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Review articles

Species diversity of nematodes in domestic and wild ruminants of Armenia

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ABSTRACT. The review provides data on species composition of nematode parasites of cattle, sheep, goats and wild ruminants (*Ovis orientalis gmelini*, *Capreolus capreolus*, *Capra aegagrus aegagrus*) of Armenia. Six species of lung nematodes and 22 species of gastrointestinal ones have been registered in ruminants of Armenia. Five of the species listed in the review (*Protostrongylus davtiani*, *Protostrongylus muraschkinzewi*, *Nematodirus davtiani*, *Trichostrongylus andreevi*, *Trichostrongylus skrjabini*) have been first identified in Armenia. The ruminant host species most studied for this territory is a domestic sheep. Data on nematodes of goats and wild ruminants are limited to sporadic reports. Data on nematodes of cattle are limited to the only one species – *Neoascaris vitulorum*. Most of the nematode species found in Armenia are common for all ruminant host species living here and noted as widespread all over the world. Eight species of nematodes detected in ruminants of Armenia able to infect humans. The taxonomy of some rare species of nematodes reported from ruminants in Armenia is not entirely clear and should be re-evaluated basing on thorough studies.

Key words: Caucasus, ruminants, lung nematodes, intestinal nematodes

Introduction

Armenia is a country lying on the south of the Lesser Caucasus. Despite of its quite small area, Armenia has a big diversity of landscapes, variety of climatic conditions and rich biodiversity. Wild ruminants on this territory are presented with European roe deer (*Capreolus capreolus* Linnaeus, 1758), bezoar ibex (*Capra aegagrus aegagrus* Erxleben, 1777) and Armenian mouflon (*Ovis orientalis gmelini* Blyth, 1841). The latter one is considered as an endemic and endangered [1]. The bezoar ibex, in turn, is a vulnerable subspecies of wild goat with a narrow areal [2]. Domestic ruminants of Armenia are presented with sheep, goats and cows. A husbandry of these ruminants, especially sheep, traditionally takes an important part in agriculture of Armenia.

The first studies concerning the nematodes of ruminants of Armenia have been conducted in 1924 [3]. Since that moment, quite a large amount of data on this problem has been accumulated. However, most of these findings have been never published in international scientific literature. The goal of our review was a synthesis the data on species composition of nematodes parasitizing ruminants in Armenia with a regard to current knowledge on distribution and taxonomy of these nematodes.

Species composition of nematodes parasitizing ruminants from Armenia

Nematodes of cattle

The published data concerning nematodes parasitizing cattle in Armenia are limited with one species only. *Neoascaris vitulorum* (Goeze, 1782)

has been found in calves [4] and appeared to be widespread in Armenia [5,6]. Beside this one species, the nematode fauna of cattle in Armenia is still unstudied.

Lung nematodes of small ruminants

Data on the species composition of lung nematodes found in small ruminants from Armenia are presented in Table 1. The species of nematodes and hosts are listed as their Linnaean names in alphabetical order.

Most of the lung nematodes listed for ruminants from Armenia have been reported as widespread in wild and domestic ruminants from different countries. For example, *C. ocreatus*, *M. capillaris* and *P. rufescens* were discovered in *Ovis musimon* in Spain [20], as well as in Hungary [21]. Beside to that, *C. ocreatus*, *M. capillaris*, *P. rufescens* and *P. hobmaieri* were discovered in *O. musimon* in Bulgaria, as well as *C. ocreatus* was found in sheep and *M. capillaris* was found in goats and chamois (*Rupicapra rupicapra*) [22,23]. *M. capillaris* and *P. rufescens* were found in sheep and goats from Algeria [24]. *C. ocreatus* was detected in Anatolian wild sheep (*Ovis orientalis anatolica*) as well as in domestic sheep in Turkey [25]. *P. rufescens* was reported in sheep from Iran [26]. *M. capillaris* was reported as predominant lungworm species in many regions, for example from sheep and goats in north-east Zair [27], in Poland [28] and Argentina [29], from goats in New Zealand [30], from bighorn sheep in USA [31], chamois in Slovakia [32] and spotted deer in India [33]. As for the areas close to Armenia, the recent study in Dagestan (North Caucasus) reported about *C. ocreatus, M. capillaris, P. hobmaieri* and *P. rufescens* in sheep and cattle [34].

Besides that, the nematode *Cystocaulus nigrescens* was reported from ruminants of Armenia several times [7,8,12]. However, later it had been established that it was a junior synonym of *C. ocreatus* [35]. So, we are using a species name *C. ocreatus* in this review. Literature data of cases of *Protostrongylus kochi* being found in Armenia we have added to those of cases of *Protostrongylus rufescens* basing on *P. kochi* has been recognized as a junior synonym of *P. rufescens* [35]. Two of the species listed in Table 1 (*P. davtiani* and *P. muraschkinzewi*) have been first identified in Armenia [14,18]. *P. muraschkinzewi* has been registered in Armenia one more time in 2008 [11], but never found anywhere else. *P. davtiani* has been

Table 1. Lung nematodes of small ruminants of Armenia

Species of nematodes	Host species	References
Cystocaulus ocreatus (Railliet et Henry, 1907)	*Capra aegagrus aegagrus*	[7]
	Capra hircus	[8,9]
	Ovis aries	[8-11]
	Ovis orientalis gmelini	[12]
Muellerius capillaris (Mueller, 1889)	*Capra aegagrus aegagrus*	[7]
	Capra hircus	[13-15]
	Ovis aries	[11,13-15]
Protostrongylus davtiani (Savina, 1940)	*Capra aegagrus aegagrus*	[7]
	Capra hircus	[14,16]
	Ovis aries	[11,14,16]
	Ovis orientalis gmelini	[12]
Protostrongylus hobmaieri (Schulz, Orlow et Kutass, 1933)	*Capra hircus*	[17]
	Ovis aries	[11,17]
Protostrongylus muraschkinzewi (Davtian, 1940)	*Capra aegagrus aegagrus*	[7]
	Capra hircus	[18]
	Ovis aries	[11,18]
	Ovis orientalis gmelini	[12]
Protostrongylus rufescens (Leukart, 1865)	*Capra aegagrus aegagrus*	[7]
	Capra hircus	[9]
	Ovis aries	[3,9,11,17,19]
	Ovis orientalis gmelini	[12]

found in domestic and wild ruminants from Kazakhstan and Crimea [36].

Gastrointestinal nematodes of small ruminants

Data on the species composition of gastrointestinal nematodes found in small ruminants from Armenia are presented in Table 2. The species of gastrointestinal nematodes and hosts are listed as their Linnaean names in alphabetical order.

As well as lung nematodes, most of the gastrointestinal nematodes listed for ruminants from Armenia are noted in different countries all over the world. There are some recent studies conducted in this field in countries bordering with Armenia [46–49]. Helminthological autopsies of *C. a. aegagrus* in Turkey are revealed, together with some other species, *M. marshalli*, *N. abnormalis*, *N. spathiger*, *T. circumcincta* and *T. colubriformis* [46]. In *C. capreolus* from Turkey there have been reported *H. contortus*, *T. circumcincta* (as well as minor morphs *T. davtiani* and *T. trifurcata*), *T. axei*, *T. andreevi*, *T. colubriformis* and *T. vitrinus* [47]. In sheep in Turkey have been found *H. contortus*, *M. marshalli*, *N. abnormalis*, *N. oiratianus*, *N. spathiger*, *T. circumcincta* (as well as *T. davtiani* and *T. trifurcata*), *T. axei* and *T. probolurus* [48]. In Iran recent studies have noted *H. contortus*, *M. marshalli*, *T. circumcincta*, *T. colubriformis*, *T. probolurus* and *T. vitrinus* in sheep and goats [49], as well as *G. pulchrum* in sheep [50]. In North Caucasus have been detected *C. ovina*, *B. trigonocephalum*, *G. pulchrum*, *H. contortus*, *N. abnormalis*, *N. filicollis*, *N. oiratianus*, *N. spathiger*, *T. circumcincta*, *T. axei*, *T. colubriformis*, *T. skrjabini*, *T. vitrinus* and *T. ovis* in sheep, cattle and domestic buffaloes, and, beside that, *T. circumcincta* in sheep and cattle, and *M. marshalli* in sheep [34].

As for areas with different climatic conditions, *M. marshalli*, *O. gruehneri*, *N. davtiani*, *N. oiratianus*, *N. spathiger* and *S. ovis* have been recently noted in *Ovis dalli dalli* in Canada [51]. *H. contortus*, *N. spathiger*, *T. circumcincta*, *T. axei*, *T. colubriformis* and *T. ovis* have been registered in sheep from Brazil [52]. In Uzbekistan (Middle Asia) *C. ovina*, *B. trigonocephalum*, *G. pulchrum*, *H. contortus*, *M. marshalli*, *N. oiratianus*, *N. spathiger*, *O. gruehneri*, *S. ovis*, *T. circumcincta*, *T. axei, T. colubriformis*, *T. probolurus*, *T. skrjabini*, *T. vitrinus* and *T. ovis* in sheep, goats and cattle have been revealed [53]. *B. trigonocephalum*, *H. contortus*, *T. axei*, *T. colubriformis*, *T. ovis* have been reported in sheep and goats from Eastern Nigeria [54], *B. trigonocephalum*, *T. colubriformis* – in sheep and goats from Southern Ethiopia [55], *H. contortus*, *T. colubriformis*, *S. ovis* – in sheep and goats from western Sudan [56]. *B. trigonocephalum*, *H. contortus*, *T. axei*, *T. colubriformis*, *T. ovis* have been reported in sheep from Mexico [57]. *C. ovina*, *B. trigonocephalum*, *H. contortus*, *M. marshalli*, *N. filicollis*, *N. spathiger*, *S. ovis*, *T. circumcincta*, *T. axei* and *T. colubriformis* have been reported in sheep and goats from Serbia [58].

Eight species of gastrointestinal nematodes, which have been recorded in ruminants of Armenia are considered to be zoonotic. Among them are *G. pulchrum* [59,60] as well as *H. contortus*, *M. marshalli*, *T. circumcincta*, *T. axei*, *T. colubriformis*, *T. probolurus* and *T. skrjabini* [49,61].

Three of the species presented in Table 2 (*N. davtiani*, *T. andreevi* and *T. skrjabini*), as well as *T. davtiani* (a minor morph of *T. circumcincta*) have been first described in Armenia [7,12,37,40]. Subsequently, *N. davtiani* has been reported in North America [51,62] and Iran [63]. *T. andreevi* has been recently detected in Turkey [47] and *T. skrjabini* has been noted in North Caucasus [34]. In general, infrequent cases of re-detection allow us to consider these three species as rare.

Aside from the species shown in Table 2, in *C. capreolus* from Armenia there were also found *Ostertagia lyrata* Sjoberg, 1926 and *Rinadia mathevossiani* (Ruchliadev, 1948) [9,37]. However, *O. lyrata* is currently considered to be a minor morph of *Ostertagia ostertagi* (Stiles, 1892) [42,64]. Minor morphs appear only together with major ones, and the quantity of the latter is greater in all cases [42]. However, *O. ostertagi* has been never found in Armenia, thus we may presume that *O. lyrata* has been registered here by mistake. According to conception of polymorphism, *R. mathevossiani* is a minor morph of *Spiculopteragia boehmi* (Gebauer, 1932) [42]. As *S. boehmi* has not been found in Armenia, the registration of *R. mathevossiani* in this spot may be considered as a mistake. It should be noted that very rare nematode species *Spiculopteragia schulzi* has been found in *C. capreolus* from Armenia [9,37]. An analysis of the data on morphology of *S. schulzi* [61,65] allows us to presume that *S. schulzi* may be a junior synonym of *Spiculopteragia houdemeri* (Schwartz, 1927). A minor morph of *S. houdemeri* is *Spiculopteragia (Rinadia) andreevae* (Drozdz, 1965), which is morphologically quite similar to *R. mathevossiani*. In this case *R. mathevossiani* registered in Armenia

Table 2. Gastrointestinal nematodes of small ruminants of Armenia

Species of nematodes	Host species	Location	References
Bunostomum trigonocephalum (Rudolphi, 1808)	*Capreolus capreolus*	SI	[37]
	Ovis aries	SI	[3]
Chabertia ovina (Fabricius, 1788)	*Capra aegagrus aegagrus*	C	[7]
	Capreolus capreolus	C	[37]
	Ovis aries	C	[3,38]
	Ovis orientalis gmelini	C	[12]
Gongylonema pulchrum Molin, 1857	*Ovis aries*	E	[3]
Haemonchus contortus (Rudolphi, 1803)	*Capra aegagrus aegagrus*	A	[7]
	Capreolus capreolus	A	[37]
	Ovis aries	A	[3,39]
	Ovis orientalis gmelini	A	[12]
Marshallagia marshalli (Ransom, 1907) /*Marshallagia occidentalis* (Ransom, 1907) *	*Capra aegagrus aegagrus*	A	[7]
	Capreolus capreolus	A	[37]
	Capra hircus	A	[40]
	Ovis aries	A	[3,39,40]
	Ovis orientalis gmelini	A	[12]
Nematodirus abnormalis May, 1920	*Capra aegagrus aegagrus*	SI	[7]
	Ovis aries	SI	[39]
	Ovis orientalis gmelini	SI	[12]
Nematodirus davtiani Grigorian, 1949	*Capra aegagrus aegagrus*	SI	[7]
	Ovis orientalis gmelini	SI	[12]
Nematodirus filicollis (Rudolphi, 1802)	*Capra aegagrus aegagrus*	SI	[7]
	Capreolus capreolus	SI	[37]
	Ovis aries	SI	[3,39]
Nematodirus oiratianus Rajevskaja, 1929	*Capra aegagrus aegagrus*	SI	[7]
	Ovis orientalis gmelini	SI	[12]
Nematodirus spathiger (Railliet, 1896)	*Capra aegagrus aegagrus*	SI	[7]
	Capreolus capreolus	SI	[37]
	Ovis aries	SI	[39]
	Ovis orientalis gmelini	SI	[12]
Ostertagia gruehneri Skrjabin, 1929	*Capreolus capreolus*	A	[9,37]
Skrjabinema ovis (Skrjabin, 1915)	*Capra aegagrus aegagrus*	C, CL	[7,9]
	Capra hircus	C, CL	[9]
	Ovis aries	C, CL	[9]
Spiculopteragia schulzi (Rajewskaja, 1930)	*Capreolus capreolus*	A	[9,37]
Teladorsagia circumcincta (Stadelmann, 1894)/ *Teladorsagia davtiani* (Grigorian, 1951) /*Teladorsagia trifurcata* (Ransom, 1907)**	*Capra aegagrus aegagrus*	A	[7]
	Capreolus capreolus	A	[37]
	Capra hircus	A	[9]
	Ovis aries	A	[3,39,40]
	Ovis orientalis gmelini	A	[12]
Trichostrongylus andreevi Grigorian, 1952	*Capreolus capreolus*	SI	[37]
Trichostrongylus axei (Cobbold, 1879)	*Capreolus capreolus*	A, SI	[9,37]
	Ovis aries	A, SI	[39,40]
	Ovis orientalis gmelini	A, SI	[12]

Table 2. Continuation

Species of nematodes	Host species	Location	References
Trichostrongylus colubriformis (Giles, 1892)	*Capra aegagrus aegagrus*	A, SI	[7]
	Capreolus capreolus	A, SI	[9,37]
	Capra hircus	A, SI	[9]
	Ovis aries	A, SI	[3,39,40]
	Ovis orientalis gmelini	A, SI	[12]
Trichostrongylus probolurus (Railliet, 1896)	*Capra aegagrus aegagrus*	A, SI	[7]
	Ovis aries	A, SI	[40]
	Ovis orientalis gmelini	A, SI	[12]
Trichostrongylus skrjabini Kalantarian, 1928	*Capreolus capreolus*	A, SI	[9,37]
	Ovis aries	A, SI	[39,40]
	Ovis orientalis gmelini	A, SI	[12]
Trichostrongylus vitrinus Looss, 1905	*Capra aegagrus aegagrus*	A, SI	[7]
	Capreolus capreolus	A, SI	[9,37]
	Ovis aries	A, SI	[39,40]
	Ovis orientalis gmelini	A, SI	[12]
Trichuris ovis (Abildgaard, 1795)	*Capra aegagrus aegagrus*	C, CL	[7]
	Capreolus capreolus	C, CL	[37]
	Capra hircus	C, CL	[9,41]
	Ovis aries	C, CL	[3,41]
	Ovis orientalis gmelini	C, CL	[12]

Explanations: A – abomasum, C – caecum, CL – colon, E – esophagus, SI – small intestine; **M. marshalli/M. occidentalis* is a polymorphic species according to Drozdz (1995), Dallas et al. (2001) [42,43], major (*M. marshalli*) and minor (*M. occidentalis*) morphs have been found in Armenia at the same time; ***T. davtiani* and *T. trifurcata* are minor morphs of *T. circumcincta* according to Daskalov (1974), Drozdz (1995), Stevenson et al. (1996) [42,44,45], *T. davtiani* has been first described by Grigorian (1951) from *O. o. gmelini* [12] and then found by Grigorian (1952) in *C. capreolus* [37], *T. trifurcata* has been registered in Armenia from *O. aries* by Kalantrian (1928) [40] and Ovnanyan (1989) [39] and from *C. aegagrus* by Grigorian (1949) [7].

from the same host as *S. schulzi* may actually be *S. andreevae*.

Conclusions

Six species of lung nematodes and 22 species of gastrointestinal ones have been registered in ruminants of Armenia as a result of studies conducted in the past and the current century. Two species of lung nematodes and three species of gastrointestinal nematodes have been first described from ruminants of Armenia. The most of the data on nematodes parasitizing ruminants in Armenia have been collected from domestic sheep. Data on nematodes of goats and wild ruminants are limited to sporadic reports. Data on nematodes in cattle are limited to one species only. Therefore, further studies in this field are required. Most nematode species found in Armenia are common for all ruminant host species living here and noted as widespread all over the world. The taxonomy of some rare species of nematodes reported from ruminants in Armenia is not entirely clear and should be re-evaluated basing on thorough morphological and molecular studies. Eight species of nematodes detected in ruminants from Armenia able to infect humans.

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References

[1] Valdez R. 2008. *Ovis orientalis.* In: The IUCN Red List of Threatened Species. https://www.iucnredlist.org.

[2] Sokolov V.E. 1986. Rare and endangered animals. Mammals. Vysshaya shkola, Moscow (in Russian).

[3] Pokrovskaya S.N. 1924. K poznaniyu nematod ovets Armenii [For cognition the fauna of nematodes of sheep in Armenia]. *Proceedings of Tropical Institute of Armenia* 1: 52-55 (in Russian).

[4] Davtian E.A. 1931. Askaridoz telyat v Armenii [Ascaridosis of calves in Armenia]. *Practical Veterinary* 7: 31-36 (in Russian).

[5] Davtian E.A. 1935. Askaridoz krupnogo rogatogo skota v Armenii [Ascaridosis of cattle in Armenia]. *Proceedings of Armenian Institute of Veterinary Studies* 1: 67-73 (in Russian).

[6] Davtian E.A. 1942. K izucheniyu biologii neoaskarid krupnogo rogatogo skota [To the study the biology of neoaskaris of cattle]. *Proceedings of Armenian Institute of Veterinary Studies* 4: 93-137 (in Russian).

[7] Grigorian G.A. 1949. Paraziticheskiye chervi bezoarovykh koz Armenii [Parasitic worms of bezoar ibex in Armenia]. *Proceedings of Armenian Institute of Veterinary Studies* 6: 151-158 (in Russian).

[8] Davtian E.A. 1940. Tsikl razvitiya *Cystocaulus nigrescens* [A life cycle of *Cystocaulus nigrescens*]. *Proceedings of Armenian Institute of Veterinary Studies* 3: 5-31 (in Russian).

[9] Grigorian G.A. 1949. K izucheniyu fauny parazi-ticheskikh chervey dikikh zhvachnykh Armenii i ikh rol' v rasprostranenii gel'mintozov sredi domashnikh ovets i koz [To the study of fauna of parasitic worms from wild ruminants of Armenia and their role in distribution of helminthoses among domestic sheep and goats]. *Proceedings of Armenian Institute of Veterinary Studies* 6: 188-194 (in Russian).

[10] Akopyan V.D. 1960. Nekotoryye dannyye o dinamike tsistokauleza ovets v Kotaykskom rayone [Some data on dynamics of sheep cystocaulosis in Kotajksk region]. *Bulletin of Science-technical Information of Armenian Research Institute of Animal Husbandry* 4-5: 60-63 (in Russian).

[11] Bojahchjan G.A. 2008. Invazirovannost' ovtsepogo-lov'ya Armenii protostrongilidami [The infection of sheep by nematodes from family Protostrongylidae in Armenia]. *Russian Journal of Parasitology* 3: 1-9 (in Russian).

[12] Grigorian G.A. 1951. K izucheniyu fauny parazi - ticheskikh chervey armeniyskogo muflona [To the studies of fauna of parasitic worms from Armenian mouflon]. *Works of Academy of Science of Armenia. Biological and Agricultural Sciences* 4: 821-826 (in Russian).

[13] Davtian E.A. 1937. Myullerioz ovets v Armyanskoy SSR [Mulleriosis of sheep in Armenian SSR]. *Soviet Veterinary* 1: 67 (in Russian).

[14] Savina N.V. 1940. K izucheniyu vozbuditeley sintetokauleza ovets i koz Armyanskoy SSR [To the studies of causative agents of synthetocaulosis of sheep and goats of Armenian SSR]. *Proceedings of Armenian Institute of Veterinary Studies* 3: 41-45 (in Russian).

[15] Gevondyan S.A. 1970. Myullerioz melkikh zhvachnykh (materialy po rasprostraneniyu, biologii, patogenezu, klinike i terapii) [Mulleriosis of small ruminants (materials on distribution, biology, pathogenesis, clinics and therapy)]. Dissertation of Doctor of Biological Sciences, Yerevan (in Russian).

[16] Davtian E.A. 1949. Zhiznennyye tsikly nematod ovets i koz Armenii [Life cycles of lung nematodes of sheep and goats of Armenia]. *Zoological Compendium of Academy of Sciences of Armenian SSR* 6: 185-266 (in Russian).

[17] Davtian E.A. 1948. Zhiznennyye tsikly legochnykh nematod ovets i koz Armenii i ekologo-epizootologicheskiye osnovy profilaktiki vyzyvayemykh imi zablevaniy [Life cycles of lung nematodes of sheep and goats of Armenia and ecological-epizootological foundations of prophylactics of diseases caused by them]. *Proceedings of Helminthological Laboratory of AS USSR* 1: 170-173 (in Russian).

[18] Davtian E.A. 1940. *Synthetocaulus muraschkinzevi* nov. sp., novaya nematoda iz legkikh ovets i koz [*Synthetocaulus muraschkinzevi* nov. sp., a new nematode from lungs of sheep and goats]. *Proceedings of Armenian Institute of Veterinary Studies* 3: 40-43 (in Russian).

[19] Davtian E.A. 1937. To the study of the biology of *Synthetocaulus kochi* Schulz, Orloff et Kutass, 1933, the lung helminth of sheep and goats. In: Works on helminthology. A collection of works dedicated to Academician K.I. Skrjabin. Moscow: 105-122 (in Russian).

[20] Meana A., Luzon M., Santiago-Moreno J., De Bulnes A., Gomez-Bautista M. 1996. Natural infection by gastrointestinal and bronchopulmonary nematodes in mouflons (*Ovis musimon*) and their response to netobimin treatment. *Journal of Wildlife Diseases* 32: 39-43. doi:10.7589/0090-3558-32.1.39

[21] Andras T. 2003. Helminthic infestation of the mouflon (*Ovis ammon musimon*) in Hungary. *Magyar Allatorvosok Lapja* 125: 94-98.

[22] Panayotova-Pencheva M. 2006. New records of protostrongylid lungworms from wild ruminants in Bulgaria. *Veterinarni Medicina* 51: 477-484. doi:10.17221/5581-VETMED

[23] Panayotova-Pencheva M. 2011. Species composition and morphology of protostrongylids (Nematoda: Protostrongylidae) in ruminants from Bulgaria. *Parasitology Research* 109: 1015-1020. doi:10.1007/s00436-011-2337-0

[24] Kouidri M., Selles S.S.M., Boulkaboul A., Khellil C., Belcacem H., Nouar Z. 2017. Study on the seasonal dynamics of lungworm infections in small ruminants slaughtered in Tiaret (Algeria). *Bulgarian Journal of Agricultural Science* 23: 142-146.

[25] Kabakci N., Yildiz K., Yasa Durum S., Yarim M. 2007. *Cystocaulus ocreatus* infection in Anatolian wild sheep and dwarf goats. *Turkish Journal of Veterinary and Animal Sciences* 31: 287-291.

[26] Borji H., Azizzadeh M., Ebrahimi M., Asadpour M. 2012. Study on small ruminant lungworms and associated risk factors in northeastern Iran. *Asian Pacific Journal of Tropical Medicine* 5: 853-856.

[27] Cabaret J., Chartier C. 1990. *Muellerius capillaris* in north-east Zaire: prevalence in sheep and goats and determination of intermediate hosts. *Journal of Helminthology* 63: 298-301. doi:10.1017/S0022149X00009184

[28] Kowal J., Kornas S., Nosal P., Basiaga M., Wajdzik M., Skalska M., Wyrobisz A. 2016. Lungworm (Nematoda: Protostrongylidae) infection in wild and domestic ruminants from Malopolska region of Poland. *Annals of Parasitology* 62: 63-66. doi:10.17420/ap6201.33

[29] Suarez V.H., Bertoni E.A., Micheloud J.F., Cafrune M.M., Vinabal A.E., Rojer J.Q., Bassanetti A.F. 2014. First record of *Muellerius capillaris* (Nematoda, Protostrongylidae) in northwestern Argentina. *Helminthologia* 51: 288-292. doi:10.2478/s11687-014-0243-6

[30] Valero G., Alley M., Manktelow B.W. 1992. A slaughterhouse survey of lung lesions in goats. *New Zealand Veterinary Journal* 40: 45-51. doi:10.1080/00480169.1992.35696

[31] Ezenwa V.O., Hines A.M., Archie E.A., Hoberg E.P., Asmundsson I.M., Hogg J.T. 2010. *Muellerius capillaris* dominates the lungworm community of bighorn sheep at the National Bison range, Montana. *Journal of Wildlife Diseases* 46: 988-993. doi:10.7589/0090-3558-46.3.988

[32] Stefancikova A., Chovancova B., Hajek B., Dudinak V., Snabel V. 2011. Revision of chamois infection by lung nematodes under ecological conditions of national parks of Slovakia with respect to ongoing global climate changes. *Helminthologia* 48: 145-154. doi:10.2478/s11687-011-0022-6

[33] Ramaswamy K., Arora B.M. 1991. Prevalence of *Muellerius capillaris* in free-ranging spotted deer (*Cervus axis*) in India and its experimental cross-transmission to goats. *Journal of Wildlife Diseases* 27: 102-104. doi:10.7589/0090-3558-27.1.102

[34] Ataev A.M., Zubairova M.M., Karsakov N.T., Gazimagomedov M.G., Kochkarev A.B. 2016. Vliyaniye ekologicheskikh faktorov na bioraznoobraziye i populyatsionnuyu strukturu gel'mintov domashnikh zhvachnykh zhivotnykh na yugovostoke severnoo kavkaza [Environmental impacts on the biodiversity and population structure of the helminths of domestic ruminants in the southeast of the North Caucasus]. *South of Russia: ecology, development* 11: 84-94 (in Russian).

[35] Boev S.N. 1975. Essentials of nemathology. Protostrongylidae. Vol. 25. Publishing House AS USSR, Moscow (in Russian).

[36] Asadov S.M. 1960. Helminthofauna of ruminants in the USSR and it's ecological and geographical analysis. Publishing House of the Academy of Sciences of Azerbaijan SSR, Baku (in Russian).

[37] Grigorian G.A. 1952. K izucheniyu fauny paraziticheskikh chervey kosuli v Armenii [To the studies of fauna of parasitic worms from roe deer in Armenia]. *Works of Academy of Science of Armenia. Biological and Agricultural Sciences* 5: 57-65 (in Russian).

[38] Akramovskij M.N. 1939. K izucheniyu rasprostraneniya i kliniki khabertioza ovets i biologii *Chabertia ovina* [To the study of distribution and clinics of sheep chabertiosis and biology of *Chabertia ovina*]. Dissertation of candidate of Biological Sciences, Yerevan (in Russian).

[39] Ovnanyan G.G. 1989. Fauna i rasprostraneniye kishechnykh Strongylata ovets v Armenii [Fauna and distribution of Strongylata of sheep intestine in Armenia]. Dissertation of Candidate of Biological Sciences, Yerevan (in Russian).

[40] Kalantarian E.B. 1928. On trichostrongylidae fauna of sheep and goats of Armenia. *Proceedings of Institute of Experimental Veterinary* 5: 40-57 (in Russian).

[41] Kalantarian E.B. 1928. Species of *Trichocephalus* in sheep and goats of Armenia. *Proceedings of Institute of Experimental Veterinary* 5: 175-178 (in Russian).

[42] Drozdz J. 1995. Polymorphism in the Ostertagiinae Lopez-Neyra, 1947 and comments on the systematics of these nematodes. *Systematic Parasitology* 32: 91-99. doi:10.1007/BF00009507

[43] Dallas J.F., Irvine R.J., Halvorsen O. 2001. DNA evidence that *Marshallagia marshalli* Ransom, 1907 and *M. occidentalis* Ransom, 1907 (Nematoda: Ostertagiinae) from Svalbard reindeer are conspecific. *Systematic Parasitology* 50: 101-103. doi:10.1023/A:1011921414269

[44] Daskalov P. 1974. On the reproductive relationships between *Ostertagia circumcincta*, *Teladorsagia davtiani* and *O. trifurcata* (Nematoda, Trichostrongylidae). *Helminthological Abstracts* 44: 494.

[45] Stevenson L.A., Gasser R.B., Chilton N.B. 1996. The ITS-2 rDNA of *Teladorsagia circumcincta*, *T. trifurcata* and *T. davtiani* (Nematoda: Trichostrongylidae) indicates that these taxa are one species.

International Journal of Parasitology 26: 1123-1126.
[46] Gonenc B., Emir H., Iacob O. 2018. Digestive tract helminths of Turkish ibex (*Capra aegagrus aegagrus* Erxleben, 1877). *Veteriner Fakultesi Dergisi* 65: 247-251.
[47] Bolukbas C.S., GurlerA.T., Beyhan Y.E., Acici M., Umur S. 2012. Helminths of roe deer (*Capreolus capreolus*) in the Middle Black Sea Region of Turkey. *Parasitology International* 61: 729-730. doi:10.1016/j.parint.2012.06.008.
[48] Cengiz Z.T., Deger M.S. 2009. Sheep trichostrongylidosis in Van province. *Acta Parasitological Turcica - Turkiye Parazitolojii Dergisi* 33: 222-226 (in Turkish).
[49] Pestehchian N., Kalani H., Faridnia R., Yousefi H.-A. 2014. Zoonotic gastrointestinal nematodes (Trichostrongylidae) from sheep and goat in Isfahan, Iran. *Acta Scientiae Vetrinariae* 42: 1243.
[50] Eslami A., Ashrafihelan J., Vahedi N., 2010. Study on the prevalence and pathology of *Gongylonema pulchrum* (gullet worm) of sheep from Iran. *Global Veterinaria* 5: 45-48.
[51] Aleuy O.A., Ruckstuhl K., Hoberg E.P., Veitch A., Simmons N., Kutz S.J. 2018. Diversity of gastrointestinal helminths in Dall's sheep and the negative association of the abomasal nematode, *Marshallagia marshalli*, with fitness indicators. *PLoS ONE*. doi:10.1371/journal.pone.0192825
[52] Almeida F.A., Bassetto C.C., Amarante M.R.V., Albuquerque A.C.A., Starling R.Z.C., Amarante A.F.T. 2018. Helminth infections and hybridization between *Haemonchus contortus* and *Haemonchus placei* in sheep from Santana do Livramento, Brazil. *Brazilian Journal of Veterinary Parasitology* 27: 280-288. doi:10.1590/s1984-296120180044
[53] Amirov O.O., Karimova R.R., Shakarboev E.B., Kuznetsov D.N. 2016. Nematody pischevaritelnoy sistemy domashnikh zhvachnykh Uzbekistsna [Nematodes of the digestive tract of domestic ruminants of Uzbekistan] *Russian Journal of Parasitology* 38: 439-446 (in Russian).
[54] Fakae B.B. 1990. Epidemiology of helminthosis of small ruminants under the traditional husbandry system in eastern Nigeria. *Veterinary Research Communications* 14: 381-391.
[55] Aragaw K., Gebreegziabher G. 2014. Small intestinal helminth parasites in slaughtered sheep and goats in Hawassa, Southern Ethiopia. *African Journal of Basic and Applied Sciences* 6: 25-29. doi:10.5829/idosi.ajbas.2014.6.2.85153
[56] Almalaik A.H.A., Bashar A.E., Abakar A.D. 2008. Prevalence and dynamics of some gastrointestinal parasites of sheep and goats in Tulus area based on post-mortem examination. *Asian Journal of Animal and Veterinary Advances* 3: 390-399. doi:10.3923/ajava.2008.390.399
[57] Garduno R.G., Perez C.C., Torres-Hernandez G., Gives P., Arece-Garcia J. 2011. Prevalence of gastrointestinal parasites in slaughtered sheep at a slaughterhouse in Tabasco, Mexico. *Veterinaria Mexico* 42:125-135.
[58] Pavlovic I., Ivanovic S., Zugic G., Jovcic D., Bojkovski J., Pajic M. 2012. Season distribution of gastrointestinal helminths of small ruminants in spread Belgrade area. *Lucrari Stiintifice Medicina Veterinara* 45: 155-160.
[59] Jelinek T., Loscher T. 1995. Human infection with *Gongylonema pulchrum*: a case report. *Tropical Medicine and Parasitology* 45: 329-330.
[60] Allen J.D., Esquela-Kerscher A. 2013. Short Report: *Gongylonema pulchrum* infection in a resident of Williamsburg, Virginia, verified by genetic analysis. *The American Journal of Tropical Medicine and Hygiene* 89: 755-757. doi:10.4269/ajtmh.13-0355
[61] Skrjabin K.I., Schikhobalova N.P., Schultz R.S. 1954. Essentials of nemathology. Trychostrongylids of man and animals. Vol. 3. Publishing House AS USSR, Moscow (in Russian).
[62] Becklund W.W., Walker M.L. 1967. *Nematodirus* of domestic sheep, *Ovis aries*, in the United States with a key to the species. *Journal of Parasitology* 53: 777-781. doi:10.2307/3276769
[63] Eslami A., Meydan, M., Maleki Sh., Zargarzadeh A. 1979. Gastrointestinal nematodes of wild sheep (*Ovis orientalis*) from Iran. *Journal of Wildlife Diseases* 15: 263-265. doi:10.7589/0090-3558-15.2.263
[64] Zarlenga D.S., Hoberg E.P., Stringfellow F., Lichtenfels J.R. 1998. Comparisons of two polymorphic species of *Ostertagia* and phylogenetic relationships within the Ostertagiinae (Nematoda: Trichostrongyloidea) inferred from ribosomal DNA repeat and mitochondrial DNA sequences. *Journal of Parasitology* 84: 806-812.
[65] Rajewskaja Z.A. 1930. *Ostertagia schulzi* n. sp. – eine neue nematode bei einem wild hirsche [*Ostertagia schulzi* n. sp. – a new nematode in a wild deer]. *Zoologischer Anzeiger* 90: 331-335 (in German).

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