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Efficiency of the method of quantitative coproovoscopic diagnostic of nematodirosis in cattle

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Cattle breeding plays a major role in increasing the production of meat and other high-quality food products. However, various parasitic diseases often hinder the increase of livestock and the increase of milk and meat productivity of animals. Strongyloidoses of the gastrointestinal tract, in particular nematodirosis, are the most common infestations among cattle. The aim of the work was to determine the effectiveness of the proposed method of quantitative coproovoscopic diagnosis of nematodirosis in cattle. The proposed useful model refers to the field of veterinary medicine, namely, veterinary parasitology, methods of coproovoscopy, in particular, quantitative methods of detecting eggs of causative agents of nematodirosis of cattle. In laboratory conditions, well-known methods of quantitative coproovoscopy were compared, namely: the method of counting helminth eggs in feces (according to Liashenko et al., 2012), the centrifuge-flotation method (according to Taylor et al., 2015), as well as the proposed method for laboratory diagnosis of nematodirosis cattle. It was determined that when using the proposed method and the centrifuge-flotation method, 100 % of positive samples were detected. At the same time, when using the method of counting helminth eggs in feces, 70 % of positive samples were detected in the diagnosis of nematodirosis in cattle. The proposed method turned out to be the most effective in terms of indicators of the intensity of nematodirous invasion, where its sensitivity was significantly higher by 1.3 times – compared to the centrifugal-flotation method according to Taylor and by 6.5 times – compared to the method of counting helminth eggs in feces according to Liashenko. In the proposed method of quantitative coproovoscopic diagnosis of nematodirosis of cattle, a combined flotation solution is used, which exhibits coagulation properties relative to undigested fodder residues, which facilitates the microscopy process. The obtained results of experimental studies allow recommending the proposed method of quantitative coproovoscopic diagnosis of cattle nematodirosis for more accurate laboratory diagnosis of this infestation.

Keywords: parasitology, nematodirosis, cattle, quantitative coproovoscopy, sensitivity, efficiency.

Ефективність способу кількісної копроовоскопічної діагностики нематодірозу великої рогатої худоби

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Скотарству належить основна роль у збільшенні виробництва м’яса та інших високоякісних продуктів харчування. Однак збільшенню поголів’я і підвищенню молочної та м’ясної продуктивності тварин часто перешкоджають різні паразитарні хвороби. До найбільш поширених інвазій серед великої рогатої худоби відносять стронгілідозів шлунково-кишкового тракту, зокрема й нематодіроз. Метою роботи було визначити ефективність запропонованого способу кількісної копроовоскопічної діагностики нематодірозу великої рогатої худоби. Запропонована корисна модель відноситься до галузі ветеринарної медицини, а саме – ветеринарної паразитології, до способів копроовоскопії, зокрема кількісних способів виявлення яєць збудників нематодірозу великої рогатої худоби. У лабораторних умовах порівнювали загальновідомі способи кількісної копроовоскопії, а саме: спосіб підрахунку яєць гельмінтів у фекаліях (за Ляшенко та ін., 2012), центрифужно-флотаційний спосіб (за Taylor et al., 2015), а також запропонований спосіб при лабораторній діагностиці нематодірозу великої рогатої худоби. Визначено, що при застосуванні запропонованого способу та із центрифужно-флотаційного методу виявляли 100 % позитивних проб. Водночас при застосуванні способу підрахунку яєць гельмінтів у фекаліях при діагностиці нематодірозу у великої рогатої худоби виявляли 70 % позитивних проб. Найбільш ефективним відносно показників інтенсивності нематодірозної інвазії виявився запропонований спосіб, де його чутливість була достовірно вищою у 1,3 раза – порівняно із центрифужно-флотаційним способом за Taylor та у 6,5 разів – порівняно із способом підрахунку яєць гельмінтів у фекаліях за Ляшенко. У запропонованому способі кількісної копроовоскопічної діагностики нематодірозу великої рогатої худоби використовується комбінований флотаційний розчин, що проявляє коагуляційні властивості відносно неперетравлених решток корму, що полегшує процес мікроскопії. Отримані результати експериментальних досліджень дозволяють рекомендувати запропонований спосіб кількісної копроовоскопічної діагностики нематодірозу великої рогатої худоби для більш точної лабораторної діагностики даної інвазії.

Ключові слова: паразитологія, нематодіроз, велика рогата худоба, кількісна копроовоскопія, чутливість, ефективність.

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Introduction

Parasitoses of ruminants in Ukraine and other countries of the world have always been and remain a separate, often significant, problem for veterinary medicine specialists. During the stable-pasture period, stable parasitocenoses can form in the body of cattle, the co-members of which are gastrointestinal helminthiasis [1–4].

Gastrointestinal helminth infections are parasitic infestations caused by a group of parasitic helminths that infect the gastrointestinal tract, the eggs of which are released into the environment with animal feces. This group of parasites includes various types of strongylidosis of the digestive organs, which also includes the causative agent of nematodirosis. Moreover, many researchers around the world report a significant prevalence of gastrointestinal helminthiasis among cows [5–9].

In particular, the scientists established that in the conditions of the Atlantic temperate climate, the following species of strongylides of the digestive tract were found in cattle according to the results of postmortem diagnosis: *Ostertagia osteragi*, *O. lyrata*, *Cooperia oncophora*, *C. macmasteri*, *C. punctata*. And according to the results of coprooscopic studies and cultivation up to L3 nematodes of the genus *Haemonchus*, *Trichostrongylus, Nematodirus*, *Bunostomum* and *Oesophagostomum* were found [10].

When determining the species of gastrointestinal nematodes parasitizing cattle in certain areas of the state of Oregon, strongylides of the digestive organs of the genera *Ostertagia*, *Cooperia*, *Nematodirus* and *Trichostrongylus* were identified during the study [11].

Gastrointestinal tracts of 672 crossbred cattle obtained from slaughterhouses were examined in the conditions of livestock farms in Kenya. In 583 (86.8 %) animals, 6 species of strongylides were found: *Haemonchus placei* (67.0 %), *Cooperia pectinata* (53.0 %), *Cooperia punctata* (41.7 %), *Oesophagostomum radiatum* (38.4 %), *Trichostronglyus axei* (24.3 %) and *Nematodirus helvetianus* (19.6 %). The intensity of infection with nematodes was on average 7000 copies/head. Moreover, animals aged from 1.5 to 3 years were the most affected by nematodes [12].

It is known that for a timely diagnosis, it is necessary to use sensitive and effective research methods [13–15]. Therefore, it is urgent to improve new, more effective methods of quantitative coproovoscopy for nematodirosis of cattle, which will allow not only to make a diagnosis, but also to determine the degree of parasitic load on the infected organism.

The aim of the study

The purpose of the research was to determine the effectiveness of the proposed method of quantitative coproovoscopic diagnosis of nematodirosis in cattle.

Materials and methods

The work was carried out during 2024 on the basis of the Laboratory of the Department of Parasitology and Veterinary-Sanitary Examination of the Poltava State Agrarian University and in the conditions of livestock farms of the Poltava district where cattle are kept.

In order to establish the effectiveness of the proposed method in production conditions, an experimental study was conducted. To do this, in the conditions of livestock farms of the Poltava district, feces were collected from cattle, and they were studied by the flotation method according to Kotelnikov-Khrenov [16].

For the experiment, samples were used in which nematodirous eggs were found. A total of 10 samples of feces were collected from cattle known to be infested with nematodirous eggs. The same sample of feces was thoroughly homogenized in a porcelain mortar and examined: by the method of counting helminth eggs in feces (according to Liashenko et al., 2012) [17], by the centrifugal-flotation method (according to Taylor et al., 2015) [18] , as well as the proposed method.

The evaluation criteria were the following indicators: the number of positive samples, the average number of nematodiruses eggs in 1 g of feces and their minimum and maximum values, as well as the presence of foreign remains of different sizes under the microscopy of the preparation:

• – a small number of small foreign remains;

•• – simultaneous detection of large number of small and insignificant number of large-sized remains.

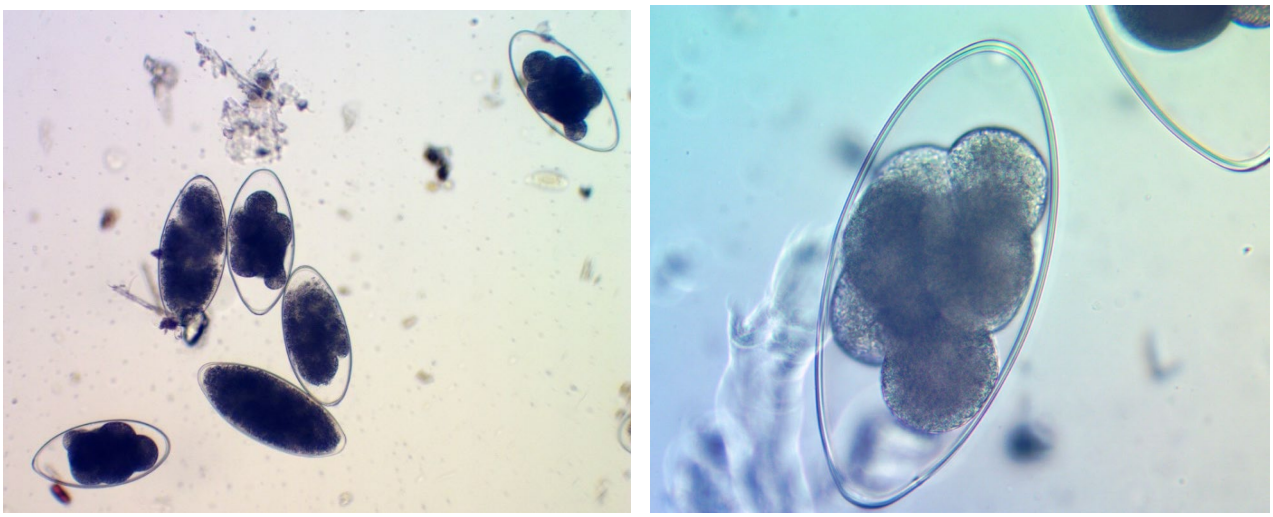
Statistical processing of the results of experimental studies was carried out by determining the arithmetic mean (M), standard deviation (SD) and probability level (P) using the technique of univariate analysis of variance, using Fisher's test.

Results and discussion

The conducted research established that all tested methods allowed detection of nematodyruses eggs (***Fig. 1***). At the same time, their sensitivity was different. Thus, when applying the proposed method and from the centrifuge-flotation method, 100 % of positive samples were detected. At the same time, when using the method of counting helminth eggs in feces, 70 % of positive samples were found in the diagnosis of nematodirosis in cattle (***Fig. 2***).

The proposed method turned out to be the most effective in terms of indicators of the intensity of nematodirous infestation, where when using the method of counting helminth eggs in feces (according to Liashenko et al., 2012), the number of detected eggs was 20.29±14.68 eggs/g (with variations from 2 to 45 eggs/g), when using the centrifugal-flotation method (according to Taylor et al., 2015) the number of detected eggs was 102.60±42.47 eggs/g (ranging from 36 to 144 eggs/g),

when using the proposed method the number of detected eggs was 131.40±49.51 eggs/g (ranging from 72 to 225 eggs/g). When comparing the efficiency of the tested methods, the proposed method showed higher results compared to the centrifugal-flotation method by 1.3 times (***Fig. 3***) and compared to the method of counting helminth eggs in feces by 6.5 times, P<0.001 (***Fig. 4***).



a b

Fig. 1. Eggs of nematodes of the genus *Nematodirus*, detected during coproscopic examination of cattle: a – × 120, b – × 400

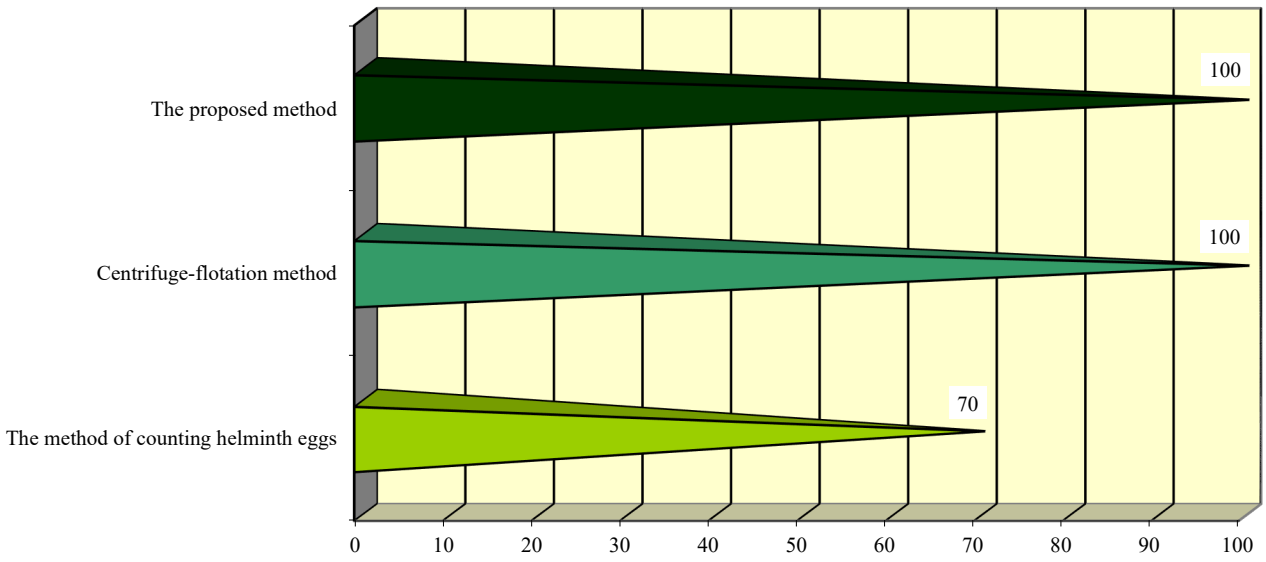


Fig. 2. Sensitivity of methods of quantitative coproovoscopy for nematodirosis of cattle

It was found that the flotation liquid used in the proposed method showed the highest coagulation properties relative to undigested feed residues. At the same time, a small amount of small remains of undigested feed was attached to the slide. On the other hand, when using Liashenko's method of counting helminth eggs in feces, a large number of small and a small number of large-sized food residues were simultaneously detected, which complicated the microscopy of the test sample.

The scientific literature notes the significant spread of strongyloidoses of the digestive organs, in particular nematodirosis, and the relevance of using sensitive, modern, ergonomic methods of copro-ovoscopy for accurate and timely diagnosis of invasion [5–9, 14, 15]. Therefore, we tested and proposed a method of quantitative coproovoscopy in the diagnosis of nematodirosis in cattle.

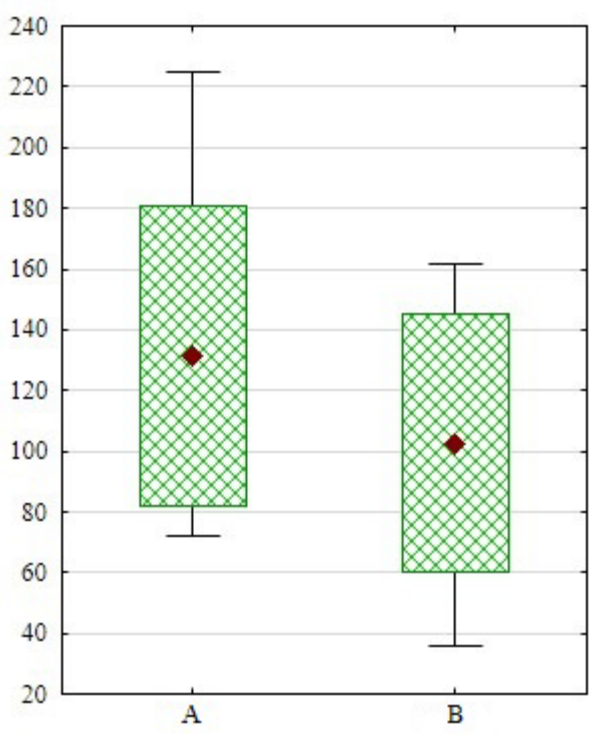


Fig. 3. Comparative efficiency of methods of quantitative coproscopy for nematodirosis of cattle (n=10): A – the proposed method, B – centrifugal-flotation method

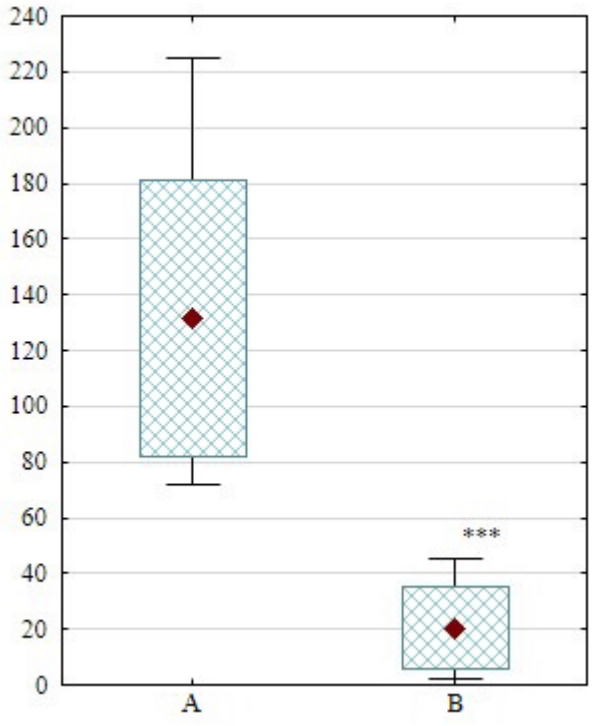


Fig. 4. Comparative efficiency of methods of quantitative coproscopy for nematodirosis of cattle (n=10):
A – the proposed method, B – method of counting helminth eggs in feces; P<0.001 – relative to A

The conducted studies determined that 100 % of positive samples were detected when using the proposed method and from the centrifugal-flotation method. At the same time, when using the method of counting helminth eggs in feces, 70 % of positive samples were detected in the diagnosis of nematodirosis in cattle. The proposed method turned out to be the most effective in terms of indicators of the intensity of nematodirous invasion, where its sensitivity was significantly higher by 1.3 times – compared to the centrifugal-flotation method according to Taylor and by 6.5 times (P<0.001) – compared to the method of counting helminth eggs in feces for Liashenko. Also, the positive effect of the proposed method of quantitative coproovoscopic diagnosis of cattle nematodirosis was manifested in the use of a combined flotation solution, which exhibits coagulation properties relative to undigested fodder residues, which facilitated the microscopy process.

The scientific results of individual scientists indicate the high efficiency of the improved methods of coproovoscopy compared to the generally known ones. Thus, an improved method of quantitative coproovoscopic diagnosis of nematodoses of the alimentary canal of ruminants was tested and proposed, which is based on the use of a calcium nitrate solution as a flotation liquid. The scientists proved that the improved method was more effective compared to well-known methods, in particular according to the indicator of the average number of detected nematode eggs in the sample compared to the methods of Liashenko et al. – by 86.9 % (P<0.001), Trach – by 37.9 % (P<0.01), Stoll – by 27.7 % (P<0.05) and Taylor et al – by 5.9 % [19, 20].

The obtained results of experimental studies allow recommending the proposed method of quantitative coproovoscopic diagnosis of cattle nematodirosis for more accurate laboratory diagnosis of this infestation.

Conclusions

The positive effect of the proposed method of quantitative coproovoscopic diagnosis of nematodirosis in cattle is characterized by the high sensitivity of the method in terms of the intensity of nematodirous invasion, where the effectiveness of the proposed method was higher compared to the centrifuge-flotation method by 1.3 times and compared to the method of counting helminth eggs in feces by 6.5 times (P<0.001). The flotation liquid used in the proposed method showed the highest coagulation properties relative to undigested feed residues, which facilitates microscopy.

Conflict of interest

The author state that there is no conflict of interest.

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