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Gastrointestinal helminth infections of dairy goats in Slovakia

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Summary

The aim of this study was to identify the most common gastrointestinal (GI) parasites in flocks of dairy goats on 30 farms in Slovakia. A total of 944 adult goats were examined during the pasturing seasons for 2014 – 2016. Eggs from one or more species of gastrointestinal parasites were identified in 906 of the samples (95.90 %). Strongyle eggs were present in most of the samples (92.00 %), followed by *Strongyloides papillosus* (14.05 %), *Trichuris* spp. (7.84 %), *Nematodirus* spp. (3.98 %), and *Moniezia* spp. (2.65 %). The counts of strongyle eggs per gram of faeces ranged from 0 to 11000. Subsamples from each farm were used to prepare faecal coprocultures to identify the genera of the nematodes. Third-stage larvae of *Trichostrongylus* spp. (100 %) and *Teladorsagia/Ostertagia* spp. (96.60 %) were present on most of the farms, followed by *Oesophagostomum* spp./*Chabertia ovina* (86.60 %) and *Haemonchus contortus* (76.60 %). *Teladorsagia*/*Ostertagia* spp. were the dominant genera on 60 % of the farms.
Keywords: goats; gastrointestinal nematodes; Slovakia

Introduction

The demand for goat-milk products is increasing very quickly in Slovakia. The health benefits of goat milk are widely known, and many farmers who had previously bred only sheep and cattle are increasing their interest in breeding goats. The number of goats in Slovakia increased from 12,926 in 2013 to 16,073 by the end of 2015 and is still increasing. Infection with gastrointestinal (GI) nematodes is the most common constraint in small-ruminant farming. They are responsible for weight loss, reduced weight gains in young animals, diarrhoea, and anorexia. Blood-feeding parasites such as *Haemonchus contortus* also cause anaemia and oedema due to the loss blood or plasma proteins (Taylor *et al*., 2007). The mild climate in Slovakia allows animals to spend most of the year on pasture where they are in contact with infective stages of parasites. Previous surveys conducted in Slovakia by Várady and Praslička (1993) and Čerňanská *et al*. (2005) only documented the occurrence of GI parasites on sheep farms. Many farmers and veterinarians have applied information from breeding sheep to breeding goats, but strategies for reducing worm infections differ greatly between sheep and goats based on the immunological, behavioural, and physiological differences between these two hosts (Hoste *et al*., 2008). More studies on caprine species are thus needed (Hoste *et al*., 2010) for understanding the differences between strategies for controlling GI infections in sheep and goats. The main goal of this study was to determine the prevalence of GI parasites in flocks of dairy goats in Slovakia, for which data is lacking.

Materials and Methods

The survey was carried out on commercial farms throughout Slova-

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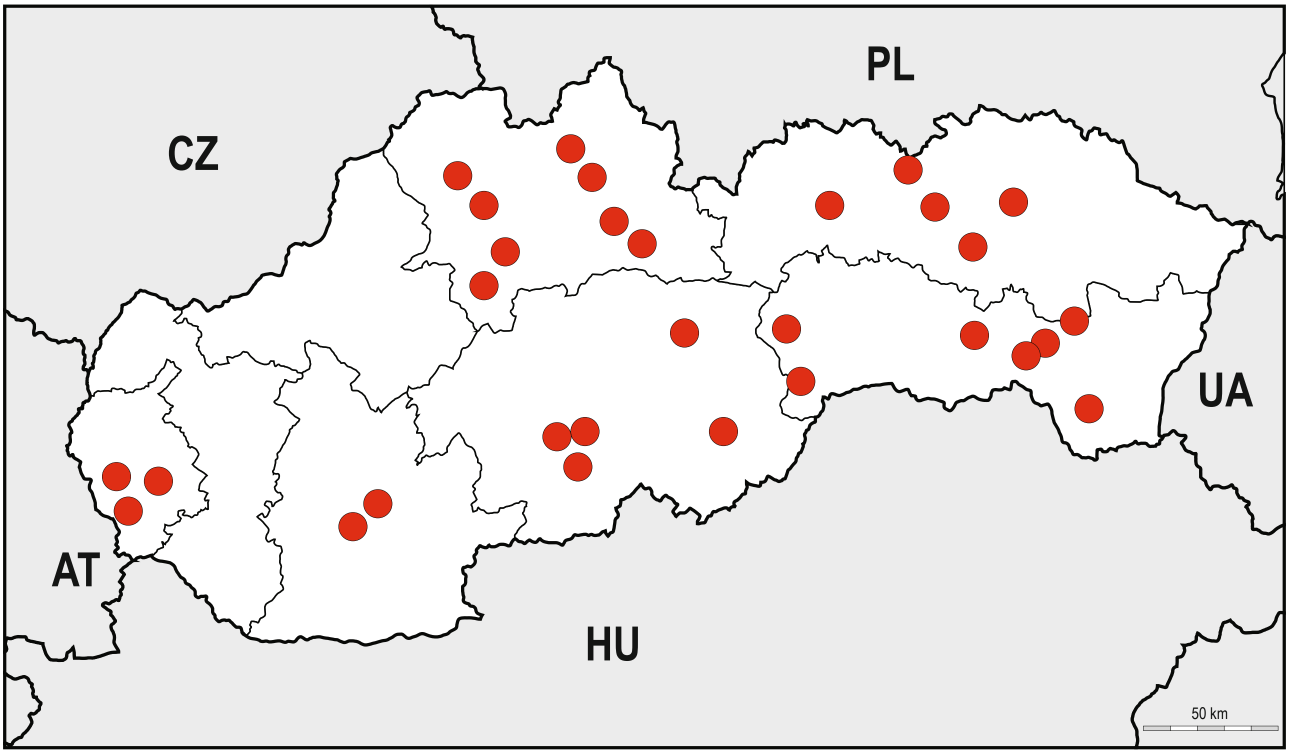

Fig.1. Location of examined goat farms in Slovakia.

kia (Fig.1) from September 2014 to December 2016 during the main pasturing seasons (April – November). A total of 944 faecal samples from 30 dairy-goat flocks were collected from the recta of adult goats and examined by flotation using a sugar solution with a specific gravity of 1.28. Individual counts of eggs per gram (EPG) of faeces were performed by a modified McMaster technique with sensitivity higher than 50 EPG. (Coles *et al*., 1992). The goats on each farm had not been treated with anthelmintics within the previous eight weeks. Coprocultures were prepared from pooled samples and incubated at 27 °C for 7 – 10 days. Third-stage larvae (L_3) of genera from the nematode family Trichostrongylidae were harvested by the Baermann technique, and 100 randomly selected L_3 from each farm were identified as described by Van Wyk *et al*. (2013). Mean (± standard deviation), minimum/maximum, and median EPG counts were calculated using Excel 2010 (Microsoft Inc.).

Results

Of the 944 samples, 906 (95.90 %) were positive for one and more GI parasites. The most prevalent were Trichostrongylidae (92.00 %) (Fig. 2), with a mean EPG of 990.07 (Table 1). *Strongyloides papillosus* (14.05 %) was the second most prevalent, followed by *Trichuris* spp. (7.84 %), *Nematodirus* spp. (3.98 %), and *Moniezia* spp. (2.65 %).

The mean, minimum-maximum, and median EPGs on each farm are summarized in Table 2. *Teladorsagia/Ostertagia* spp. were the dominant species on 60 % of the farms (Table 3). *Trichostrongylus* spp. (100 %) and *Teladorsagia/Ostertagia* spp. (96.66 %) were present on most of the farms, followed by *Oesophagostomum* spp./*Chabertia ovina* (86.66 %) and *H. contortus* (76.66 %) (Fig. 3). A total of 3000 infective larvae were identified, 100 on each farm

Table 1. Mean (± standard deviation (SD), minimum-maximum, and median strongyle eggs per gram of faeces on Slovak goat farms.

Parasite	Mean EPG ± SD	Minimum-Maximum (EPG)	Median
Trichostrongylidae	990.07 ± 1135.72	0 – 11000	650
Strongyloides papillosus	150.37 ± 170.70	50 – 1200	100
Trichuris spp.	87.10 ± 60.05	50 – 600	50
Nematodirus spp.	82.05 ± 59.79	50 – 400	50
Moniezia spp.	320.63 ± 640.28	50 – 3100	150

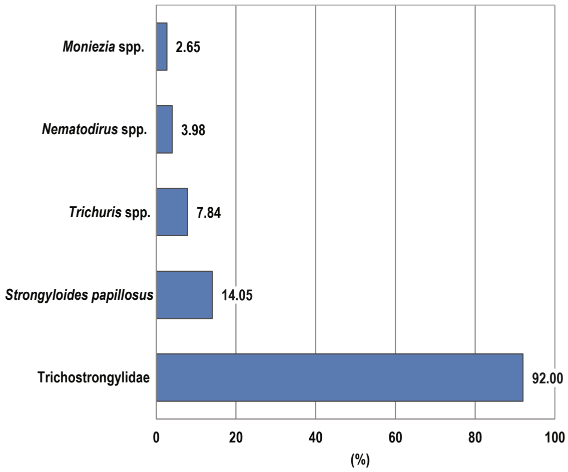

Fig. 2. Incidence of gastrointestinal parasites on Slovak goat farms.

(Fig. 4). *Teladorsagia/Ostertagia* spp. were the most prevalent parasites (40.90 %), followed by *Trichostrongylus* spp. (20.90 %), *Oesophagostomum* spp./*Ch. ovina* (19.50 %), *H. contortus* (18.80 %), and *Bunostomum* spp. (0.20 %). The compositions and percentages of L_3 larvae on each farm are presented in Table 4.

Discussion

Our survey was the first large scalestudy to focus on GI parasites of goats under field conditions on Slovak farms. Most of the farms were positive for one or more genera of GI parasites. Previous surveys conducted on farms of small ruminants in the last three decades in Slovakia focused on sheep (Várady & Praslička, 1993; Čerňanská *et al*., 2005). Little information was thus available about the intensity of infection and the identities of helminth parasites in goats. We confirmed a high prevalence of trichostrongylids as typical parasites of grazing ruminants. *S. papillosus* was the second most prevalent. Strongyloidosis can cause serious problems, especially in young animals. Young goats up to 12 months of age were the most susceptible to experimental infection with *S. papillosus* (Piennar *et al*., 1999).

Transmission may be passive (food and water) or active by the percutaneous penetration of larvae (Dimitrijević *et al*., 2012). Ruptured skin in interdigital regions enables invasion by other pathogenic agents (Abbott & Lewis, 2005). Infectious larvae may also migrate to the udder due to systemic circulation before birth, so galactogenic transmission is possible (Šibalić & Cvetković, 1996).

Table 2. Mean (± standard deviation (SD), minimum-maximum, and median strongyle eggs per gram of faeces on Slovak goat farms.

Farm	Mean EPG ± SD	Minimum-Maximum (EPG)	Median
Devín	221.42 ± 258.06	0 – 1050	150
Záhorská Bystrica	935.41 ± 1325.11	50 – 6500	550
Stupava	775.00 ± 1416.88	0 – 6450	350
Veľký Blh	1180.35 ±1123.31	50 – 4200	850
Klokoč	1027.27 ± 599.37	150 – 2000	750
Kopernica	387.50 ± 268.96	50 – 1250	350
Jánova Lehota	513.33 ± 597.34	50 – 3250	300
Branovo	361.11 ± 247.79	50 – 900	300
Gbelce	277.77 ± 396.24	0 – 2100	150
Malý Horeš	697.14 ± 1148.84	0 – 6900	400
Zbehňov	1952.77 ± 1599.17	150 – 6600	1650
Zemplínska Teplica	430.55 ± 383.92	50 – 1450	300
Slanec	1391.66 ± 753.18	500 – 3700	1250
Hanková	998.61 ± 575.96	150 – 2500	900
Silica	520.83 ± 260.18	150 – 1200	450
Tvarožná	1665.27 ± 1356.81	250 – 6850	1350
Proč	675.00 ± 459.25	150 – 2200	550
Rajecké Teplice	315.27 ± 210.28	100 – 1000	250
Turčianske Kľačany	1070.83 ± 667. 01	0 – 1900	350
Biely Potok	1188.88 ± 529.29	200 – 2350	1200
Vlkolínec	872.22 ± 544.60	200 – 2150	650
Čižatice	1425.86 ± 1646.08	0 – 5850	650
Záskalie	2242.42 ± 1418.33	600 – 5850	1700
Beňova Lehota	1656.94 ± 1528.07	150 – 6000	1050
Kláštor pod Znievom	1308.06 ± 1948.03	150 – 11 000	600
Bytča	1597.22 ± 1446.83	150 – 8450	1300
Valča	1713.46 ± 1641. 56	0 – 7750	1250
Kremná	1241.66 ± 815.60	50 – 3350	1250
Šindliar	593.18 ± 592.43	0 – 1900	350
Záborské	491.17 ± 437.31	50 – 2000	450

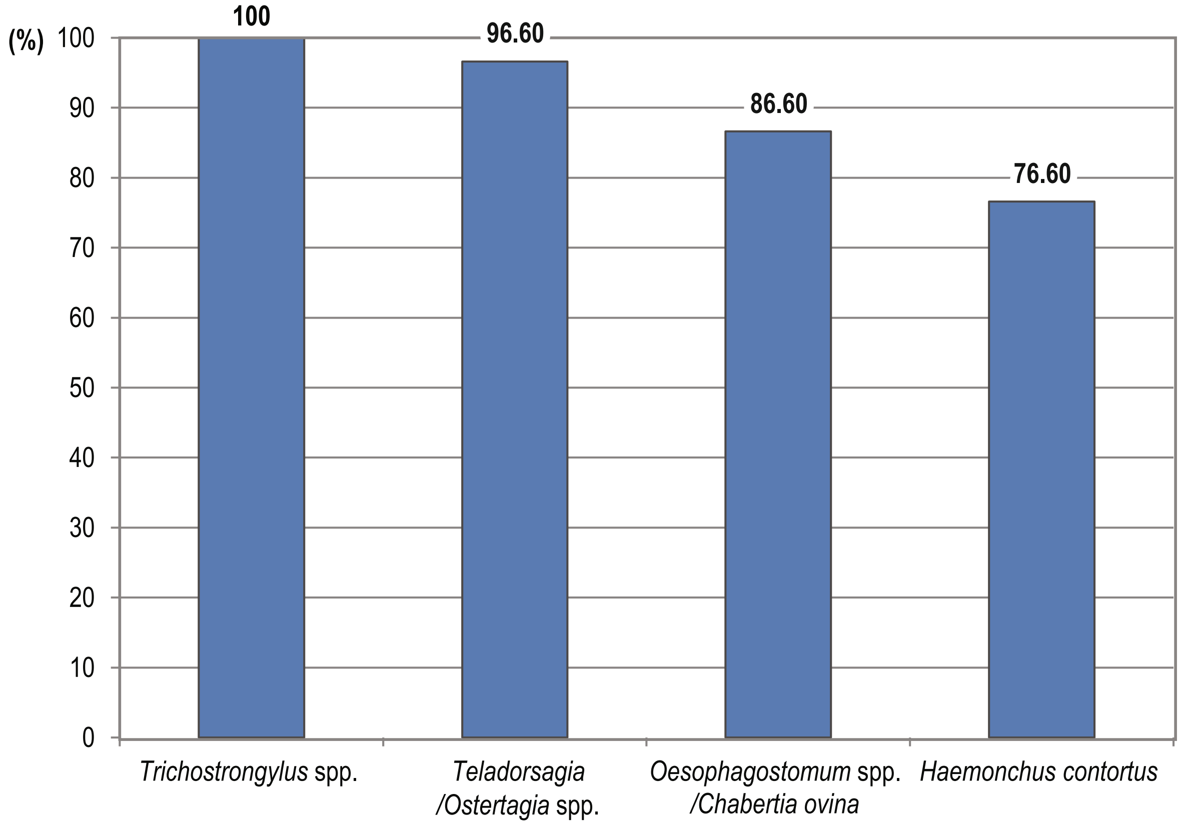

Fig. 3. Presence of L_3 larvae on Slovak goat farms.

Grazing ruminants are usually infected with more than one species of GI parasites. Clinical signs are less common in adult goats but are a source of infection for young animals. The farms in our survey that had mixed infections with *S. papillosus*, *Moniezia* spp., and trichostrongylids had substantial problems with morbidity and mortality in young yeanlings. Identifying *Eimeria* spp. was not the aim of our study, but they were routinely found in the faecal samples. *Eimeria* spp. have been reported on goat farms worldwide (Ruiz *et al*., 2006) and have important roles in mixed GI infections of grazing ruminants.

Similar surveys of parasites on goat farms have been conducted in other European countries. Di Cerbo *et al*. (2010) reported that 96 % of 2,554 samples from 110 goat farms in Lombardy (Northern Italy) were positive for GI parasites. The taxa identified were Strongylida (39.66 %), *Skrjabinema* spp. (24.41 %), *Strongyloides* spp. (15.46 %), *Trichuris* spp. (12.12 %), *Nematodirus* spp. (11.85 %), *Moniezia benedeni* (8.37 %), *Capillaria* spp. (0.54 %), *Marshallagia* spp. (0.07 %), and *Eimeria* spp. (91.94 %). Domke *et al*. (2013) reported 61.10 % prevalence of trichostrongylid eggs in various regions in Norway, with a mean EPG of 154 in 614 goats. Other parasites were *S. papillosus* (11.10 %), *Nematodirus spathiger* (6.50 %), and *N. battus* (5.80 %).

The composition of trichostrongylid L_3 stages on pasture are predominantly influenced by temperature and moisture (O'Connor *et al*., 2006; Manfredi, 2006). We confirmed that *Teladorsagia/Ostertagia* spp. and *Trichostrongylus* spp. were the most common GI parasites on the Slovak goat farms. These genera are typical for countries with cool wet winters, where they survive due their ability to develop at lower temperatures and have intermediate (*Trichostrongylus* spp.) or low (*Teladorsagia circumcincta*) sus-

Table 3. Dominant gastrointestinal infective nematode larvae on Slovak goat farms.

Dominant species	Number of farms	%
Teladorsagia/Ostertagia spp.	18	60.00
Haemonchus contortus	6	20.00
Trichostrongylus spp.	4	13.30
Oesophagostomum spp./*Chabertia ovina*	2	6.70

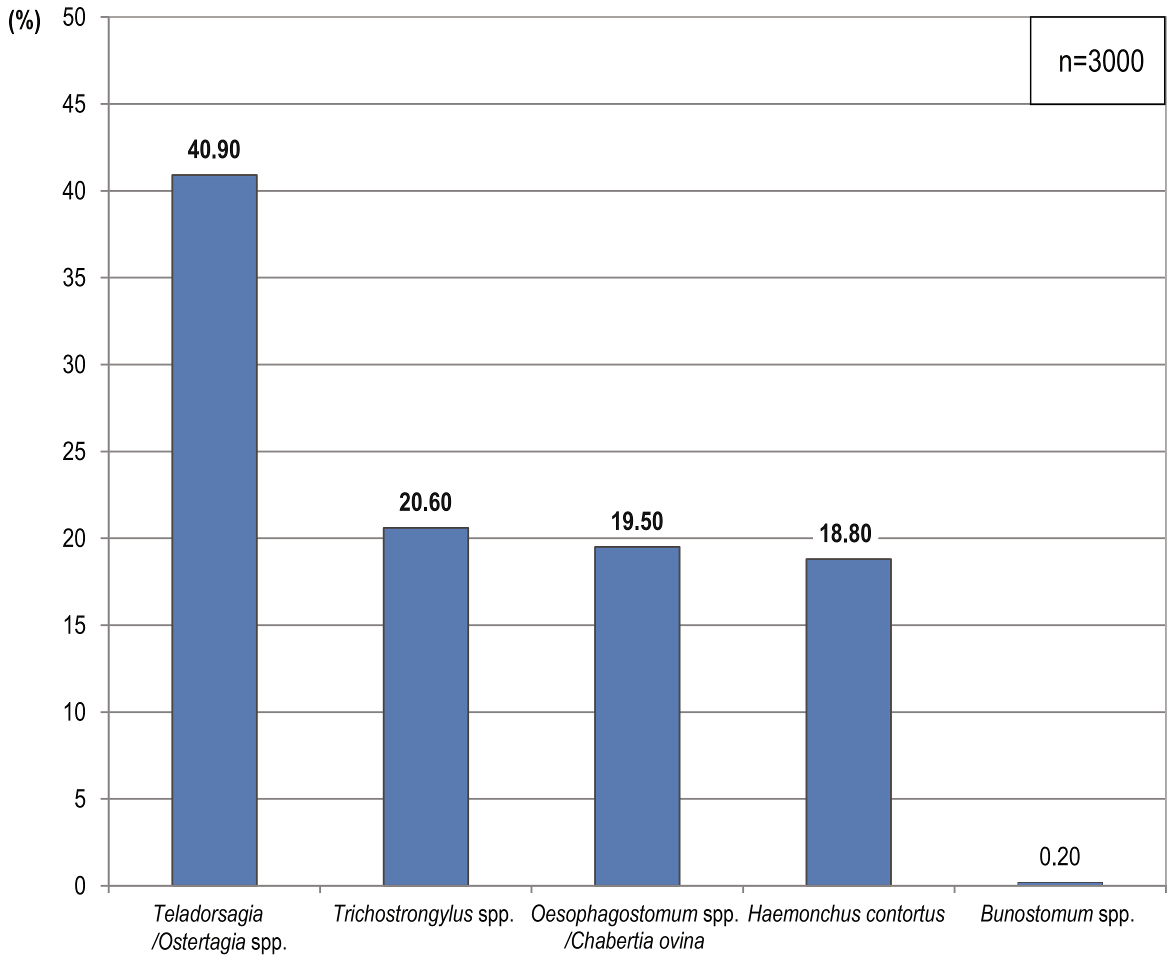

Fig. 4. Percentage of L_3 larvae on Slovak goat farms.

ceptibilities to cold (O'Connor *et al*., 2006). *Teladorsagia/Ostertagia* spp. or *Trichostrongylus* spp. have also been reported as the dominant GI parasites of goats in Greece (Papadopoulos *et al*., 2007), Italy (Zanzani *et al*., 2014), Norway (Domke *et al*., 2013), Turkey (Umur & Yukari, 2005), and Poland (Gorski *et al*., 2004).

H. contortus is a highly fecund blood-feeding parasite dominant in tropical and subtropical areas such as southeastern Asia, southern India, central Africa and America, and northern South America (O'Connor *et al*., 2006). Parasites can also survive winter in colder regions (Waller *et al*., 2004) due to arrested development of fourth-stage larvae (L_4) in the abomasal mucosa of the host. *H. contortus* has been reported in goat herds in Denmark (Holm *et al.*, 2014), Lithuania (Stadaliene *et al*., 2015), Greece (Gallidis *et al.*, 2009), and Switzerland and Germany (Schuerle *et al*., 2009). Data for the prevalence of *H. contortus* in Slovakia are only from surveys on sheep farms. The prevalence in sheep has increased from 26.10 % (Várady & Praslička, 1993) to 48.10 % (Čerňanská *et al*., 2005). *H. contortus* in our survey was found on 76 % of the goat farms, and a morphological differentiation of L_3 larvae estimated that 18.80 % of the total of 3000 larvae examined were *H. contortus*. This parasite is the most pathogenic GI nematode of small ruminants, so these percentages should be a warning for farmers. The first step to reduce the parasite populations on pasture is to understand the differences between goats and sheep and to apply this information.

Goats require a more diverse pasture composition and higher dose rates of anthelmintics for effective treatment (McKenna, 1984; Veneziano, 2004). Using the same doses for both hosts decreases the bioavailability of active drug in goats due their more rapid metabolism (Swan & Gross, 1985; Gokbulut *et al*., 2014). The efficacy of the drug is reduced, increasing the rate of development of anthelmintic resistance in goats, which can then be transferred to sheep (Gillham & Obendorf, 1985). Knowledge of the epidemiology and life cycles of parasites should be an integral part of farm management. Implementation of these approaches can minimize the losses caused by GI parasites on farms of small ruminants.

Table 4. Morphological identification of L_3 larvae on Slovak goat farms.

Farm	L_3 (%)				
	HC	Trich.	Tel./Ost.	Oesoph./Chab.	Bun.
Devín	50	3	16	31	0
Záhorská Bystrica	23	7	56	14	0
Stupava	0	10	72	17	1
Veľký Blh	10	15	66	9	0
Klokoč	31	32	25	11	1
Kopernica	0	13	54	33	0
Jánova Lehota	0	24	8	68	0
Branovo	77	8	10	1	4
Gbelce	91	9	0	0	0
Malý Horeš	4	29	67	0	0
Zbehňov	0	21	79	0	0
Zemplínska Teplica	3	31	56	10	0
Slanec	11	33	41	15	0
Hanková	0	5	52	43	0
Silica	0	2	77	21	0
Tvarožná	0	13	55	32	0
Proč	3	32	49	16	0
Rajecké Teplice	6	5	65	24	0
Turčianske Kľačany	2	28	54	16	0
Biely Potok	7	13	60	20	0
Vlkolínec	16	30	51	3	0
Čižatice	31	28	41	0	0
Záskalie	3	18	35	44	0
Beňova Lehota	18	36	16	30	0
Kláštor pod Znievom	43	27	7	23	0
Bytča	40	28	10	22	0
Valča	6	34	32	28	0
Kremná	61	13	23	3	0
Šindliar	20	26	30	24	0
Záborské	8	46	20	26	0

HC – *Haemonchus contortus*; Trich. – *Trichostrongylus* spp.; Tel./Ost. – *Teladorsagia/Ostertagia* spp.; Bun – *Bunostomum* spp.;
Oesoph./Chab. – *Oesophagostomum* spp./*Chabertia ovina*

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Conflict of Interest

We declare no conflicts of interest.

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