

Innovative technologies used in the fight against infections in agriculture

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Abstract. The study considers a new approach to disinfection of livestock buildings - by creating an aerosol using portable systems (cold fog generators). The preparation "AlcoPerit" was chosen as a disinfectant, which has proven high antimicrobial activity against most pathogenic microorganisms, including those in spore form. This agent, in view of its safety for the macroorganism (humans and animals), can be used in the presence of animals, which in some cases can be the most important aspect. The work was carried out in a cowshed, poultry house and on a pig farm. The agent was aerosolized using both stationary systems - ULV System 57360A2 sprayer and portable cold fog generators. As a result of the work carried out, it was found that it is the latter method that can be considered innovative - portable systems are easy to move, such treatment does not require highly qualified personnel, and a correctly selected disinfectant allows for high-quality disinfection in almost any conditions, including in the presence of animals.

1 Introduction

One of the key tasks facing veterinary specialists is the effective prevention of the spread of infectious diseases among animals. To achieve this goal, it is necessary to control infectious processes, which implies managing infections in such a way as to minimize their impact on animal health and, accordingly, on human health [1-2]. The main methods used to manage epizootic and epidemiological processes are high-quality and timely disinfection. This is especially relevant in industrial agricultural production, where high animal densities and specific housing conditions can contribute to the rapid spread of pathogenic microorganisms. In large industrial complexes and farms, especially in the event of an unfavorable epizootic situation, pathogens can accumulate in places where animals are kept. This, in turn, can lead to outbreaks of infectious diseases, which creates serious risks for both animal health and the health of people working with them [3-5]. For example, viruses such as African swine fever or bird flu can spread quickly in conditions where proper preventive and disinfection measures are not observed. At the international level, the World Organisation for Animal Health (WOAH) plays an important role in developing animal health standards. This organisation is actively involved in the control of epizootic

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diseases and the prevention of their spread [3]. The main principles of WOAHA are to develop recommendations and standards that help countries implement effective measures to prevent and control animal diseases. In its activities, WOAHA relies on scientific research and reports on the results of the use of various disinfectants, which allows it to formulate well-founded recommendations for veterinary services [4,6]. In the event of epizootic outbreaks of infectious diseases, aerosol disinfection is of particular importance. This method allows for the effective disinfection of the air, surfaces and equipment in production facilities, which is especially important in conditions where animals are present. In this case, the treatment occurs by forming a cloud consisting of the smallest particles of disinfectant 5-50 microns, which, getting into the environment, settle on the surfaces of the livestock complex for some time, penetrating even the smallest cracks. In addition, spraying particles of this size allows spraying the disinfectant without harm to the body of farm animals [7,8]. Unlike hot fog generators, cold fog treatment can be carried out in the presence of animals if the disinfectant is not toxic to animals. Also, the use of such portable systems ensures high-quality precise application of the disinfectant, economical consumption, minimizes the processing time, and also allows high-quality treatment of the air environment, which is a huge advantage - due to the fact that many infectious diseases are transmitted by airborne droplets. In addition to cold fog generators, it is possible to use disinfection units for aerosol disinfection. The use of modern portable aerosol generators allows you to create the necessary concentrations of disinfectants to destroy pathogens in the air and on surfaces [8]. This approach not only ensures a high degree of disinfection, but also allows for treatment in the presence of animals, minimizing their stress and ensuring safety. It is also important to note that disinfection should be part of a comprehensive biosecurity system that includes not only sanitary measures, but also organizational measures such as access control to the farm, staff training, and animal health monitoring. Effective biosecurity requires continuous risk analysis and adaptation of measures depending on the current epizootic situation. In conclusion, infection control and disinfection are important elements of the veterinary disease control and prevention system [9]. Given globalization and the increase in international transport of animals and animal products, the importance of these measures will only increase. Veterinary professionals working in this field must be prepared to respond quickly to emerging threats, using modern technologies and scientific developments to ensure the health of animals and people [1, 10].

2 Material and methods of research

The disinfectant "AlcoPerit" with proven antimicrobial activity against most pathogenic microorganisms, including those in spore form (Figure 1) was used to treat livestock premises. The active ingredients of the product are hydrogen peroxide and ethyl alcohol, and the composition also includes complexing agents and stabilizers that are absolutely safe for the body of animals and humans and the environment.



Fig. 1. The drug "AlcoPerit".

The preparation is intended for effective and safe aerosol disinfection of the air and surfaces of industrial agricultural facilities (livestock and poultry complexes, greenhouses, vegetable stores, etc.). To create an aerosol of the disinfectant "AlcoPerit", the working solution was dispersed using aerosol system sprayers (ULV System 57360A2) made in Italy, capable of aerosolizing 90-95% of the disinfectant into a fraction with an average median particle size of 0.5-20 μm (Figure 2).



Fig. 2. ULV System 57360A2 Sprayer.

In order to distribute the aerosol evenly in the production areas of livestock complexes, sprayers on 2-meter-high stands (Figure 3) were installed at a distance of 10 meters from the gates and at a distance of 10 meters from each other. The consumption of the disinfectant was 4 ml/m^3 of the volume of the premises, which allows for the sanitization of not only the air environment, but also surfaces (Figure 4). The aerosol creation time was 15 minutes, the exposure was 20 minutes. All tests were conducted in the presence of animals,

a clinical examination of the animals was carried out before the start of disinfection, 30 minutes after the end of disinfection and daily for 10 days. Productivity indicators were assessed based on the data from the reports of the veterinary services of the farms.



Fig. 3. Aerosol disinfection of a livestock complex using sprayers installed on 2-meter high stands in the presence of animals.



Fig. 4. Sanitation of the air environment and surfaces of the livestock complex with fine aerosol was carried out for 15 minutes.

Aerosol disinfection with the Alcoperit preparation is also possible using a cold fog generator (Figure 5). Such portable systems are capable of forming an aerosol with an average median particle size of 5-50 microns by feeding the disinfectant into the air flow under high pressure. The main advantage of using aerosol generators is mobility, high precision of application of the disinfectant solution and acceleration of the processing process.



Fig. 5. Disinfection using portable aerosol generators.

Industrial tests of the effectiveness of aerosol disinfection with Alcoperit were conducted in the cowshed of Sovremennye Tekhnologii LLC, Moscow Region, Podolsk District, Ryzhovo settlement (196 heads of cattle); Konstantinovskaya Poultry Farm, Mosselprom CJSC, Moscow Region (29.7 thousand heads of broilers), Lazarevskoye Pig Breeding Farm, Lazarevo settlement, Shchekino District, Tula Region (428 heads of young animals). The obtained data were processed at the Department of Immunology and Biotechnology of the Moscow State Academy of Veterinary Medicine and Biotechnology – MVA named after K.I. Skryabin.

Before the experiment, a clinical examination of all animals and poultry was conducted in the livestock complex, poultry house and pigsty. To assess the effectiveness of antimicrobial activity of aerosol disinfection, the microbial background of the air was measured by sedimentation, and surface swabs were taken. After aerosol disinfection with a fine aerosol (5-25 μm) and subsequent exposure for 20 minutes, the microbial background of the air and surface swabs were measured again. Clinical examination of animals and poultry was performed 30 minutes after disinfection, 24 hours later, and daily for the next 10 days. The changes in the general condition of the animals, the condition of the general integument - skin and fur/feather in birds, mucous membranes (conjunctiva), the presence of discharge from the eyes and nasal cavity (if any, the nature of the exudate was assessed), any respiratory distress, the appearance of shortness of breath, coughing, as well as changes in behavior were assessed. In the event of animal and poultry mortality, a pathological autopsy was planned with subsequent histopathological examination of respiratory tract tissues. In addition, an assessment was made of changes in productivity - weight gain or loss of pigs and poultry, as well as milk yields of cattle. For this, data from reports of veterinary services were used (30 days after the treatment of premises using the aerosol method).

3 Results

After aerosol treatment with the disinfectant "Alcoperit" no animal deaths were observed during the entire observation period.

Local irritant effect on the mucous membranes was noted single in birds during the first examination - 30 minutes after disinfection. The following changes were noted: weak conjunctival hyperemia in 18 birds. According to the poultry house workers, clinical signs were not observed in these animals already 1 hour after disinfection. During the second examination (24 hours after aerosolization of the room) no signs of irritation were observed. Considering the number of livestock contained in the poultry house (29.7 heads),

the presence of weak conjunctival hyperemia in only 18 birds can be considered the absence of an irritating effect of the aerosol. No negative impact of the aerosol on the general integument, respiratory nervous system (shortness of breath, cough, alopecia and skin irritation, changes in behavior, appetite and thirst) was observed in animals and poultry. At the same time, an increase in productivity was observed: in broilers - weight gain by 1.3%, in pigs - by 1.8%, according to the data of the veterinary services of farms. The productivity of cattle remained unchanged (Table 1).

Table 1. Safety of the aerosol disinfectant "Alcoperit" for farm animals.

The indicator under study	Animal species		
	Broilers	Pigs	Cattle
Aerosol toxicity (mortality)	Absent	Absent	Absent
Local irritant effect on: - mucous membranes - skin	Single Absent	Absent Absent	Absent Absent
Productivity	101.3%	101.8%	100%

When assessing antimicrobial activity, we compared swabs taken from surfaces and the microbial background of the air environment before and after treatment (Figure 6). Before disinfection, no preliminary mechanical cleaning of the premises from contaminants was carried out. The data obtained indicate high efficiency of aerosol disinfection: before the experiment, continuous growth of microflora was observed, after - single colonies.

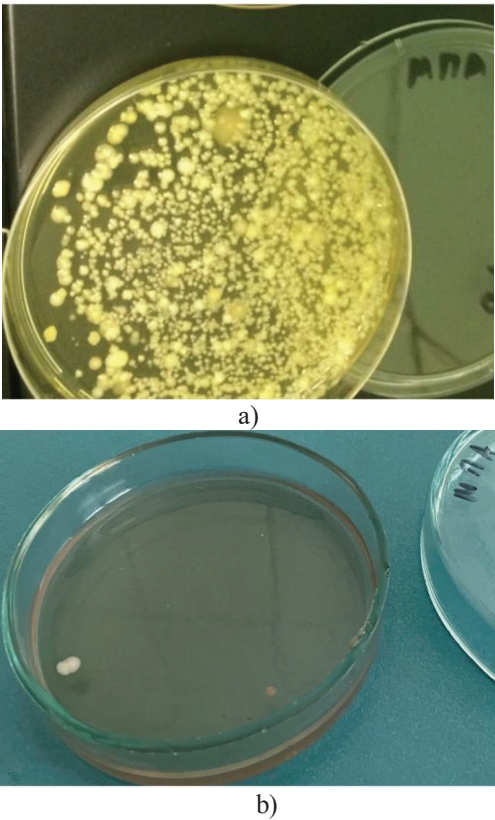


Fig. 6. Evaluation of the effectiveness of aerosol disinfection: a) before disinfection, continuous growth of microflora is observed; b) after disinfection – single colonies.

4 Conclusions

Aerosol disinfection is truly innovative in agriculture. It does not require high financial and labor costs compared to other methods of room treatment, but at the same time, it is highly effective. Before aerosolization, there is no need for mechanical cleaning of the premises, since the fine aerosol created by sprayers is able to penetrate into the most inaccessible places. The use of portable systems - portable cold fog generators does not require high qualification of specialists performing room disinfection. Also important is the factor of selecting a disinfectant - it must have high antimicrobial activity, but at the same time be safe for the body of animals and humans. The drug "Alcoperit" belongs to the 4th class of low-hazard substances and meets all the requirements for disinfectants. The disinfecting effect of the Alcoperit preparation in relation to microbial contamination of the air and surfaces is determined by the concentration of microorganisms, exposure and processing features that would guarantee effective disinfection of all places where the pathogen could get. Aerosol disinfection with the Alcoperit preparation is recommended to be carried out in the form of a finely dispersed aerosol (5-25 microns), followed by exposure for 20 minutes.

Aerosol treatment of livestock buildings and poultry houses with the "Alcoperit" agent is an innovative technology that can be recommended for disinfection of production facilities at agricultural enterprises. The results of the study can be used in the agricultural sector, namely for disinfection of livestock complexes.

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