Research Article

Bioindication of Sanitary and Hygienic Pollution of Water Bodies and Soils of the Mountainous Zone of the North Caucasus Region by the Detection of Eggs of Socially Dangerous Helminths

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Abstract | In the mountain rivers R. Terek, R. Malka, R. Baksan, R. Cherek, R. Chegem, R. Gizhgit, R. Kendelen, R. Kichmalka, R. Khaznidon, R. Sukan-su.at 12.00-30.0% of the samples, eggs of *Trichocephalus* ovis (Abildgaard, 1795) and *Trichocephalus* skrjabini (Baskakow, 1924) were found. Study of the dynamics of soil pollution by eggs of the genus *Trichocephalus* (Schrank, 1788) in the mountainous zone in 2017–2020. revealed moderate pollution of water and soil samples from reservoirs with a tendency to increase from 13.0 to 28.0% (on average by 19.8%). with an increase in the number of eggs per 1 liter of water from 7.2 ± 0.5 to 19.1 ± 1.2 ind. (on average 12.1 ± 0.8 specimens per liter of water). The number of water samples contaminated with eggs of nematodes of the genus *Trichocephalus* (Schrank, 1788) was high in densely populated areas. In natural water bodies of pastures in Kabardino-Balkaria, their number was 96.30%, in water bodies of pastures in settlements - 88.40%. in the water area of rivers - 72.70%, in reservoirs on the territory of farms - 90.60%, in kosher reservoirs - 100%, in watering places for sheep - 100%, in reservoirs of sheep resting areas - 100%. %. Eggs of nematodes in samples of water, soil, feces, hay, silage and forage during the winter retained viability at the level of 22.6, respectively; 28.0; 37.4; 81.6; 74.2; 92.6%. The sanitary and hygienic state of water and soil in 10 mountain rivers in the territory of Kabardino-Balkaria can be assessed as unfavorable from the point of view of contamination with eggs of nematodes of the genus *Trichocephalus* and other helminths.

Keywords | Kabardino-Balkarian Republic; mountain rivers, pastures; the soil; water; sanitation; hygiene; pollution; eggs; nematodes of the genus *Trichocephalus* (Shrank, 1788).

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INTRODUCTION

Zoonotic types of helminths, including *Trichocephalus* ovis (Abildgaard, 1795) and *Trichocephalus* skrjabini (Baskakow, 1924) of animals and humans is a global medical and veterinary problem in the list of parasitic zoonoses in the world. The epizootic and epidemic situation of the dangerous zoonoses disease in the regions of the Russian Federation in recent years tends to worsen infestations) (Onishchenko, 2006; Vasilevich, et al., 2010; Bittirov et al.,

2014; Kolodiy et al., 2012; Zalikhanov et al., 2018; Vasilevich, et al., 2010). According to medical services for the past 20 years, the incidence of trichocephalosis has increased by a factor of 7.5 (Bittirov, et al., 2012; Bittirov, 2013; Artamonova et al., 1997; Bittirov et al., 2019). Trichocephalosis invasion among animals and the population throughout the territory of the Russian Federation has acquired an enzootic character with the formation of regional epizootic and epidemic rural and urban foci (Vasilevich et al., 2010). To date, it has become apparent that a high level of extensity and intensification of different species of ungulate animals with trichocephalosis with coverage of 10-30% of adult livestock . In the regions of the North Caucasus, the infection trichocephalosis of dogs is 70-100% . In Russia, trichocephalosis in domestic and wild animals has become a natural - focal invasion, with multilevel protection of vital strategies in definitive and intermediate hosts through the eggs contaminated by the genus *Trichocephalus* (Schrank, 1788) external environment. Concerning the activity of the manifestation of the epidemic process of trichocephalosis, in connection with the level of contamination with eggs of the *Trichocephalus* (Schrank, 1788) of the mountain ecosystem of Kabardino-Balkaria, scientific studies have not been conducted, little information on the sanitary-hygienic state of the mountain objects on their contamination by the eggs of the *Trichocephalus* (Schrank, 1788) (Vasilevich et al., 2010; Kolodiy et al., 2012; Zalikhanov et al., 2018; Bittirov et al., 2019; Ardavova et al., 2010; Kabardiev et al., 2015). The goal is to conduct local-background ecological and sanitary-hygienic studies with an assessment of the contamination of mountain objects in the Kabardino-Balkaria Republic with eggs genus *Trichocephalus*..

MATERIALS AND METHODS

The work was carried out on the basis of the laboratory of parasitology of the Federal State Biological University "Pre-Caspian Zone Scientific Research Veterinary Institute" in 2017-2020. For this purpose, from the places of resting and resting of animals in the mountain tracts of the mountain rivers R. Terek, R. Malka, R. Baksan, R. Cherek, R. Chegem, R. Gizhgit, R. Kendelen, R. Kichmalka, R. Khaznidon, R. Sukan-su, 100 samples of water were taken for examination for detection of eggs genus *Trichocephalus* (Schrank, 1788). In the biotopes of the mountain zone, taking into account the vertical belts of the Kabardino-Balkaria Republic, we set up experiments to determine the timing of the development of eggs genus *Trichocephalus* (Schrank, 1788) at altitudes of 1000-2500 m above sea level. The experiments were performed using fresh eggs genus *Trichocephalus* washed from the uterus. Samples of eggs in the amount of 10-15 thousand were placed on the experimental plot monthly from March to November. For this eggs genus *Trichocephalus*, was placed in glass jars, which were then placed on a biological platform. Samples of water soil,, faeces, hay, silage, mixed fodder with eggs *Trichocephalus* were taken daily to determine the viability of invasive elements. In each case, 100 specimens were examined under a microscope eggs from soil, water, feces, hay, silage, concentrated feed samples. The viability of eggs *Trichocephalus* winter season was studied in a mountainous zone. In the samples of soil, water, feces, hay, silage, mixed fodder in late November; fresh eggs genus *Trichocephalus* were introduced and left during the winter until March of the following year in the external environment. After the winter period, eggs genus *Trichocephalus* were investigated by methods of helminthooscopy and the MUK «Methods of Sanitary and Parasitological Studies» 1-14. The data was subjected to statistical processing according to the program «Biometry».

RESULTS AND DISCUSSION

Sanitary-helminthological examinations of water samples made it possible to identify unfavorable mountainous territories in epizootic and epidemiologically dangerous conditions with regard to the occurrence of doses of invasions eggs genus *Trichocephalus* (Table 1). According to the results of studies of s samples water in places of rest and recreation of animals in the mountain rivers Kabardino-Balkaria Republic (R. Terek, R. Malka, R. Baksan, R. Cherek, R. Chegem, R. Gizhgit, R. Kendelen, R. Kichmalka, R. Khaznidon, R. Sukan-su), respectively at 12.00; 18.00; 16.00; 15.00; 6.00; 30,0; 28.00; 16.00; 19.00; 14.00% of the samples water found eggs genus *Trichocephalus* (Schrank, 1788) in an amount per 1 l of sample, respectively, 14.3 ± 2.0; 8.7 ± 0.7; 3.5 ± 0.4; 11.3 ± 2.0; 7.0 ± 0.6; 17.4 ± 1.8; 8.3 ± 0.9; 10.1 ± 1.3; 13.0 ± 1.1; 9.4 ± 1.1 ekz. (Table 1). In samples water in places of resting of animals in Kabardino-Balkaria Republic mountainous 10 the mountain rivers per 1 liter of sample water, on average, were found 10,46±1,17 ekzemplyar eggs genus *Trichocephalus*.

The study of the dynamics of soil pollution by eggs and larvae of the genus *Trichocephalus* (Schrank, 1788) in the mountainous zone in 2017–2020 revealed moderate soil contamination with a tendency to increase from 13.0 to 28.0% (on average 19.8%) with an increase in the number eggs per 1 liter of water sample from 7.2 to 19.1 ind. (on average 12.1 specimens per 1 liter of water sample) 1-14 (Table 2).

Table 1: Sanitary and hygienic condition of the water of mountain objects of Kabardino-Balkaria Republic for their contamination with eggs genus *Trichocephalus* (Schrank, 1788)

Investigated water objects - natural boundary	Investigated water samples	Amount contaminated water samples	% contaminated samples water	Number of eggs genus *Trichocephalus* in 1 liter samples water, ekzemplyar
R. Terek	100	13	13,00	14,3±2,0
R. Malka	100	18	18,00	8,7±0,7
R. Baksan	100	16	16,00	3,5±0,5
R. Cherek	100	15	15,00	11,3±2,0
R. Chegem	100	6	6,00	7,2±0,6
R. Gizhgit	100	30	30.00	17,4±1,8
R. Kendelen	100	28	28,00	8,3±0,9
R. Kichmalka	100	16	16,00	10,1±1,3
R. Khaznidon	100	19	19,00	13,0±1,4
R. Sukan-su	100	15	15,00	9,4±1,1
Total:	1000	176	-	-
Average:	-	-	17,60	10,47±1,18

Table 2: Number water and soil samples with eggs and larvae genus *Trichocephalus* (according to water - and soilscopy)

Year	Investigated water and soil samples, ekzemplyar	Discovered water and soil samples with eggs genus *Trichocephalus*, ekz.	EI, %	Amount eggs genus *Trichocephalus* in 1 liter samples water, ekzemplyar
2017	100	13	13,0	7,2±0,5
2018	100	17	17,0	9,2±0,7
2019	100	21	21,0	12,8±0,9
2020	100	28	28,0	19,1±1,2
Total:	400	79	-	-
Average:	-	-	19,8	12,1±0,8

Table 3: Contamination mountain objects of Kabardino-Balkaria Republic eggs genus *Trichocephalus* (according to water - and soilscopy)

Objects	Number of water and soil, units	Investigated samples water and soil, units	Samples water and soil with eggs genus *Trichocephalus*	% contaminated samples	Power contaminated objects
Water near the village pastures	26	293	282	96,30	+++
Remote pasture water	10	310	274	88,40	+++
Mountain river water	14	300	218	72,70	+++
Rural household water	58	320	290	90,60	+++
The water kosharny territories	34	300	300	100,0	+++
Watering places of for animals	23	300	300	100,0	+++

Conditional designations: + - weak power pollution;
++ - medium power pollution;
+++ - strong degree of s contamination.

he number of water and soil samples contaminated with eggs and larvae of nematodes of the genus *Trichocephalus* (Schrank, 1788) was high in areas densely populated by animals and people. On the reservoirs of distant pastures of Kabardino-Balkaria, their number was 96.30%, in the reservoirs of pastures of settlements - 88.40%. along the river banks - 72.70%, on the territories of farms - 90.60%, in the reservoirs of koshar territories - 100%, at watering holes for sheep - 100%, in places of sheep rest - 100% 1-14 (Table 3).

In the experiments on the open ground in the water and

Table 4: Indicators overwintering eggs genus *Trichocephalus* (Schrank, 1788) in water and soil on pasture pastures Kabardino-Balkaria Republic (according to occupy of water - and soilscopy)

Height above the level sea, m	Number of eggs genus *Trichocephalus* in water and soil in autumn when bookmarking experience, ekz.	Number of eggs genus *Trichocephalus* in 1 liter samples water, ekz.	Number of non-viable eggs genus *Trichocephalus* in water and soil in the spring, ekzemplyar	% viable eggs genus *Trichocephalus* in water and soil in the spring
1000	500±10	483±25,92	127±11,33	26,29
1500	500±10	469±23,71	93±8,64	19,83
2000	500±10	447±21,48	56±4,50	12,53
2500	500±10	414±18,66	33±2,75	7,97

Table 5: Indicators of overwintering of eggs genus *Trichocephalus* (Schrank, 1788) in the mountain zone in samples of water, soil and mixed fodder

Objects of research	Number of samples, ekz.	Investigated eggs genus *Trichocephalus*, total, ekz.	Number of non-viable eggs genus *Trichocephalus* in water and soil in the spring		% viable eggs genus *Trichocephalus* in water and soil in the spring	
			ekz.	%	ekz.	%
Water	50	500±12	113±17	22,62	387±28	77,45
Soil	50	500±18	140±11	28,10	360±25	72,06
Faeces	50	500±20	187±14	37,43	313±22	62,61
Mixed fodder	50	500±19	463±15	92,58	37±6	7,41

soil of the pasture pastures of the Kabardino-Balkaria Republic, at the altitudes of 1000, 1500, 2000, 2500 m above sea level, respectively, 26.29; 19.83; 12.53 and 7.97% of the eggs genus *Trichocephalus* (Table 4).

During the winter period, the number of non-viable eggs of the eggs genus *Trichocephalus*, including those in the samples of water. soil, faeces and mixed fodder, was not sufficient was, respectively, 72.0; 77.45; 62.61; and 7.41% (Table 5).

The data indicate a high level of pollution of the mountain rivers R. Terek, R. Malka, R. Baksan, R. Cherek, R. Chegem, R. Gizhgit, R. Kendelen, R. Kichmalka, R. Khaznidon, R. Sukan-su. eggs of eggs of the genus *Trichocephalus* (Schrank, 1788) in the grazing period. .In water samples from mountain rivers in the conditions of distant pastures of the Kabardino-Balkarian Republic at altitudes of 1000, 1500, 2000, 2500 m above sea level, respectively 26.29; 19.83; 12.53 and 7.97% of eggs remain viable for a long time, which is consistent with the data of (Vasilevich et al., 2010; Bittirov et al., 2019).

CONCLUSION

In the mountain rivers R. Terek, R. Malka, R. Baksan, R. Cherek, R. Chegem, R. Gizhgit, R. Kendelen, R. Kichmalka, R. Khaznidon, R. Sukan-su.at 12.00-30.0% of the samples, eggs of *Trichocephalus* ovis (Abildgaard, 1795) and *Trichocephalus* skrjabini (Baskakow, 1924) were found. Study of the dynamics of soil pollution by eggs and larvae of the genus *Trichocephalus* (Schrank, 1788) in the mountainous zone in 2017–2020. revealed moderate pollution of water and soil samples from reservoirs with a tendency to increase from 13.0 to 28.0% (on average by 19.8%). with an increase in the number of eggs per 1 liter of water from 7.2 ± 0.5 to 19.1 ± 1.2 ind. (on average 12.1 ± 0.8 specimens per liter of water). The number of water samples contaminated with eggs of nematodes of the genus *Trichocephalus* (Schrank, 1788) was high in densely populated areas. In natural water bodies of pastures in Kabardino-Balkaria, their number was 96.30%, in water bodies of pastures in settlements - 88.40%. in the water area of rivers - 72.70%, in reservoirs on the territory of farms - 90.60%, in kosher reservoirs - 100%, in watering places for sheep - 100%, in reservoirs of sheep resting areas - 100%. %. Eggs of nematodes in samples of water, soil, feces, hay, silage and forage during the winter retained viability at the level of 22.6, respectively; 28.0; 37.4; 81.6; 74.2; 92.6%. The sanitary and hygienic state of water and soil in 10 mountain rivers in the territory of Kabardino-Balkaria can be assessed as unfavorable from the point of view of contamination with eggs of nematodes of the genus *Trichocephalus* and other helminths. The data indicate a high level of pollution of the mountain rivers R. Terek, R. Malka, R. Baksan, R. Cherek, R. Chegem, R. Gizhgit, R. Kendelen, R. Kichmalka, R. Khaznidon, R. Sukan-su. eggs of eggs of the genus *Trichocephalus* (Schrank, 1788) in the grazing period. .In water samples from mountain rivers in the conditions of distant pastures of the Kabardino-Balkarian Republic at altitudes of 1000, 1500, 2000, 2500 m above sea level, respectively 26.29; 19.83; 12.53 and 7.97% of eggs remain

viable for a long time

CONFLICT OF INTEREST

The authors have declared that there are no conflicts of interest.

NOVELTY STATEMENT

The authors declare that the results obtained on the topic of the article were obtained empirically, and the reflected information is new for science in the field of parasitology.

AUTHORS' CONTRIBUTION

All authors took part in the Bioindication of sanitary and hygienic pollution of water bodies and soils of the mountainous zone of the North Caucasus region to identify eggs of socially dangerous helminths, collected materials, analyzed the material, and participated in writing the manuscript. Collectively reviewed the manuscript. All authors read and approved the final version of the manuscript.

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