CHAPTER 14

GASTROINTESTINAL HELMINTHS OF SHEEP BREED IN SPREAD BELGRADE AREA

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INTRODUCTION

Breeding of sheep represents a significant branch of livestock production. Despite the fact that the number of sheep in the social and individual sector of production varies from time to time, this branch of the economy and its improvement is given exceptional attention. The reason for this lies not only in tradition, but also in the knowledge that the breeding of small ruminants represents national wealth, both due to the production of wool and milk, as well as sheep and lammb meat, which is a highly sought after item on the world market.

The improvement of this production is related to solving a number of different problems, which aim primarily to increase the economy while preserving the health and well-being of the animals. As part of these tasks, primary attention must be paid to health care.

There are many factors that contribute to the appearance, maintenance and spread of parasitosis. Among them are: joint keeping of animals of different age categories, joint grazing of animals of different age categories often of different owners, a large number of animals of older categories - carriers of a significant number of parasites, favorable climatic conditions for the development and survival of paraparasitic stages and transitional hosts that are necessary for the development of certain a type of parasite in the external environment, and therefore the infection of animals.

The absence or inadequate implementation of control measures also contributes to the prevalence of parasitosis. The lack of enlightenment of the population, primarily livestock farmers, is one of the significant factors in the epizootiology of these diseases. The grazing diet allows sheep to have constant contact with transitional hosts (oribatids, molluscs, etc.) and eggs and larval forms of parasites, so that there is no sheep that is not infected with at least one parasite species. Based on research in the world and in our country, diseases of parasitic etiology dominate in sheep both in terms of prevalence and incidence, and are accompanied by significant morbidity and moderate mortality.

The damage that occurs in sheep production is a consequence of the negative pathogenic effects of parasites on the host organism. In favorable conditions for the development and survival of the preparasitic stages in the external environment, conditions are created for infections of greater intensity, often with a greater number of parasite species, with different localization in the host organism. The consequence of this is the development of a clinically manifested disease, with the death of a large number of individuals, most often among the younger categories. The fact is, however, that in most cases, parasitic infections occur subclinically, that is, “imperceptibly” to the eye of the herdsman. Negative economic effects are also present in these situations and are manifested by a decrease in animal production, i.e. a decrease in the production of wool and milk, a poorer upbringing of the young, a decrease in general body resistance, i.e. an increased susceptibility to agents of other etiologies.

GASTROINTESTINAL HELMINTHS OF SHEEP

Distribution of gastrointestinal helminths in sheep

Numerous literature data support the fact that gastrointestinal shelminths is the most common parasitic disease of small ruminants. All over the world, an extremely large number of older animals are infected with a large number of species of nematodes that participate in the etiology of this disease. It is of even greater importance that the infection of the young that occurs already in the first months of life. At the same time, adults are the main contaminant of pastures and are responsible for maintaining parasitic infections in herds. Parasitic gastroenteritis of ruminants is a disease caused by a large number of nematode species from the genera *Strongilidae*, *Trichostrongylidae* and *Ancylostomidae*. The disease is related to the grazing diet and the biological cycle of the parasite, which takes place without transitional hosts.

These studies were carried out in the north of Europe, where sheep and goat breeding were developed. In southern Greenland, sheep were dominated by *Nematodirus* spp. *Trichostrongylidae* spp. and *Ostertagia* spp. In Iceland, during the slaughter season, which lasts from September to October, they examined the kid and established an infection with *Teladorsagia* spp., *Trichostrongylus* spp., *Nematodirus* spp. *Oesophagostomum* spp. In Sweden, they investigated the distribution and eradication possibilities of *Haemonchus contortus*, and in Poland, they investigated the excretion of parasite eggs in sheep feces and their role in pasture contamination, as well as the prevalence of certain helminthosis in sheep herds in that country.

In Western Europe, these studies were most present in countries with a long tradition of sheep production. In the British Isles, in Scotland, researches have shown the influence of climatic variations on the prevalence and distribution of certain helminthosis of sheep, especially *Haemonchus contortus, Nematodirus* spp. and *Trichostrongylus* spp., while studies of the natural dynamics of occurrence of gastrointestinal nematodes in sheep in England have established that it is more similar to the dynamics of occurrence in the continental part of Europe than in other parts of the British Isles. in France) found that in small ruminants the highest prevalence of nematodes from the genera *Ostertagia* spp., *Trichostrongylus* spp., *Nematodirus* spp., *Bunostomum* spp., *Capillaria* spp. and *Trichuris* spp. Differences in the distribution of individual types of helminths in the investigated areas were not significant due to the uniform microclimate in them.

In the Mediterranean area, where goat and sheep breeding is one of the main economic branches, extensive research was also conducted that monitored the prevalence of helminths in sheep during the grazing season, concluding that the seasonal variation is directly correlated with external conditions and that it reaches its peak at the beginning and end of the grazing season and that it depends on the type of helminth. In sheep and goats in Sicily, they established the presence of *Trichostrongylus* spp., *Nematodirus* spp., *Oesophagostomum* spp. and *Chabertia ovina*. In Spain, they investigated the etiology and epizootiology of gastrointestinal strongylids in the Toledo area and followed the occurrence of these parasites in goats in the dry areas of central Spain. The conclusion is that the seasonal distribution is certainly more significant in areas that are less susceptible to drying out and that are not conducive to the development of trichostrongylid larvae.

In the Western Balkan these studies were carried out in Macedonia, Bulgaria and Romania. The obtained results indicate that in lambs, infection with gastrointestinal nematodes is established very quickly after leaving for pasture, and that polyparasitism occurs as a regular occurrence in sheep and goats and is caused mostly by nematodes from the genus *Nematodirus* spp. *Trichostrongylidae* and *Strongyloides* spp.

In the Middle East, these studies are also in the center of attention due to the large number of herds of goats and sheep conditioned by climatic and religious factors. In Syria, the presence of *Haemonchus contortus, Ostertagia* spp. and *Trichostrongylu* spp. as the dominant parasite species of sheep and goats, and in sheep in Jordan, they came to the conclusion that representatives of the same genera dominate here as well. Research into the helminofauna of sheep and goats in Turkey has established that it does not fundamentally differ from neighboring countries in terms of composition and seasonal distribution.

African countries also have widespread farming of small ruminants. Climatic (deserts, semi-deserts, droughts, etc.), religious (large number of Muslim population) and economic conditions (most of the population is on the brink of existence and keeping goats or sheep is the most profitable form of livestock production with the least investment) caused the presence of a large number of small herds along the entire African continent. In Morocco and Egypt, representatives of the genera *Haemonchus, Ostertagia* spp., and *Trichostrongyloidea* were identified as the most numerous species. In Ethiopia and Nigeria, he established the presence of *Haemonchus contortus, Trichostrongylus* spp., *Oesophagostomum* spp., *Cooperia* spp. and *Bunostomum trigonocephalum.* In his research, he states that mixed infections were the most common. In sheep in the southern forest regions of Ivory Coast, infections with *Haemonchus contortus, Trichostrongylus* spp., O*esophagostomum* spp., *Cooperia* spp. and Nematodirus spp. as well as in sheep in Kenya and Cameroon. An identical faunistic composition of the parasite was also found in the very south of Africa, in sheep, goats and unborn lambs.

In Asia, sheep farming conditions are similar to helminth species. One part of the findings refers to research carried out in the former USSR, and then in Russia. However, the countries of the Indian subcontinent, Pakistan, India and Bangladesh, are certainly leading in this regard. In that area, the dominant species of nematodes are from the genera *Haemonchus, Trichostrongylus* spp., *Oesophagostomum* spp. and *Nematodirus* spp. In goats in Mongolia, the highest prevalence and intensity of infections was caused by nematodes from the genera *Ostertagia* spp., *Marshallagia* spp., and *Nematodirus* spp. In the People's Republic of China, research indicated that the highest prevalence and intensity of infections was with *Ostertagia* spp., *Trichostrongylus* spp,, *Trichocephalus* spp. and *Nematodirus* spp.

The American continent is not spared from the presence of gastrointestinal strongylids. They are a constant health problem for sheep and goats. In the USA, a large number of researches were carried out as part of the US Food and Drug Administration experiment. The conclusion of the research is that the most common gastrointestinal strongylids from the genera *Nematodirus* spp. *Trichostrongylidae, Haemonchus contortus* and *Strongyloides papillosus.*

In South America, the situation is very similar. Small herds of sheep and goats are most often present along the high slopes of the Andes, and in smaller numbers on the pampas plains. As for the seasonal dynamics, it is identical to that occurring in Central European herds, and the parasitofauna is within the known strongylid species (*Ostertagia, Teladorsagia, Marshallagia, Haemonchus contortus, Nematodirus, Trichostrongylus, Bunostomum, Cooperia,* and *Oesophagostomum*), with several species within them, whose distribution is within the ecological valence of the environment.

In Australia, the dominant parasitic species are represented by certain species from the genera: *Ostertagia* spp., *Haemonchus, Trichostrongylus* spp., and *Chabertia*, while in certain areas of New Zealand representatives of the genera dominate: *Ostertagia* spp., *Cooperia* spp., *Oesophagostomum* spp., *Trichostrongylus* spp., and *Bunostomum* spp.

Biology characteristic of gastrointestinal helminths in sheep

Parasitic gastroenteritis of ruminants is a disease caused by a large number of nematode species from the genera *Strongilidae, Trichostrongylidae* and *Ancylostomidae*. The disease is related to the grazing diet and the biological cycle of the parasite, which takes place without transitional hosts.

Those genera include numerous subgenera, such as *Ostertagia*, *Teladorsagia*, *Haemonchus*, *Trichostrongylus*, *Cooperia*, *Nematodirus*, *Mecistocirrus*, *Bunostomum*, *Oesophagostomum*, and *Chabertia*. At the typical diagnostic stage, these trichostrongyle parasites (eggs on fecal flotation) are indistinguishable. Their life cycles are generally the same, differing only in slight nuances, such as the length of each stage, their location in the GI tract of adults, or their preferred environmental temperature ranges. Life cycles of all the trichostrongyles are direct and rely on animals to graze contaminated pastures to initiate infection. For these reasons, their diagnosis, treatment, control and prevention are very similar.

The developmental cycle of the parasite is straightforward. Females lay eggs that are eliminated in the external environment with feces. It is considered that the most fertile female is *H.contortus*, which lays 5,000-10,000 eggs per day. The eggs are of the strongylid type, 60-110 μm in size, with 8-16 (32) blastomeres. Eggs of *Nematodirus* spp. are 2 times larger, 130-260 μm, with 4-8 blastomeres. L3 of this species develop in eggs. In the external environment, embryogenesis, hatching of larvae, their molting and formation of infectious L3 occur. The infection is peroral through contaminated food or water, L3 enter the wall of the appropriate part of the digestive tract - the histotropic phase of development, and then return to the lumen and become adults. *Bunostomum* spp. percutaneous and p/o a L3 infection follow pulmonary-tracheal migration. The prepatent period is different for different species: *Oesophagostomum* usually 4-6 weeks, *Chabertia* 5-7 weeks, *Trichostrongylidae* 2-3 weeks, (if hypobiosis of the larvae in the mucosa has occurred, then adults emerge 4-6 months later). Bunostomum 40 -60 days. Parasites live in the host for several months to 1-2 years.

The development of eggs and larvae, as well as the activity of L3, depends on temperature, humidity, oxygen and sunlight. Temperature: *H.contortus* optimal temperature for egg embryonation and formation of L3 is 35^{o}C; eggs of *Ostertagia, Trichostrongylus* and *Oesophagostomum* spp. embryonate at a temperature below 26^{o}C, but for a longer time. They are more resistant to lower temperatures and desiccation - embryonation of eggs and hatching of larvae takes place even at 5^{o}C. Eggs of *Ostertagia* spp. survive 20 days at -5^{o}C. For embryonated eggs of *Nematodirus* spp. the optimal temperature is 21^{o}C.

Embryonic development in eggs depends on soil moisture, atmospheric precipitation (dew). The position of the eggs in the breech, i.e. blocks of faeces, helps the survival of the eggs in many ways. Infectious L3 are negatively geotropic and positively phototropic to moderate sunlight intensity. The humidity of the environment is necessary for their activity and the length of their survival in the external environment depends on it - during the winter and hot summers, the largest number of larvae die. The most infectious larvae are found on plants in April and September, less in May and October, and the least in July and August.

In natural conditions, every animal is infected - constant contamination of the pasture. This is contributed by the increased susceptibility of the already infected herd, the introduction of susceptible animals into the infected herd and the increase in the intensity of the infection in the already infected herd. Immunity is developed through continuous infections and then there is the elimination of the present parasites (self cure mechanism), complete or partial inhibition of the development of newly introduced larvae (spring rise) and complete or partial inhibition of the reproductive abilities of female parasites (spring rise). The seasonal dynamics of certain types of parasites, the degree of infection and the occurrence of diseases vary not only in different areas but also in the same area during the year. The parasite-host relationship is complex: physiological state and general condition, cultivation and feeding method, lambing time, soil configuration and macroclimate.

Recommendations for pasture rest times can be based on these factors; pastures can be rested for shorter periods of time when it is hot, but they need to be rested for longer periods of time in cool, dry weather. Similarly, humid, mild temperatures and rainfall events in temperate-arid climates increase the success of trichostrongyles and accelerate the rate of their development on pasture. Increased monitoring is required during these high-risk periods. In addition, trichostrongyles require vegetation to complete their life cycle, so animals on a dry lot will have a substantially decreased risk of detrimental infection.

Pathological importance of certain types of gastrointestinal helminths

Most GI parasite infections in ruminants are mixed, with several genera infecting a single animal. Notable exceptions are haemonchosis and type II ostertagiasis . In general, clinical signs are present in only a small proportion of a group of animals, even though all the animals have GI parasites. The clinical signs associated with GI parasitism are typically nonspecific and manifest as a chronic, slowly progressive illness unless a very high infectious dose is encountered or other concurrent risk factors are present.

Heavily infected animals experience gradual weight loss or decreased weight gain (in the case of young animals), ill thrift, gradually decreasing milk production, and poor hair coat. More severely affected animals show lethargy and weakness, and they may spend more time away from the group or lying down. Emaciation may occur in long-standing cases because of inappetence that progresses to anorexia, as well as poor nutrient absorption. Chronic GI parasitism may also predispose animals to secondary infections (bacterial, viral, fungal) that they would normally be able to resist.

Whether or not the animal has diarrhea, heavy GI parasitism causes a protein-losing enteropathy as a result of either increased loss from diarrhea or decreased absorption from direct damage to the mucosa by the parasites. Clinical signs of hypoproteinemia might include submandibular edema (bottle jaw) or ventral edema. In addition to inadequate protein absorption, heavily parasitized ruminants are likely to show poor absorption of critical vitamins and minerals from their diet.

Bloodsucking species of trichostrongyles (eg, *Haemonchus* spp) cause severe anemia; however, some anemia can also be found with most heavy trichostrongyle infections. Because trichostrongyles use cutting or slicing mouthparts to attach to abomasal or intestinal mucosa, blood can leak from these sites. Clinical anemia is commonly chronic, and many animals can compensate until their hematocrit is < 10%. Severe anemia presents as cardiovascular collapse: increased heart rate, increased respiratory rate and effort (open-mouth breathing, cheek puffing), poor perfusion, cold extremities, and sudden death. Acute decompensation may follow a quicker clinical course after heavy exposure (eg, after large rainfall events that accelerate larval development), or after an animal with chronic parasitism reaches critical levels of anemia, hypoproteinemia, and/or emaciation.

Oesophagostomosis

Oesophagostomum larvae develop in the mucosa and submucosa of the colon (cecum and colon) but also in the ileum, causing loss of blood and plasma proteins due to severe inflammation of the mucosa. Clinical symptoms isfever, diarrhea, inappetence and weight loss, death; in older categories - chronic course - with less pronounced symptoms, decline in productive abilities; solid immunity develops, but reinfections can lead to acute allergic enteritis (type III hypersensitivity) in the proximal part of the colon with eosinophilic infiltration, profuse secretion and hypertrophy. The larvae in the nodules cause acute ulcerative colitis, and the chronic course leads to death. Clinical signs are loss of appetite andanemia.

Chabertiosis

Infections with *Chabertia ovina* are usually of moderate intensity. Adults and larvae do not suck blood but may ingest some if a blood vessel is damaged. Nevertheless they harm the gut's lining where they attach, whereby they often change their attachment site multiplying the lesions. These causes small but numerous local ulcers, sometimes also bleeding, which can be significant in case of massive infections. In case of high intensity infection (over 800 parasites in small ruminants), colitis occurs and death is possible. Heavy infection with *Chabertia ovina* adults can severely damage the mucosa of the colon, with resulting congestion, ulceration, and small hemorrhages. Infected small ruminants are unthrifty, and their feces are soft, contain mucus, and may be streaked with blood. Immunity develops quickly, and outbreaks occur only in young animals or under conditions of severe stress.

Bunostomosis

It occurs frequently, and the parasites are highly pathogenic; animals at the age of 5-8 months are most often infected. An infection with 20-100 and the death of lambs is caused by 500-600 parasites leading to the manifestation of clinical symptoms. Clinical symptoms are anemia (they feed on blood and have a negative effect on hematopoietic), inappetence, weight loss, diarrhea with mucus and blood, hypoproteinemia, edema in the subjaw area, cachexia and will die.

Trichostrongylidosis

Heavy infections with *Trichuris* spp (whipworms) are not common; however, they may occur in young lambs or kids or during drought conditions when animals are fed supplemental feed on the ground. The eggs are very resistant to environmental conditions and can remain persistent on farms with contamination. Congestion and edema of the cecal mucosa develop, accompanied by diarrhea and unthriftiness. Both, larvae and adult parasites cause pathogenic effects. The course of the infection depends on the number of parasites and the species are hematophagous and pathogenic, the age and diet of the host; the disease manifests itself in animals younger than two years. The main pathogenic effects are hyplastic gastritis and catarrhal enteritis.

Ostertagiosis

The parasitized glands of the gastric mucosa are destroyed; the cells that produce HCl are destroyed, protein digestion stops, pepsinogen cannot be converted into pepsin and therefore appears in the plasma (the permeability of the damaged mucosa is increased), which leads to the release of plasma proteins into the lumen of the abomasum and peripheral edema. The lesions are in the form of whitish raised nodules that merge, so the abomasal mucosa looks like cracked skin.

Hemonchosis

Acute course induce hemorrhagic anemia (normocytic hypochromic), dark-colored feces - melena, edema, general serious condition, decline in quality and quantity of wool and sudden death. Chronic course: inappetence, progressive weight loss, general serious condition, anemia, diarrhea rarely occurs, constipation is even more common.

Nematodirosis

Nematodirosis is characterized by sudden-onset unthriftiness, profuse diarrhea, and marked dehydration, with death as early as 2–3 days after an outbreak begins. Nematodirosis is commonly confined to lambs or weaner sheep, but in low-rainfall country where outbreaks are sporadic, older sheep may have heavy infections. Nematodirosis lesions usually consist of dehydration and a mild catarrhal enteritis; however, acute inflammation of the entire small intestine may develop. Counts of ≥ 10,000 worms, together with characteristic clinical signs and history, are indicative of clinical infections. Affected lambs may pass large numbers of eggs, which can be identified easily. If the onset of disease precedes maturation of the female worms, eggs will not be identified on fecal examination.

Trichostrongylosis

Anorexia, persistent diarrhea, and weight loss are the main clinical signs of *Trichostrongylus* infection. Villous atrophy (or stunting of villi) impairs digestion and malabsorption; protein loss occurs across the damaged mucosa.In these infections, dark hemorrhagic diarrhea with weight loss is typical. Infection of lambs with thet parasite has particular pathogenic significance in some regions; a sudden increase in L3 on pasture during May and June can lead to high-intensity lamb infections and outbreaks of clinical symptoms. The parasite can be highly pathogenic because large numbers of larvae hatch over a short period at a time when young lambs are beginning to consume sizable quantities of grass. Disease may be associated with developing larval stages and may occur within 2 weeks of challenge (the prepatent period is 15 days).

Cooperiosis

Infection with *Cooperia* spp. hada clinical signs are diarrhea (aqueous, green or black) with subsequent dehydration and weight loss as a consequence of poor food conversion. Other signs are the same as for other gastrointestinal roundworms: apathy, loss of appetite, reduced weight gains, etc. Massive infections are particularly harmful for young animals, which can become anemic. L4 larvae and adults burrow into the gut's wall, particularly in the first part (duodenum) and harm the tissues and blood vessels, but do not suck blood. As a general rule, *Cooperia* worms are less harmful than other gastrointestinal worms such as *Haemonchus* and *Ostertagia*. However, they worsen the damaged caused by other worms.

Skrjabinemosis

Skrjabinema ovis are usually nonpathogenic pinworms. Adults are 8–10 mm long and live in the rectum and anus. Clinical signs include possible anal pruritus.

Localization of the most important gastrointestinal strongylids of sheep

genus	species	host	localisation
Strongilidae	*Oesophagostomum. venulosum*	small ruminant	large intestine
	Oe. columbianum	small ruminant	
	Chabertia ovina	small ruminant	
	Haemonchus contortus	small and large ruminant	
	Ostertagia circumcincta	mali preživari	abomasus
	Ost. ostertagi	small and large ruminant	
Trichostrongylidae	*Trichostrongylus axei*	small and large ruminant	small intestine
	Trich.colubriformis	small ruminant	
	Cooperia curticei	small ruminant	
	Coop. punctata	small ruminant	
	Cooperia oncophora	small and large ruminant	
	Nematodirus filicolis	small ruminant	
	Nem. Spatiger	small ruminant	
	Nem. Battus	small ruminant	
Ancylostomatidae	*Bunostomum trigonocephalum*	small ruminant	

GASTROINTESTINAL HELMINTHS OF SHEEP BREED IN SPREAD BELGRADE AREA

Breeding of sheep and goats were increased during last decade on Belgrade area. Today, small flocks of sheep and goats play an important role in providing animal protein for diet, especially for those people who live in village at mountains part of Belgrade area. Both, sheep and goats are milked and they produce the bulk milk supply.

Topography and climate condition of Belgrade

Belgrade is the capital and largest city of Serbia. It is located at the confluence of the Sava and Danube rivers and the crossroads of the Pannonian Plain and the Balkan Peninsula. The city has an urban area of 360 km^2 while together with its metropolitan area it covers 3,223 km^2. The spread area of Belgrade has extremely favorable conditions for modern agricultural production (climate, agricultural land, watercourses, developed processing industry). This economic branch is of strategic importance for supplying Belgrade with food products, along with the resources that abound in the wider environment (Vojvodina and Šumadija). The Belgrade region has a significant land potential of about 322,292 hectares of agricultural land, which makes up 70% of the total territory of the City of Belgrade.

Topography

Geographical and climate data about examined area was next: Belgrade is situated in South-Eastern Europe**,** on the Balkan Peninsula**.** It lies at the point where the river Sava merges into the Danube**,** on the slope between two alluvial planes. The river waters surround it from three sides, and that is why since ancient times it has been the guardian of river passages.

Belgrade lies 116.75 metres above sea level and is located at confluence of the Danube and Sava rivers. The city has an urban area of 360 square kilometres, while together with its metropolitan area it covers 3,223 km^2. On the right bank of the Sava (examined area), central Belgrade has a hilly terrain, while the highest point of Belgrade proper is Torlak hill at 303 m. The mountains of Avala (511 m) and Kosmaj (628 m) lie south of the city. Across the Sava and Danube, the land is mostly flat, consisting of alluvial plains and loessial plateaus.

After World War II, New Belgrade was built on the left bank of the Sava river, connecting Belgrade with Zemun. Smaller, chiefly residential communities across the Danube, like Krnjača, Kotež and Borča, also merged with the city, while Pančevo, a heavily industrialised satellite city, remains separate. The city has an urban area of 360 km^2 (140 sq mi), while together with its metropolitan area it covers 3,223 km^2.

One of the characteristics of the city terrain is mass wasting. On the territory covered by the General Urban Plan there are 1,155 recorded mass wasting points, out of which 602 are active and 248 are labeled as 'high risk'. They cover almost 30% of the city territory and include several types of mass wasting. Downhill creeps are located on the slopes above the rivers, mostly on the clay or loam soils, inclined between 7 and 20%. The most critical ones are in Karaburma, Zvezdara, Višnjica, Vinča and Ritopek, in the Danube valley, and Umka, and especially its neighbourhood of Duboko, in the Sava valley. They have moving and dormant phases, and some of them have been recorded for centuries. Less active downhill creep areas include the entire Terazije slope above the Sava (Kalemegdan, Savamala), which can be seen by the inclination of the Pobednik monument and the tower of the Cathedral Church, and the Voždovac section, between Banjica and Autokomanda.

Landslides encompass smaller areas, develop on the steep cliffs, sometimes being inclined up to 90%. They are mostly located in the artificial loess hills of Zemun: Gardoš, Ćukovac and Kalvarija.

However, the majority of the land movement in Belgrade, some 90%, is triggered by the construction works and faulty water supply system (burst pipes, etc.). The neighbourhood of Mirijevo is considered to be the most successful project of fixing the problem. During the construction of the neighborhood from the 1970s, the terrain was systematically improved and the movement of the land is today completely halted

Climate condition

Belgrade's climate exhibits influences of oceanic, under the Köppen climate classification, has a humid subtropical climate (*Cfa*) bordering on a humid continental climate (*Dfa*) with four seasons and uniformly spread precipitation. Monthly averages range from 1.4 °C in January to 23.0 °C in July, with an annual mean of 12.5 °C. There are, on average, 44.6 days a year when the maximum temperature is at or above 30 °C 95 days when the temperature is above 25 °C. On the other hand Belgrade experiences 52.1 days per year in which the minimum temperature falls below 0 °C, with 13.8 days having a maximum temperature below freezing as well. Belgrade receives about 691 mm of precipitation a year, with late spring being wettest. The average annual number of sunny hours is 2,112. (http://www.hidmet.gov.rs/).

Agricultural production in the wider Belgrade area

The city is divided into 17 municipalities. Most of the municipalities are situated on the southern side of the Danube and Sava rivers, in the Šumadija region. Three municipalities (Zemun, Novi Beograd, and Surčin), are on the northern bank of the Sava in the Syrmia region and the municipality of Palilula, spanning the Danube, is in both the Šumadija and Banat regions. The wider area of Belgrade municipalities consists of many villages, and the land is suitable for agriculture, especially for the cultivation of agricultural crops and animal husbandry.

Breeding of sheep and goats were increased during last decade on Belgrade area. Today, small flocks of sheep and goats play an important role in providing animal protein for diet, especially for those people who live in village at mountains part of Belgrade area. Both, sheep and goats are milked and they produce the bulk milk supply, together with a large proportion of the meat that is consumed. Along with the increasing number of flocks began on examination of their health status. During those examination especially was paid to the parasitic infections

The first serious studies of parasitic fauna of sheep and goats in the area of Belgrade were done in the period 2009-2010.In the meantime, there has been an increase in the number of herds, changes in microlimatic conditions and environmental conditions. Due to the sudden urbanization, which is inevitably accompanied by pollution of land and water, an increase in the number of non-owner dogs, the approach of wild animals to human settlements (foxes, etc.)? This has affected the quality of the environment, the grazing areas where sheep are kept, as well as the global epidemiological and hygienic condition of the city. All this affects, together with parasitic infections, the production results (milk yield, growth, quantity and quality of wool) in sheep.

For these reasons, after ten years, we returned to examining the parasitic fauna of small ruminants in the area of Belgrade in order to see the current situation causing these changes.

Methods of examination

Fecal examination

Faeces examination was conducted by methods of direct smear and flotation. During our examination we always used fresh samples of faeces. For direct smear, a small quantity of faeces is placed on a slide, mixed with a drop of water, spread out and examined directly. At least three slides from different parts of faecal sample should be examined. This method is suitable for very rapid examination, but it will usually fail to detected low-grade infection. Flotation techniques use solutions which have higher specific gravity than the organisms to be floated so that the organisms rise to the top and the debris sinks to the bottom.

During our examination we used Zinc sulphate solution with specific gravity 1.36 (700 g ZnSO4 in 1000 ml water). The intensity of infection was measured by McMaster method. The number of eggs per gram can be calculated as follows: count the number of eggs within the grid of each chamber ignoring those outside the squares and then multiply the total by 50 – this gives the number of eggs per gram of faeces (e.p.g.)

A centrifugation fecal flotation performed on individual animal feces and at composite samples from multiple animals within a herd enables a qualitative assessment of the types of GI nematodes shedding eggs in the feces and a subjective assessment of the magnitude of infection. Composite fecal sampling is a robust method for evaluating parasite burden within a herd that is a resource-efficient option for owners and producers.

Fecal egg counts can provide robust information about herd health, and with good record keeping they can create a strong clinical picture of infection patterns within herds over time.

Necropsy examination

During necropsy the abomasum was cut open and the contents were washed into a bucket, under a strong flow of water. More water was added to give a total volume of five litres. While agitating the bucket, four subsamples of 50 ml (altogether 1/25 of the total material) were taken. The rest was washed through a sieve with a grid aperture of 250 μm, and searched macroscopically for large nematodes. The subsamples were washed gently through a sieve with a grid aperture of 100 μm. Material remaining in the sieve was poured into a Petri dish and examined on a dark background under a binocular microscope. All adult, male nematodes,with well-developed spicules, were transferred to a microscope slide, identified by species and counted. In order to estimate the total adult nematode burden of each species, the number of male nematodes of each speciesfound in the subsamples was multiplied by 25 and then again by 2, accounting for the adult female nematodes.

The same method was used on the small intestine, except that the intestine was not cut open, but its content was pressed out and theremaining material washed out with running water. The large intestine was cut open and itscontents washed through a sieve with a grid aperture of 250 μm. The contents of the sieve were put in small portions into a large tray, water was added, and the contents were macroscopically searched for large nematodes.

Found parasites either fixing in 10% formalin, were mounted in lactofenol for identification, and mounted in Canada balsam.

Determination of adult parasites and parasites eggs we performed by its morphological characteristic.

First study of endoparasites infection (2009-2010)

The first study about season distribution of gastrointestinal helminthes of small ruminant at spread Belgrade area was started in March 2009 and finished in January 2010. During study we examined a total of 91 flocks of goats and sheep from 6 Belgrade districs Mladenovac, Lazarevac, Obrenovac, Grocka, and Vozdovac (from the village Mladenovac, Vlaska, Mala Krsna, Velika Krsna, Medjuluzje, Senjak, Velika Ivanča, Orašac, Mala Vrbica, Rajkovac, Dubona, Šepšin, Resnik, Velike Granice, Granice, Koracica, Jagnjilo, Markovac, Lazarevac, Arapovac, Junkovac, Leskovac, Sokolovo Rabrovac, Vrbovno, Zvecka, Krtinska and Stepojevac).

During study we collected fecal samples at monthly intervals. A total of 910 fecal samples were analyzed using standard coprological techniques. A total of 89 sheep's we were analyzed by post-mortem examination. Total differential worm counts were performed on all the alimentary tract and lungs using the technique. The faecal samples were obtained from a different source all together as they were collected from flocks in the field, and the results support the other findings. These counts were also of value in providing some information on the egg rise. The number of guts and lungs examined in this survey thought small in number, but in combination with results of coprological examination, samples appeared to represent the population adequately.

During the period 2009-2010 the next helminth species were found: The prevalence of individual species was the next: *Ostertagia circumcincta* (95,23%), *O.trifurcata* (91,53%), *O.ostertagi* (23,33%), *Trichostrongylus axei* (100%), *T.colubriformis* (89,57%), *T.capricola* (62,85%), *Nematodirus spathiger* (100%), *N. filicolis* (43,31%), *Haemonchus contortus* (88,95%), *Marshallagia marshalli* (23,77%), *Skrjabinema ovis* (5,26%), *Bunostomum trigonocephalum* (13,28%), *Chabertia ovina* (64,14%), *Oesophagostomum venulosum* (28,39%), и *Cooperia curticei* (60.52%).

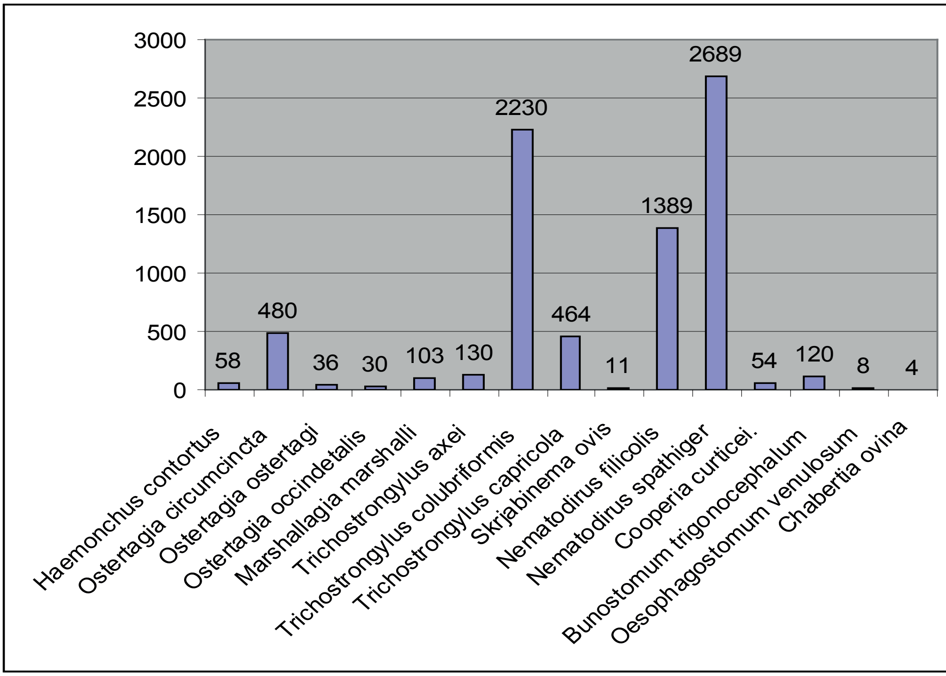
Species in the genus *Ostertagia, Trichostrongylus* and *Nematodirus* were present after the first appearance of those present during the entire study period.

Haemonchus contortus is ordered in animals during the warmer and *Marshallagia marshali* during the colder period of the year. Species in the genus *Cooperia*, and *Oesophagostomum. Bunostomum* were often present in lambs sacrificed during all the monitoring period. Species in the genus *Cooperia*, and *Oesophagostomum. Bunostomum* were often present in lambs sacrificed during the monitoring period

At the beginning of our research, conducted in March, the real extent of gastrointestinal infections strongilidae was 83.33%, after which he soon reached a level of 100% in the same way and moved to the end of follow-up period. Extensity of infection established genera gastrointestinal strongilidae was different. The distribution of parasites of the genera *Ostertagia, Trichostrongylus* and *Nematodirus* was reached during the monitoring period almost the maximum level.

The distribution of species within the established genera also varied. Within the genus *Ostertagia* most abundant were dominated by *Ostertagia circumcincta* and *O.trifurcata*. Prevalence of infection with *Ostertagia ostertagi* and *O.occidentalis* was higher during the colder periods of the year.

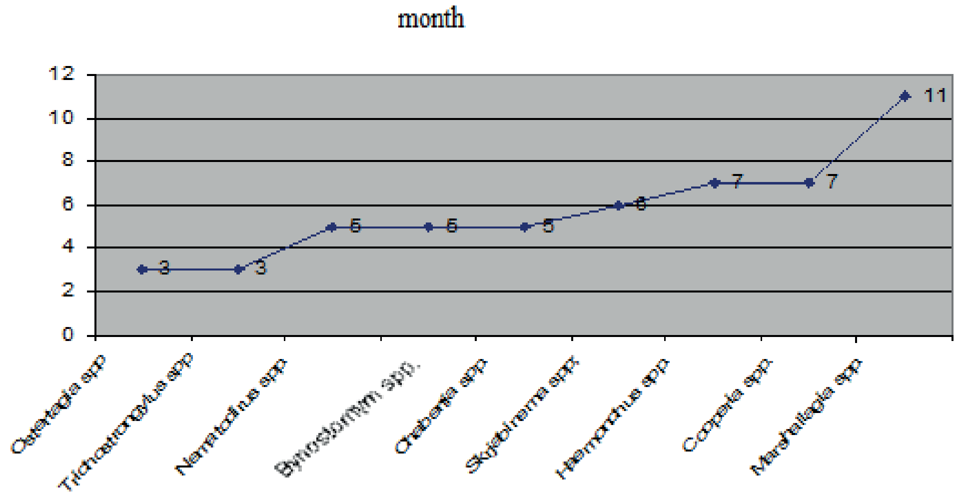
Among the species of the genus *Trichostrongylus* was the most prevalent *Trichostrongylus colubriformis*. Extensity of infection with *T.axei* and *T.vitrinus* varied, without any regularity. Extensity of infection with *Nematodirus filicollis* and *N.spathiiger* demonstrated a tendency to increase and leveled off at the highest level of the whole study period.



Intensity of infection of with gastrointestinal parasites

The dynamics of the first occurrence of established species of gastro-intestinal strongilida was as follows:

- In March: *Teladorsagia* (*Ostertagia*) *circumcincta, Ostertagia ostertagi, Trichostrongylus colubriformis, Nematodirus filicoliis* and *N.spathiger*
- In May: *Ostertagia trifurcata, Trichostrongylus axei, Bunostomum trigonocephalum* and *Chabertia ovina;*
- In June: *Skrjabinema ovis*
- In July: *Haemonchus contortus, Cooperia curticei* and *Oesophagostomum venulosum;*
- In November: *Marshallagia marshalli*



The season dynamics of GI parasitesx in period 2009-2010

Second study of endoparasites infection (2018-2019)

The study of endoparasites infection performed during 2018-2019. we were carried out in 152 flocks of sheep originated from from 6 Belgrade districs Mladenovac, Lazarevac, Obrenovac, Grocka, and Vozdovac (from the village Mladenovac, Vlaska, Mala Krsna, Velika Krsna,Medjuluzje, Senjak, Velika Ivanca, Orašac, Mala Vrbica, Rajkovac, Dubona, Šepšin, Resnik, Ritopek, Vrčin, Vinča, Leštane, Pinosava, Grocka, Velike Granice, Granice, Koracica, Jagnjilo, Markovac, Lazarevac, Arapovac, Junkovac, Leskovac, Sokolovo, Rabrovac, Vrbovno, Zvecka, Krtinska and Stepojevac). During our examination we were examined total of 631 fecal samples. Examination we performed using standard coprological technique.

Total of 73 sheep and lambs we were examined by post-mortem examination. Total differential worm counts were done on the entire alimentary tract using the standard paristology necropsy technique. Determination of adult and eggs of parasites were done by morphological characteristic.

The faecal samples were obtained from a different source all together as they were collected from flocks in the field, and the results support the other findings. These counts were also of value in providing some information's on the peripartuirent egg rise. The number of guts and lungs examined in this survey thought small in number, but in combination with results of coprological examination, samples appeared to represent the population adequately.

In period 2018-2019 we found next helminth species: *Teladorsagia* (*Ostertagia*) *circumcincta* in 75,23%, *Ostertagia trifurcata* 71,53%, *O.ostertagi* 21.99%, *Trichostrongylus axei* 62,23%, *T.colubriformis* 69,57%, *T.vitrinus* 62,85%, *Nematodirus spathiger* 77,43%, *N,filicolis* 33,31%, *Haemonchus contortus* 58,95%, *Marshallagia marshalli* 27,77%, *Skrjabinema ovis* 11,31%, *Bunostomum trigonocephalum* 13,28%, *Chabertia ovina* 63.85%, *Oesophagostomum venulosum* 27.91%, *Cooperia curticei* 60.52%,*C.oncophora* 28,39% and *C.punctata* 13,28%.

genus	species	**intensity of infection**		
		min	**max**	**averige**
Haemonchus	*contortus*	**12**	**104**	**58**
Ostertagia	*circumcincta*	**5**	**955**	**480**
	ostertagi	**8**	**64**	**36**
	occidentalis	**8**	**52**	**30**
Marshallagia	*marshalli*	**18**	**188**	**103**
Trichostrongylus	*axei*	**2**	**258**	**130**
	colubriformis	**3**	**4457**	**2230**
	capricola	**7**	**921**	**464**
Skrjabinema	*ovis*	**3**	**19**	**11**
Nematodirus	*filicollis*	**96**	**2700**	**1398**
	spathiger	**17**	**5361**	**2689**
Cooperia	*curticei*	**11**	**97**	**54**
Bunostomum	*trigonocephalum*	**8**	**232**	**120**
Oesophagostomum	*venulosum*	**2**	**14**	**8**
Chabertia	*ovina*	**2**	**6**	**4**

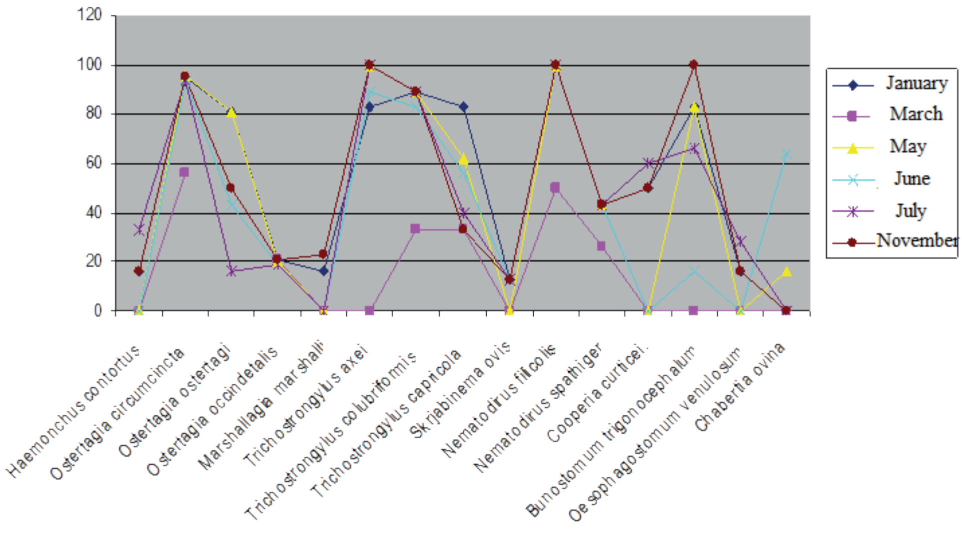
Intensity of infections (finding number of eggs/g feces)

Most prevalence species of nematode are *Trichostrongylus* and *Nematodirus* species. The distribution of species within the established genera also varied. Within the genus *Ostertagia* most abundant were dominated by *Ostertagia circumcincta* and *O.trifurcata*. Prevalence of infection with Ostertagia ostertagi and *Ostertagia occidentalis* was higher during the colder periods of the year.Among the species of the genus *Trichostrongylus* was the most prevalent *Trichostrongylus colubriformis*. Extensity of infection with *Trichostrongylus axei* and *T.vitrinus* varied, without any regularity. Extensity of infection with *Nematodirus filicollis* and *N.spathiiger* demonstrated a tendency to increase and leveled off at the highest level of the whole study period.

The dynamics of the first occurrence of established species of gastro-intestinal strongilida was as follows:

- In March: *Teladorsagia* (*Ostertagia*) *circumcincta, Ostertagia ostertagi, Trichostrongylus colubriformis, T.vitrinus, Nematodirus filicoliis* and *N.spathiger*
- In May: *Ostertagia trifurcata, Trichostrongylus axei, Bunostomum trigonocephalum* and *Chabertia ovina;*

- In June: *Skrjabinema ovis*
- In July: *Haemonchus contortus, Cooperia curticei, C.oncophora C.punctata Oesophagostomum venulosum;*
- In November: *Marshallagia marshalli*



The season dynamics of GI parasitesx in period 2018-2019

The seasonal dynamics itself varied within the limits that are usually found in the found parasite species. We will see that in the month of March - the period that coincides with the period of the first outing to pasture, the largest number of parasite species appeared ("spring-rise" phenomenon).

The next peak occurs in May, when we find four types of parasites, in July when there are three, while in June and November we have only one type of parasite each.

The ecological parameters that influence it are the micro and macro climate of the steam area, vegetation and the number of animals in the pasture. The population pressure on the pasture (number of animals per unit area) and the method of grazing - whether it is forced or stationary also affect the load on the pasture and the degree of its infection.

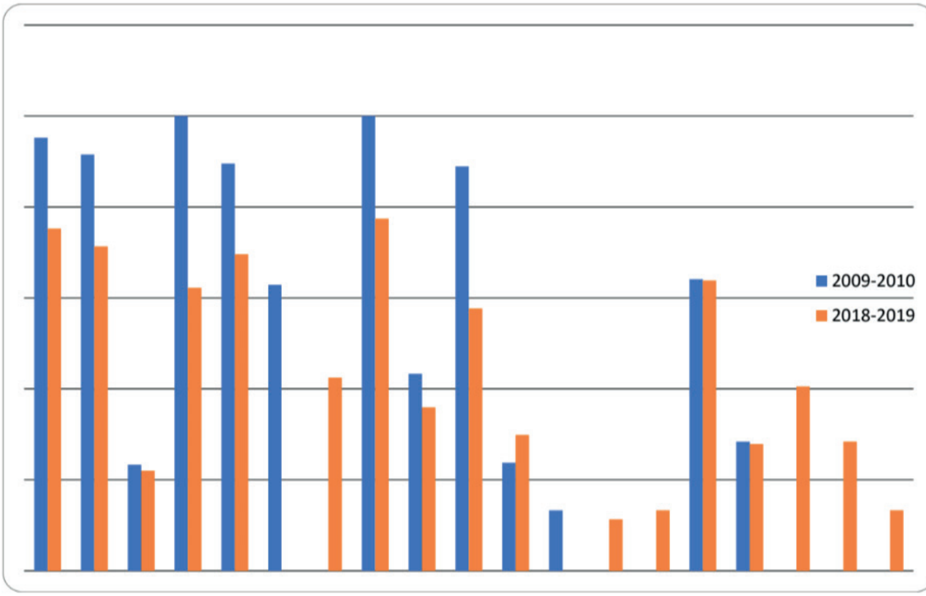
During our research done in the period 2018-2019, a difference in the biodiversity of GI helminths is noticed in comparison with the research done in the period 2009-2010. This research has for the first time identified parasites of the genus *Cooperia* that were not previously present in the Belgrade area. They are usually found in sheep flocks in southern and south-east Serbia.

Simultaneously with the increase in the number of GI helminth species, the prevalence of previously established species decreased. This is most noticeable in the three bridge prevalence genera of the GI nematode *Ostertagia, Trichostrongylus* and *Nematodirus* species.

If we make a comparison with the results we had during the research done in the period 2009-2010, it can be seen that the prevalence of certain types of parasites has decreased, but the number of parasite species has increased. There are many reasons for that, and the main one is that in the past period there has been a significant increase in the number of herds in the villages around the city. these were mainly animals that were procured from other parts of Serbia where these types of parasites are present.

YEARS			
2009-2010		**2018-2019**	
parasites species	**%**	**parasites species**	**%**
Teladorsagia (Ostertagia) circumcincta	95.23	*Teladorsagia (Ostertagia) circumcincta*	75.23
Ostertagia trifurcata	91.53	*Ostertagia trifurcata*	71.33
Ostertagia ostertagi	23.33	*Ostertagia ostertagi*	21.99
Trchostrongylus axei	100.00	*Trichostrongylus axei*	62.23
Trichostrongylus colubriformis	89.57	*Trichostrongylus colubriformis*	69.57
Trichostrongylus capricola	62.85	*Trichostrongylus vitrinus*	42.45
Nematodirus spathiger	100.00	*Nematodirus spathiger*	77.43
Nematodirus filicolis	43.31	*Nematodirus filicolis*	35.91
Hameonchus contortus	88.95	*Haemonchus contortus*	57.65
Marshallagia marshalli	23.77	*Marshallagia marshalli*	29.89
Skrjabinema ovis	5,26	*Skrjabinema ovis*	11.31
Bunostomum trigonocephalum	13,28	*Bunostomum trigonocephalum*	13.28
Chabertia ovina	64.14	*Chabertia ovina*	63.85
Oesophagostomum venulosum	28.39	*Oesophagostomum venulosum*	27.91
Cooperia curticei	60.52	*Cooperia curticei*	40.52
		Cooperia oncophora	28.39
		Cooperia punctata	13.28

Comparative prevalence of GI helminths og sheep in perid 2009-210 and 2018-2019



Comparative prevalence of GI helminths og sheep in perid 2009-2010 and 2018-2019

Although most of the gastro-intestinal species appear to follow this general pattern of seasonal distribution, some variations in intensively and duration of these characteristics with different worm species occurred. Thus with *Trichostrongylus* and *Nematodirus* species infection at mature sheep the spring peak was more pronounced that the autumn infection.

The season dynamics of the established parasites species during both period of examination (2009-2010 and 2018-2019) was as follows:

- In March have occurred *Ostertagia spp.* and *Trichostrongylus spp.*
- In May, the observed infection with *Nematodirus spp, Bunostomum spp.* and *Chabertia spp.* (*ovina*)
- In June was the first record of *Skrjabinema spp*;
- In July were established eggs of *Haemonchus spp.* (*contortus*) and *Cooperia spp.*
- In November showed the presence of *Marshallagia spp*

Climate variations are a significant factor of seasonal distribution of certain species of sheep helminates**.** There are discrepancies in the seasonal distribution between certain regions in Serbia. Thus, certain species within the genera *Ostertagia, Trichostrongylus* and *Nematodirus* occur earlier in the plains (north Serbia Vojvodina) and the area of Belgrade than in hilly and mountainous areas.

Found parasites species were present at small ruminats in other parts of Serbia. This was confirmed by during examination performed in the hilly areas of Serbia (Šar

Planina, Stara Planina) (Vujić et al.,1911,2015a), south, south-east and south-west part of Serbia, (Pavlović et al.2013a,b, 2018a), at Timok District (Jovanović et al.1991), Belgrade area (Pavlović et al.2009,2012) Vojvodina (Pavlović et al.2017b) and Kosovo (Pavlović et al.1995,Milanović et al.2018). Same parasitic species were occurred at other Balkan countries like Macedonia or Bulgaria (Georgievski,1989, Zurliiski and Rusev,1990).

Generally speaking the occured parasites represent a global problem. Way of breeding usualy at shepeng had prerequisite to a lot of infections including parasitoses. Pasture breeding make possible contact within sheep and eggs, larvar stages and intermediate host of parasites. Those induce that there are no one sheep without parasites. The countries of Magreb, Middle East and Northern Africa are also in permanent probleme with parasitic infections and losses ensued by them. Negative influence of parasitic infection reflected througt lost of weight and decrement quantum of lactation (Bahgat et al.1988, Dogana, et al.1989, Ashraf and Nepote,1989, Fakae,1990, Smith,1990, Quesadaet al.1990).

CONCLUSION

However, since the parasitic infections are in majority sub clinical this problem is not played due attention by a sheep breeder from the village in the Belgrade area. The prophylactic treatment is not conducted in the majority of flocks or it is only partially performed what can be seen by the records from the slaughter line and from production results. In aim of introducing parasites fauna of sheep and prepare measure to its control we must to continue our examination. This was the only way to obtain better product results, characteristics and quality of sheep and lambs meat.

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