Study of the ability of organic and mineral sorbents to sorption of secondary Fusarium metabolites

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Abstract. This paper presents research on the study of the adsorption properties of sorbents of mineral and organic origin. From the research results, it was seen that the maximum adsorption properties for zearalenone at room temperature of 19-21 ° C and pH 7 were shown by sorbents: bentonite of the Biklyansky deposits 34.7%, bentonite of The biklyansky burned 25.3%, bentonite of the tarn-Varna deposits 31.4% Mycosorb 65.7%, Phytosorb 57.5%, zeolite 27.3%, Zookarb 21.2% showed the lowest sorption capacity for zearalenone. In relation to the T-2 toxin, the adsorption properties of sorbents at a temperature of 19-21 ° C and pH 7 showed: Phytosorb 57.5%, bentonite of the Biklyansky deposits 51.7%, bentonite of the tarn-Varna deposits 57.4%, Mycosorb 55.7%, Zoocarb 43.8%, zeolite 36.2%, bentonite of the biklyansky fired 31.4%. According to the results of research, it can be concluded that when the average temperature increases from 20-21 ° C to 38-39 ° C, sorbents significantly increase the adsorption of toxins from 50-70% by such sorbents as phytosorb, Mycosorb, bentonite of the Biklyansky Deposit.

1 Introduction

Problem of mycotoxins has acquired a global character due to the violation of the ecological balance with intensive technologies of crop cultivation, as well as due to an increase in the content of photo-oxidants in the atmosphere (air pollution), which causes plants to lose resistance to phytopathogens [1, 2, 3]. Agricultural foods and feeds affected by microscopic fungi change their nutritional value and become toxic to human and animal health [4, 6, 7, 8]. Such products and feeds can cause disorders of the nervous system, liver, kidneys, immune system, disrupt reproductive ability [9, 10, 11, 12]. The most toxic are trichothecene mycotoxins (T-2 toxin, etc.), aflatoxins. Mycotoxin zearalenone, is dangerous at the level of 1-15 mg/ kg of feed, causes deterioration of fertilization, swelling of the vulva, abortions, etc. [13, 14, 15, 16]. T-2 toxin entering the body of animals primarily disrupts the function of the oral mucosa, and with prolonged admission causes necrotic lesions in the area of the

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corner of the oral cavity. In birds, the T-2 toxin causes exhaustion, loss of feather cover. In low doses, T-2 toxin can have an immunotoxic effect on hematopoietic organs and cause leukopenia in the body. There is evidence of increased toxicity of the mycotoxins zearalenone and T-2 toxin when ingested together in animals [5, 17, 18]. One of the modern approaches to the problem of reducing the harmful effects of ecotoxicants is the use of various kinds of sorbents (clays, bentonites, zeolites, etc.).

One of the modern approaches to the problem of reducing the harmful effects of ecotoxicants is the use of various kinds of compounds that can change the free structure of toxins (clays, bentonites, zeolites, microorganisms, etc.).

The aim of our research is to search for compounds with the greatest adsorption capacity in vivo to the mycotoxins zearalenone and T-2 toxin.

2 Materials and methods

For the experiment, mycotoxins were obtained in the Department of toxicology of the FSBI "FCTRB-VNIVI". The study of the adsorption capacity in vitro, put a technique that takes into account the detection of secondary metabolites of micromycetes [19,20,21]. In the experiments, preparations divided into the following groups were used: in the first group, a Microbond preparation was used, a feed additive for the adsorption of mycotoxins and heavy metals; in the second group, bentonite clay from the Apastovsky deposit of the Republic of Tatarstan, heat–treated at 500^0C; in the third group, bentonite from the Tarn–Varsky deposit of the Republic of Tatarstan was used; in the fourth group, bentonite clay from the Apastovsky deposit of the Republic of Tatarstan was used; the fifth group was the zeolite sorbent from the Tatarsko–Shatrashansky deposit of the Republic of Tatarstan; the sixth group was the Biosorb bacterial sorbent produced by the Federal State Budgetary Institution "FCTRB-VNIVI"; the seventh group was the zeolite from the Main deposit of the Ulyanovsk region; The eighth group of Zoocarb is a carbon sorbent developed at the NTU "Engineering and Technological Institute of Carbon Black".

3 Results and discussion

A comparative study of the sorption properties of the mycotoxins zearalenone and T-2 toxin, sorbents of various origins, was carried out. The results of studies of the adsorption capacity of sorbents with respect to zearalenone at a temperature of 19-21 ° C are shown in Figure 1.

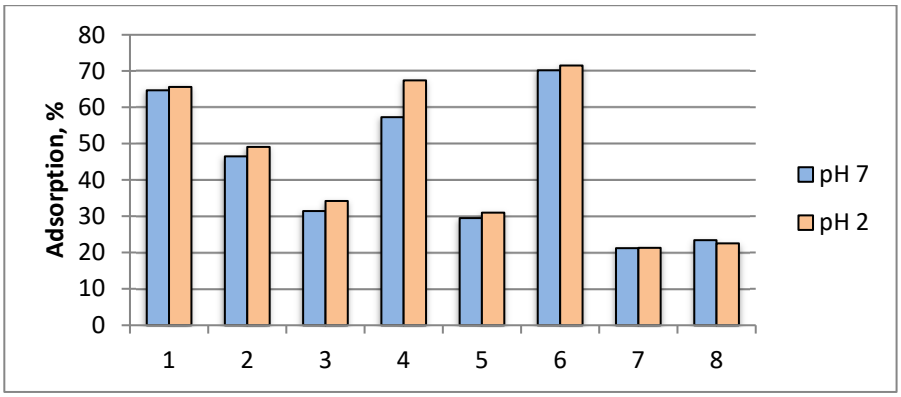

Fig. 1. Adsorption capacity of sorbents with respect to zearalenone at a temperature of 19-21°C.

It can be seen from Figure 1 that the following properties showed adsorption in relation to zearalenone: Microbond 64.7%, bentonite clay of the Apastovsky deposit heat-treated 46.5%, bentonite of the Tarn-Varna deposits 31.4%, bentonite clay of the Apastovsky deposit 57.3%, zeolite of the Tatarsko-Shatrashansky deposit 29.5%, Biosorb 70.2%, zeolite of the Main deposit 21.2%, Zoocarb 23.4%. When the acidity was reduced to pH 2 at a temperature of 19-21 ° C, the sorbents showed the following adsorption properties: Microbond 65.6%, bentonite clay of the Apastovsky deposit heat-treated 49.1%, bentonite of the Tarn-Varna deposits 34.2%, bentonite clay of the Apastovsky deposit 64.7%, zeolite of the Tatarsko-Shatrashansky deposit 31.0%, Biosorb 71.5%, zeolite of the Main deposit 21.3%, Zoocarb 22.5%.

The study of the adsorption properties of sorbents with respect to zearalenone at a temperature of 38-39 ° C is shown in Figure 2.

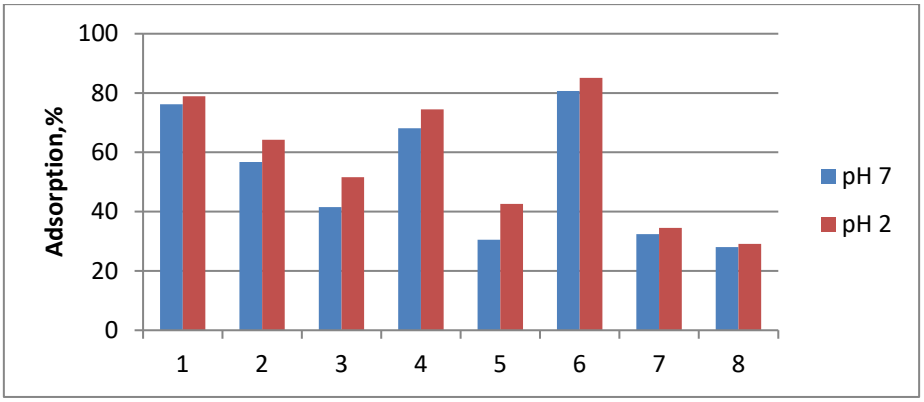

Fig. 2. Adsorption capacity of sorbents with respect to zearalenone at a temperature of 38-39°C.

Figure 2 shows that an increase in temperature to 38-39 ° C and pH 7, sorbents increased the adsorption of zearalenone. Microbond reduced the concentration of zearalenone by 76.2%, bentonite clay of the Apastovsky field heat-treated reduced the content of zearalenone by 56.7%, bentonite of the Tarn-Varna deposits reduced the concentration of zearalenone by 41.5%, bentonite clay of the Apastovsky field reduced the content of zearalenone by 68.1%, zeolite of the Tatarsko-Shatrashansky field reduced the concentration of zearalenone by 30.5%, Biosorb reduced the concentration of zearalenona on 80.7%, the zeolite of the Main deposit reduced the concentration of zearalenone by 32.4%, Zookarb reduced the concentration of zearalenone by 28.0%. When the acidity was reduced to pH 2 at a temperature of 19-21 ° C, the sorbents showed the following adsorption properties: Microbond reduced the concentration of zearalenone by 78.9%, bentonite clay of the Apastovsky field heat-treated reduced the content of zearalenone by 64.2%, bentonite of the Tarn-Varna deposits reduced the content of zearalenone by 51.6%, bentonite clay of the Apastovsky field reduced the content of zearalenone by 69.8%, zeolite of the Tatarsko-Shatrashansky field reduced the content of zearalenone by 42.6%, Biosorb reduced the content of zearalenona on 85.1%, The zeolite of the Main deposit reduced the content of zearalenone by 34.5%, Zookarb reduced the concentration of zearalenone by 29.1%.

The study of the sorption capacity of drugs against mycotoxin T-2 at a temperature of 19-21 ° C is shown in Figure 3.

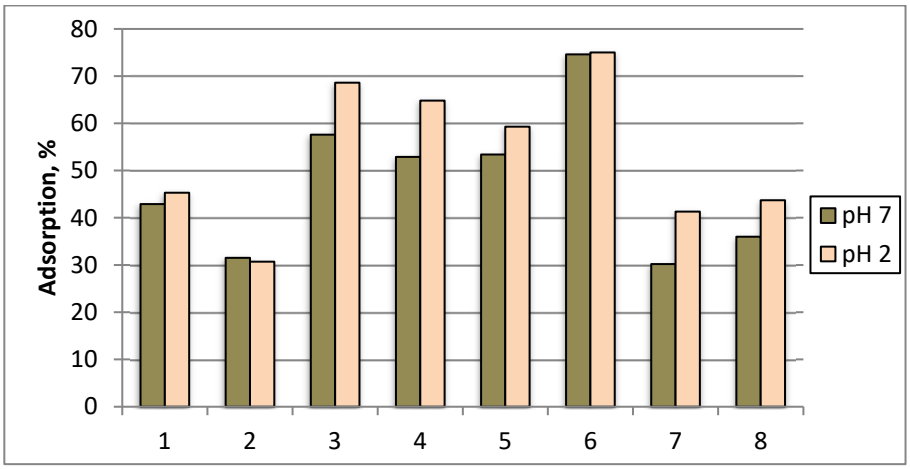

Fig. 3. Adsorption capacity of sorbents with respect to T-2 toxin at a temperature of 19-21°C.

From the results of the studies in Figure 3, it can be seen that the microbond preparation reduced the concentration of T-2 toxin by 42.9%, bentonite clay from the Apastovsky field heat-treated reduced the content of T-2 toxin by 31.5%, bentonite from the Tarn-Varna deposits reduced the concentration of T-2 toxin by 57.6%, bentonite clay from the Apastovsky field reduced the content of T-2 toxin by 52.9%, the zeolite of the Tatarsko-Shatrashansky deposit reduced the concentration of T-2 toxin by 53.4%, Biosorb reduced the content of T-2 toxin by 74.6%, the zeolite of the Mainskoye deposit reduced the concentration of T-2 toxin by 30.2%, Zookarb reduced the concentration of T-2 toxin by 36.0%. When the acidity was reduced to pH 2 at a temperature of 19-21°C, the sorbents showed the following adsorption properties: Microbond reduced the concentration of T-2 toxin by 45.3%, bentonite clay of the Apastovsky deposit heat-treated reduced the concentration of T-2 toxin by 30.7%, bentonite of the Tarn-Varna deposits reduced the content of T-2 toxin by 68.6%, bentonite clay of the Apastovsky deposit reduced the concentration of T-2 toxin by 64.8%, zeolite of the Tatarsko-Shatrashansky deposit reduced the concentration of T-2 toxin by 59.3%, Biosorb reduced the content of T-2 toxin by 75.0%, The zeolite of the Main deposit reduced the concentration of T-2 toxin by 41.3%, Zookarb reduced the concentration of T-2 toxin by 43.7%.

The study of the sorption capacity of drugs against T-2 toxin at a temperature of 38-39°C is shown in Figure 4.

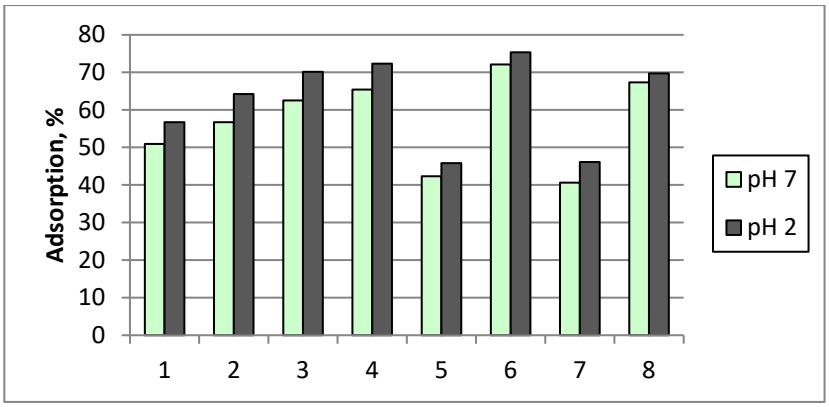

Fig. 4. Adsorption capacity of sorbents in relation to T-2 toxin at a temperature of 38-39°C.

Figure 4 shows that an increase in temperature to 38-39 ° C and pH 7, sorbents increased the adsorption of T-2 toxin. Microbond reduced the concentration of T-2 toxin by 50.9%, bentonite clay of the Apastovsky deposit heat-treated reduced the content of T-2 toxin by 56.7%, bentonite of the Tarn-Varna deposits reduced the concentration of T-2 toxin by 62.5%, bentonite clay of the Apastovsky deposit reduced the content of T-2 toxin by 65.4%, zeolite of the Tatarsko-Shatrashansky deposit reduced the concentration of T-2 toxin by 42.3%, Biosorb reduced the concentration of T-2 toxin by 72.1%, zeolite of the Main deposit reduced the concentration of T-2 toxin by 40.6%, Zookarb reduced the concentration of T-2 toxin by 67.3%. When the acidity was reduced to pH 2 at a temperature of 19-21 ° C, the sorbents showed the following adsorption properties: The microbond reduced the concentration of T-2 toxin by 56.7%, bentonite clay of the Apastovsky deposit heat-treated reduced the content of T-2 toxin by 64.2%, bentonite of the Tarn-Varna deposits reduced the content of T-2 toxin by 70.1%, bentonite clay of the Apastovsky deposit reduced the content of T-2 toxin by 72.3%, zeolite of the Tatarsko-Shatrashansky deposit reduced the content of T-2 toxin by 45.8%, Biosorb reduced the content of T-2 toxin by 75.3%, The zeolite of the Main deposit reduced the content of T-2 toxin by 46.1%, Zookarb reduced the concentration of T-2 toxin by 69.7%. From the above data, it can be seen that when the temperature rises to 38-39 ° C, the sorption activity of sorbents increases with respect to T-2 toxin.

4 Conclusion

According to the research results, the maximum sorption properties for zearalenone at a temperature of 19-21 ° C and pH 7 were shown by the sorbent Biosorb 70.2%, Microbond 57.5% and bentonite clay of the Apastovsky deposit 57.3%. When studying the sorption properties with respect to T-2 toxin, the maximum efficiency at room temperature of 19-21 ° C and pH 7 was shown by Biosorb sorbent 74.6%, Tarn-Varna bentonite deposits 57.6%, Tatarsko-Shatrashansky zeolite deposits RT 53.4% and bentonite clay Apastovsky deposits of the Republic of Tatarstan 52.9%. The presented data show that the difference in the physico-chemical properties of the mycotoxins zearalenone and T-2 toxin explains the nature of the sorption activity of the studied drugs. The data obtained are of great value for the effective use of the studied drugs for fusariotoxicosis in animal husbandry and poultry farming.

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