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BACTERIOLOGICAL CONTROL OF SERVICE DOG AIRS WITH THE HELP OF DISINFECTANT CHEMICALS AND THEIR CHARACTERISTICS

БАКТЕРІОЛОГІЧНИЙ КОНТРОЛЬ ВОЛЬЄРІВ СЛУЖБОВИХ СОБАК ЗА ДОПОМОГОЮ ДЕЗІНФІКУЮЧИХ ХІМІЧНИХ ЗАСОБІВ ТА ЇХ ХАРАКТЕРИСТИКА

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Annotation. *Development of reliably and safety method of desinfection associated with a number of issues, in particular, theoretical and methodological nature. One of the main problem in developing such methods is their use only safe and reliable chemicals. That have not determinental effecton health of the dogs, service personnel, cynologist*

Despite the large number of works, about desinfectants are still acute the need to formulate new safe methods and improve already available solutions, about disinfection of service dog cages.

This article describe the theoretical and practical principles that are basic chemical desinfectants. Their application to the main corpses of microorganism. The moments of the basic concepts in disinfection will also be described. How we, like vet, can get control under dangerous pathogen. And what is the main criteria of chemical desinfectants.

Keywords: *methodological approach, bactericidal, virocidal, germicidal, tuberculocytic activity, disinfection modes, die of microbes, chemical disinfectant.*

Chemical control of bacteria. Characteristics of the main disinfectants suitable for disinfection of enclosures of service dogs. [9]

In nature, there are many plants, animals, mushrooms of various shapes and colors, without which we cannot imagine our life, everyday life, etc. However, as we know, there is a group of elusive, invisible beings without which our life could not exist at all, this is the kingdom of small particles. Bacteria are the oldest inhabitants of our planet, the history of their evolution goes back about 3.5 billion years, at the same time when the appearance of humans dates back about a million years. However, bacteria have five significant advantages over higher forms of organisms:

(1) they are small in size but have a large absorption capacity;

(2) fast metabolism;

(3) rapid rates of reproduction and movement;

(4) fast pace of adaptation to adverse factors;

(5) bacteria have a wide variability of representatives in different places. [9] Today, the main task of epidemiologists, nutritionists, and veterinary doctors is to ensure that water is safe to drink, that supermarket shelves are filled with products that do not have bacterial insemination, and that antibiotics counteract infections. Controlling the level of exposure to disease-causing microbes on us and animals is a monumental concept of our existence, which stretches back many centuries of history of successes and failures.

Basic ideas about microbiological control.

The method of microbiological control in the external environment is possible with the help of: sterilization, disinfection, antiseptics or decontamination. Sterilization is the destruction of all forms of microbial life. Disinfection destroys most of the microbiota, reducing bacterial insemination of inanimate surfaces. Antiseptic is still the same disinfection, but on the surfaces of living organisms. Decontamination is the mechanical cleaning of most microbes, both from living and non-living surfaces.[2]

Relative stability of microbial forms.

The primary goal of microbiological control is microorganisms that have the ability to cause disease and spoilage. That are present in the body of an animal or a person, or in the environment. These target categories of microorganisms are rarely simple or homogeneous; in fact, these are mixed microbes with sharp differences in pathogenicity and resistance. Contamination with contaminants that can have far-reaching consequences if not properly controlled include bacterial vegetative cells, endospores, fungal hyphae, spores, yeasts, protozoan cyst trophozoites, helminth eggs, viruses, and prions.

Table 1 - Comparison of the stability of bacterial endospore and vegetative cell under the influence of various factors

Method	Endospore *	A vegetative cell *	Relatively stable **
Heating (wet)	120 ° C	80 ° C	1,5×
Radiation (x-ray)	4,000 Grey	1,000 Grey	4×
Sterilization gas (ethylene oxide)	1,200 мg/ 1	700 мg/1	1,7×
Sporicidal liquid (2% glutaraldehyde)	3 hours	10 minutes	18×

*Values are based on the method (concentration, exposure time, intensity) required to destroy the most resistant representatives in each group. [8]

**The highest resistance of a spore against a vegetative cell is given as an average. [8]

For comparison, prions, bacterial endospores have the highest resistance, protozoan cysts, fungal spores (zygospores), some viruses have average resistance. In general, a naked virus is more resistant than an enveloped virus.

Bacteria with increased resistance of the vegetative cell are Mycobacterium tuberculosis, Staphylococcus aureus, Pseudomonas species. Most vegetative cells have the least resistance; fungal spores (except zygospores) and hyphae, enveloped viruses, yeasts, trophozoites of protozoa.

While conducting a review of the literature, I came across the materials of a case of salmonellosis that happened in the educational clinics of a veterinary university located in the USA. [10] During the 7-week outbreak, Salmonella infantis was isolated from 35 infected animals, including 28 horses, 4 cows, 1 camel, 1 goat, and 1 dog. During the outbreak period, the examined faecal samples were negative for S.

Infantis. Over the course of the outbreak, several infected horses developed fever and diarrhea, and even some veterinary students felt they were infected. A total of 148 samples were isolated from the pure bacterial culture from the first to the seventh week of the outbreak.

Cultures of S. infantis were obtained from rectal thermometers, horse stall mats, and even from the hands of a hospital employee. A large part of the teaching hospital was closed. The object was then washed with a stream of high-pressure water and disinfected with quaternary ammonium. Carpets from the surgical department were washed a second time with 0.5% chlorhexidine solution. Salmonella was not isolated when re-cultivated from cleaned surfaces and the hospital was reopened. However, in the first two animals after the discovery of the horse and the cow, positive faecal samples containing Salmonella infantis were found immediately after a few days of stay in the clinic.

Environmental samples were again positive for the pathogen. There was a second outbreak of salmonellosis. And the second outbreak was worse than the first, because diarrhea and fever were observed in more than 80 percent of animals in the feces of which the causative agent of salmonella was found. Two animals did not respond to treatment and were humanely euthanized.

Having analyzed this article, we can think that the disinfection of the hospital was a failure, because there were difficulties with the rough surfaces of the wall blocks, the pores of the mats and the concrete floor.

The problem with salmonella would be solved if, firstly, the walls of the stable were painted with a special epoxy composition, which would make it possible to make the surface smooth and easy to clean. Secondly, it is better to replace porous mats with mats made of strong, one-piece rubber.

The walls and floor were treated with a quaternary ammonium detergent, but sodium hypochlorite would have worked more effectively. The surface must be completely free of organic particles before disinfection.

Perhaps another reason for the re-flash is that cleaning the surface with a high-pressure water jet has a number of disadvantages compared to manual brushing, as the exposure time in the detergent and in quaternary ammonia increases. [2]

And finally, it is the staff's compliance with measures of prevention and control over infectious agents. The concept of the death of a microbe. Death is a phenomenon characterized by the loss of life processes. Signs of death in multicellular organisms, such as higher animals, are loss of nervous activity, breathing, or heartbeat. But this will be contrasted with the death of a microbe, in which it is difficult to detect signs of death. Lethal factors (radiation and chemicals) do not necessarily change the appearance of the microbial cell. Even after the cessation of movement, the microbe cannot be considered dead. And this fact makes it necessary to develop parameters that would outline cell death. [8]

The destructive effect of chemical or physical agents occurs at the level of an individual cell. [8] If a cell is continuously exposed to agents such as intense heat or toxic chemicals, various cellular structures lose their functions and the cell may suffer irreversible damage. [8]

Today, the most practical way to detect these damages is to determine the ability to reproduce, given a favorable environment. If a micro gets into a pleasant environment, but has permanent and irreversible changes in its structure, then it will not be viable for a long time and there will be no signs of growth and vital activity.

Permanent loss of reproductive properties in a microorganism, even under ideal growth conditions, began to be accepted by microbiologists as the definition of death. [8] Domestic sources offer to control the effectiveness of disinfectants with the help of test objects: silk threads impregnated with E. coli culture and spore-forming bacteria (B. Suptilis, B. stearothermophylus) are placed in a solution of disinfectants - phenol (5%) , lysol (5), perchloric lime (10%) and others for 5 and 60 minutes.

They are washed from the disinfectant, sown in MPB and incubated in a thermostat for 24 hours at 37°C. Control cultures without the action of disinfectants. [8]

Factors affecting the mortality of microorganisms. Cultured cells show differences in the uptake of a particular microbicide agent. The death of the entire population is a non-instantaneous phenomenon and is achieved when a certain threshold of action of the microbicidal agent is reached (a combination of time and concentration).

Death proceeds logarithmically.

When the time or concentration of the agent is increased. Because many microbiocides aim to disrupt the metabolism of bacterial cells, and young, actively dividing cells die much faster than old cells, which have much less metabolic activity.

Table 2 - Concentration and time are required for the chemical destruction of individual microbes

Microorganisms	Concentration	Time
Agent: Chlorine		
Mycobacterium tuberculosis	50 ppm	50 sec
Cysts Entamoeba	0.1 ppm	150 min
Agent: Ethyl alcohol		
Staphylococcus aureus	70%	10 min
Escherichia coli	70%	2 min
Agent: hydrogen peroxide		
Staphylococcus aureus	3%	12,5 sec
Herpes virus	3%	12,8 sec
Agent: Quaternary ammonium		
Staphylococcus aureus	450 ppm	10 min
Salmonella typhi	300 ppm	10 min

The effectiveness of a particular tool, in addition to time, is determined by several factors other than time. These additional factors affect the effect of the antimicrobial agent:

1. The number of microorganisms in the population. A higher pollutant load requires more time to destroy.

2. Character of microorganisms in the population. In most real-world disinfection and sterilization situations, the target population is not a single microbial

species, but a mixture of bacteria, fungi, spores, and viruses that have a wide variation in resistance.

3. Temperature and reaction of the medium.

4. Concentration (dosage, intensity) of the agent. For example, ultraviolet radiation is most effective at a wavelength of 260 nm and most disinfectants are more active at higher concentrations. [8]

5. Modes of action of the agent. It either kills or inhibits the microorganism. 6. The presence of interfering solvents - organic particles, blood, saliva, feces, which can slow down disinfection even when heated.

Chemical agents in microbiological control.

Chemical control of microbes as a field of science dates back to the early 1800s, when doctors began using chlorinated lime and iodine to treat wounds and wipe their hands before surgery. Today, about 10,000 different antimicrobial chemicals are produced, about 1,000 of them are routinely used in everyday practice for treatment and cleaning the house. [9]

There is a real need to avoid contamination and spoilage, but the number that exists today that can kill, disinfect, antiseptic, clean and disinfect, deodorize, fight plaque, and purify the air indicates a preoccupation with this issue, which indicates a preoccupation with this a question that can sometimes be excessive. [9]

Antimicrobial agents are found in liquid, gas, or even solid form and range from disinfectants and antiseptics to sterilizers and preservatives (substances that are able to prevent the deterioration of a substance). For convenience and sometimes safety, many solid and gaseous antimicrobial substances are able to dissolve in water, alcohols, or a mixture of 2 liquid components.

A solution containing exclusively pure water is an aqueous solution, however, if the solvent is alcohol or a water-alcohol mixture, it will be a tincture. [5] The choice of a chemical agent that will have bactericidal properties. The rational choice of a disinfectant is an important issue in veterinary and human medicine. Since the list of disinfectants today is very wide, the requirements for such products are as follows:

1. Fast action even in low concentrations.
2. Solubility in water, alcohol and long-term stability in these solutions.
3. A wide range of action without toxic effects on humans and animals. [9]
4. Penetration into inanimate surfaces and long-term action there.
5. Resistance to inactivation by organic substances.
6. Absence of corrosive effect and staining effect.
7. Disinfecting and deodorizing properties.
8. Availability and availability in free access.

To date, no substance meets these requirements, but glutaraldehyde and hydrogen peroxide come closer to the ideal. [8]

Bactericidal agents, regarding chemical groups. There are several general groups of chemical compounds that are widely used for antimicrobial purposes in veterinary medicine. These agents include halogens, heavy metals, alcohols, phenolic compounds, oxidants, aldehydes, detergents and gases. [3]

Halogen antimicrobial agents. Halogens include fluorine, bromine, chlorine, and iodine. This group of disinfectants is highly effective because it has a bactericidal effect that is not bacteriostatic, but prolonged over time, which may even have a sporicidal effect with prolonged exposure. For reference, today a third of disinfectants are based on halogenated compounds. [1]

Chlorides and their derivatives Chlorides have been used in disinfection and antiseptics for about 200 years. Liquid and gaseous chlorine, hypochlorite and chloramine showed the highest degree of control over microorganisms. In solution, these components combine with water, forming hypochlorite acid, which will further oxidize the sulfhydryl groups of cysteine amino acids and interfere with the formation of disulfide bridges in many proteins. [7]

As a result, protein denaturation becomes irreversible and metabolic processes in the cell stop. Chlorides kill not only bacteria and their spores, but also fungi and viruses. The effectiveness of chlorides decreases with an alkaline environment, exposure to light, and the presence of organic substances.

May produce chlorine gas, which may combine with other chemicals such as ammonium. 5.25% sodium hypochlorite solution is effective against parvovirus and feline calicivirus in a 1:30 dilution, and against microsporia is effective in a 1:10 dilution, recommended exposure time is 10 minutes, the solution is stable for a day after dilution, the solution has a corrosive effect on metals, is inactivated by organic matter. [3].

Iodine and its derivatives Iodine is a harsh chemical that dissolves in water and alcohol. There are two forms of iodine: free iodine in solution and iodoform. Iodine quickly enters the cell and destroys hydrogen and disulfide bonds. [9]

In working concentrations, iodine kills all types of microorganisms. The effectiveness of io is not so negatively affected by the reaction of the environment and the presence of organic matter, as in the case of chlorine. Inactivated by cationic soaps and detergents [1]

Phenol and its derivatives. Phenol (carbolic acid) is a caustic, poisonous compound obtained from the distillation of coal tar. It was first adapted as a bactericidal agent in surgery by Lister in 1867 and was at that time the only agent before the appearance of less toxic substances based on phenol. The phenol solution is currently used in a limited number of cases, but phenol remains today as an arbitration unit against which the effectiveness of other phenol-based disinfectants, of which there are hundreds, are determined. [4]

Phenols have one or more aromatic rings with an added functional group. The most important among them are alkaline phenols (cresol), chlorinated phenols and disphenols. In high concentrations, there are cell poisons that quickly destroy the cell wall and precipitate membrane proteins; at low concentrations, they inactivate critically important proteins. Phenols are powerful microbicides and destroy vegetative bacteria (including the causative agent of tuberculosis), fungi and viruses, but the sporicidal effect is less pronounced. The advantage of these means is that. That they continue to act in the presence of organic substances and detergents, but their high toxicity makes them dangerous for use as antiseptics. [3]

Perhaps the most common phenol is triclosan, also known as dichlorophenoxyphenol, an antibacterial compound added to dozens of products, from soap to cat litter. It acts as a disinfectant and antiseptic with a wide range of action. [1]

Chlorhexidine The chlorhexidine compound (Ibicleans, Hibitan) is a complex chemical substance that contains chlorine and two phenolic solutions. Its mode of action is aimed at both cell membranes (loss of surface tension, which will lead to loss of selective permeability), thereby causing protein denaturation. [9]

In high concentrations, it has a bactericidal effect on gram-positive and gram-negative microorganisms. However, inactive on disputes. Its effect on viruses and fungi is diverse. It has advantages over other antiseptics due to its softness, quick action, low toxicity and inability to penetrate deep into tissues.

Alcohol as a microbiocidal agent Alcohols are colorless hydrocarbons with one or more functional groups. Of all alcohols, only ethyl and isopropyl are available for disinfection, since methyl has a weak bactericidal effect, and higher alcohols do not dissolve well in water, or are too expensive for routine use. In the presence of organic substances, it is quickly inactivated. [3]

The mechanism of action depends on the concentration of alcohol. Concentrations of 50% and higher dissolve membrane lipids and disrupt cell integrity. Alcohol is an exception to the rule that the higher the concentration of the disinfectant solution, the higher the degree of disinfection, because water is needed for protein coagulation and alcohol will have a higher activity at a concentration of 70% alcohol and 30% water than absolute alcohol, which dehydrates the cell and inhibits the growth of microbes , but is not a protein coagulant. [1]

However, alcohols do not destroy spores, but with sufficient exposure, they can have a sufficient bactericidal effect on vegetative forms, even mycobacterium tuberculosis, leprosy, etc. However, it has a number of advantages in inactivating viruses. [3]

Hydrogen peroxide and related bactericides hydrogen peroxide is a caustic colorless substance that decomposes in the presence of light, metals, catalase with the formation of oxygen and water. The bactericidal action of hydrogen peroxide consists in the direct or indirect action of oxygen. Oxygen forms hydroxyl free radicals, which are very toxic to the cell. [9]

Although most microorganisms produce catalase to inactivate metabolic peroxides, it cannot neutralize the entire amount of peroxide entering the bacterial cell during disinfection. Hydrogen peroxide is an excellent agent that has a bactericidal, virucidal and fungicidal effect, and in high concentrations also has a sporicidal effect. [1]

Recently, the problem of delicate disinfection of equipment for diagnostic procedures, such as endoscopes, colonoscopes, gastrostomies, etc., has become acute, so low-temperature sterilization cabinets containing liquid chemicals for sterilization have been invented to sterilize this equipment. The main types of chemicals are powerful oxidizing agents, such as 35% hydrogen peroxide and 35% acetic acid solution, which get into delicate mechanisms and kill microorganisms resistant to other agents and do not expose to corrosion and damage to working parts. [4]

Surfactants: detergents Detergents are polar molecules that act as surfactants. Most anionic detergents have limited microbicidal properties. This includes most soaps. Cationic detergents, including quaternary ammonium compounds, are much more effective. [1]

The activity of cationic detergents is due to the double-headed nature of the molecule, which has a positive end that binds to negatively charged surface proteins, and a long, unattached hydrocarbon chain destroys the cell membrane upon prolonged exposure. The latter, in turn, loses its selective permeability, which leads to the death of the cell. [3]

The main disadvantages of this group of chemicals include the fact that they can be used only for low-level infections, since these disinfectants do not affect spores, tuberculosis bacteria and pseudomonads. Their activity decreases in the presence of organic substances, and their effectiveness increases when the environment is alkaline. [4]

Soaps function mainly as a cleaning and sanitizing agent in the home and industry. The properties of soap help to wash away large parts of dirt, soil, dust, grease and other debris that contains a large number of microorganisms. [9]

Soap acquires a greater bactericidal effect in combination with iodine and chlorhexidine preparations. The use of soap before chemical disinfection improves the disinfection performance of cages, equipment, inventory of livestock premises. Disinfectants containing heavy metal salts in the component. Various forms of the metallic elements mercury, silver, gold, copper, arsenic, and zinc have been used in microbiological control for centuries. They are often called heavy metals because of their high atomic mass. However, from this list, only drugs that contain mercury and silver have a germicidal effect. Although some metals such as (zinc and iron) are actually needed in small concentrations as cofactors for enzymes, high molecular weight heavy metals such as mercury, silver and gold can be toxic even in minute amounts (1 part per million). This property of having a toxic effect in small concentrations is called oligodynamic effect. Heavy metal bactericides are organic or inorganic salts of heavy metals and they come in the form of an aqueous solution, tincture, ointment and soap. [6]

Mercury, silver and most other metals affect microorganisms by binding to functional groups of proteins, leading to profound disturbances in metabolism. This mode of action can kill a large number of types of microbes, including vegetative bacteria, fungal cells, spores, algae, protozoa, and viruses, but not endospores. [5]

But, unfortunately, there are certain difficulties with the use of heavy metal salts for disinfection:

1. Metals can be very toxic to humans and animals when they enter the body, when inhaled, even in minimal amounts, for that reason they are also toxic to bacterial cells. [3]
2. They can often provoke allergic reactions.
3. A large amount of biological fluids and waste can neutralize their effect. [5]
4. Microbes can often develop resistance against these agents.
5. Dangerous for the ecosystem. [8]

Aldehydes as germicides. Organic substances containing the functional group –CHO (strong reducing group) in the terminal carbon are called aldehydes. A few common substances such as fats and sugars are technically aldehydes. Two aldehydes, formaldehyde and glutaraldehyde, are the most widely used in the fight against microorganisms. [8]

Glutaraldehyde is a yellow oily substance with a slight odor. The mechanism of action consists in the crosslinking of protein molecules on the surface. In this process, amino acids are alkylated, which means that the hydrogen atom in the amino acid is replaced by the aldehyde group itself. It can irreversibly disrupt the activity of metabolic processes in the cell itself. [8]

Glutaraldehyde is a fast and effective broad-spectrum agent and is recognized as a high-level disinfectant, killing even spores in three hours.[4]

Even the most resistant forms of viruses are neutralized in a relatively short time. Active even in the presence of organic contaminants, non-corrosive, does not damage plastic. Its main disadvantage is that it is unstable when the reaction of the medium and temperature increases. [3]

Formaldehyde is a caustic irritant gas that dissolves in water to form a solution of formaldehyde, which is formalin. Pure formalin is a 37% solution of gaseous formaldehyde in water. The chemical substance is microbiocidal due to attachment to functional groups of amino acids. Formalin is a medium- to high-level disinfectant, although it works much more slowly than glutaraldehyde. [8]

Formaldehyde is an extremely toxic drug (has a carcinogenic effect) and irritates the skin, which limits the range of use of this drug. [3]

A third aldehyde, ortho-phthalaldehyde, appeared relatively recently and was registered by the EPA as a high-level disinfectant, ortho-phthalaldehyde is a pale blue liquid with a slight odor most similar to glutaraldehyde, stable, non-irritating to the eyes and nasal mucosa, acts faster than glutaraldehyde. It has shown high efficiency against vegetative forms of mycobacteria tuberculosis and pseudomonads, however, it copes poorly with the sporicidal task, and one of the disadvantages is that it stains proteins, including in the skin of animals and humans. [8]

Use of aldehydes. Glutaraldehyde is a milder disinfectant for disinfecting equipment and dog care products, in veterinary medical practice it is often used to sterilize equipment for invasive and minimally invasive procedures (2% solutions of Cydex and Sporocidin) [1].

As for formalin, its 8% tincture is used to disinfect surgical instruments. In fish farming, working solutions are used to destroy parasites on fish and control the growth of algae and pathogenic microorganisms in water bodies. [5]

Conclusions

Chemical agents are classified by aggregate state and chemical nature.

Chemical disinfectants can be both microbiocidal and microbiostatic, they are also classified as high, medium and low level disinfectants.

Factors that determine the effectiveness of disinfection: the number, type of microorganisms involved, the presence of organic substances, the strength of the agent and exposure. Halogens are effective chemicals that have both bactericidal and bacteriostatic effects Phenols are powerful bactericides and are generally used for disinfection.

Softer phenols - bis phenols are used as antiseptics. Alcohols dissolve membrane lipids and destroy membrane proteins, their effect depends on the concentration, and generally acts as a bacteriostatic agent.

Hydrogen peroxide is a universal disinfectant that can be used both for processing the inventory of dog enclosures and even dog wounds. Surfactants are of two types - detergents and soaps. They reduce the surface tension of the cell membrane, causing membrane disruption. Cationic detergents are limited disinfectants for microorganisms and organic pollution Aldehydes are powerful disinfectants that irreversibly destroy cell structures.

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Анотація. *Розробка надійного та безпечного методу дезінфекції пов'язане з низкою питань, зокрема теоретико- методологічного характеру. Одна з основних проблем розробки таких методів, є використання лише безпечних та надійних хімічних речовин, які б не мали шкідливого впливу на здоров'я собак, обслуговуючого персоналу, кінологів. [8]*

Нежважаючи на велику кількість праць, щодо деззасобів, все ще є гостра потреба у формулюванні нових безпечних методів та вдосконаленні вже наявних рішень, щодо дезінфекції вольєрів службових собак.

В дані статті описуються теоретичні та практичні засади, щодо основних груп хімічних дезінфектантів, їх вплив на основні групи мікроорганізмів. Описується також і моменти основних понять у дезінфекції, яким чином ми, як фахівці ветеринарної медицини здатні контролювати пошireність хвороб тварин та стійкість основних типів збудників за дії бактерицидних засобів . Які критерії ми повинні ставити щодо деззасобів.

Ключові слова: *методичні підходи, бактерицидна, вірусоцидна, спороцидна, туберкулоцидна активність, режими дезінфекції, загибель мікроорганізмів, хімічні дезінфектанти.*