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Disinvasive action of aldehyde and chlorine disinfectants on the test-culture of *Toxocara canis* eggs

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Disinfection of environmental objects with highly effective disinfectants is a reliable and effective means of preventing the occurrence of outbreaks of infectious and parasitic diseases. The purpose of our work was to determine the disinfection properties of modern disinfectants based on the test culture of *Toxocara canis* helminths and to establish the optimal modes of their use. It has been proven that an aldehyde disinfectant containing didecyldimethylammonium chloride (2.25%), benzalkonium chloride (8.0%), glutaraldehyde (15.0%), phosphoric acid, nonionic surfactants, water exhibits disinvasive activity against test cultures of *Toxocara canis* eggs at a concentration of 2.0-4.0% at a temperature of 20±0.5°C and an exposure of 3-24 hours, and the ovocidal efficiency is from 90.60% to 99.70%. Aldehyde disinfectant can be used for disinfection of soil (black earth, sandy loam, loamy) contaminated with *Toxocara canis* eggs, at a concentration of 4.0% at 6:00 exposure and a consumption rate of 3000 cm^3/m^2. Chlorine agent, contains dichlorantin, dimethylhydantoin (12.4-16.4%), dispersant (9.0-12%), nonionic surfactants, corrosion inhibitor, filler exhibits disinvasive activity against *Toxocara canis* test culture in a concentration of 3.0-4.0% with an exposure of 3-24 hours, and the ovocidal efficiency in this case ranges from 97.40% to 98.82%. The chlorine agent is effective for soil disinfection only at a depth of up to 2 cm at a concentration of 4.0% at a consumption rate of 1000 cm^3/m^2 and an exposure time of 24 hours.

Keywords: disinfectant, disinfection, eggs *Toxocara canis*, concentration, exposure, test-object, soil.

Introduction

Parasitic diseases of agricultural and domestic animals are still an urgent problem in veterinary medicine, the solution of which requires a comprehensive, scientifically grounded, innovative approach (Abou-El-Naga, 2018; Paliy et al., 2018a).

The most widespread helminths among domestic animals are nematodes *Toxocara canis* and *Toxocara cati* et the dog and feline, respectively (Dalimi et al., 2006; Sudhakar et al., 2013). The eggs of these parasites are common environmental pollutants (Paliy et al., 2019), largely due to the fact that many species of dogs and cats serve as pets, others are wild on city streets. Helminth eggs in the feces of dogs and cats become infectious within a few weeks after they enter the environment (sandpit, city parks, public beaches, etc.) (Despommier, 2003; Papavasilopoulos et al., 2018). With an increase in the population of dogs and cats, soil contamination with toxocara eggs can be detected in public places - city yards, playgrounds, etc., regardless of the season (Sommerfelt et al., 2006; Thomas & Jeyathilakan, 2014). Thus, in the study of 152 samples of dog feces, thirteen were positive, infested with helminth eggs, including *T. canis* and *T. leonina* (Tarsitano et al., 2010). *T. canis* eggs were found in high numbers in most soil samples collected from dog centers (Dunsmore et al., 1984). Along with this, it was found that under the conditions of the canine center, the source of environmental pollution by exogenous forms of helminths *T. canis* is the fly *Musca domestica* L. (Paliy et al., 2018b). 26% of sand samples contaminated with *T. canis* helminths were identified (Ristić et al., 2020). Soil contamination with toxocar eggs is higher in urban than in rural areas. It has also been found that it is the same in spring and autumn (Mizgajska-Wiktor & Jarosz, 2007). Thus, soil contaminated with exogenous forms of helminths plays a leading role in the preservation and spread of invasions among susceptible animals (Rosa Xavier et al., 2010; Mizgajska-Wiktor et al., 2017).

Toxocara canis larvae survive in water at temperatures between 15 and 35°C, helminth eggs survive cooling down to 1 and -2°C for 6 weeks and can develop to the invasive stage (Azam et al., 2011). A temperature of 12-37°C provides the best conditions for infection with human and animal helminth eggs (Raissi et al., 2019). The development of helminth eggs in the environment is considered as a potential threat to public health, and the precise definition of the stages of development and a clear differentiation of viable and non-viable eggs can be used in the study of antiparasitic compounds (Abou-El-Naga, 2018).

Toxocariasis is a dangerous parasitic zoonosis that affects millions of children and adolescents around the world (Chen et al, 2018). Infected humans are potential sources of invasion for definitive hosts (carnivores) or other humans (Strube et al., 2013). The spread of helminth eggs in the environment is facilitated by the synanthropic bird (Rahbar et al, 2015). Important in the spreading of eggs *Toxocara* spp. have earthworms (Mizgajska, 2001). *Musca domestica* L. plays the leading role in the transmission of exogenous forms of helminths (Paliy et al., 2018c).

The clinical manifestation of toxocariasis in humans ranges from asymptomatic to severe infection with organ trauma caused by the migration of parasite larvae (Nicoletti, 2013). Today, toxocariasis is a serious environmental problem in large cities and towns (Raissi et al., 2019).

Human toxocariasis remains a threat, despite the availability of highly effective anthelmintics for dogs and cats. Effective prevention strategies require a good understanding of the biology and epidemiology of these parasites and the risk factors that lead to their transmission to humans (Overgaauw & van Knapen, 2013). In this regard, complex veterinary and sanitary measures aimed at the destruction of exogenous forms of helminths in the environment using highly effective disinfectants are of paramount importance (Paliy et al., 2020c).

The purpose of our work was to determine the disinfection properties of modern disinfectants on a test culture of *Toxocara canis* helminths and to establish the optimal modes of their use.

Materials and methods

Experimental studies were carried out in the laboratory of veterinary sanitation at parasitology of the National Scientific Center "Institute of Experimental and Clinical Veterinary Medicine" (Kharkiv) according to the guidelines "Testing and application of disinvasive drugs in veterinary medicine" (2010) and other techniques (Melnichuk & Yuskiv, 2018).

The following agents from various chemical groups were used as disinfectants:

Agent No. 1 (aldehyde) – didecyldimethylammonium chloride (2.25%), benzalkonium chloride (8.0%), glutaraldehyde (15.0%), phosphoric acid, nonionic surfactants (surfactants) and water. The product is a clear, light yellow liquid with a specific odor.

Agent No. 2 (chlorine) – dichlorantin, dimethylhydantoin (12.4-16.4%), dispersant (9.0-12%), nonionic surfactants, corrosion inhibitor, filler. Chlorine is at least 14.0%. The product is in powder form.

Toxocara canis culture was obtained using the feces of dogs, in which at least 2-3 specimens of helminth eggs were found by the flotation method in the field of view of a microscope at low magnification (Verocai et al., 2010).

The resulting helminth eggs were thoroughly mixed with saline until a homogeneous suspension was obtained, and some were sent to the refrigerator for storage at a temperature of 3.0±0.5°C, and the other part was cultivated at a temperature of 26.0-28.0±0.5°C for 20 30 days, with daily aeration at room temperature for one hour. The viability of helminth cultures was monitored by microscopy methods according to the degree of protoplast cleavage and staining according to Maretskiy A.Ya. (1954) and (Ubhayawardana, 2018). The culture of helminth eggs was prepared in advance in a large volume for use both in the experiment and in the control.

Before testing disinfectants, an aqueous emulsion of helminth eggs in the amount of 300-600 specimens was placed in Petri dishes or on watch glasses. Excess water was removed with filter paper strips. After that, working solutions of disinfectants in appropriate concentrations were separately added to the eggs of helminths at an exposure time of 1 to 72 hours.

Working solutions of disinfectants were prepared immediately before use and tested under laboratory conditions at room temperature. In the control, up to a Petri dish or on watch glasses with a culture of helminth eggs, instead of working solutions of disinfectants, a sterile isotonic solution was added. After that, the washed *T. canis* eggs were cultivated in a thermostat at a temperature of 26-28±0.5°C for 28 days with daily aeration for 1:00. At the same time, antimicrobial drugs were added every 2-3 days to prevent the development of molds and protozoa, which can affect the viability of eggs. The absence of development of *T. canis* eggs in the test samples, in the presence of development in the control culture, was a sign, respectively, of the presence or absence of disinfection properties of the disinfectant under study.

An aqueous emulsion of *T. canis* egg culture in the amount of 300-600 specimens that were at the protoplast stage (before blastomere fragmentation) and larvae were transferred to sterile test objects (wood, tiles, metal).

Excess water was removed with filter paper strips. After that, the research and control test objects were placed in boxes at a room temperature of 20-25±0.5°C. Then the test samples were treated with solutions of disinfectants, which were evenly applied to the test objects. On control samples, sterile isotonic solution was applied in the same volume. After applying disinfectants, helminth eggs were washed three times with water and examined under a microscope in order to identify changes in their structure (changes in membranes, embryos and inhibition of embryogenesis). Special methods were also used: coloring the eggs, observing their development in favorable conditions, provoking movement and hatching of the larva, feeding the experimental animals (bio method).

For coloring the eggs of the control and experimental cultures, we used the technique proposed by Maretskiy A.Ya. (1954). The method of observing the development of eggs in favorable conditions, proposed by G. Proshin (1957), was used to determine the viability of eggs at the protoplast stage after their treatment with a disinfectant. The method of provoking movement and hatching of larvae proposed by M. Zavadovskiy (1915) was used in experiments to determine the viability of only mature eggs (with formed larvae).

The ovocidal effect (mode of application) of a disinfectant was considered established if, during microscopic examination, the absence of development of eggs or larvae of helminths was observed after exposure to working solutions of disinfectants and the presence of development of eggs and larvae in control cultures. Determination of the disinfection effect of disinfectants during disinfection of soil contaminated with T. canis eggs was carried out according to generally accepted methods (Zavgorodniy et al., 2013).

Facilities were tested by comparison to the recommended natrium hydroxide in the concentration of 5.0% and expositions 24, 48, 72 and 96 hours. The experiment was carried out with the following types of soils: black earth, sandy loam, loamy. In four wooden boxes with holes from the bottom and walls for air penetration, partitioned into 36 sections, research samples were laid. The soil in two boxes was separately treated with research disinfectants, the positive control ("PC") was treated with 5.0% hot sodium hydroxide solution for costs 1000 cm^3/m^2, for negative control ("NC") distilled water was used. Each 12 sections were filled with soil of a different structure (black earth, sandy loam, loamy). Samples of test cultures of *T. canis* eggs, which were at the stage of blastomere cleavage and invasive larva, were placed in soil layers in sections to a depth of 1 cm, 2 cm, and 5 cm from the surface. Feces were applied on filter paper with a thin layer, into which invasive cultures of *T. canis* eggs were additionally introduced in an amount of at least 1000 specimens in one sample. Samples were laid in five repetitions. The working solution of the disinfectant was prepared immediately before use and tested at a flow rate of 2000 cm^3/m^2, 3000 cm^3/m^2, 4000 cm^3/m^2. After the appropriate exposures, the samples were taken out and examined according to the above methods.

The data were presented like athmetic mean (M) and the arithmetic mean error (m).

Results and discussion

At the preliminary stage of the research, the disinvasive action of aldehyde and chlorine disinfectants was determined based on the results of their action on the test culture of *Toxocara canis* helminths at different stages of development. Experiments to determine the disinvasion properties of the aldehyde agent No. 1 were performed using concentrations of 0.5%; 1.0%, 2.0%, 3.0%, 3.5% and 4.0% at a temperature of 20±0.5°C and exposure for 3, 6 and 24 hours (Table 1).

Table 1. Degree of disinvasive action of aldehyde agent No. 1 on *T. canis* egg culture

Concentration in preparation, %	Terms of living of life of *Toxocara canis*, day														
	3			6			14			21			28		
	Exposition, hours														
	3	6	24	3	6	24	3	6	24	3	6	24	3	6	24
0.5	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1.0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2.0	+	+	+	+	+	+	+	+	+	+	+	+	+	+	–
3.0	+	+	+	+	+	–	+	+	–	+	–	–	–	–	–
3.5	+	+	+	+	–	–	+	–	–	–	–	–	–	–	–
4.0	+	+	+	+	–	–	–	–	–	–	–	–	–	–	–
Positive control	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Negative control	+	+	+	+	+	–	+	+	–	+	+	–	+	+	–

Notes: – death of helminth eggs, + development of helminth eggs.

Analyzing the results presented in Table 1, it should be noted that the treatment of the test culture with solutions of aldehyde agent No. 1 at a concentration of 0.5%, 1.0% and 2.0% at a temperature of 20±0.5°C for 3, 6 and 24 hours did not affect the development of *T. canis* eggs. Treatment of the test culture with solutions of the agent with a concentration of 2.0% for 24 hours caused its death only on the 28th day. Along with this, it was determined that the concentration of the agent 3.0%, 3.5% and 4.0% affected the delay in the development of eggs of the test culture and caused their death, that is, it revealed a disinvasive property. Tool No. 1 showed the highest disinvasion activity at a concentration of 3.5-4.0% at exposure 6 and 24 hours.

Experiments to determine the disinfection properties of chlorine agent No. 2 were carried out using a concentration of 2.5%, 3.0%, 3.5% and 4.0% at a temperature of 20±0.5°C and an exposure of 3, 6 and 24 hours (Table 2).

Table 2. Degree of disinfection effect of chlorine agent No. 2 on *T. canis* egg culture

Concentration in preparation, %	Terms of living of life of *Toxocara canis*, day														
	3			6			14			21			28		
	Exposition, hours														
	3	6	24	3	6	24	3	6	24	3	6	24	3	6	24
2.5	+	+	+	+	+	–	+	+	–	+	+	–	–	–	–
3.0	+	+	–	+	+	–	+	–	–	–	+	–	+	–	–
3.5	+	+	–	+	–	–	+	–	–	–	–	–	–	–	–
4.0	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–
Positive control	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Negative control	+	+	+	+	+	–	+	+	–	+	+	–	+	+	–

Notes: – death of helminth eggs, + development of helminth eggs.

According to the results (Table 2), the concentration of chlorine disinfectant of 2.5-4.0% affected the delay in the development of eggs of the test culture and caused their death, that is, they found a disinvasive property. It should be noted that the chlorine preparation No. 2 showed the highest disinvasion activity when applied at a concentration of 3.5-4.0% at exposures of 6 and 24 hours. After obtaining preliminary positive results, the ovocidal efficiency of working solutions of disinfectants on the *T. canis* test culture was determined (Table 3).

Table 3. Ovocidal effectiveness of disinfectants on *T. canis* test culture

Test-culture	Concentration, %	Exposition, hours	Death of helminth eggs in experimental cultures, day	Ovocidal efficiency, %
		Aldehyde means No 1		
		3	24	90.60
	3.0	6	21	90.86
		24	6	91.10
		3	18	97.00
Toxocara canis	3.5	6	6	98.78
		24	6	98.82
		3	10	99.60
	4.0	6	6	99.64
		24	6	99.70
		Chlorine means No 2		
		3	24	90.70
	2.5	6	24	90.88
		24	16	91.15
		3	16	97.40
Toxocara canis	3.0	6	10	98.78
		24	3	98.82
		3	6	99.65
	4.0	6	6	99.68
		24	3	99.73

Analyzing the results shown in Table 3, it should be noted that the ovocidal effect of means No. 1 at a concentration of 3.0% and an exposure of 3:00 was equal to 90.60% and was lower than in means No. 2 by 6.7%. In general, the ovocidal efficiency of *T. canis* eggs for the investigated exposures of means No. 1 is from 90.60% to 99.70%, and means No. 2 – from 97.40% to 98.82%. Based on preliminary experience data to determine decontaminating concentrations of disinfectants on the surface of test objects (wood, tile, metal) the means No. 1 was used in concentrations of 3.5% and 4.0%, and the means No. 2 – in concentrations of 3.0% and 4.0% (Table 4).

Table 4. Disinfectant properties of disinfectants relative to the *T. canis* test culture applied to the test objects

Concentration, %	Test-object	Exposition, hours		
		3	6	24
		Average *OE* of 3 experiment		
	tile	80.44±0.01*	80.89±0.01*	92.33±0.01
3.5	wood	69.22±0.01*	79.78±0.01	80.67±0.01
	metal	90.33±0.01	90.58±0.01	93.87±0.01
	tile	91.10±0.01*	99.64±0.01	99.70±0.01
4.0	wood	80.44±0.01*	90.60±0.02	90.85±0.02
	metal	99.55±0.01	99.64±0.01	99.90±0.01
	tile	83.44±0.01*	86.89±0.01	96.40±0.01
3.0	wood	70.22±0.01*	80.78±0.02	94.78±0.01
	metal	92.33±0.01*	92.58±0.01	98.82±0.02
	tile	93.10±0.01*	99.78±0.01	99.83±0.01
4.0	wood	81.64±0.01*	90.68±0.02	95.65±0.01
	metal	99.65±0.01	99.84±0.01	99.93±0.01
	tile	–	–	–
Positive	wood	–	–	–
	metal	–	–	–
	tile	–	–	90.70±0.01
Negative	wood	–	–	53.70±0.02
	metal	–	–	90.70±0.01

Notes: – failure *OE,* $p<0.05$.

During realization of researches on determination of disinvasive properties of means № 1 relatively the test culture of *T. canis* inflicted and test-objects set that 3.5% and 4.0% solutions on the surface of all test objects for culture of und out disinvasive properties. Preparation No. 2 relative to the test culture of *T. canis* applied and the test objects showed disinfection properties at a concentration of 3.0% and 4.0%. It should be noted that in the conditions of study of sensitiveness of eggs of helmints of *T. canis* in disinfectant at treatments it is necessary to take into account physical description of surfaces, that stipulates efficiency of disinfestation. In particular, according to the results obtained, disinfectants at the tested concentrations of all exposures showed disinfection properties on the surface of tiles and metal plates, but had a lower disinfection activity on unpainted wood, therefore, the rougher the surface of the object is processed, the lower the efficiency of its disinfection. Comparing the results of the experiments, it should be noted that the exposure of time (6 and 24 hours) affects the disinvasive activity of the means, that is, the degree of inhibition of the development of test cultures and their death. It was found that during disinfestation, an exposure of at least 3:00 is required.

In order to determine the possibility of disinfecting soil contaminated with *T. canis* eggs, means No. 1 was used at a concentration of 4.0% at various consumption rates (Table 5).

Table 5. Ovocidal efficiency of 4.0% solution of means No. 1 on *T. canis* eggs in soils (n=5)

Soil type	Laying depth, cm	Exposition, hours	Ovocidal efficiency, %		
			experiment	negative control	positive control
Black earth	1	24	94.8±1.20*	is absent	91.6±1.20
		48	100	is absent	100
		72	100	is absent	100
		96	100	is absent	100
	2	24	93.8±1.69	is absent	92.8±1.69
		48	99.8±0.73	is absent	98.8±0.73
		72	100	is absent	100
		96	100	is absent	100
	5	24	88.4±3.26*	is absent	77.4±3.78
		48	91.8±1.54*	is absent	80.6±3.06
		72	92.2±2.27*	is absent	87.0±1.82
		96	92.0±2.49*	is absent	88.0±1.87
Sandy loam	1	24	100	is absent	100
		48	100	is absent	100
		72	100	is absent	100
		96	100	is absent	100
	2	24	100	is absent	85.2±2.24
		48	100	is absent	86.8±1.36
		72	100	is absent	92.2±1.16
		96	100	is absent	90.0±1.00
	5	24	94.2±1.43*	is absent	87.2±3.15
		48	95.6±1.57*	is absent	92.2±1.24
		72	95.6±1.20*	is absent	92.6±2.32
		96	96.6±2.16*	is absent	91.8±2.31
Loamy	1	24	100	is absent	100
		48	100	is absent	100
		72	100	is absent	100
		96	100	is absent	100
	2	24	100	is absent	96.8±1.85
		48	100	is absent	99.2±0.58
		72	100	is absent	100
		96	100	is absent	100
	5	24	84.0±2.51*	is absent	75.0±2.64
		48	87.4±2.44*	is absent	78.6±2.32
		72	87.8±2.42*	is absent	82.0±2.17
		96	88.2±1.93*	is absent	82.4±1.29

$p<0.05$.

According to the results of the studies, it was found that disinfection of soil (black earth) to a depth of 1 cm from helminth eggs with means No. 1 is achieved when it is used at a concentration of 4.0% at a consumption rate of 1000 cm^3/m^2 and exposure for 24 hours (80.6%). At a depth of 5 cm, the maximum efficiency (74%) was found when the agent was applied with an exposure of 48 hours. In loamy soil at a depth of 1 cm with an ovocidal exposure for 24 hours, the disinfectant efficiency was 80.8%. High efficiency of 4.0% solution of preparation No. 1 was found at a consumption rate of 2000 cm^3/m^2 for *T. canis* eggs in all types of soil at a depth of 1-2 cm, starting from a 24-hour exposure. In the control, the viability of toxocara was 95%. The efficiency of

hot 5.0% sodium hydroxide solution at a flow rate of 1000 cm^3/m^2 was from 84.0±2.51% in loamy soil at a depth of 5 cm with an exposure of 24 hours to 100% in all soils at a depth of 1 and 2 cm.

At a depth of 5 cm in black earth, the efficiency of the means No. 1 was the maximum at exposure of 72 hours and amounted to 87.0±1.82%, in the sandy loam soil – 92.2±1.16% at the same exposure, in the loamy soil – 82.4±1.29% at 96 hours exposure.In sandy loam soils, the level of disinvasion efficacy of the aldehyde agent was high (100%) at a depth of 1 cm over a 24-hour exposure. At a depth of 2 cm, the disinvasion efficiency of the drug decreased by 7.4% ($p<0.01$), but with an extension of the exposure for 48 hours, it was 100%. At a depth of 5 cm, the drug activity varied from 87.0±2.45% to 93.2±1.66%. The best results were obtained at a consumption rate of 3000 cm^3/m^2.

In sandy loam soils, the level of disinvasion efficiency of the aldehyde means was high (100%) at a depth of 1 cm and 2 cm after a 24-hour exposure. At a depth of 5 cm, the drug activity varied from 94.2±1.43% to 96.6±2.16%. In loamy soil at a depth of 5 cm for a 24-hour exposure, the level of disinvasion efficiency was 9% higher than the level of the positive control. So a 4.0% solution of means No. 1 at a consumption rate of 3000 cm^3/m^2 can be used for soil disinfection.

In order to determine the possibility of disinfecting soil contaminated with *T. canis* helminth eggs, chlorine means No. 2 at a concentration of 4.0% was used at various consumption rates (Table 6).

Table 6. Ovocidal efficiency of 4.0% solution of agent No. 2 on *T. canis* eggs in soils (n=5)

Soil type	Laying depth, cm	Exposition, hours	Ovocidal efficiency, %		
			experiment	negative control	positive control
Black earth	1	24	96.3±1.20*	is absent	91.6±1.20
		48	100	is absent	100
		72	100	is absent	100
		96	100	is absent	100
	2	24	93.6±1.69	is absent	92.8±1.69
		48	98.9±0.73	is absent	98.8±0.73
		72	100	is absent	100
		96	100	is absent	100
	5	24	68.4±3.26*	is absent	77.4±3.78
		48	65.8±1.54*	is absent	80.6±3.06
		72	63.0±2.27*	is absent	87.0±1.82
		96	63.0±2.49*	is absent	88.0±1.87
Sandy loam	1	24	100	is absent	100
		48	100	is absent	100
		72	100	is absent	100
		96	100	is absent	100
	2	24	100	is absent	85.2±2.24
		48	100	is absent	86.8±1.36
		72	100	is absent	92.2±1.16
		96	100	is absent	90.0±1.00
	5	24	70.2±1.43*	is absent	87.2±3.15
		48	72.6±1.57*	is absent	92.2±1.24
		72	71.6±1.20*	is absent	92.6±2.32
		96	70.6±2.16*	is absent	91.8±2.31
Loamy	1	24	100	is absent	100
		48	100	is absent	100
		72	100	is absent	100
		96	100	is absent	100
	2	24	100	is absent	96.8±1.85
		48	100	is absent	99.2±0.58
		72	100	is absent	100
		96	100	is absent	100
	5	24	66.0±2.51*	is absent	75.0±2.64
		48	61.4±2.44*	is absent	78.6±2.32
		72	60.8±2.42*	is absent	82.0±2.17
		96	60.2±1.93*	is absent	82.4±1.29

Notes: $p<0.05$.

According to the results of the studies, it was found that disinfection of soil (black earth) to a depth of 1 cm from helminth eggs with agent No. 2 is achieved when it is applied at a concentration of 4.0% at a consumption rate of 1000 cm^3/m^2 and exposure for 24 hours (90.6%). At a depth of 5 cm, the maximum efficiency (61%) was found when the agent was used with an exposure of 72 hours. In loamy soil at a depth of 1 cm with an ovocidal exposure for 24 hours, the effectiveness of agent No. 2 was 87.8%, in sandy soil – 92.3%. However, at a depth of 5 cm, its effectiveness was low – 60.5% and 61.7% in line. When the consumption rate increased to 2000 cm^3/m^2, decontamination of the soil (black earth) to a depth of 1 cm from helminth eggs, the means No.

2 achieved an efficiency of 96.3% at 24 hours exposure. At a depth of 5 cm maximum efficiency (63.0%) identified when using the tool at least 72 hours of exposure. So, chlorine agent No. 2 for decontamination of the soil is not recommended, as it is effective only at a depth of up to 2 cm.

It has been reported that the treatment of *A. suum* eggs with many commercially available disinfectants does not affect embryogenesis. Although some disinfectants can delay or stop the development of *A. suum* eggs, they are unlikely to completely kill them (Oh et al., 2016). Our results complement other studies that have proven disinvasive activity against helminth eggs (*A. columbae*) formalin, povidone iodide and TH4 (Bessat & Dewair, 2019). In other experiments, it was found that quaternary ammonium compounds do not affect *Ascaris suum* eggs, but phenol (5.0%) and cresol (3.0%) are effective (Labare et al., 2013), as well as ammonia (Pecson & Nelson, 2005), some short-chain fatty acids (Butkus et al., 2011), preparations based on sodium hypochlorite (Naidoo et al., 2016).

The high disinfecting efficiency of Virkon®S on *Toxascaris leonina* has been proven (El-Dakhly et al., 2018). In a comparative study of a number of disinfectants, iodine turned out to be the most effective on *T. canis* eggs, even in comparison with glutaraldehyde (Ayçiçek et al., 2001), ethanol and sodium hypochlorite (Morrondo et al., 2006), 50% hydrogen peroxide solution and 3.0% benzene dehydroxide (Shalaby et al., 2011). Other researchers indicate that disinfectants based on benzalkonium chloride and formaldehyde did not affect the embryogenesis of *T. canis* (Verocai et al., 2010). Bleach turned out to be an ineffective disinfectant for the eggs of these helminths (von Dohlen et al., 2017). The issue of disinfection of livestock facilities under low ambient temperatures remains relevant today (Paliy et al., 2020b).

Taking into account the results obtained, it should be noted that disinfection of environmental objects with highly effective disinfectants (Paliy et al., 2015; 2016; 2020a) is a reliable and effective means of preventing outbreaks of infectious and parasitic diseases (Zavgorodniy et al., 2013).

Conclusions

Aldehyde disinfectant, which contains didecyldimethylammonium chloride (2.25%), benzalkonium chloride (8.0%), glutaraldehyde (15.0%), phosphoric acid, nonionic surfactants, water exhibits disinvasive activity against the test-cultures of *T. canis* eggs at a concentration of 2.0-4.0% at a temperature of 20±0.5°C and an exposure of 3-24 hours, while the ovocidal efficiency is from 90.60% to 99.70%. It was found that the specified aldehyde disinfectant can be used for disinfection of soil (black earth, sandy loam, loamy) contaminated with *T. canis* eggs, at a concentration of 4.0% at 6:00 exposure and a consumption rate of 3000 cm^3/m^2.

A chlorine agent that contains dichlorantin, dimethylhydantoin (12.4-16.4%), a dispersant (9.0-12%), nonionic surfactants, a corrosion inhibitor, a filler exhibits disinvasive activity in relation to the test culture of *T. canis* at a concentration of 3.0-4.0% with an exposure of 3-24 hours, and the ovocidal efficiency in this case ranges from 97.40% to 98.82%. It is not advisable to use the chlorine agent under study for soil disinfection, since it is effective only at a depth of up to 2 cm at a concentration of 4.0% at a consumption rate of 1000 cm^3/m^2 and an exposure time of 24 hours.

The results obtained expand the range of highly effective disinfectants that exhibit disinvasive properties on exogenous forms of helminth development, and can be used in the general complex of veterinary and sanitary preventive and therapeutic measures.

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