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CLINICAL AND PATHOMORPHOLOGICAL CHANGES IN MYCOTOXICOSIS OF COWS

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Abstract

The defeat of feed by microscopic fungi is a fairly common phenomenon at this stage of the management of the agricultural sector. This is due to weather conditions (high rainfall) and errors in harvesting and storage of grain. Feeding affected feed leads to irreversible processes in the body of cows, reducing their productivity. The aim of the study was to establish marker indicators for the rapid diagnosis of mycotoxicoses in cows. So, when exposed simultaneously to T-2 toxin and toxins of the fungus Aspergillus fumigatus, destructive changes in the skin and mucous membranes were diagnosed, and pathology of the limbs was diagnosed, which was characterized by lameness. The laboratory revealed an increase in the level of leukocytes up to 37.1 g/l and a decrease in the content of hemoglobin in the blood of sick animals. Also, a characteristic feature was the latch of the contents of the rumen at pH 8.0, which in turn leads to a decrease in the number of ciliates. Also a sign of poisoning are changes in the fecal matter: liquid, musty odors and with an increased pH of up to 7.5. At the autopsy of the dead animals, a characteristic sign was: necrosis of the mucous membranes of the oral cavity, esophagus, gastrointestinal tract, protein degeneration in the liver and kidneys, and serous pulmonary edema. Infertility is 67.35 %, which leads to multiple unsuccessful insemination, which is due to destructive changes in the organs of the reproductive system. So, in sick animals, ovarian hypotrophy was diagnosed at the level of 54.09 %, ovarian cysts v in 8.18 %, yellow persistent bodies in the postpartum period – 7.54 %. The prospect of further research will be the development of preventive methods for treating cows and increasing their reproductive function of mycotoxicoses.

Keywords: gynecological pathology, mycotoxicoses of cows, signs of mycotoxicoses, cicatricial digestion

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1. Introduction

In feeding animals, feeds affected by different genera (species) of fungi are often forced to be used, which has a negative impact on animal health [1–4].

Grain used for the manufacture of animal feed is often contaminated with various types of fungi during cultivation, harvesting or storage [1].

Researchers point out that the contamination of agricultural grain with microscopic fungi and their toxins is quite common and amounts to about 25 % [5].

A variety of mycotoxins are found in animal feed. Aflatoxins are produced by Aspergillus and are the most dangerous. They disrupt the functioning of the kidneys and liver, reduce immunity, and, in addition, are carcinogens [6]. Other authors also point out the possibility of excretion of this mycotoxin with milk, which is dangerous for calves [7].

Zearalenone is a mycotoxin with a pronounced estrogenic activity. When it enters the body of cows, the general estrogenic background rises, which leads to a violation of the sexual cycle in cows, and, as a result, to infertility due to inferior sexual cycles [8–10].

T-2 toxin is produced by fungi of the genus Fusarium. There are about 200 species of fungi that produce a toxin similar in structure. It leads to destructive changes in the skin, mucous membranes of the gastrointestinal tract [11].

Deoxynivalenol (DON, Vamitoxin) causes the greatest economic damage. Toxicosis proceeds subclinically and leads mainly to a decrease in the productivity of cows, a decrease in appetite and a decrease in overall resistance [12, 13].

Most authors point to the frequent combination of several mycotoxins. Thus, the most common combination of vomitoxin and zearalenone [1, 3].

Alternaria is considered a major mycotoxin producer as it occurs in high abundance in various food matrices and can produce a variety of toxic compounds. Alternaria toxins are often found in fruits (apple, melon, blueberry, citrus, etc.), tomatoes, olives, and grains such as wheat, barley, and sorghum. In terms of its toxicity, the most important mycotoxin produced by Alternaria species is tenuazonic acid (TeA). This toxin exhibits acute toxicity and oral LD50 in rats and mice has been determined to be in the range of 81–186 mg kg^{1}. TeA is a derivative of tetramic acid and its consumption is associated with cardiovascular collapse and gastrointestinal bleeding [14].

Cows receiving low-quality feed in the long term receive irreversible changes in almost all organs and systems [10–12]. Depending on the type of microscopic fungi and the variety of their toxins, these destructive changes can manifest themselves in the digestive tract (T-2 toxin) [12], the reproductive system (zearalenone) [15].

In addition, most authors point out that feed mycotoxicoses cause a violation of mineral and vitamin metabolism, which leads to their decrease in dairy products obtained from cows [12].

The aim of the research was to establish marker indicators for the rapid diagnosis of mycotoxicoses in cows. For this, the following tasks were set: to establish the clinical signs of mycotoxicosis in this farm, to examine the blood for hematological parameters, to establish indicators of cicatricial digestion and to establish macroscopic changes in tissues and organs at autopsy.

2. Materials and methods

The experiments were carried out in the winter-spring period in farms where mycotoxicoses caused by T-2 toxin and Aspergillus fumigatus were diagnosed. Mycotoxicoses were diagnosed in the spring when roughage or grain forage was used as feed for cows with signs of damage by fungi of the genus Fusarium and Aspergillus.

The counting of erythrocytes, leukocytes, hemoglobin was carried out in an automatic hematological analyzer DATA-CELL-16 plus.

The isolation of microscopic fungi was carried out on Sabouraud and Czapek media. The results were converted to decimal logarithms and the relative ratio of different groups of microorganisms in the intestinal population was established.

The digital material was subjected to statistical processing on a personal computer by conventional methods of variation statistics with the calculation of the arithmetic mean (M), arithmetic mean error ($\pm m$), Student's test (t), and correlation coefficient (r) using Microsoft Excel.

3. Results

Clinically, in a group and individual study of the livestock of cows, a decrease in fatness (below average) was found. The hairline is dull, tousled, of different lengths, areas of alopecia are noticeable (**Fig. 1**).

Decrease in productivity, in our opinion, occurs due to damage to the gastrointestinal tract, which leads to the complication of the absorption of proteins, carbohydrates, minerals and vitamins. These data are consistent with the works of most authors [11].

In associated mycotoxicosis caused by T-2 toxin and Aspergillus fumigatus, skin necrosis has been noted in some animals. The mucous membranes were pale pink, up to complete anemia. Body temperature is within normal limits. In some animals, lameness, the damage of a hoof horn, and swelling of the interhoof gap were noted (**Fig. 2**).

When performing studies in cows, samples of cicatricial contents and blood were taken.

Morphological studies of blood in mycotoxicoses of cows (**Table 1**).

They indicate a significant increase in leukocytes from 22.1 to 37.1 g/l. At the same time, the hemoglobin index was in the lower permissible limit and varied from 74 to 97 g/l. The indi-

cator of hemoglobin content in the erythrocyte was 1.8 times lower than that of healthy animals. However, the indicators of the number of erythrocytes, hemoglobin, hemoglobin concentration in the erythrocyte were at the level of healthy animals and amounted to 6.58±0.24 T/l, 87.4±4.27 g/l, 36.2±0.88 g/l, respectively. Similar data were obtained by other authors [8, 10, 12].

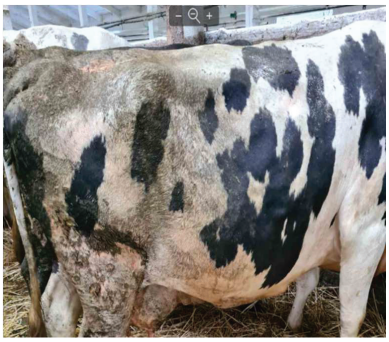

Fig. 1. General condition of the animal with mycotoxicosis

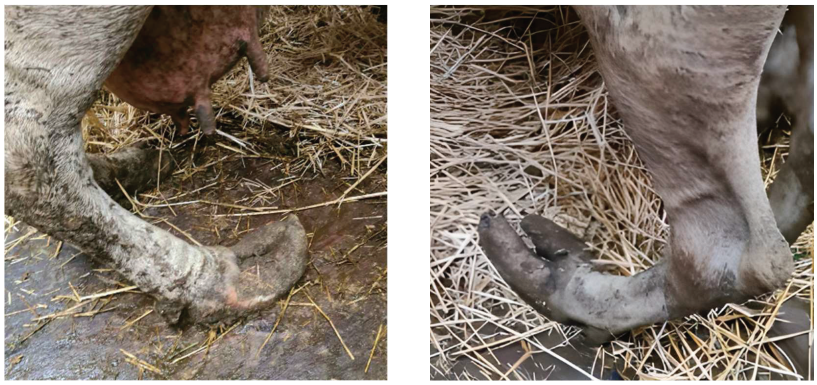

Fig. 2. The damage of the limbs of cows by mycotoxicosis

The data of the study of cicatricial contents (**Table 2**) indicate morpho-functional changes in the scar:

− color varied from dirty green to dirty brown;

– smell of many samples is musty;

− there was no floating layer in the rumen content fraction;

– despite the change in the concentration of hydrogen ions and scar content, enzymatic processes occurred very quickly, which is associated with a change in the microflora of the scar;

– indicator of the number of ciliates – from 1×10^5 to 3.5×10^5, which is much less than the lower limits of the norm (from 4.5×10^5 to 1.2×10^6);

– pH of the rumen was in the zone of alkalization (from 6.9 to 8.0), at a rate of 6.3 to 7.4.

At the same time, the number of ciliates in the content of the rumen decreased from 0.15 million/ml to 0.3 million/ml against the background of an increase in the number of mold fungi of the genus Aspergillus.

All this indicates a violation of cicatricial digestion and developing putrefactive processes.

The samples of cicatricial contents stored in a refrigerator were distinguished by the abundant growth of mold fungi of the genus Aspergillus.

The revealed changes in the rumen (alkaline pH, low number of ciliates) created favorable conditions for the growth of microscopic fungi. Feeds affected by fungi were the main cause of the above changes in cicatricial digestion.

Pathological studies revealed that when eating concentrated feed contaminated with microscopic fungi Aspergillus fumigatus and containing T-2 mycotoxin, necrosis of the mucous mem-

branes of the oral cavity, esophagus, gastrointestinal tract, as well as the liver and spleen occurs. The liver revealed protein degeneration with foci of necrosis, an increase and change in Kupffer cells, which had a shape that was not characteristic of them (**Fig. 3**).

It should be noted that the phagocytic clearance functions of Kupffer cells are connected, first of all, with their immune protective function, they act as fixers of immune complexes. Kupffer cells, along with other cells of the reticuloendothelial system, phagocytose various infectious agents and remove destroyed erythrocytes from the blood stream. As a result of damage to Kupffer cells, the nonspecific immunity of the body is sharply reduced.

Similar pathohistological changes were found in other internal organs. Serous edema of the interalveolar septa was noted in the lungs (**Fig. 4**). Protein degeneration and necrosis of the epithelium of the renal tubules were recorded in the kidneys.

In the wall of the duodenum and small intestine, infiltration of lymphocytes and separate foci of necrosis on the mucosa were observed. In the wall of the abomasum, infiltration of lymphoid cells and focal necrosis of the mucosa were noted.

The data obtained indicate a complex negative effect of mycotoxins on the main organs and systems of cattle.

It has been established that with mycotoxicosis in cows, the number of barren animals is 1205 heads, which is 67.35 % of the total number of animals. At the same time, there are frequent cases of multiple unsuccessful insemination of cows. This is indicated by a rather low index of fertilization – 0.16 (**Table 3**).

During the studies, the main gynecological pathologies were established (**Table 4**).

Table 1

The results of morphological studies of the blood of cows with mycotoxicoses

Indicators	Norm	Sample number					
		1	2	3	4	5	*M±m*
Erythrocytes, T/l	5–10	6.61	6.32	7.33	5.9	6.72	6.58±0.24
Leukocytes, g/l	4–12	27.2	23.7	37.1	29.4	22.1	27.2±2.63
Hemoglobin, g/l	80–150	81	93	74	92	97	87.4±4.27
Hematocrit (HCT), %	25–46	22.1	25.2	42.3	24.7	26	28.06±3.62
Mean erythrocyte volume (MCV), FL	40–60	41	43	45	42	44	43.0±0.71
Average concentration of hemoglobin in an erythrocyte, g/l	32–36	33.1	37.2	36.1	38.4	36.2	36.2±0.88
Average content of hemoglobin in an erythrocyte, pg	19.5–24.5	15.1	13.2	16.3	14.2	15.3	14.82±0.53

Table 2

The results of the study of the cicatricial content of cows with mycotoxicoses

Sample number	Color	Smell	Buoyancy	pH	Number of ciliates, ml/l
1	dirty green	musty	2 layers, bottom fermented	6.9	0.3
2	dirty green	musty	2 layers	8.0	0.15
3	dirty green	natural	homogeneous	7.5	0.2
4	dirty green	natural	homogeneous	7.4	0.25
5	dirty green	neutral	2 layers	7.9	0.17
Control – healthy	dirty brown	neutral	homogeneous	6.3–7.4	0.3–0.7

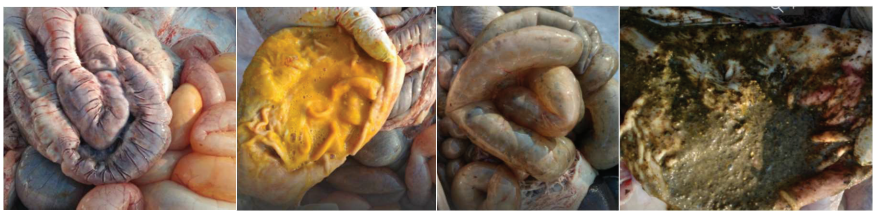

Fig. 3. Intestinal damage due to mycotoxicosis

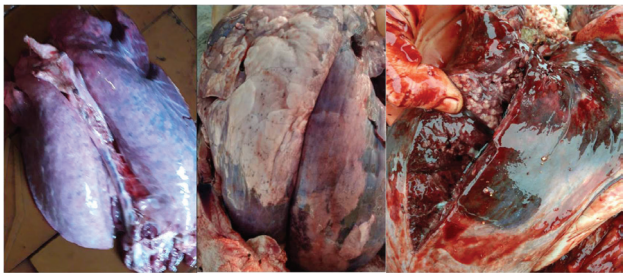

Fig. 4. Lung damage due to mycotoxicosis

Table 3

Reproduction indicators of cows for mycotoxicosis

Index	Number	%
Animals explored	1,789	100
pregnant	356	19.90
Number of cows in the postpartum period	112	6.26
Number of cows in the service period	116	6.48
Number of barren animals	1,205	67.35
Fertilization index	0.16	×

Table 4

The results of gynecological examination

Indicator	Sick cows identified, total	Hypotrophy of the organs of the reproductive system	Ovarian pathology			Uterus pathology		
			Cysts	Hypotrophy	Persistent corpus luteum	Endometritis	Salpingitis	Crvicitis
Number	782	512	64	423	59	115	5	27
%	100	65.47	8.18	54.09	7.54	14.71	0.64	3.45

When cows are affected by toxins of microscopic fungi, their reproductive ability is sharply reduced to 32.75 %. At the same time, the main pathology is violations of the organs of the reproductive system, clinically manifested by hypotrophy of the organs of the reproductive system 65.47 %, including 54.09 % ovarian hypotrophy. Cysts accounted for 8.18 %, persistent corpus luteum 7.54 %, endometritis 14.71 %, salpingitis 0.64 %, cervicitis 3.45 %.

The research was carried out on the number of dairy cows in the conditions of the economy of the Sumy region. In the study of beef cattle, other results can be obtained, which is confirmed by the studies of other authors [16].

In further studies, it is planned to investigate the change in biochemical and hematological parameters of the blood of dairy cows under the influence of mycotoxins produced by fungi of the genus Fusarium. At the same time, recommendations will be given on the complex diagnosis of mycotoxicoses, correction of indicators of homeostasis of the body of cows in order to restore their reproductive function.

4. Conclusions

A complex of clinical signs, consisting of lesions of the skin (areas of necrosis), mucous membranes of the oral cavity, lesions of the hoof horn, ulcers between the digital arch, an increase in the pH of the scar above 7.5 and a simultaneous decrease in the number of ciliates to 0.25 million/l or less indicates chronic mycotoxicosis in cows.

Against the background of mycotoxicosis of cows, infertility occurs up to 65.35 % of the total number of livestock, consisting of ovarian pathology 69.81 % of the total number of infertile animals and uterine pathology – 18.8 %.

The autopsy is characterized by signs of serous edema of the interalveolar septa of the lungs, protein degeneration and necrosis of the epithelium of the renal tubules, foci of necrosis on the mucous membrane of the duodenum and small intestine and abomasum.

Conflict of interest

The authors declare that there is no conflict of interest in relation to this paper, as well as the published research results, including the financial aspects of conducting the research, obtaining and using its results, as well as any non-financial personal relationships.

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