 30th day it increased in 1.6 times compared with the indicators obtained in the control group.

Table 2: Influence of the antitoxic complex on the biochemical parameters of quails at mycotoxicosis (M±m; n=5)

Indicators	Groups		
	1 experimental	2 experimental	3 control
	15thday of the experiment		
AST, U/l	319.6±5.43*	365.2±5.19	308.2±2.16
ALT, U/l	22.8±0.85**	27.9±0.74	16.2±0.92
$DC_{(232)}$, AU	0.587±0.03*	0.721±0.06	0.392±0.05
$KD_{(273)}$, AU	0.481±0.05	0.575±0.02	0.417±0.01
$MDA_{(537)}$, μM /l	2.08±0.14*	2.55±0.11	1.34±0.09
30thday of the experiment			
AST, U/l	310.5±5.66*	393.3±4.45	307.1±2.46
ALT, U/l	19.6±0.77**	28.6±1.30	17.5±1.13
$DC_{(232)}$, AU	0.528±0.04***	0.794±0.09	0.383±0.07
$KD_{(273)}$, AU	0.473±0.01**	0.627±0.05	0.403±0.04
$MDA_{(537)}$, μM /l	1.82±0.09***	3.63±0.17	1.29±0.11

Note: (*p≤0.05; ** p≥0.01; ** p≥0.001) the differences are significant in relation to the group without treatment

In quails of the 1st group receiving the antitoxic complex, the activity of AST by the middle of the experiment was lower by 14.3% than the values of the same indicator in the 2nd group, and by the end of the experiment it was lower by 26.6%, but at the same time it exceeded the values obtained from the control group of poultry. A similar dynamics was observed in the ALT concentration, since the significant difference on the 15th day of observation was 22.4% and on the 30th day of the study it was 45.9%, relative to the quail of the 2nd group, but remained higher than the corresponding indicator of the intact quails.

Quail intoxication was accompanied by an increase in LPO processes, which was confirmed by an increase in all lipoperoxidation products. The differences between the intact poultry of the 3rd group and the quails of the 2nd experimental group (without treatment) in the middle of the experiment amounted in the following values: DC – 83.9%, KD – 37.9% and MDA – 1.9 times, and by the end of the experiment DC – 2.1 times , KD – 55.6%, and MDA – 2.8 times, respectively.

The pharmacological effectiveness of the antitoxic complex was manifested in the preventive effect on the development of pathological LPO generation under the influence of mycotoxins. The difference between the quails of the 1st and 2nd groups in the middle of the experiment was: by DC – 22.8%, by KD – 19.6%, and by MDA – 22.6%; by the end of the experiment the difference was: by DC – 50.4%, by KD – 32.6% and by MDA – 2 times.

DISCUSSION

The results of our studies confirm the data that the combined effect of mycotoxins in doses below the maximum permissible level leads to the development of clinical mycotoxicosis in poultry [10, 11]. Aflatoxin and T-2 toxin, when interacting, exhibit synergistic toxicity, causing mortality and decrease in weight gain of quails. These effects were demonstrated in a number of studies on broiler chickens regarding ochratoxin A, aflatoxin and T-2 toxin, which indicated that in most cases, a significant decrease in body weight in poultry

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from the second week of the experiment was observed [12-14]. Our results are partially consistent with these data, since in the group without the antitoxic treatment, on the background of prolonged intake of mycotoxins, a constant decrease in body weight of quails was recorded without a dominant manifestation over the periods.

Mycotoxins can induce oxidative stress. In experimental mycotoxicosis in poultry, an increase in the products of lipid peroxidation in the body was revealed starting from the 7th day of the experiment, as well as during the final sampling, by 21st day [15, 16]. Received data indicate that at intoxication of quails with aflatoxin and T-2 toxin the maximum accumulation of lipid peroxidation products occurred at the end of the experiment – on the 30th day with a dominant increase in MDA in poultry blood serum.

Given the diversity of mycotoxin structures, it is necessary to combine different strategies for the treatment and prevention of mycotoxicosis. The most famous method of decontamination of mycotoxins is the use of adsorbents or enterosorbents, which can have organic or inorganic (mainly clay minerals) nature. Numerous studies in animals have reported that aluminosilicates are effective as adsorbents for mycotoxins [17, 18].

We used a new way in the fight against mycotoxicosis in the treatment of diverse substances obtained from natural resources. The studies proved the effectiveness of the complex of substances of polysaccharide and phospholipid nature at combined poultry mycotoxicosis. This effect is confirmed by the previously determined pharmacological properties of lecithin and plant fibers during intoxication, manifested by their ability to regulate the toxicokinetics of heterogenous compounds, including the stages of absorption, hepatic-intestinal recirculation, biotransformation and detoxification [19-23].

CONCLUSION

Thus, the results of the experiment allow us to conclude that during mycotoxin intoxication in quails, the activity of aminotransferases increases, indicating damage of the membranes of hepatocytes leading to the release of intracellular substances into blood. This process is accompanied by the activation of lipid peroxidation. The use of the complex of substances of the polysaccharide and phospholipid nature improves lipoperoxidation and the state of liver of poultry contaminated with mycotoxins, which is manifested by an increase in the safety and weight gain of quails, as well as by a decrease in the clinical manifestations of intoxication.

CONFLICT OF INTEREST

The authors declare no competing interests in relation to the work.

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None.

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