Part 2. Biosafety

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BIOSAFETY IN THE HOUSING ENVIRONMENT AS A FACTOR FOR COMPREHENSIVE PREVENTION OF METABOLIC SYNDROME IN HORSES

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Summary. The aim of this study was to evaluate the effectiveness of a comprehensive biosecurity program in the prevention of equine metabolic syndrome, specifically focusing on the use of biocide complexes in horse housing environments and their impact on both the microclimate and the horses' health. Materials used included biocides such as 'DZPT-2', based on glutaraldehyde, and 'Yodesol' (iodine-based), 'Geocid' (benzalkonium chloride and deltamethrin-based), which were applied during the disinfection and decontamination processes in horse stables. Methods involved a combination of biosecurity measures, including disinfection procedures and the monitoring of microbial and parasitic loads in the stables. Additionally, the effects of these treatments on horses' immune systems were assessed. The results indicated that the application of the mentioned biocides significantly improved the microclimate within the horse stables, reducing microbial load without negatively impacting the horses' non-specific immunity. The study confirmed that these biocides do not have adverse effects on the general health of the horses, and their use was associated with a noticeable improvement in the overall environmental conditions. The findings support the notion that maintaining proper hygiene and implementing comprehensive biosecurity measures can effectively reduce the risk of infections and contribute to the prevention of metabolic disorders such as metabolic syndrome in horses. In conclusion, the study demonstrates the importance of biosecurity practices, including regular disinfection and the use of effective biocides, in ensuring the health and well-being of horses and preventing metabolic complications associated with poor environmental conditions

Keywords: disinfection, microbiological load, immunity, metabolic disorders

Introduction. Disinfection is an important part of preventing and controlling infectious diseases in horses. It reduces the risk of spreading pathogens that cause diseases such as ringworm, streptococcal, and other infections. Disinfection includes cleaning equipment, facilities, and animals, which reduces the risk of pathogen transmission (Halatiuk, 2009; Kryvoshyia, 2013).

Disinfection is quite widespread in horse breeding. For instance, equine dentistry requires adherence to hygiene standards because equipment can be difficult to disinfect. After procedures, the number of bacteria on equipment remains high, indicating the need for effective disinfection methods. Studies have detected bacteria in varying amounts on dental equipment after cleaning or disinfection, indicating a risk of spreading infections during use (Alsing-Johansson et al., 2021; Verwilghen and Weese, 2021).

Eye antiseptics: Studies have shown that 0.1% polyhexamethylene guanidine is more effective than 0.2% povidone iodine in reducing bacterial load during ophthalmic procedures in horses. When disinfecting hooves, colloidal iron is added to chlorhexidine, which significantly increases the effectiveness of hoof disinfection by reducing the bacterial load (Isola et al., 2021).

General recommendations are especially important: keeping clean, hand hygiene, avoiding stress, regular deworming, and vaccination are the main preventive measures in stables. All new or returning animals should be quarantined as an important preventive measure. Repeated hand washing and disinfection can prevent the spread of infectious agents to humans and horses (Hopka, Khomenko and Pavlenko, 2004; Sinitsyn et al., 2013).

When keeping horses, disinfection measures are aimed at preventing and controlling infectious diseases such as equine influenza, which is highly contagious and transmitted by airborne droplets. Glanders is a bacterial disease that can also affect humans. Leptospirosis is a zoonotic infection that can be transmitted through water and wet bedding. Salmonellosis is a bacterial gastrointestinal disease. Pasteurellosis often occurs in poor housing conditions. Purulent skin and hoof infections can be caused by staphylococci and streptococci. Mycoses, or fungal diseases, include trichophytosis, also known as ringworm (Halatiuk, 2009; Nedosiekov et al., 2021; Ponomarenko et al., 2021).

Disinfecting the premises helps reduce the risk of infection, especially in stables with a large number of animals. Disinfection is carried out both preventively and after the disease is detected (Kovalenko, 2017; Paliy et al., 2024a).

The impact of disinfection on the development of internal non-contagious pathologies, such as laminitis, is also known. Laminitis is a multifactorial disease of the hoof plate that develops against the background of systemic disorders, including metabolic syndrome, endotoxemia, hormonal imbalance, and disruption of the body's microbial homeostasis (Tuniyazi et al., 2021). Environmental stressors, such as high concentrations of ammonia, hydrogen sulfide, fungal toxins, and pathogenic bacteria, are known to hurt homeostasis and contribute to the development of chronic hoof inflammation (Peters, Nawrot and Baccarelli, 2021).

Equine metabolic syndrome is a pathological condition characterized by obesity, insulin resistance, and a high risk of laminitis. It is most often recorded in animals kept in conditions of limited physical activity, with excessive or irrational nutrition (Durham, 2017). At the same time, the role of the gastrointestinal microbiota and endotoxins in the pathogenesis of metabolic syndrome and laminitis is being increasingly studied (Milinovich et al., 2010).

Keeping horses in an unfavorable microclimate contributes to chronic stress, increased cortisol secretion, decreased levels of immunoglobulins (IgA, IgM), and, as a result, reduced natural resistance (Pritchard and Whay, 2010). Under conditions of high microbiological load, the risk of endotoxemia increases significantly, which, according to Noble et al. (2013), is a trigger for the development of laminitis.

In recent years, scientific studies have emphasized the importance of regularly sanitizing horse facilities to maintain hygiene, normalize the microclimate, and reduce the risk of developing metabolic syndrome and related complications. Disinfectants based on essential oils and bioactive complexes, such as Barez, are particularly promising because they are non-toxic, immunomodulatory, and reduce the bacterial load on mucous membranes and skin (Kovalenko et al., 2018).

In horse breeding, phenolic disinfectants are used because they are effective in the presence of organic matter and can control outbreaks of diseases such as rotavirus diarrhea and salmonellosis. Other disinfectants, such as chlorhexidine, iodophores, and alcohol solutions, are also used, but they may be less effective in the presence of organic matter. Effective preventive disinfection of horse housing requires an integrated approach that includes using various disinfectants, complying with hygiene standards, and developing action plans for infectious disease outbreaks. This approach helps reduce the risk of pathogen spread and ensures animal health (Halatiuk, 2009; Nedosiekov et al., 2021).

A hygiene plan should be developed that includes general biosecurity procedures and standard operating procedures for the event of an infectious disease outbreak, a zoonotic disease outbreak, or multidrug-resistant bacterial colonization. Enhanced hygiene measures, including the use of protective clothing, cleaning, disinfection, and isolation of potentially infected animals, should be taken as soon as a disease is suspected. Rapid confirmation of the pathogen by testing appropriate samples is crucial. All safety measures must be adjusted according to the infectivity of the pathogen in question and the main routes of transmission (Paliy et al., 2024b). In addition to locking down the stables, clinic, or showground, it is important to segregate horses. Extensive hygiene measures should be maintained until all animals test negative and do not show clinical signs of disease for a certain period (Kovalenko et al., 2018).

Currently, many disinfectants and antiseptics are used for disinfection in equine clinics, racetracks, and breeding farms, but these antimicrobials are generally not tested for commonly encountered pathogens, and their antimicrobial efficacy is unknown. The antimicrobial efficacy of ethanol, chlorhexidine, povidone iodine, sodium hypochlorite, peroxymonosulfate compound, and benzalkonium chloride was analyzed by the scientists using the quantitative suspension test method against field isolates of *Escherichia coli, Pseudomonas aeruginosa, Salmonella spp, Streprococcus zooepidemicus, Streptococcus equi, Rhodococcus equi*, and *Staphylococcus auerus*, which are the most common pathogens of horses, in the presence of organic load (Mete, 2019; Frees, 2018; Adler et al., 2016).

When choosing disinfectants, their potential impact on workers and animals should be considered, and personnel should be provided with personal respiratory protection (Paliy, 2018). Before using any disinfectant in the presence of horses, the manufacturer's instructions must be carefully read, and a veterinarian must be consulted to avoid possible negative consequences for animal health.

Horses are treated for insects with insecticides and repellents that repel or kill pests such as horseflies, mosquitoes, ticks, and midges. These are applied to the horse's coat and last for several days. These products kill and repel flying and crawling insects. Repellent shampoos and gels have a short-term effect and are often used after training or bathing. Collars containing repellents are easy to use, especially in field conditions, as they release their active ingredients slowly. Regular indoor spraying helps to reduce the insect population (Hopka, Khomenko and Pavlenko, 2004; Paliy et al., 2021; Nedosiekov et al., 2021).

It is always necessary to test the product on a small area of the horse's skin. Do not use the product near the eyes, mucous membranes, or genitals.

Horses are treated for worms with anthelmintics, which can be administered as pastes, gels, tablets, or injections. Such treatments are required at least two to four times a year, depending on the conditions of the facility, the horse's age, and the region. Before deworming, it is advisable to perform a faecal test to determine the type of parasite. The dosage depends on the horse's weight — it is important not to exceed the recommended amount. Preventative treatments are usually carried out in spring, summer, and autumn. After treatment, it is advisable to monitor the state of the gastrointestinal tract (Kovalenko et al., 2017).

To keep horses at the proper level, it is necessary to follow special procedures and a plan for sanitary work, especially adjusting the rotation of disinfectants during disinfection.

Our work **aims** to evaluate the effectiveness of a set of biosafety measures in preventing metabolic disorders. In particular, we focus on the use of biocides in housing environments and their effect on microclimates and horses' bodies.

Materials and methods. A study was conducted to evaluate the efficacy and safety of three products: 'DZPT-2' based on glutaraldehyde, 'Iodesol' based on iodine, and 'Geocide' based on benzalkonium chloride and deltamethrin. The study took place at the Rymchuk private horse farm in Bashtanka District of Mykolaiv Region, as well as at the Institute of Veterinary Medicine of NAAS in Kyiv and the National Scientific Center 'Institute of Experimental and Clinical Veterinary Medicine' in Kharkiv.

The objects of the study were seven horses of the thoroughbred English breed (first group), which were treated with the biocidal drug 'Iodesol', and seven horses (second group), which were treated according to the scheme with the biocidal drug 'Iodesol' and the drug 'Geocide', and kept indoors. A separate control group of seven horses was formed, which was not treated with any drugs. The animals were selected for the experiments according to the principle of analogous pairs, taking into account age, live weight, sex, and physiological condition. The average age of the animals was 5.4 ± 2.3 years, and their average body weight was 505 ± 45.3 kg. The feeding and housing conditions of the experimental and control groups corresponded to the technological processes adopted on each farm.

The clinical trials were conducted following the recommendations of the 'European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes' (CE, 1986) and Council Directive 2010/63/EU (CEC, 2010), and under Art. 26 of the Law of Ukraine No. 3447-IV of 21.02.2006 'About protection of animals from cruel treatment' (VRU, 2006) and basic bioethical principles (Simmonds, 2017). Under the current procedure, the research program was reviewed and approved by the Bioethics Committee of the National Scientific Center 'Institute of Experimental and Clinical Veterinary Medicine'.

According to the 'insert leaflet', the disinfectant 'DZPT-2' was used to treat enterobacteria, Gram-positive cocci, Gram-negative bacilli and bacilli in an aqueous solution at a concentration of 0.5% for six hours in the animal-free premises.

For preventive purposes, the premises were disinfected in the presence of horses with the drug 'Iodezol' once every two weeks, after thorough mechanical and sanitary cleaning of the surfaces of the facilities. A 0.2% solution of the product was prepared at a rate of 0.3 l of solution per 1 m^2 and left to dry completely for 30 min.

After feeding the horses, the premises and equipment were mechanically cleaned and washed with tap water. In the experimental group, the premises were disinfected once a week using a cold fog generator with the 'Geocide' aerosol method and a 0.5% working solution for a one-hour exposure at a consumption rate of 0.05 l/m^3. Disinfection was carried out with ventilation turned on. Sanitary and hygienic studies were conducted according to current methods.

The study of the general parameters of the indoor microclimate, in particular temperature, humidity, and air velocity, was conducted using an aspiration psychrometer MV 41 L, a weekly thermograph, a hygrometer M 16, a hygrograph M 21, an anemometer wing ASO 13, and a layer catathermometer. The concentration of harmful gases was measured using a universal gas analyser UG 2; the level of carbon dioxide was measured using the Hess method; illumination was measured using a lux meter YU 16 (Kovalenko et al., 2017); dust contamination was measured using the weight method; and microbial contamination was measured using the sedimentation method (Harkavenko et al., 2020).

Flushes were collected twice: once after cleaning and again after disinfection (three hours after treatment). Six samples were taken from each of the test surfaces (floor, walls, windows, machines, and feeders). The cultures were then plated on diagnostic thioglycol medium and MPA. The cultures were then incubated at 37°C for 48–72 h. The colonies that grew on each plate were then counted separately and their average number calculated.

The following were determined in whole blood: haemoglobin concentration by the haemoglobin cyanide method; total leukocytes and erythrocytes by counting under a microscope in a chamber with a Goryaev grid. Biochemical studies were performed according to generally accepted methods, as described in the reference book (Vlizlo, 2012).

Statistical analysis of the data was performed using Minitab 19 and Minitab Inc. Based on the results of statistical processing, the following indicators are presented in the tables: mean ± SD. A significant difference between the study groups was established based on the Mann–Whitney test ($P < 0.05$).

Results and discussion. The results of the studies on the microclimate in the premises of the two experimental groups of horses undergoing treatment with 'Iodezol' at a concentration of 0.2% (group 1), treatment according to a scheme involving the biocidal preparation 'Iodezol' and the preparation 'Geocide' (group 2), and the standard control group are shown in Table 1. The results of the experimental studies revealed that the microclimate indicators differed depending on the room in which the samples were taken. Microbial contamination in stables should not exceed 150 thousand microbial bodies/m^3. Total microbial contamination is determined by a complex association of bacterial, viral, and fungal microorganisms. The estimated level of contamination before disinfection with 'DZPT-2' was about 352.3–420.3 thousand CFU/cm^2 of area, as determined by quantitative analysis of serial dilutions of samples. After the premises and equipment in the production areas were disinfected using an aerosol, the number of microorganisms in the analyzed samples decreased significantly.

Table 1 — Microclimate parameters of horse stables after treatment with biocidal drugs (mean ± SD, n = 7)

Characteristics	Animal group		
	control	1st experimental	2nd experimental
Air temperature, °C	14.20 ± 0.11	12.30 ± 0.52	11.30 ± 0.14
Relative air humidity, %.	75.20 ± 3.14	68.30 ± 2.10*	65.20 ± 1.70*
Air velocity, m/s	0.8 ± 0.002	0.9 ± 0.001	0.9 ± 0.001
Ammonia, mg/m^3	10.1 ± 0.01	6.50 ± 0.02**	5.20 ± 0.05**
Hydrogen sulfide, mg/m^3	5.30 ± 0.02	3.09 ± 0.01**	2.12 ± 0.01**
Carbon dioxide (CO_2), %	0.3 ± 0.0022	0.19 ± 0.001**	0.15 ± 0.004**
Dust, mg/m	8.72 ± 0.08	4.12 ± 0.03**	3.14 ± 0.04**
Artificial lighting, lux	50	50	50
Microbial contamination thousand microbial bodies/m^3	180.5 ± 12.1	70.3 ± 1.43**	52.12 ± 0.11**

Notes: * — P < 0.01, ** — P < 0.001 relative to control indicators.

The problem of microbiological contamination in horse housing includes establishing permissible limits for the number of microorganisms that could negatively impact their health. The lack of standardized norms across different countries makes it difficult to determine specific numerical values. However, research highlights important aspects of microclimate management that mitigate risks associated with microorganisms (Colavita et al., 2016).

Studies analyzing indoor microbial levels, for example, emphasize controlling the accumulation of dust and gases, such as CO_2 and ammonia, which can lower air quality and create favorable conditions for microbial growth (Carrillo Heredero et al., 2024). The type of ventilation, the bedding materials used, and the general cleanliness of the space affect the quality of the microflora (Yarnell et al., 2017).

Another aspect to consider is the diversity and seasonality of microbial contamination, which affect the composition of the microflora. Studies have shown that the number of microorganisms is significantly higher in the summer. This may require a different management approach depending on the season (Witkowska et al., 2012).

Although there are no specific standards for the concentration of microorganisms in equine facilities, general recommendations for managing microclimate conditions, such as ventilation, humidity, and dust control, are essential for reducing the risk of pathogen development and ensuring the health of horses.

Disinfecting with the drug 'Iodesol' effectively reduced microbial contamination in the air in all areas where animals were kept. The number of microorganisms in the air decreased by 61% in the first experimental section and by 71% in the second experimental section, which used a combination of two biocides, 'Iodesol' and, later, 'Geocide'. There was a significant difference (P < 0.01).

Table 1 shows that disinfection with the iodine-based product 'Iodesol' and the benzalkonium chloride-based product 'Geocide' has a positive effect on optimizing the main parameters of the microclimate of livestock premises. The relative humidity decreased by 10% and 13%, respectively, in rooms where disinfection was carried out in the presence of horses in the first and second experimental groups (P < 0.01).

The air temperature in all experimental horse rooms was between 11°C and 14°C, which is within the normal range. Air velocity ranged from 0.8 to 0.9 m/s, with no significant difference between experimental and control groups.

The concentration of harmful gases (ammonia, hydrogen sulfide, and carbon dioxide) decreased in the indoor air of all experimental groups compared to the control group. The ammonia content in the room of the first experimental group decreased by 36% after using the preparation. The hydrogen sulfide concentration in the room of the second experimental group decreased by 60% after using the two preparations.

The results of the research show that disinfection with a complex of three biocidal preparations contributed to the optimization of the microclimate in the premises for keeping horses. At the same time, a decrease in humidity, as well as the presence of harmful gases (ammonia, carbon dioxide, and hydrogen sulfide), dust contamination, and microbial contamination of the air, was observed.

After 30 days of observation to determine the prolonged effect of the disinfectant complex, 'DZPT-2', 'Iodesol', and 'Geocide', an effective bactericidal effect was revealed, which maintained the microbial background of the facility within the normal range during the study period.

The effectiveness of the drugs is due to their compositions: iodine in 'Iodesol', benzalkonium chloride as a detergent in 'Geocide', and glutaraldehyde in

'DZPT-2'. These components provide the drugs with a long-lasting bactericidal effect against infectious agents.

Experiments show that 'Iodesol' disinfection solutions are effective and economically feasible for preventing respiratory diseases in horses in livestock facilities. The economic benefits of using the disinfectant preparation 'Geocide' for disinfection include reducing the duration of disinfection, the number of staff required, and the cost of drugs due to its multifaceted action (disinfection, disinsection, and disinfestation).

High-quality mechanical preparation of premises for disinfection reduces the amount of solution required per unit area, is cost-effective, and protects the environment from excessive chemical exposure.

Studies of the physiological state of horses in the experimental groups show that, during the observation period, the body temperature of horses increased slightly under the influence of the drugs 'Iodesol' and 'Geocide' by an average of 0.4°C.

A statistically significant increase in respiratory movements was found in the first days of the experiment. In the first experimental group, this increase compared to the control group amounted to five respiratory movements; in the second experimental group, it amounted to three. It should be noted that, at the same time, breathing became deeper. Compared to the control group, pulse beats tended to increase. In particular, the studies noted that, within one hour of applying the drug, the pulse beat frequency increased by an average of 10–15%, and, 1.5–2 h after disinfection, these indicators differed by only 1–2%.

Thus, disinfection with 'Iodesol' and 'Geocide' resulted in a slight increase in body temperature, heart rate, and respiration, which is associated with an increase in the intensity of redox processes in tissues and organs, as well as stress.

Subsequent studies on horses were conducted to investigate the safety of using 'Iodesol' and 'Geocide' for aerosol disinfection on the hematological and immunological parameters of animals. The goal was to assess the safety of the drugs and justify their use in production conditions. Clinical observations and hematological studies (hemoglobin content and number of red and white blood cells) showed that exposure to 0.2% and 0.5% solutions of the biocidal preparations 'Iodesol' and 'Geocide' did not cause changes in hemoglobin content, a decrease in the number of red blood cells, or a decrease in the number of white blood cells compared to the norm for the species and age group and the control group. The results of these studies are shown in Table 2.

The results revealed that, 30 days after the premises were treated with the drugs, positive changes in the animals' blood morphology and biochemistry were observed in the experimental groups.

Thus, the hemoglobin level in the second experimental group increased by 3.5% ($p < 0.05$) compared to the control group. This increase may indicate the activation of hematopoiesis and an increase in oxidation-reduction reactions. The number of red blood cells increased by 9.1% ($p < 0.05$), which indicates an increase in the blood's oxygen capacity.

The decrease in leukocytes by 5.7% indicates an absence of inflammation or decreased immune system load after treatment of the premises. Concurrently, a 7% increase in total protein in the blood suggests increased liver synthetic function or metabolic activation.

ALT activity in experimental group 2 increased by 16.2% ($p < 0.05$) and AST by 17.7% ($p < 0.05$) compared to control, which is within the physiological norm and may reflect the metabolic activity of hepatocytes. Glucose and albumin remained at a stable level, which confirms the absence of hyperglycemia or protein metabolism disorders.

Thus, the results indicate that the drugs 'Iodesol' and 'Geocide' are safe and do not negatively affect the main hematological and biochemical parameters.

Based on the data in Table 3, it was determined that the drugs did not cause inhibition of nonspecific resistance in animals. On the contrary, there was a tendency to increase it. Specifically, the phagocytic activity of leukocytes in the second experimental group increased by 4.3%, reaching 44.2% ($p < 0.01$), indicating the activation of cellular immunity. The bactericidal activity of the blood serum increased by 4.9%, reaching 55.7%, which indicates stimulation of the humoral link of nonspecific immunity. The lysozyme activity in the second experimental group exceeded the control values by 3.3% and the lymphocyte content by 7.4% ($p < 0.01$). This may indicate the stabilization or activation of the adaptive immune response. Compared to control animals, the level of T-lymphocytes increased by 2.6% ($p < 0.05$), and the level of B lymphocytes increased by 10% ($p < 0.01$), confirming the activation of both major lymphocyte populations.

According to the results shown in Table 3, there were no statistically significant differences in total phagocytic activity and phagocytosis intensity among the experimental animals.

Thus, according to the immunopharmacological characteristics of the preparations 'Iodesol' and 'Geocide', they do not exhibit a negative immunotropic effect and have no contraindications for use in sanitizing the premises of a horse breeding complex in the presence of animals.

Therefore, when choosing disinfectants for use in the presence of horses, it is important to consider their effectiveness and safety for animals (Ponomarenko et al., 2021). Phenolic compounds are effective against many bacteria, viruses, and fungi, and they remain active in the presence of organic contaminants.

However, they can be toxic to other animal species, such as cats and pigs, so care should be taken when using them. Iodine-based products (iodophores), such as povidone iodine, are often used to disinfect hands and equipment. They are effective against many microorganisms but may be less suitable for large areas (Kovalenko et al., 2017).

Table 2 — The effect of aerosol treatment of premises with 'Iodesol' and 'Geocide' on the morphological and biochemical parameters of horse blood (mean ± SD, n = 7)

Indicators	Observation period, days	Animal groups		
		control	1st experimental	2nd experimental
Hemoglobin, g/l	1	134.87 ± 10.42	137.51 ± 12.06	140.28 ± 11.39
	15	136.62 ± 9.76	139.08 ± 11.44	141.73 ± 10.27
	30	135.94 ± 10.23	138.36 ± 10.58	140.65 ± 9.88*
Erythrocytes, T/l	1	9.14 ± 1.23	9.33 ± 1.15	9.61 ± 1.08
	15	9.21 ± 1.18	9.45 ± 1.07	9.72 ± 1.02
	30	9.03 ± 1.26	9.51 ± 1.04*	9.85 ± 0.93*
Leukocytes, G/l	1	8.48 ± 0.97	8.29 ± 1.12	8.15 ± 1.19
	15	8.61 ± 1.07	8.12 ± 1.06*	8.04 ± 1.03*
	30	8.39 ± 1.14	7.97 ± 1.09	7.91 ± 1.08
Total protein, g/l	1	69.84 ± 4.12	72.09 ± 3.47	74.18 ± 3.25*
	15	70.97 ± 3.83	73.42 ± 3.19	75.46 ± 2.91
	30	70.23 ± 4.05	73.88 ± 3.36	75.15 ± 2.87
Glucose, mol/l	1	4.91 ± 0.38	5.07 ± 0.36	5.29 ± 0.31
	15	4.86 ± 0.44	5.03 ± 0.41	5.17 ± 0.36
	30	4.94 ± 0.35	5.08 ± 0.39	5.24 ± 0.33
Albumin, %,	1	38.97 ± 2.41	38.52 ± 2.83	37.95 ± 3.08
	15	38.75 ± 2.66	38.18 ± 2.94	38.04 ± 2.65
	30	38.42 ± 2.59	38.03 ± 2.87	37.88 ± 2.91
ALT, mmol×h/l	1	0.76 ± 0.144	0.79 ± 0.180	0.83 ± 0.180
	15	0.72 ± 0.144	0.79 ± 0.144	0.82 ± 0.180
	30	0.68 ± 0.108	0.76 ± 0.144	0.79 ± 0.144*
AST, mmol×h/l	1	1.40 ± 0.216	1.51 ± 0.180	1.58 ± 0.216
	15	1.44 ± 0.252	1.58 ± 0.216*	1.66 ± 0.180
	30	1.47 ± 0.180	1.65 ± 0.180	1.73 ± 0.216*

Note: * — $p < 0.05$ relative to the control indicators.

Table 3 — The effect of aerosol treatment of premises with 'Iodesol' and 'Geocide' on the indicators of nonspecific resistance of horses (mean ± SD, n = 7)

Indicator	Observation period, days	Animal groups		
		Control	1 experimental group	2 experimental group
Phagocytic activity, %	1	41.3 ± 0.65	43.2 ± 0.87	42.8 ± 0.72
	15	41.8 ± 0.58	43.9 ± 1.01	43.1 ± 0.95
	30	42.0 ± 0.77	44.2 ± 0.90	43.8 ± 0.66**
Bactericidal activity, %	1	52.5 ± 0.88	54.3 ± 1.01	53.1 ± 0.94
	15	52.90 ± 0.74	54.9 ± 0.85	53.9 ± 0.71
	30	53.1 ± 0.67	55.7 ± 0.76	54.2 ± 0.80
Lysozyme activity, %	1	50.3 ± 2.10	52.1 ± 1.95	51.8 ± 1.87
	15	50.2 ± 1.85	52.9 ± 1.72	52.3 ± 1.68
	30	50.8 ± 1.94	53.1 ± 1.84	52.5 ± 1.75
Lymphocytes, %	1	9.2 ± 0.22	9.2 ± 0.20	9.3 ± 0.21
	15	9.4 ± 0.30	9.8 ± 0.27	9.9 ± 0.24**
	30	9.4 ± 0.29	10.1 ± 0.33	10.1 ± 0.31
T-lymphocytes, %	1	72.1 ± 1.94	72.9 ± 2.04	73.3 ± 2.08
	15	72.7 ± 1.86	73.8 ± 2.11*	74.0 ± 2.27**
	30	72.4 ± 2.00	74.3 ± 2.12	73.8 ± 2.34
B-lymphocytes, %	1	21.4 ± 2.05	22.5 ± 1.95	23.1 ± 1.84
	15	21.8 ± 2.10	22.9 ± 2.00	23.6 ± 1.98
	30	21.9 ± 2.20	23.4 ± 2.08*	24.1 ± 2.12**

Notes: * — $P < 0.05$, ** — $P < 0.01$ relative to the control indicators.

Disinfectants such as quaternary ammonium compounds, hypochlorites (e. g., bleach), chlorhexidine, and pine oil are less effective in the presence of organic materials. Formaldehyde disinfectants are highly toxic and not recommended for use around horses. Some products are designed for the dry disinfection of horse housing. These products can be used in the absence or presence of animals by spreading them evenly over the floor.

Before applying disinfectants, the following general recommendations should be followed: before applying disinfectants, surfaces should be thoroughly cleaned of dirt and organic materials to increase the effectiveness of the treatment. Always follow the recommendations for concentration, method of application, and exposure time for each product. The premises should be well ventilated during and after disinfection. When working with chemical disinfectants, appropriate protective equipment should be used to prevent contact with skin and mucous membranes (Gehlen et. al., 2022).

Always consult a veterinary professional before selecting and using disinfectants to ensure the health and safety of your horses. Some disinfectants can be dangerous or toxic to horses, especially if used improperly. Only apply disinfectant after removing the horses from the room (unless the product is approved for use in their presence). Be sure to ventilate the room before returning the animals.

Conclusions. According to the results of the quantitative analysis of the serial dilutions of the samples, the estimated level of contamination decreased to 85% of the colony-forming units per cm^2 of area after the premises were disinfected with 'DZPT-2'.

After disinfecting the facility with 'Iodesol' and 'Geocide' at concentrations of 0.2% and 0.5%, respectively, a decrease in the concentration of harmful gases was observed: ammonia decreased by 36% and hydrogen sulfide by 60%. Relative humidity decreased by 13%, and the number of airborne microorganisms decreased by 71%.

Using solutions of 'Iodesol' and 'Geocide' at 0.2% and 0.5% concentrations to disinfect premises occupied by horses is harmless to the animals. This is evidenced by the indicators of nonspecific resistance factors, such as bactericidal and lysozyme activity in the blood serum. These values remained within normal limits during the study period.

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