

## Effectiveness of using the method for determining contamination level of the distal extremity section in dogs with dipylidium cocoons

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### Article info

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Parasitic zoonotic helminthiasis with complex cycles and mechanisms of invasion transmission are a sanitary and hygienic problem on the global and local scale. The pathogens of these invasions are biologically, ecologically, physiologically, epidemiologically, epizootologically protected in natural conditions and actively circulate among different species of animals and humans directly or indirectly through the pathogens' eggs with the tendency to contaminate the environment of existence. The presence of a large number of eggs in the environment guarantees the reliable functioning of the "parasite-host" system and leads to infecting of both intermediate and definitive hosts. The constant presence of viable helminthes eggs guarantees long-term maintenance of the epizootologic process. In this connection, the aim of the research was to determine the effectiveness of the method for determining the contamination level of the distal extremity section in dogs with dipylidium cocoons. The experimental studies were conducted in the Laboratory of Parasitology of Poltava State Agrarian University and veterinary clinic "Aibolyt" (city of Poltava). The method that allows detect the contamination of the distal extremity section in dogs in case of dipylidiasis was improved. According to the results of the conducted studies, it was determined that the use of the method for determining the contamination of the distal extremity section in dogs with dipylidium cocoons as to the number of positive samples and the average number of isolated invasive elements turned out to be the most effective. The sensitivity of the improved method in detecting dipylidium cocoons was higher by 30.0 and 90.0 % compared to the analogue method and the express method, respectively. Also, the improved method showed higher effectiveness in comparison with the analogue method – by 58.2 % ( $P < 0.001$ ) and with express method – by 89.8 % ( $P < 0.001$ ). The use in the improved method of the flotation solution, which demonstrates coagulation properties against foreign remains, facilitates the microscopy process. The obtained data allow us to recommend the improved method for determining the contamination level of the distal extremity section in dogs with dipylidium cocoons, as an effective and sensitive method for conducting sanitary and hygienic studies in monitoring dipylidiasis in dogs.

**Keywords:** parasitology, dogs, dipylidiasis, cocoons, contamination level, effectiveness.

## Ефективність застосування способу визначення рівня контамінації дистального відділу кінцівок собак коконами дипілідій

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Паразитарні зоонозні гельмінтози зі складними циклами та механізмами передачі інвазії є санітарно-гігієнічною проблемою у глобальному та локальному масштабі. Збудники даних інвазій біологічно, екологічно, фізіологічно, епідеміологічно, епізоотологічно захищені в природних умовах та активно циркулюють між різними видами тварин і людиною прямо або опосередковано через яйця патогенів з тенденцією контамінації середовища існування. Наявність великої кількості яєць у довкіллі гарантує надійне функціонування системи «паразит-хазяїн» та призводить до зараження як проміжних, так і дефінітивних хазяїв. Постійна наявність життєздатних яєць гельмінтів гарантує тривале підтримання епізоотологічного процесу. У зв'язку з цим, метою досліджень було визначити ефективність застосування способу визначення рівня контамінації дистального відділу кінцівок собак коконами дипілідій. Експериментальні дослідження виконували у лабораторії паразитології Полтавського державного аграрного університету та ветеринарній клініці «Айболить» (м. Полтава). Проведено удосконалення способу, який дозволяє виявити контамінацію дистального відділу кінцівок у собак за дипілідіозу. Відповідно до результатів проведених досліджень визначено, що застосування способу для встановлення контамінації дистального відділу кінцівок у собак коконами дипілідій за показником числа позитивних проб та середньої кількості виділених інвазійних елементів виявився найбільш ефективним. Чутливість удосконаленого способу при виявленні коконів дипілідій виявилася вищою на 30,0 та 90,0 % порівняно зі способом-аналогом та експрес-методом відповідно. Також, удосконалений спосіб показав вищу результативність порівняно зі способом-аналогом – на 58,2 % ( $P < 0,001$ ) та з експрес-методом – на 89,8 % ( $P < 0,001$ ). Використання в удосконаленому способі флотаційного розчину, що проявляє коагуляційні властивості відносно сторонніх решток, полегшує процес мікроскопії. Отримані дані дозволяють рекомендувати удосконалений спосіб визначення рівня контамінації дистального відділу кінцівок у собак коконами дипілідій, як ефективний та чутливий метод проведення санітарно-гігієнічних досліджень у моніторингу дипілідіозу собак.

**Ключові слова:** паразитологія, собаки, дипілідіоз, кокони, рівень контамінації, ефективність.

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## Introduction

Environmental contamination with parasitic elements is a serious problem worldwide. Helminthes' eggs and larvae, like other parasites, are extremely ecologically plastic, viable in unfavorable environmental conditions for a long period, for which insects and various types of invertebrates, cold-blooded and warm-blooded vertebrates are the natural reservoirs [1–5]. In particular, researchers have established that on the territory of Kharkiv region the average level of soil contamination in rural areas made 12.5 %. The level of soil contamination in park areas of urbanized territories with exogenous stages of helminthes made 5–55 %, and in residential areas of cities – 20.0–23.3 %. In cities, soil contamination with pathogens that parasitize in dogs and cats is represented by eggs of *Toxocara* spp. and *Dipylidium caninum* [6].

Scientists examined soil in various parks and public places of the city of Khorremshehr in south-western Iran for contamination with eggs of *Toxocara* spp. nematodes, which were isolated in 18 % of the examined samples [108]. Scientists from Australia examined samples taken from city parks, where 44.2 % of them were contaminated with helminthes' eggs. The most common were hookworms (10.2 %) and *Trichuris* spp. (1.3 %) [7].

On the territory of Poland, the presence of *Toxocara* spp. (37.5–96 %) and *Trichuris* spp. (37.5–60 %) geo-helminthes' eggs was detected in soil and water samples [8, 9]. While examining water samples from the rivers in the South Africa, *Toxocara* spp., *Trichuris* spp. and *Taenia* spp. eggs were found [10]. In some regions of Japan, 107 sandboxes in public parks were examined and found to be contaminated with *Toxocara* spp. and *Capillaria* spp. eggs [11].

On the territory of Estonia, scientists identified environmental contamination with the eggs of nematodes that parasitize in dogs in rural areas. *Trichuris* spp. eggs were found in 15.5 % of samples, *U. stenocephala* – in 14.7 %, *T. canis* – in 4.3 % [12]. Scientists from Chile analyzed 170 dog feces samples collected from different locations. The diversity of parasite species varied depending on the surveyed area. The most frequently detected eggs were *T. canis* – in 27 samples and *A. caninum* – in 4 samples [13].

Scientists from Nigeria studied the contamination of the streets of a megapolis with the eggs of helminthic pathogens. The following eggs were found: *Ancylostoma* spp. – in 24.6 % of samples, *Toxocara* spp. – in 9.8 %, and *Uncinaria* spp. – in 2.5 %. The samples collected from residential areas and markets had the highest contamination level [14]. In Ecuador, when studying public beaches, eggs of 10 parasites species were found, 9 of which were potentially zoonotic. *Ancylostoma* spp. – 19.4 % and *Toxocara* spp. – 7.2 % turned out to be the most widespread. *Trichuris* spp. eggs were found less frequently [15]. In Ireland, it was found that soil samples taken at the entrances to parks were the most contaminated with *T. canis* eggs compared to other places within the parks [16].

## The aim of the study

In this connection, the aim of the research was to determine the effectiveness of using the method for determining the contamination level of the distal extremity section in dogs with dipylidium cocoons.

## Materials and methods

The work was carried out during 2025 in the Laboratory of Parasitology of Poltava State Agrarian University and the veterinary clinic “Aibolyt” (the city of Poltava).

To define the effectiveness of the improved method for determining the contamination of the distal extremity section in dogs with dipylidium cocoons, the comparative study was conducted using the analogue method [17] and the known express method [18] using dogs that were infected with the dipylidiasis pathogen. The infection of dogs was previously confirmed by coproovoscopic examination [19].

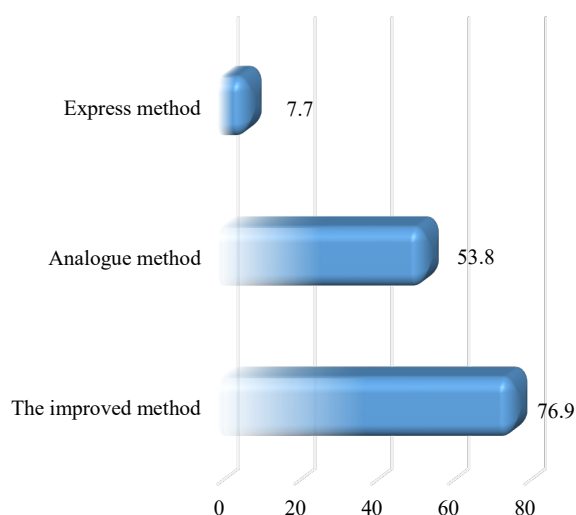
The following indicators served as the evaluation criteria: the number of positive samples, the average number of detected invasive elements – dipylidium cocoons in 1 sample and their minimum and maximum values, as well as the presence of foreign remains (garbage, hair, dust, etc.) of various sizes under the preparation's microscopy. The contamination of the microscopic field with foreign remains was conditionally divided into: insignificant contamination – the number of foreign residues – up to 5 specimens in the microscopic field; average contamination – from 6 to 10 specimens of foreign remains in the microscopic field; heavy contamination – 11 or more foreign specimens in the microscopic field.

Statistical processing of the experimental study results was conducted by determining the arithmetic mean (M), standard deviation (SD), and probability level (P) using the one-way analysis of variance technique using Fisher's criterion.

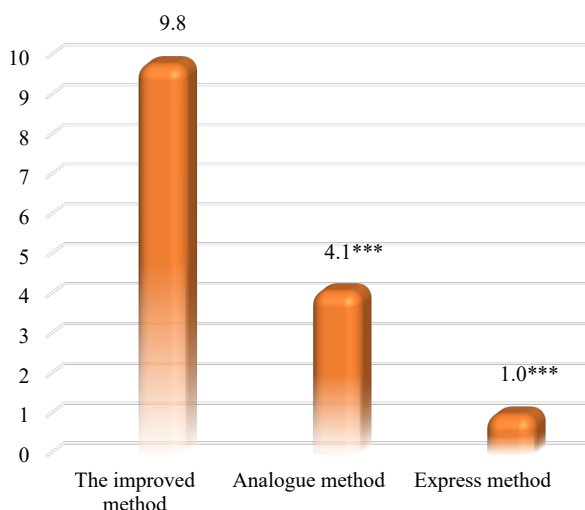
## Results and discussion

By the conducted studies it was established that the use of the method for detecting the distal extremity section contamination in dogs with dipylidium cocoons by the number of positive samples turned out to be the most effective. The sensitivity of the improved method for detecting dipylidium cocoons made 76.9 %. At the same time, 53.8 % of positive samples were detected by the analogue method, and 7.7 % – by the express method, which is by 30.0 and 90.0 % less than when using the improved method (**Fig. 1**).

Also, the improved method turned out to be more effective by the indicator of the average number of detected invasive elements, where at its use  $9.8 \pm 2.7$  dipylidium cocoons were isolated, which turned out to be by 58.2 % more ( $4.1 \pm 1.7$  cocoons,  $P < 0.001$ ) compared to the analogue method, and by 89.8 % more ( $1.0 \pm 0.0$  cocoons,  $P < 0.001$ ) compared to the known express method (**Fig. 2**).



**Fig. 1.** Sensitivity of the tested methods for determining the contamination of the distal extremity section in dogs with dipylidium cocoons (n=13, %)



**Fig. 2.** Indicators of the number of detected dipylidium cocoons when using the tested methods for determining the contamination of the distal extremity section in dogs (n=13, specimens)

Notes: \*\*\* – P<0.001 – compared to the similar digital indicator obtained by using the improved method.

During the microscopy of the preparations made from the material taken from dogs, using the improved method, insignificant amount of small foreign residues was detected in the samples –  $5.2 \pm 1.9$  specimens. Somewhat more small-sized foreign remains were found while conducting the microscopy of preparations made by using the analogue method –  $6.1 \pm 2.3$  specimens, which is by 17.3 % more than when using the improved method (**Table 1**).

The largest amount of foreign residues were detected by microscopy of the preparations using the well-known express method –  $36.5 \pm 9.6$  specimens, which is 7.0 times more (P<0.001) than when using the improved method. At the same time in the microscopic field, a large amount

of small and large foreign remains, and especially hairs were detected, which complicated microscopy and significantly worsened the process of detecting invasive elements in the field of view.

**Table 1**

Comparative effectiveness of the methods for examining the distal extremity section in dogs to detect dipylidium cocoons (n=13)

Method of study	Invasive elements detected, min–max	Foreign residues, specimens, M±SD
The improved method	5–15	$5.2 \pm 1.9$
Analogue method	2–6	$6.1 \pm 2.3$
Express method	1	$36.5 \pm 9.6^{***}$

Notes: \*\*\* – P<0.001 – compared to the similar digital indicator obtained by using the improved method.

Scientific studies indicate a significant spread of dipylidiasis in dogs in the majority of the countries of the world, where one of the factors of such spreading is a high level of environmental contamination with dipylidium cocoons [20, 21]. Therefore, we have improved the method for determining the contamination level of the distal extremity section in dogs with dipylidium cocoons and established its effectiveness.

According to the results of the conducted research, it was determined that the use of the method for revealing the contamination of the distal extremity section in dogs with dipylidium cocoons, based on the number of positive samples and the average number of isolated invasive elements turned out to be the most effective. The sensitivity of the proposed method for detecting dipylidium cocoons was higher by 30.0 and 90.0 % compared to the analogue method and the express method, respectively. Also, the proposed method showed higher effectiveness in comparison with the analogue method – by 58.2 % (P<0.001) and the express method – by 89.8 % (P<0.001). The use of the flotation solution, which exhibits coagulation properties as to foreign residues, facilitates the microscopy process.

There are reports in the scientific literature that indicate the relevance of determining the level of contamination of the distal extremity section in dogs with propagative stages of parasites' development. According to the authors' data, the contamination level of the distal extremity section in dogs with cystoisospora oocysts on the territory of Kharkiv made 12.4 % and  $2.4 \pm 1.7$  oocysts. Moreover, the most contaminated were the wash offs from the distal extremity sections in dogs that were walked on the territory near houses (22.4 %,  $2.7 \pm 1.9$  oocysts). Less contaminated with cystoisospora oocysts were wash offs from the distal extremity sections of dogs that were walked in city squares and parks (9.3 %,  $1.8 \pm 0.9$  oocysts) and suburban green areas (1.0 %,  $1.0 \pm 0.0$  oocysts) [22].

The obtained data allow us to recommend the improved method for determining the level of contamination of the distal extremity section in dogs with dipylidium cocoons as an effective and sensitive method for conducting sanitary and hygienic studies in monitoring dipylidiasis caninum.

## Conclusions

The high effectiveness of the improved method for determining the contamination level of the distal extremity section in dogs with dipylidium cocoons was proven. The method consists in the following: it is simple to perform and does not require expensive equipment and deficit reagents; the proposed supersaturated flotation solution used in the method demonstrates high flotation ability relative to dipylidium cocoons – 9.8 specimens / sample (with fluctuations from 5 to 15 specimens); the flotation solution showing coagulation properties relative to foreign residues is used in the method, which facilitates the process of microscopy and detection of invasive elements in the field of view.

## Conflict of interest

The author (s) state that there is no conflict of interest.

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