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PREVALENCE AND INTENSITY OF INFECTION WITH GASTROINTESTINAL NEMATODES IN SHEEP IN EASTERN SERBIA

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A coprological examination of 680 grazing sheep was performed in Eastern Serbia from March 2011 to November 2012 in order to determine the presence of gastrointestinal (GI) nematode parasites. Fecal samples were randomly collected and examined by using qualitative and quantitative coprological techniques. It was found that 74.56% sheep were infected. Samples that contained nematode eggs were processed for larval development and eleven nematode genera were identified: Haemonchus (46.91%), Ostertagia (25.88%), Marshallagia (21.91%), Cooperia (14.12%), Trichostrongylus (39.85%), Nematodirus (35.88%), Bunostomum (23.97%), Strongyloides (17.06%) Oesophagostomum (40.73%), Chabertia (32.79%) and Trichuris (10.88%). Higher prevalence of infection was observed in females ($p<0.01$), as well as in adults ($p<0.001$). Regarding the intensity of infection, in 40.63% sheep it was low, in 51.87% moderate and in 7.50% high. There was no difference in intensity of infection considering sex and age of animals. Moreover, simultaneous infection with different number of nematode genera was dependent on sheep's age ($p<0.001$). These results suggest that GI nematodes are a conspicuous problem of grazing sheep in the study area.

Key words: Eastern Serbia, gastrointestinal nematodes, sheep

INTRODUCTION

Gastrointestinal parasitism in sheep is a substantial problem to farmers worldwide. Being the limiting factor of sheep productivity, GI nematodes have a highly detrimental effect on the sheep industry (Coop and Holmes, 1996; Jones, 2001), resulting in significant economic losses in meat, milk and wool production, as well as in sheep reproduction (Levya *et al.,* 1982; Urquhart *et al.,* 1996; Hayat *et al.,* 1996; Suarez *et al.,* 2009).

Sheep breeding based exclusively on pasture increases the risk to many infections, especially for those caused by parasites. Spending much time on uncultivated pastures, sheep are continuously exposed to many nematode eggs,

larvae and intermediate hosts of various parasitic worms. In addition, survival and development of free-living stages of nematode larvae are highly affected by climate and pastures management, influencing the change in nematode epidemiology (Morgan and van Dijk, 2012).

There were approximately 1.5 million sheep in Serbia in 2011 (Statistic Office of the Republic of Serbia), raised mainly in its Central part (about 1.2 million). Sheep farming plays a prominent role in the economy of Eastern Serbia being the major source of income for people living in villages. However, the extensive way of sheep raising in this part of Serbia is almost the rule, including individuals of different sex and age on the same pasture. Besides, anthelmintic treatment is just occasionally applied.

Any comprehensive study considering the importance of nematode infections and their distribution in sheep in Eastern Serbia has not recently been conducted. Therefore, the main objectives of this study were to assess the prevalence and intensity of infection caused by GI nematode genera in sheep depending on sex and age of animals.

MATERIAL AND METHODS

The study was conducted in Eastern Serbia from March 2011 to November 2012. Grazing sheep of both sexes (215 males and 465 females, a total of 680) were randomly chosen. There were 408 adults (one-year-old and above) and 272 lambs. Rotational grazing in the study area was not practiced.

Fecal samples were collected directly from the rectum of each animal or, when possible, during defecation. In the laboratory they were subjected to the flotation technique with saturated sodium chloride solution (MAFF, 1986). Positive fecal samples were further processed in McMaster chambers to identify the egg counts of GI nematodes and the degree of infection was assessed according to Soulsby (1982). Animals were categorized as low, moderate and highly infected depending on the nematode egg per gram (EPG) counts. Egg counts from 50 to 799, 800 to 1200 and over 1200 per gram of feces were considered to result from low, moderate and high infection, respectively. None of the sheep examined were dewormed 60 days prior to sampling.

Samples positive for nematode eggs were processed as described by van Wyk *et al.* (2004) in order to identify the third-stage (L3) nematode larvae according to the same authors.

Statistical analysis

The data obtained were analyzed using Chi-square test (χ^2) to determine if the prevalence and intensity of GI nematode infection depend on sex and age of the animals. In all the analyses, confidence level was held at 95%. The results are given in tables and figures.

RESULTS

Gastrointestinal nematode eggs were found in 507 (74.56%) out of 680 sheep examined. In the infected animals, eleven GI nematode genera were identified: *Haemonchus, Ostertagia, Marshallagia, Cooperia, Trichostrongylus, Nematodirus, Bunostomum, Strongyloides, Oesophagostomum, Chabertia* and *Trichuris*. The most prevalent genus was *Haemonchus* (Table 1).

Table 1. Prevalence of GI nematode genera in sheep in Eastern Serbia

Nematode genera identified	Prevalence (in 680 sheep)	
	No	%
Haemonchus	319	46.91
Ostertagia	176	25.88
Marshallagia	149	21.91
Cooperia	96	14.12
Trichostrongylus	271	39.85
Nematodirus	244	35.88
Bunostomum	163	23.97
Strongyloides	116	17.06
Oesophagostomum	277	40.73
Chabertia	223	32.79
Trichuris	74	10.88
Total infected	507	74.56

Table 2. Prevalence of infection with GI nematodes in relation of sex and age of sheep

Sex	Age	Total No.	Positive No.	Prevalence (%)
Male	Adult	143	128	89.51
	Young	72	18	25.00
	Total	215	146	67.91
Female	Adult	265	246	92.83
	Young	200	115	57.50
	Total	465	361	77.63
Male and female	Adult	408	374	91.67
	Young	272	133	48.90
	Total	680	507	74.56

According to Chi-square test, the prevalence of infection significantly differed between sexes (χ^2=7.33, p<0.01) as well as between sheep of different age (χ^2=155.14, p<0.001). In addition, a significant difference was observed among males of different age (χ^2=88.51, p<0.001) as well as among females (χ^2=79.91, p<0.001) (Table 2).

The intensity of infection was low in 206 (40.63%) sheep, moderate in 263 (51.87%) and high in 38 (7.50%) individuals. Chi-square test showed there was no influence of sex and age of sheep (χ^2=2.923, p>0.05 and χ^2=0.697, p>0.05, respectively) on intensity of infection (Table 3 and 4).

Table 3. Intensity of infection with GI nematodes in relation to the sex of the sheep

Sex	Intensity of infection			Total
	Low	Moderate	High	
Male	67 (45.89%)	71 (48.63%)	8 (5.50%)	146 (28.80%)
Female	139 (38.50%)	192 (53.19%)	30 (8.31%)	361 (71.20%)
Total	206 (40.63%)	263 (51.87%)	38 (7.50%)	507 (100.0%)

Table 4. Intensity of infection with GI nematodes in relation to the age of the sheep

Age	Intensity of infection			Total
	Low	Moderate	High	
Adult	148 (39.57%)	197 (52.67%)	29 (7.75)	374 (73.77%)
Young	58 (43.61%)	66 (49.62%)	9 (6.77%)	133 (26.23%)
Total	206 (40.63%)	263 (51.87%)	38 (7.50%)	507 (100.0%)

Sheep of both sexes were similarly arranged according to the number of nematode genera identified (χ^2=7.945, p>0.05), whereas distribution of individuals was highly dependent of their age (χ^2=27.887, p<0.001). There were 94 sheep infected with only one nematode genus and polyparasitism was observed in as many as 413 sheep. Simultaneous presence of six different nematode genera was detected in only 15 sheep, whereas the vast majority of animals were infected with two nematode genera (Table 5 and 6, Figure 1 and 2).

Table 5. Distribution of infected sheep of different sexes in relation to the number of nematode genera identified

Sex	No. of nematode genera						Total
	1	2	3	4	5	6	
Male	20 (13.70%)	52 (35.62%)	46 (31.51%)	15 (10.27%)	9 (6.16%)	4 (2.74%)	146 (28.80%)
Female	74 (20.50%)	140 (38.78%)	75 (20.78%)	39 (10.80%)	22 (6.09%)	11 (3.05%)	361 (71.20%)
Total	94 (18.54%)	192 (37.87%)	121 (23.87%)	54 (10.65%)	31 (6.11%)	15 (2.96%)	507 (100.0%)

Table 6. Distribution of infected sheep of different age in relation to the number of nematode genera identified

Age	No. of nematode genera						Total
	1	2	3	4	5	6	
Adult	57 (15.24%)	130 (34.76%)	103 (27.54%)	42 (11.23%)	28 (7.49%)	14 (3.74%)	374 (73.77%)
Young	37 (27.82%)	62 (46.62%)	18 (13.53%)	12 (9.02%)	3 (2.26%)	1 (0.75%)	133 (26.23%)
Total	94 (18.54%)	192 (37.87%)	121 (23.87%)	54 (10.65%)	31 (6.11%)	15 (2.96%)	507 (100.0%)

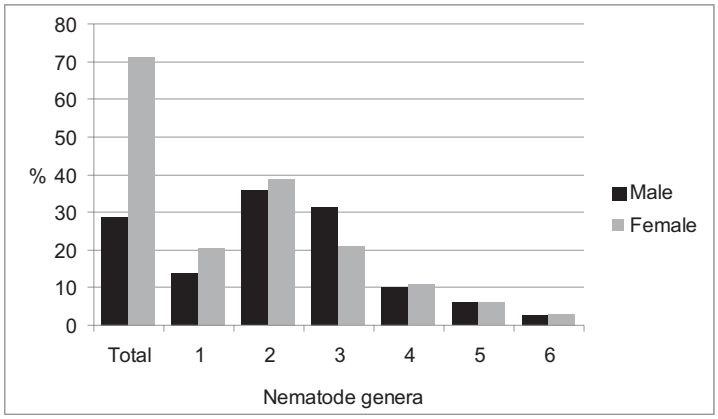

Figure 1. Number of GI nematode genera in relation to sex

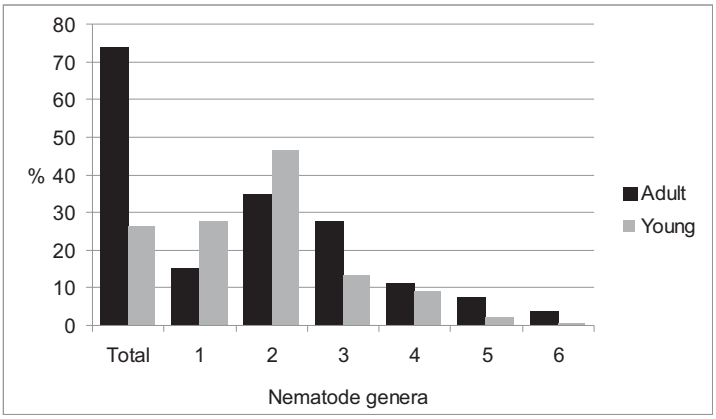

Figure 2. Number of GI nematode genera in relation to age

DISCUSSION

The present study revealed that 74.56% of grazing sheep examined in Eastern Serbia were infected with GI nematodes. This finding indicates that nematodoses are significant problem of sheep, strongly affecting their well being.

In our study, higher prevalence of infection was observed in adults than in young animals. This could be the result of longer exposition of adult sheep to the parasite eggs and larvae during several grazing seasons. Besides, females were more susceptible to GI nematodes than males. In a previous study (Ilić and Dimitrijević, 2005) the prevalence of nematodoses in sheep varied between 46.37% and 70.24% depending on the study area.

In order to prevent GI parasitic infections and decrease the economic losses, seasonal anthelmintic treatments should be performed. On the other hand, sustainable control of sheep nematodes has been seriously jeopardized by existing of widespread resistance to anthelmintic drugs (Kaplan, 2004; Papadopoulos, 2008; Papadopoulos *et al*., 2012). Therefore, there is a need for new strategies in control of nematode infections in sheep that should replace conventional, unsustainable chemical-based method (Sayers and Sweeney, 2005; Waller, 2006; Torres-Acosta and Hoste, 2008).

In our study, the intensity of infection was mostly low to moderate, with no statistical significance among sheep of different sex and age. This is in line with the previous study of Idris *et al*. (2012).

Detection of eleven nematode genera indicates the high level of pasture contamination with nematode eggs or larvae due to constant cohabitation of different sex and age groups of sheep. Moreover, inadequate pasture management contributes to the high prevalence of nematode infection (Lindqvist *et al*., 2001). In addition, the most prevalent nematode genera were *Haemonchus, Oesophagostomum, Trichostrongylus, Nematodirus* and *Chabertia*, similar to the

results in other studies (Pedreira *et al*., 2006; Tariq *et al*., 2008; Mederos *et al*., 2010; Idris *et al*., 2012).

According to the number of parasite genera identified, adult sheep were arranged significantly different than the young ones, although two nematode genera were simultaneously detected in most of the animals.

It can be concluded that infections with GI nematodes are significant problem of sheep in Eastern Serbia. Thus, appropriate education, control and prevention strategies should be applied to reduce the prevalence and intensity of the parasitic infection.

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PREVALENCIJA I INTENZITET INFEKCIJE GASTROINTESTINALNIM NEMATODAMA KOD OVACA U ISTOČNOJ SRBIJI

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SADRŽAJ

U periodu od marta 2011. do novembra 2012. godine, na teritoriji Istočne Srbije sprovedeno je koprološko ispitivanje 680 ovaca držanih u pašnom načinu gajenja na prisustvo gastrointestinalnih (GI) nematoda. Uzorci fecesa uzimani su metodom slučajnog uzorka i ispitivani korišćenjem kvalitativnih i kvantitativnih koproloških tehnika. Ispitivanjem je utvrđeno 74,56% inficiranih ovaca. Uzorci u kojima su pronađena jaja nematoda podvrgnuti su determinaciji larvi, pri čemu je identifikovano jedanaest rodova nematoda: *Haemonchus* (46,91%), *Ostertagia* (25,88%), *Marshallagia* (21,91%), *Cooperia* (14,12%), *Trichostrongylus* (39,85%), *Nematodirus* (35,88%), *Bunostomum* (23,97%), *Strongyloides* (17,06%) *Oesophagostomum* (40,73%), *Chabertia* (32,79%) i *Trichuris* (10,88%). Veća prevalencija infekcije uočena je kod ženki ($p<0,01$), kao i kod adultnih životinja ($p<0,001$). Kod 40,63% ovaca, infekcija je bila niskog, kod 51,87% umerenog, a kod 7,50% visokog intenziteta. Nisu dokazane razlike u intenzitetu infekcije u zavisnosti od pola i starosti životinja. Istovremena infekcija sa više rodova nematoda zavisila je od starosti ovaca ($p<0,001$). Dobijeni rezultati upućuju na zaključak da su GI nematode značajan problem ovaca držanih na pašnjaku u ispitivanom području.