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Prophylactic Efficacy of Adsorbents in Case of Combined Impact of T-2 and Aflatoxin B1 on the Organism of the Mink.

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ABSTRACT

The aim of the research was to study the preventive treatment in case of combined impact of T-2 and aflatoxin B1 mycotoxinson the organism of the mink. The experiment was conducted in Pastel minks. Minks were divided into four groups of 10 animals each. Group 1 served as biological control. Group 2 received T-2 toxin at a dose of 200 µg/kg and aflatoxin B1 at a dose of 50 µg/kg of feed in addition to the basic ration. Group 3 received T-2 toxin at a dose of 200 µg/kg, aflatoxin B1 at a dose of 50 µg/kg of feed and sodium bentonite at a dose of 2% of the weight of the ration. Group 4 received T-2 toxin at a dose of 200 µg/kg, aflatoxin B1 at a dose of 50 µg/kg of feed and phytosorb at a dose of 0.5% of the weight of the ration. The experiment lasted 30 days, hematological and biochemical blood tests were performed every 10 days. Doses of toxins were taken according to the currently existing maximum permissible levels in Russia. The data obtained were compared with those of the biological control group. The results of the experiment indicate that the intake of mink feed containing simultaneously two mycotoxins - T-2 toxin and aflatoxin B1causes pronounced and statistically significant changes in hematological and biochemical parameters towards their deterioration. The addition of bentonite from Tarn-Varskoe deposit at a dose of 2% and enterosorbent Phytosorbat a dose of 0.5% of the weight of the feed to the ration of animals has a preventive effect in case of T-2 and aflatoxicosis in minks with the normalization of hematological, biochemical and biological parameters.
Keywords: T-2 toxin, aflatoxin B1, bentonite from the Tarn-Varskoe deposit, Phytosorb, combined impact, fur-bearing animals, minks

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INTRODUCTION

Mink is a leading object of the caged fur farming. Its breeding stock in the total number of fur-bearing animals in Russia is 83%. In the conditions of caged breeding, the death of minks is mainly the result of diseases of non-infectious etiology and only about 7% dies from infectious diseases. The main cause of the death of animals, as well as their low productivity on farms is the use of poor-quality feed [3].

Mycotoxins are the most dangerous contaminants of feed and food products in natural conditions, characterized by high toxicity, mutagenic, teratogenic, carcinogenic and immunosuppressive properties [1, 2]. Microscopic fungi are ubiquitous and contamination of feed and agricultural products by them is possible at any stage of production, therefore mycotoxins are inevitable contaminants of food and feed. Taking into account the complexity of feed, the combined impact of toxins isnot excluded [3-20].

Mycotoxicosis is an urgent problem in fur farming. According to [21, 22], fur animals are more sensitive to mycotoxins than laboratory and farm animals. The feeding of fur-bearing animals on fur farms has greatly changed over the past decades. If previously they were fed meat, dairy products, now plant feed is used for feeding animals[6].

The aim of the research was to study the preventive treatment in case of combined impact of T-2 toxin and aflatoxin B1 on the organism of the mink.

MATERIALS AND METHODS

The research was carried out in the Department of Toxicology of the FGBNU "FTSTRB-VNIVI" (Kazan) and on the fur farm "Koschakovskiy" in the Pestrechinsky District in the Republic of Tatarstan. Experimental studies were conducted in Pastel minks. Before the experiment, the animals were kept in a 2-week quarantine, feeding was carried out according to the norms adopted in zootechnics. The experimental and control groups of animals were formed based on the principle of analogues. During the whole experiment the animals were in the same housing and feeding conditions.

To carry out the research, four groups of 10 animals each were formed. Group 1 served as biological control. Group 2 received T-2 toxin at a dose of 200 µg/kg and aflatoxin B1 at a dose of 50 µg/kg of feed in addition to the basic ration. Group 3 received T-2 toxin at a dose of 200 µg/kg, aflatoxin B1 at a dose of 50 µg/kg of feed and sodium bentonite at a dose of 2% of the weight of the ration. Group 4 received T-2 toxin at a dose of 200 µg/kg, aflatoxin B1 at a dose of 50 µg/kg of feed and phytosorb at a dose of 0.5% of the weight of the ration.

The experiment lasted 30 days, hematological and biochemical blood tests were performed every 10 days. Doses of toxins were taken according to the currently existing maximum permissible levels in Russia.

For experimental studies, crystalline T-2 toxin and aflatoxin B1 with a purity of at least 96% obtained in the laboratory of mycotoxinsin FGBNU "FTSTRB-VNIVI" were used. The bentonite used by us is sodium bentonite from Biklyanskoyedeposit in the Republic of Tatarstan. Phytosorbis an organic adsorbent based on acid-detergent fiber and lignin of a barley grain shell. Earlier, we had investigated the possibility of using this mineral and lignins as adsorbents of mycotoxins [24-26].

After carrying out the necessary procedures, determined by the aim and objectives of the experiment, blood was taken from the tails of minks. The number of erythrocytes, leukocytes, hemoglobin concentration in peripheral blood was determined according to standard methods, the biochemical parameters of blood serum (total protein, glucose, urea, aspartate aminotransferase, Alanine aminotransferase, total calcium, inorganic phosphorus) were determined with the EXPRESS PLUS analyzer.

The processing of the digital material was carried out by the method of variation statistics using the Student's t- test on a personal computer with the Excel program.

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RESULTS AND DISCUSSION

In minks, the simulated combined mycotoxicosis was accompanied by a decrease in appetite since 7thday, starting from the second half of the experiment (since 17th day) - by diarrhea, the quality of the skin changed: the coat became dull and disheveled; by the end of the experiment, some animals had been affected by alopecia.

The results of the study of hematological parameters are presented in Table 1.

It has been found that in the minks of Group 2, the number of red blood cells decreased by 9.6% on 10th day, by 19.3%on 20th day, by 32.1% on 30th day. In the minks of Group 3, a decrease in the number of red blood cells was 4.8% on 10th day, 7.6% and 19.5% on 20th and 30th days, respectively. In the minks of Group 4, the number of red blood cells decreased by 3.6%; 9.4% and 22.3% on 10th,20th and 30th days, respectively.

Hemoglobin concentration in the blood of the minks of Group 2 decreased by 5.6% on 10th day compared to the basic data, by 13.3% on 20th day, by 26.6% on 30th day; in Group 3, the decrease was 2.3% on 10th day, by 7.06% and 16.65% on 20th and 30th days, respectively. In the minks of Group 4, the decrease in hemoglobin concentration was 3.4% on 10th day, 9.14% and 21.65% on 20th and 30th days, respectively.

Table 1: Hematological parameters in the minks in case of T-2 and aflatoxicosis when phytosorb and bentonite are used (n = 10).

Group	The day of the experiment	Red blood cells, $\times10^{12}$/L	Hemoglobin, g/L	ESR, mm/h	White blood cells, $\times10^{9}$/L
1	10	8.43±0.35	162.7±5.47	2.73±0.03	4.88±0.39
	20	8.31±0.41	161.5±4.53	2.65±0.04	5.03±0.42
	30	8.26±0.38	160.6±5.18	2.54±0.04	4.96±0.43
2	10	7.61±0.34	153.53±5.45	3.90±0.03*	4.61±0.37
	20	6.70±0.40*	139.95±4.50*	5.67±0.02*	3.69±0.43*
	30	5.60±0.37*	117.80±5.20*	6.73±0.04*	3.00±0.42*
3	10	8.01±0.42	158.84±5.48*	2.52±0.04	5.00±0.38
	20	7.67±0.36	149.16±4.52	3.84±0.03	4.38±0.43
	30	6.64±0.40	133.86±5.16	4.97±0.02	3.90±0.44
4	10	8.12±0.39	157.08±5.44	3.05±0.03	4.70±0.39
	20	7.52±0.43	150.09±4.54	4.34±0.04	4.63±0.43
	30	6.41±0.41	125.83±5.19	4.72±0.04	4.24±0.42

* $p<0.05$

ESR in the blood of the minks of Group 2 increased by 13.9% on 10th day, by 15.67% and 16.73% on 20th and 30th days, respectively. In the minks of Group 3, ESR increased by 12.5% on 10th day of the experiment, by 13.8% and 14.9% on 20th and 30th days, respectively. In the minks of Group 4, an increase in ESR was 23.0% on 10th day, 17.1% and 4.7% on 20th and 30th days, respectively.

The number of white blood cells in the minks of Group 2 decreased by 5.3% on 10th day, by 26.5% and 39.3% on 20th and 30th days, respectively. In Group 3, an increase in the number of leukocytes was 2.6% on 10th day; on 20th and 30th days, the number of white blood cells decreased by 12.7% and 21.3%, respectively. In Group 4, a decrease in the number of leukocytes was 3.6% on 10th day; on 20th and 30th days, their decrease was 7.8% and 14.3%, respectively.

The levels of total protein and protein fractions in the blood serum of the minks in case of T-2 and aflatoxin B1 when bentonite and phytosorb were used are shown in Table 2.

The results have shown that the level of total protein in the minks of Group 2 decreased by 3.7% on 10th day, by 18.5% and 27.4% on 20th and 30th days, respectively. On 10th day of the experiment, the level of total protein in Group 3 was higher than in the control by 3.3%; on 20th day, it decreased by 9.1%; on 30th day - by 18.3%. In Group 4, the level of total protein was lower than in the control by 1.6% on 10th day, by 11.1% - on 20th day, by 13.5% - on 30th day.

The level of albumins in the minks of Group 2decreased by 12.3% on 10th day of the experiment, on 20thday - by 20.4%, on 30th day - by 25.1%. In Group, 3it decreased by 6.8% on 10thday, by 13.4% on 20th day, by 17.8% on 30th day. The level of albumins in animals of Group 4 decreased by 4.3%, 8.6% and 12.5% on 10th, 20th and 30th days, respectively.

The level of α-globulins in the minks of Group 2 increased by 11.8% compared to the control on 10th day of the experiment, by 19.4% on 20 day, by 11.7% on 30th day. The level of α-globulins in Group 3 increased by 6.3% on 10th day of the experiment, by 13.3%on20th day, by 15.0% on 30th day. The level of α-globulins in Group 4 increased by 1.5% on 10th day, by 7% on 20th day, by 12.6% on 30th day.

Table 2: The levels of total protein and protein fractions in the blood serum of minks in case of T-2 and aflatoxicosis when phytosorb and bentonite are used (n = 10).

Group	The day of the experiment	Total protein, g/L	Protein fractions, %			
			Albumins, %	α-globulins, %	β-globulins, %	γ-globulins, %
1	10	75.34±2.45	52.44±2.11	14.67±0.93	15.70±2.18	17.19±1.68
	20	75.06±2.36	50.37±2.17	14.37±0.79	15.35±2.46	19.91±1.56
	30	74.13±2.47	51.64±2.53	14.86±0.85	15.63±2.33	17.87±1.49
2	10	72.50±2.44	45.96±2.13*	16.41±0.92	17.09±2.17	15.91±1.69
	20	56.54±2.35*	40.08±2.15*	17.16±0.76*	18.17±2.43*	14.70±1.55*
	30	53.75±2.46*	38.64±2.55*	16.61±0.85	17.19±2.32	20.25±1.48*
3	10	77.80±2.43	48.83±2.12	15.60±0.91	16.69±2.19	16.18±1.67
	20	68.17±2.35	43.60±2.16	16.28±0.75	16.47±2.45	18.34±1.57
	30	60.52±2.45	42.41±2.51	17.09±0.94	17.36±2.31	16.35±1.47
4	10	74.09±2.44	50.15±2.10	14.89±0.92	15.95±2.17	17.38±1.66
	20	66.73±2.34	46.03±2.17	15.37±0.78	16.14±2.44	19.16±1.58
	30	64.13±2.48	45.15±2.54	16.73±0.86	17.25±2.34	16.00±1.47

* $p<0.05$

The level of β-globulins in Group 2 of minks increased by 8.8% compared to the control on 10thday of the experiment, by 18.4% days on 20th day, by 9.1% on 30th day. The level of β-globulins in Group 3 increased by 6.3% on 10th day, by 7.3% on 20th day, and by 11.1% on 30th day. The level of β-globulins in Group 4 increased by 1.6% on 10th day of the experiment, by 5.8% on 20th day, by 10.4% on 30th day.

The level of γ-globulins in Group 2 of minks, as compared to the control, decreased by 7.4% on 10th day of the experiment, by 14.4% on 20th day, increased by 13.3% on 30th day. The level of γ-globulins in Group 3 decreased by 5.8% on 10th day of the experiment, by 7.8% on 20th day, by 8.4% on 30th day. The level of γ-globulins in the minks of Group 4increased by 1.1% on 10th day of the experiment, then decreased by 3.7% on 20th day, by 10.4% on 30th day.

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Biochemical parameters of the mink blood in case of T-2 and aflatoxicosis when phytosorb and bentonite are used are presented in Table 3.

Table 3: Biochemical parameters of the mink blood in case of T-2 and aflatoxicosis when phytosorb and bentonite are used (n = 10).

Parameter	The day of the experiment	Group			
		1	2	3	4
Glucose, mmol/L	10	4.93±0.53	4.94±0.54	4.62±0.52	4.66±0.53
	20	4.86±0.47	3.90±0.45*	4.40±0.46	4.43±0.44
	30	4.87±0.51	3.46±0.53*	4.21±0.52	4.10±0.54
Inorganicphosphorus, mmol/L	10	0.86±0.14	0.94±0.13*	0.86±0.12	0.87±0.15
	20	0.85±0.17	0.96±0.17*	0.89±0.16	0.91±0.18
	30	0.83±0.13	0.95±0.14*	0.89±0.12	0.91±0.11
Total calcium, mg/dL	10	2.14±0.45	2.22±0.46	2.18±0.44	2.19±0.47
	20	2.11±0.41	1.91±0.41	2.03±0.42	2.02±0.40
	30	2.10±0.39	1.84±0.36*	2.01±0.37	1.98±0.38
AST, U/L	10	149.3±9.6	170.64±9.5*	150.43±9.4	156.54±9.7
	20	153.5±8.8	203.54±8.6*	174.68±8.7	182.05±8.9
	30	158.4±9.3	237.12±9.4*	194.19±9.5	208.13±9.4
ALT, U/L	10	93.5±2.01	113.88±2.02	108.83±2.03	110.98±2.05
	20	97.4±2.05	130.51±2.06*	117.36±2.07	120.19±2.09
	30	96.6±1.94	142.00±1.93*	126.25±1.95	129.05±1.96
Alkalinephosphatase, U/L	10	56.7±3.36	92.42±3.36*	64.52±3.37	69.40±3.35
	20	55.3±3.40	131.06±3.41*	75.48±3.43	94.36±3.45
	30	54.7±2.95	162.07±2.95*	102.72±2.96	107.43±2.97

* $p<0.05$

It has been found that in the minks of Group 2 glucose concentration decreased by 10.1%, 19.6% and 28.8% on 10^{th}, 20^{th} and 30^{th} days, respectively. In Group 3, it decreased by 6.3%, 9.4% and 13.5%, respectively. In the minks of Group 3, it has been noted that glucose levels decreased by 5.6%, 8.7% and 15.8% on 10^{th}, 20^{th} and 30^{th} days, respectively.

Inorganic phosphorus concentration increased by 9.6%; 13.3% and 14.6% on 10^{th}, 20^{th} and 30^{th} days, respectively. In Group 3, the increase was 0.6%; 4.8% and 7.4%. In the blood of the minks of Group 4, there was an increase in the concentration of inorganic phosphorus by 1.8%; 7.4% and 9.6% on 10^{th}, 20^{th} and 30^{th} days, respectively.

The total calcium concentration in the minks of Group 2 increased by 3.8% on 10^{th} day of the experiment, decreased by 9.5%and 12.3% on 20th and 30th days, respectively. In the minks of Group 3, the total calcium level increased by 1.8% on 10^{th} day of the experiment, decreased by 3.5% and 4.2% on 20th and 30th days, respectively. In the blood of the minks of Group 4, an increase in the total calcium concentration was 2.5% on 10^{th} day; at the end of the experiment there was a decrease of 5.9%.

The activity of AST in the minks of Group 2 on 10^{th}, 20^{th} and 30^{th} days increased by 14.3%; 32.6% and 49.7%, respectively. In Group 3, it was increasing and increased by 22.6% on 30^{th}day. In the blood of the minks of Group 4 there was an increase in AST activity of 4.8%; 18.6% and 31.4% on 10^{th}, 20^{th} and 30^{th} days.

The activity of ALT in the minks of Group 2 increased by 21.8%; 34.0% and 47.0% on 10^{th}, 20^{th} and 30^{th} days in comparison with the control. In Group 3, in the blood of the minks it increased by 16.4%, 20.5% and 30.7% on 10^{th}, 20^{th} and 30^{th} days. In the blood of the minks of Group 4, an increase in ALT activity was 18.7%; 23.4% and 33.6%, respectively.

The activity of alkaline phosphatase in the minks of Group 2, increased by 63.0%; 137% and 196.3% in comparison with the control on 10^{th}, 20^{th} and 30^{th} days, respectively. In Group 3, it increased by 13.8%; 36.5%

and 87.9%. In the blood of the minks of Group 4, an increase in the activity of alkaline phosphatase was 21.4%; 70.7% and 96.4% on 10^{th}, 20^{th} and 30^{th} days, respectively.

CONCLUSION

The results of the experiment has indicated that the intake of feed by minks containing simultaneously two mycotoxins - T-2 toxin and aflatoxin B1causes pronounced changes in hematological and biochemical parameters towards their deterioration. The addition of nutrient-inert components to the feed is one of the most modern approaches to the problem of harm reduction from mycotoxins in animals. Sorbents reduce the bioavailability of mycotoxins adsorbing them, the absorption of mycotoxin in the digestive tract decreases, which simultaneously reduces its toxic effect on the animal. Thus, the addition of bentonite from the Tarn-Varskoe deposit and enterosorbent Phytosorb to the ration of animals has a preventive effect in case of T-2 and aflatoxicosisin minks normalizing hematological and biochemical parameters.

REFERENCES

[1] Erin, T.A. et al. Rabbitbreeding and nutriafarming. 1994
[2] Da Rocha et al.Food Control 2014; 36: 159–165
[3] Hussein S Hussein, Jeffrey M Brasel Toxicology 2001; 167:101-134
[4] Garcia AR, Avila E, Rosiles R, Petrone VM Avian Dis. 2003; 47: 691–699
[5] Binder EM et al. Anim. Feed Sci. Tech. 2007; 137, 265–282.
[6] Grenier B, Oswald I. World Mycotoxin J. 2011; 4, 285–313
[7] Elisabeth Streit et al. Toxins 2012; 4, 788-809; doi:10.3390/toxins4100788
[8] Ferreras MC et al. Journal of Comparative Pathology 2013; 148: 236-242
[9] Ivanov, A.V. et al. The success of medical mycology.2014; 13: 347-349.
[10] Stepanycheva EA et al. 13th European fusarium seminar. Fusarium: pathogenicity, mycotoxins, taxonomy, genomics, biosynthesis, metabolomics, resistance, disease control. book of abstracts. 2015; 194
[11] Smith MC et al. Toxins 2016; 8(4): 94
[12] Pasquali M et al. A European database of Fusariumgraminearum and F.culmorumtrichothecene genotypes Frontiers in Microbiology.2016; T. 7.№ APR.C. 00406
[13] Smith, MC Toxins 2016, 8(4): 94
[14] Semenov EI et al. Research Journal of Pharmaceutical, Biological and Chemical Sciences 2016; 7: 1860-1868
[15] Semenov E.I. et al. Research Journal of Pharmaceutical, Biological and Chemical Sciences 2016; 7: 2229-2237
[16] PapunidiK.Kh., et al. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2016; 7: 2214-2221
[17] Yumangulova GM et al. Journal of Pharmacy Research 2017; 11: 1226-1229
[18] PapunidiKK, et al. Bali Medical Journal 2017; 6: 83-87
[19] SemenovEI. et al. Bali Medical Journal 2017; 6: 110-114
[20] H.J. (Ine) van der Fels-Klerx et al. Toxins 2018; 10, 54; doi:10.3390/toxins10020054
[21] Christensen, C. Mirocha C. Appf. Wierob 1965; 13: 653
[22] Clark, q.D. et al. Vet Rec., 1980; 11: 1841-1845
[23] Balakirev, N.A., Aleksandrova, V.S. Rabbit breeding and fur farming 1997; 1: 12
[24] Tremasov, M.Y., Semenov, E.I.Bulletin of veterinary science 2009; 4 (51): 36-40
[25] Kanarskaya, Z.A. et al. Chemistry of Natural Compounds 2016; V. 52. № 6.P. 1073-1077
[26] Kanarsky, A.V. et al. Proceedings of the Academy of Sciences. Chemicalseries 2017; 11: 2165-2172