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The Technology of Preventing Ecological and Economic Damage Caused by Echinococcosis

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Abstract*: *The article presents the data about the mechanism of transmitting echinococcosis from the source of infection to a susceptible animal. It has been found that the main sources of infection are sick dogs, and, more rarely, wild animals. The factors that promote the spread of echinococcosis are home-slaughtering cattle, feeding the viscera of slaughtered animals to dogs, failure to observe the deadlines and the methods of dogs dehelminthization, poor dogs dehelminthization scale, and unordered dog keeping. The article also presents the results of the studies for comparative assessment of various methods of coproovoscopic diagnosing helminthoses in dogs.

Keywords*: *Animals, dog, echinococcosis, helminth-ovoscopic methods of diagnostics, humans.

I. INTRODUCTION

In the recent years, the veterinary service of the Kostanay region (Kazakhstan) has been actively working on preventing parasitic diseases to avoid economic losses caused by helminthoses, and larval cestodiases in particular. Echinococcosis is widely spread among ruminants in Northern Kazakhstan.

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According to some researchers, echinococcosis (Echinococcus granulosus) may infect all farm animals and humans [1], [2].

In all animals and humans, Echinococcus mainly affects the liver and the lungs, but can also affect other organs (the kidneys, the heart, the spleen, the reproductive organs, or the brain).

The main sources of infection are dogs, which scatter eggs of Echinococcus granulosus with feces. Besides, wild animals, like wolves and jackals, may also be involved in spreading the infection. With that, sheep and cattle become infected on the pastures contaminated with the eggs of Echinococcus, i.e., the main way of transmitting the disease from carnivores to agricultural animals is through the food [3]-[6].

To prevent the spread of echinococcosis among agricultural animals, veterinary experts perform preventive dehelminthization of dogs.

Dehelminthization of dogs should be performed at special sites, where dog feces are collected into a metal container and neutralized by boiling for 10 – 15 minutes, or poured with a 10 % solution of calcium hydrochloride and kept for three hours, and the soil at the dehelminthization site is processed with a 3 % solution sodium hydroxide [7].

According to the results of monitoring and analysis of the veterinary reports for 2016 – 2018, no ruminants affected with echinococcosis were registered in the Kostanay region. However, the results of a joint study with the veterinary service of the region showed that veterinary-sanitary examination of the meat at slaughterhouses and markets revealed the spread of echinococcosis among agricultural animals.

It is known that the species composition of helminths in dogs, the spread of helminthoses, and the extensity and intensity of infestation should be analyzed for studying the epizootology of helminthoses in domestic carnivores. It is the basis for developing integrated measures for the prevention and therapy of hazardous zoonotic diseases [1]-[3].

In recent years, several methods of diagnosing helminthoses have been developed, especially in the area of molecular biology, biochemistry and immunology, such as the polymerase chain reaction (PCR) and the enzyme-linked immunosorbent assay (ELISA).

However, today these methods are expensive, and are not always applicable in daily practice.

According to the researchers, the scatological method in which samples of feces are used for detecting parasitic elements (e.g., eggs and larvae of helminths, oocysts, and protozoa cysts) and counting their number is the most widely used one.

With that, it is considered that it is important not only to detect and identify the parasitic elements but also to determine their number.

Counting the number of eggs plays the key role in monitoring infestations with helminths, in determining the degree of pastures contamination, or in establishing the efficiency of the antihelminthic drug.

All methods of counting eggs that determine the number of parasitic elements per gram of feces (eggs, larvae, and cysts) are based on microscopic examination of the samples of feces.

II. PROCEDURE FOR PAPER SUBMISSION

A. General description

Currently, a lot of flotation and combined coproovoscopy methods are proposed for the diagnosis of helminthoses in animals. Some scientists believe that solutions of individual salts, with increasing their density, increase the flotation ability of helminth eggs, while others, on the contrary, believe that this delays eggs flotation [8].

Given the infestation with echinococcosis annually detected in cattle, sheep, and pigs, the authors set the goal of studying the spread of echinococcosis in the territory of the Kostanay region. To achieve the goal, the following tasks were set: identification of the factors and ways of Echinococcus migration at livestock breeding facilities and at personal farmsteads of the population, comparative assessment of the existing diagnostic methods and the experimental method with the use of the experimental solution for helminthovoscopic diagnosing cestodiases in animals, which was developed in the conditions of the Faculty of Veterinary Medicine and Cattle Breeding Technology of the Kostanay State University n.a. A. Baitursynov.

B. Algorithm

The objects of the study in the territory of the Kostanay region were the products of slaughtering ruminants and sheep subjected to veterinary and sanitary inspection at slaughterhouses and markets in the period of 2016 – 2018, the data of veterinary reports and examinations of the population provided by the Committee of Public Health of the Ministry of Healthcare and by the scientific-practical center of sanitary-epidemiological expertise and monitoring for the Kostanay region. To detect echinococcosis in ruminants, the authors visited the slaughtering facilities in the region, where, together with the veterinary doctors, performed a veterinary-sanitary examination following the current veterinary and sanitary rules approved by the Order of the Minister of Agriculture of the Republic of Kazakhstan No. 7-1/587 dated June 29, 2015. After opening the liver and other parenchymatous organs of the slaughtered animals, their infestation with Echinococcus was identified, the number of cysts was counted, their location and size, and the extensiveness and intensity of infestation at farms were determined.

III. RESULT ANALYSIS

From the data of the veterinary service, it was found that in the Kostanay region, 32 slaughtering facilities for farm animals were operating, which ensured the veterinary and sanitary safety of 17 districts and three cities by 97 %. Each slaughtering facility had a veterinarian assigned by the local executive bodies and a laboratory, which ensured the veterinary and sanitary safety of the products.

The results of studying the Echinococcus infestation rate of the animals were compared to the infestation rate of the population. The rate calculated per 100 thousand of the population in the Kostanay region in 2016 – 2018 was 1.5 %. According to the above data, a decrease in the number of echinococcosis cases among the residents of the area was observed.

Reduction of the number of cases per 100 thousand of the population over three years shows that this type of zoonotic infestation is the most prevalent in the Naurzum, the Auliekol, and the Karasus districts, where the prevalence rate of the disease was 8.3 %, 4.4 %, and 3.7 % per 100 thousand of population, respectively, as shown in Fig.1.

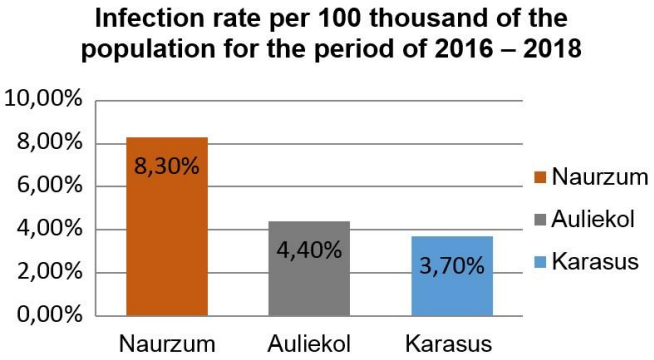

Fig. 1. Infestation by echinococcosis per 100 thousand of the population in the Kostanay region in 2016 – 2018

Monitoring the registration of echinococcosis cases in the population in the context of the age showed that out of eight cases in 2016, three cases had occurred at the age of 14 years, and the infestation rate per 100.0 thousand people had been 1.74 %.

In 2017, out of seven registered cases of echinococcosis in the age context among people, two cases were at the age under 14 years and the infestation rate per 100.0 thousand people amounted to 1.14 %.

In 2018, seven cases of echinococcosis were registered; the incidence rate per 100.0 thousand people was 1.13 %.

Additionally, the authors analyzed the routine veterinary preventive measures for dehelminthization of dogs against echinococcosis.

According to the regional veterinary service, anthelmintic drugs are spared from the republican budget for ensuring veterinary and sanitary safety, including the prevention of echinococcosis.

The veterinary service of the local executive bodies (in 17 districts and three cities) quarterly performs preventive dehelminthization of dogs. With that, the spared average number of anthelmintic drugs against echinococcosis per one district or town is 1,500 doses, or 375 doses per quarter evenly.

The planned activities are performed strictly following the veterinary regulations for preventing and eliminating echinococcosis in animals (order of the Ministry of Agriculture No. 503 dated September 16, 2004), which stated it necessary to periodically perform dehelminthization of guard dogs and police dogs. In the settlements disadvantaged for echinococcosis, dehelminthization should be performed every 45 – 50 days for all the dogs over the age of three months, the dogs kept with herds, and the dogs owned by the enterprises, organizations and the population [9].

To determine the degree of dogs infestation with Echinococcus, samples of feces were taken in the territory of the Kostanay region, where cases of echinococcosis in humans had been registered.

The studies were performed in the framework of the project "Scientific support for veterinary well-being and food security in the Kostanay region for the year 2019".

To diagnose helminthoses in dogs, the following methods were used:

1) Fulleborn's method. The essence of the method consisted of the following. A 3 – 5 g sample of feces was placed into a 75 – 100 ml plastic or glass cup, and 50 – 75 ml of a saturated solution of sodium chloride were gradually added with thorough stirring of the suspension with a glass rod. The surfaced larger particles were immediately removed, and the suspension of feces was filtered into another cup through a stainless metal or nylon sieve with the diameter of 0.3 – 0.5 mm. During settling of the mixture, eggs of many species of nematodes and cestodes surfaced. After 30 minutes, three drops of the surface film were taken with a wire or a coiled loop (0.8 – 1 cm in diameter) and placed on a glass slide. Without covering the drops with a cover glass, they were watched at low microscope magnification, and the number of eggs of each helminth was counted in three drops [9]-[11].

2) Darling's method. A 3 – 5 g sample of feces was mixed in a pounder with water in the amount required for one centrifuge tube. The obtained emulsion was filtered through gauze into a similar tube, topped with water, and centrifuged for three minutes. The liquid was then drained to the precipitate, and the residue was stirred with the Darling's liquid (saturated solution of table salt mixed with an equal amount of glycerin), and centrifuged for five minutes.

3) Method of G. A. Kotelnikov and V. M. Khrenov. A 3 g sample of feces was placed in a cup; ammonium nitrate solution was added and carefully stirred with a glass rod. After that, the solution was topped up to 50 ml with table salt in portions. The obtained suspended matter was filtered through a metal or nylon strainer into another cup and allowed to settle for ten minutes.

4) An experimental method of diagnosing helminthoses in dogs. This method involved taking 3 g of feces, mixing them in 40 ml of combined experimental flotation liquid consisting of a saturated solution of table salt mixed with an equal amount of sugar syrup (1,500 g per one liter) prepared in the ratio of 5:1, after which the mixture was filtered. The obtained liquid was centrifuged for two minutes at 1,500 rpm, after which the surface film was subjected to microscopy. The sample was allowed to settle and centrifuged for the same duration according to the method. The specific gravity of the prepared flotation solutions was determined with a densimeter at the ambient temperature of 20 °C. The results of the comparative tests are shown in Table I.

Table-I: Specific gravity of the flotation liquid for coproovoscopic studies

Research methods	Reagents		The specific gravity of the flotation liquid
	Chemical formula	*Flow rate, g/l*	
Fulleborn	NaCl	400	1.18
Kotelnikov & Khrenov	NH_4NO_3	1500	1.25
Darling	NaCl +$C_3H_8O_3$	400 (NaCl)	1.20
Experimental method	NaCl+$C_{12}H_{22}O_{11}$	400 (NaCl) +1500 ($C_{12}H_{22}O_{11}$)	1.28

The data in Table I show that the greatest specific weight is observed in flotation combined fluids: the fluid for the experimental method with the solution density of 1.28 g/l, and the fluid for the method of Kotelnikov & Khrenov with ammonium nitrate, with the density of the solution of 1.25 g/l. In the method of Darling, the density of the solution was 1.20 g/l. The lowest density of the solution was observed in the method of Fulleborn — 1.18 g/l.

For the comparative assessment of various methods of coproovoscopic diagnostics of helminthoses in dogs, feces were taken from 55 dogs at the experimental production farm Zarechnoye, in Kostanay-2 and settlement Molokanovka in the Kostanay region. After that, all prepared samples were studied using various helminth-ovoscopic methods, as shown in Table 2.

From Table II it follows that the most efficient method for diagnosing cestodiases and nematodes in frugivorous animals is the experimental method with the use of a solution of sodium chloride and glucose. The methods of Darling, Fulleborn and Kotelnikov & Khrenov were less efficient. With that, the overall rate of helminth eggs' detection decreased.

Table II shows that of all methods of diagnosing helminthoses in dogs, the most efficient are two methods, namely, the experimental method and the Darling's method.

Table-II: The results of coproovoscopic diagnostics of cestodiases in dogs using various methods

Cestode eggs detected in flotation solutions of			
sodium chloride	*ammonium nitrate*	*sodium chloride + glycerin*	*sodium chloride + sugar syrup*
7 ± 1	9 ± 1	11 ± 1	21 ± 3
12 ± 2	10 ± 2	16 ± 2	26 ± 3
10 ± 1	12 ± 2	14 ± 2	19 ± 2
10 ± 2	11 ± 1	15 ± 2	22 ± 2

IV. CONCLUSION

As a result of the research, it has been found that the main sources of infection of echinococcosis in the Kostanay region are dogs, while the intermediate hosts are farm animals and humans.

Based on the comparative analysis of the epizootic and epidemiological situation for echinococcosis in the Kostanay region, it should be noted that echinococcosis in the population occurs in all districts of the region with approximately the same level of livestock breeding development, and with the presence of large numbers of dogs. In 2018, seven cases of echinococcosis were registered; the incidence rate per 100.0 thousand of the population being 1.13 %.

Creating specialized stationary slaughterhouses in each district of the region allowed reducing the echinococcosis incidence rate in farm animals.

The authors believe that the required amount of antihelminthic drugs for preventing echinococcosis in the districts and towns of the Kostanay region should be increased, and the drugs are to be distributed depending on the specific epizootic and epidemiological situation for echinococcosis.

The comparative assessment of the coproovoscopic methods of diagnosing helminthoses has shown the advantage of the experimental method with the use of sodium chloride solution and sugar syrup, which consists in its efficiency, compared to the cost of other methods.

Thus, the experimental method with the use of the sodium chloride solution and sugar syrup can be recommended for use in the veterinary practice for diagnosing helminthoses, including echinococcosis and other tapeworm infections in carnivores.

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