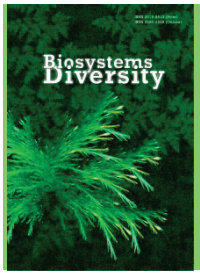

Biosystems Diversity

ISSN 2519-8513 (Print)
ISSN 2520-2529 (Online)
Biosyst. Divers.,
2021, 29(3), 251–257
doi: 10.15421/012131

Prevalence of gastrointestinal helminths in ruminants in Ukraine: a 5-year meta-analysis

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Article info

Received 01.07.2021
Received in revised form 28.07.2021
Accepted 29.07.2021

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Kruchynenko, O. V., Mykhailiutenko, S. M., Petrenko, M. A., & Kuzmenko, L. M. (2021). Prevalence of gastrointestinal helminths in ruminants in Ukraine: A 5-year meta-analysis. Biosystems Diversity, 29(3), 251–257. doi:10.15421/012131

The production of environmentally friendly livestock products is currently receiving much attention, especially in the European Union. The problem of monitoring the quality and safety of meat and milk in modern conditions is relevant not only for Ukraine but also for the world community. The scientific substantiation of the methods of research on meat for sale subject to invasive diseases is especially important, as the product may pose risks to the consumer. One of the criteria for assessing the welfare of a herd is the prevalence of helminthiases in cattle. Ruminant parasitoses in Ukraine have always been and remain a separate, often significant, problem for veterinary specialists. Helminths have evolved to use a wide range of ecological niches. In this study, we tried to quantify the prevalence of helminthiases among ruminants (cattle, sheep and goats) in Ukraine. The relevant studies were searched for in the online databases. The meta-analysis included 15 publications from January 2015 to December 2020 which reported the spread of parasites in Ukraine. The research results show that the infestation of ruminants with gastrointestinal helminths on the territory of Ukraine is 56.7%. Egger's regression test revealed no significant publication bias. During the period of pastured farming, stable parasitocenoses are formed in the body of ruminants. The parasitoses are caused by helminths (gastrointestinal strongyles, liver flukes, paramphistomas, dicrocelia). They are recorded in monoinvasions or mixed invasions. Ruminants, according to helminthological examination in different climatic zones, are constantly infested with trematodes. In Ukraine, the presence of three species of flukes has been confirmed in ruminants: *Fasciola hepatica*, *Dicrocoelium dendriticum* and *Paramphistomum cervi*. Parasitization by those species negatively affects the profitability of dairy farming. Trematodes cause significant economic losses: reduced milk productivity of cows, reduced live weight gain of young animals, negative impact on reproduction. At the same time, fascioliasis is socially significant and dangerous to humans. According to the analyzed literature sources, two types of cestodes have been registered in Ukraine: *Moniezia benedeni* and *M. expansa*. The epizootic situation regarding nematodes is just as fraught. That is the most numerous group of helminths, their fauna is represented by the following species: *Strongyloides papillosus*, *Nematodirus spathiger*, *Bunostomum* spp., *Oesophagostomum radiatum*, *Haemonchus contortus*, *Toxocara vitulorum*, *Trichuris skrjabini*, *T. ovis* and *T. globulosa*. It is proven that in cattle parasitocenoses are recorded more often than monoinvasions. The highest rates of prevalence of infection were observed when polyinvasion included gastrointestinal strongyles, namely from the order Strongylida. *Strongyloides papillosus* is the most common taxonomic representative, while *Fasciola hepatica* has the lowest prevalence of infection, especially in sheep. Updated data on helminthiasis will expand the screening strategy to maintain the health of farm ruminants and reduce economic losses.

Keywords: cattle; sheep; goats; Trematoda; Cestoda; Nematoda.

Introduction

Despite preventive measures, gastrointestinal helminthiases of ruminants are widespread. Stable parasitocenoses of helminths (gastrointestinal strongylates, fascioles, dicrocelia, paramphistomas, cestodes) and protozoa are formed in the body of cattle. An analysis of publications over the past five years confirms the circulation of pathogens in the world (Akca et al., 2014; Jones et al., 2017; Karshima et al., 2018; Squire et al., 2018; Scala et al., 2019). Fascioliasis is the most common disease caused by trematodes of cattle, sheep and goats. Its pathogens are *Fasciola hepatica* L., 1758 and *F. gigantica* Cobbold, 1855. However, according to some researchers, in nature there are not only the above species, but also their hybrids (Amer et al., 2016; Aghayan et al., 2019). *Fasciola* spp., according to publications, are found on five continents of the globe, in more than 50 countries (Mehmood et al., 2017). In particular, *Fasciola* is common in Iran. There, the prevalence of fasciolosis did not exceed 9.0% in cattle, 4.2% in sheep and 3.1% in goats, respectively (Khademvatan et al., 2019). Another team of scientists conducted a meta-analysis of this disease, finding the incidence to be 21.0% in cattle, 2.4% in sheep and 2.0% in goats (Soosaraei et al., 2020). The highest rates of *Fasciola* spp. infection, 10.8%, is reported in slaughter animals of the province of Gilan (Ghanimatdan et al., 2019). Recent molecular genetic studies have not found any hybrid forms of *Fasciola* in southeastern Iran (Mirahmadi et al., 2018).

Yuan et al. (2015) conducted research on *Fasciola* in China. The authors indicate that fascioliasis in goats is widespread at the level of 3.5% to 37.0%, with the average number of eggs in 1 g of feces EPG = 29.0–166.0. At the same time, the prevalence in cattle ranged from 13.3% to 46.2% with average EPG = 36.4–100.0. In Europe, including the Russian Federation, fascioliasis infection has also been reported among ruminants (Bennema et al., 2009; Kuerpick et al., 2012; Beesley et al., 2018). A sharp decrease to 2.2% is found in the prevalence of trematodes in cattle, in particular in Tyumen region (Siben et al., 2018). Some scientific reports suggest that among cattle, *Fasciola* spp. are recorded less often in sheep and goats (Abdulhakim & Addis, 2012; Abdolali et al., 2016; Pinilla et al., 2020). According to other studies, fascioliasis is more common in sheep and goats (Huklaeva, 2009; Gazimagomedov & Ataev, 2011; Taye et al., 2016; Pinilla León et al., 2019). Fascioliasis has been shown to cause significant economic damage to livestock farms (Jaja et al., 2017; Arbabi et al., 2018; Arias-Pacheco, 2020). Global livestock losses caused by fascioliasis are more than $ 3 billion per year (Rinaldi et al., 2015; Elelu & Eisler, 2017; Mehmood et al., 2017).

Numerous publications have confirmed the presence of zoonotic foci of another dangerous trematode disease in the world, namely dicroceliasis (Majidi-Rad et al., 2018; Shamsi et al., 2020). To date, three pathogens are known: *Dicrocoelium dendriticum* (Rudolphi, 1819), *D. hospes* (Looss, 1907) and *D. chinensis* (Sudarikov and Ryjikov, 1951) (Maurelli et al.,

2007; Otranto et al., 2007; Gorjipoor et al., 2013). There are scientific reports of the spread of *Dicrocoelium* spp. in cattle in Nigeria (Elelu & Eisler, 2017) and Algeria (Chougar et al., 2019). In cattle, sheep and goats on farms in Iran, *Dicrocoelium* infection has also been recorded (Arbabi et al., 2011; Khanjari et al., 2014; Mohamadzadeh et al., 2016; Majidi-Rad et al., 2018). *Dicrocoelium dendriticum* has been recorded in Saudi Arabia, for example, the prevalence was 0.5% in imported sheep (Albogami et al., 2015). In Sardinia, *D. dendriticum* was found on average in 25.5% of animals on sheep farms (Scala et al., 2019). Dicroceliasis has been observed in the Russian Federation, the rate of prevalence in cattle ranging from 0.1% to 20.6% (Shmakova, 2019).

The problem of *Paramphistomum* infections of animals is not new and has been studied for a long time (Hanna et al., 1988, Huson et al., 2017). Scientists have identified more than 70 species from the superfamily Paramphistomoidea in ruminants globally (Sanguankiat et al., 2016; Ali et al., 2018; Kahl et al., 2021). Thus, according to researchers, three species have been registered in Uttarakhand, India: *Paramphistomum cervi*, *Gastrothylax crumenifer* and *Fischoederius elongates* (Maitra et al., 2014). Also, Chaoudhary et al. (2014) confirmed the parasitism of *Paramphistomum cervi* in sheep in the state of Gujarat, western India. Coprological studies have established the rates of prevalence in sheep (16.3%) and goats (13.6%) (Godara et al., 2014). *Calicophoron daubneyi* is found in cattle and sheep kept in Wales, Western Europe (Jones et al., 2017). In Ethiopia, bovine helminthiasis was diagnosed, on average, in 51.8% of slaughtered animals (Ayalew et al., 2016). According to researchers, 30.0% of cattle were affected by *Paramphistomum* spp. in Bangladesh (Ahmed et al., 2015). At the same time, quite high rates of infection were recorded in goats (≈ 73.0%). Polyinfections, made up by different species of amphistomes (*Paramphistomum cervi*, *Cotylophoron cotylophorum* and *Gastrothylax crumenifer*), were found in 60.0 % of goats (Uddin et al., 2006). In Iran, the following species were found in cattle: *Paramphistomum cervi* (13.3 %), *Cotylophoron cotylophorum* (19.5%), *Gastrothylax crumenifer* (5.9%) and *Carmyerius spatiosus* (2.7%) (Hajipour et al., 2021). The overall prevalence among domesticated animals did not exceed 9.7%. Also, cattle were found to be more prone to paramphistomosis than sheep and goats. Similar results were obtained by scientists from Ireland. According to their research, cattle have a higher risk of paramphistomosis than sheep and goats (Naranjo-Lucena et al., 2018).

Among cestodes of ruminants, one of the most common is *Moniezia*. The genetic diversity of *Moniezia* spp. was confirmed in ruminants (Diop et al., 2015). According to Nguyen et al. (2012), *M. benedeni* is more common in cattle, and *M. expansa* in sheep and goats. The work of other scientists also proves that *M. benedeni* predominates in cattle (Irie et al., 2013). The rate of prevalence of anoplocephalic cestodes was 47.4% in sheep, and only 6.2% in goats. The diseases occurred not as monoinfections. At the same time, the species composition of cestodes was determined. Thus, in sheep they are represented by *Avitellina centripunctata* (38.7%), *M. expansa* (15.4%), *Stilesia globipunctata* (16.7%) and *Thysaniezia ovilla* (0.4%). The goats were infected with *M. expansa* (6.2%) and *T. ovilla* (2.1%) (Ndom et al., 2016).

In Sri Lanka, the recorded parasites of cattle include hookworms (*Bunostomum* spp.), whipworms (*Trichuris* spp.), digenetic trematodes (*Paramphistomum* spp.), cestodes (*Moniezia* spp.) (Gunathilaka et al., 2018). In South Africa, goats are parasitized by *Trichuris* spp., *Strongyloides papillosus*, *Moniezia* spp., and Strongylata spp. On average, prevalence rate did not exceed 37.1% (Mpofu et al., 2020). The following genera of nematodes were found in sheep in Southwestern Serbia: *Ostertagia*, *Trichostrongylus*, *Nematodirus*, *Haemonchus contortus*, *Oesophagostomum*, *Chabertia ovina*, *Cooperia*, *Marshallagia*, *Skrjabinema* and *Bunostomum*. Parasitosis was observed in 82.6% of animals (Pavlović et al., 2017). From May 2014 to April 2015, the parasitofauna of ruminants was studied in Sohag (Egypt). The prevalence of helminths averaged 47.5% in cattle, 30.0% in buffaloes, and 50.3% in sheep. The dominant nematodes belonged to the family Trichostrongylidae (Al-Aboody et al., 2016).

Studies in Northeastern Colombia have confirmed the circulation in ruminants of parasites such as *Eimeria* spp., *Fasciola hepatica* and helminths of the order Strongylida. The prevalence in sheep was higher (63.0%) than in cattle (50.5%) and, accordingly, the pathogens of the Strongylida order predominated in sheep (31.9%) compared to cattle (16.5%) (Pinilla Leon et al., 2019). The following species of parasites have been identified on Portuguese sheep farms: *Nematodirus* spp., *Skrjabinema* spp., *Moniezia expansa*, *M. benedeni*, *Trichuris* spp., *Capillaria* spp., *Eimeria* spp., *Dicrocoelium* spp. and *Fasciola hepatica* (Ruano et al., 2020). Given the above, the purpose of our study was to conduct a meta-analysis of the prevalence of gastrointestinal helminthiasis in Ukraine in 2015–2020.

Material and methods

The study followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines published in (Moher et al., 2009). From January 2015 to December 2020, two authors (O. V. Kruchynenko and S. M. Mykhailiutenko) independently searched for publications in English and Ukrainian. The prevalence of gastrointestinal helminths in ruminants in Ukraine was assessed using Scopus, PubMed, Science Direct, Web of Science and Google Scholar databases. The search was performed by keywords: prevalence, gastrointestinal helminths, *Fasciola hepatica*, *Dicrocoelium dendriticum*, *Paramphistomum* spp., *Moniezia* spp., Strongylida, *Strongyloides papillosus*, *Trichuris* spp., cattle, sheep, goats, Ukraine. The exclusion criteria included: 1) identified publications that duplicated each other; 2) the total number of studied animals (less than 90); 3) inability to determine the exact number of positive cases and the total number of examined animals. Later, differences in the individual findings of authors were resolved through discussion and consensus with a third author (M. A. Petrenko). The meta-analysis included 15 publications (Fig. 1).

The data required in analysis included the author's name, year of study and year of publication, sample size, number of positive cases, status and region of study, study design, study type, species of host and helminth, determination of host and animal at least to the genus level. Preliminary analysis, including summation, subtraction and division, was performed using Microsoft Excel 2016. Statistical and meta-analysis were carried out with Jamovi 1.6 (The Jamovi Project, 2021). Prevalence for individual studies was determined by multiplying the ratio of cases to sample size by 100. The binomial formula $95\%\ CI = p \pm z1\text{-}\alpha / 2\sqrt{p}\,(1\text{-}p / n)$ was employed to determine the 95% confidence interval (95% CI). It was assumed that the true effect sizes might differ within eligible studies; therefore, the random-effects model was used to determine pooled prevalence estimates (Hedges & Vevea, 1998). Heterogeneity within studies was evaluated using the Cochran's Q-test while percentage variation in prevalence estimate due to heterogeneity was quantified using the formula $I^2 = 100 \times (Q - df) / Q$, where Q is Chi square and df is the degree of freedom which is the number of studies minus one. According to Higgins & Thompson (2002), I^2 values of 0, 25, 50 and 75% were considered as no, low, moderate and high heterogeneities, respectively. Representation of included studies based on effect size and CI was illustrated by forest plot diagram. Confidence intervals of 95% of the distribution of gastrointestinal helminths of ruminants were calculated in Open Source Epidemiologic Statistics for Public Health, Version 3.01, updated 2013/04/06 (www.openepi.com).

Results

The existing descriptive approach to the synthesis of information in veterinary medicine currently has a major drawback – the lack of systematicity; descriptive reviews do not use strict scientific methods, which are usually used in the presentation of research data. As a result, such publications are difficult to reproduce, they only partially reflect the subjective opinion of their authors. Thus, of the 34 studies obtained, nineteen were removed after scanning the titles, making a detailed review of the abstract and establishing the lack of a clearly defined number of positive cases or sample sizes. A total of 15 studies were included in the meta-analysis. The process of selecting research data for the included publications and the list of excluded ones is presented in Figure 2. We analyzed the materials of articles published in 2015–2020. Mostly (n = 8) the research was conducted in the Central Ukraine (Table 1). Ten publications determined the prevalence of helminthiasis in sheep only. Four publications were devoted to the study of bovine parasitosis, only three studies were conducted on goats.

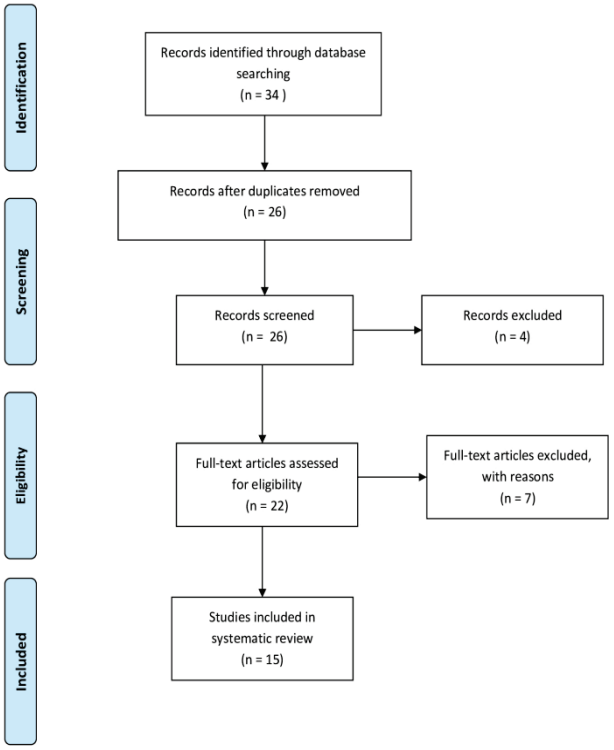

Fig. 1. Flow diagram for the selection process of eligible studies for the meta-analysis

A total of 19,389 positive cases were recorded from a sample of 34,060. The biological material collected during the individual studies included faeces or helminths detected during autopsy (Fig. 2). The overall prevalence of gastrointestinal helminths was 56.7% (95% CI: 56.2–57.3). Hence, among the study regions the ruminant helminthiases are most prevalent in the central Ukraine. Polyinfections dominate over monoinfections (Table 2). Estimation of prevalence and heterogeneity. The studies included in the meta-analysis were high heterogenous, $I^2 = 99.8\%$ ($P < 0.001$). Based on Egger's regression test, there was no significant publication bias ($P = 0.534$) the forest plot diagram of current meta-analysis (Fig. 3). Most of the analyzed work is devoted to animal diseases in Central Ukraine. The studies are descriptive and not generalized in systematic reviews and meta-analyses.

The black boxes sizes are proportional to the study weight, with the lines indicating 95% confidence intervals (CIs).

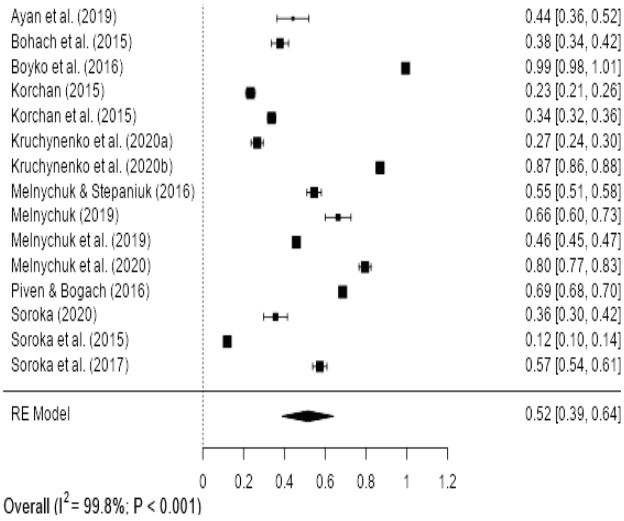

Fig. 2. Forest plot of prevalence of helminths among domestic ruminants in Ukraine

Table 1
Summary of the main characteristics of included studies in the meta-analysis

Source of literature	Region	Host	Method of diagnosis	Sample size	Cases	Prevalence (%)
Ayan et al. (2019)	–	sheep	microscopy	156	69	44.2
Bohach et al. (2015)	South	sheep	microscopy	520	197	37.9
Boyko et al. (2016)	Central	sheep	microscopy	98	98	100.0
Korchan (2015)	Central	goats	microscopy post mortem	1253	293	23.4
Korchan et al. (2015)	Central, East, South	goats	microscopy	2290	772	33.7
Kruchynenko et al. (2020a)	Central	cattle, sheep, goats	post mortem	832	222	26.6
Kruchynenko et al. (2020b)	Central	cattle	microscopy post mortem	6660	5791	86.9
Melnychuk & Stepaniuk (2016)	Central	sheep	microscopy	760	415	54.6
Melnychuk (2019)	South	sheep	post mortem	214	142	66.3
Melnychuk et al. (2019)	Central, South-Eastern	sheep	microscopy	9787	4494	45.9
Melnychuk et al. (2020)	Central, South-Eastern	sheep	post mortem	710	565	79.6
Piven & Bogach (2016)	South	sheep	microscopy	8151	5593	68.6
Soroka (2020)	North	sheep	microscopy	258	92	35.7
Soroka et al. (2015)	South	cattle	microscopy post mortem	1701	204	11.9
Soroka et al. (2017)	North	cattle	microscopy	770	442	57.4
Overall	–	–	–	34160	19389	56.7

Table 2
Pooled prevalence estimates and distribution of helminths species according to class of parasites

Group	Parasite species	Number of studies	Pooled prevalence estimates			(95 % CI)
			sample size	cases	prevalence, %	
Trematodes	*Fasciola hepatica* Linnaeus, 1758	2	6768	673	9.9	9.2–10.7
	Dicrocoelium dendriticum (Rudolphi, 1819)	5	10602	2010	18.9	18.2–19.7
	Paramphistomum spp. (Fischoeder, 1901)	1	6660	1034	15.5	14.7–16.4
Cestodes	*Moniezia spp.*	2	8384	5641	67.3	66.3–68.3
Nematodes	*Strongyloides papillosus* (Wedl, 1856)	1	98	98	100.0	96.2–100.0
	Strongylida: *Bunostomum, Oesophagostomum, Nematodirus, Chabertia, Cooperia, Trichostrongylus, Ostertagia, Haemonchus*	7	19287	12047	62.5	61.8–63.1
	Trichuris spp.	2	3607	811	22.5	21.1–23.9

Note: for helminths of the order Strongylida, genera are given.

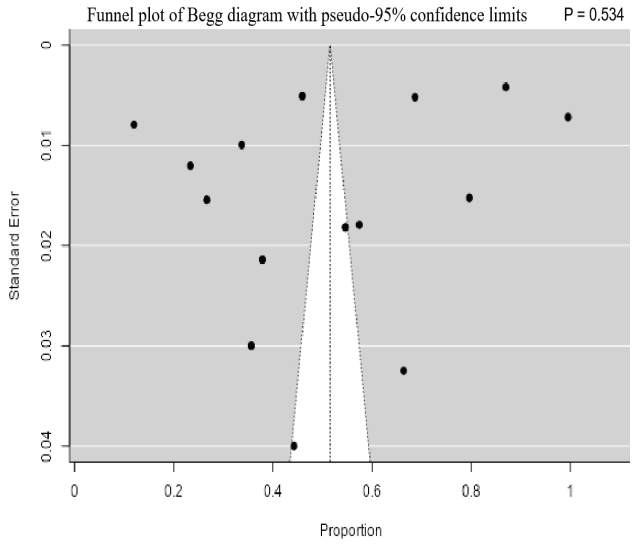

Fig. 3. Funnel plot for the studies included in meta-analysis

Black dots are publications, included in the meta-analysis. The x axis indicates the prevalence of helminths, and the y axis shows the standard error of distribution (P > 0.05 indicates no publication error).

Discussion

It is important for scientists and practitioners to understand and implement the principles of confirmation and objectivity in research, using tools such as systematic review and meta-analysis, which are already regularly used worldwide (Brown, 2002; Sargeant & O'Connor, 2020). We conducted the first meta-analysis on the prevalence of gastrointestinal helminthiasis in ruminants in Ukraine. This research is extremely relevant because it provides useful epidemiological information needed to reduce economic losses in livestock. Based on 15 publications, the total prevalence of helminthiases of the gastrointestinal tract is 56.8% (95% CI: 56.2–57.3). In our work, the studies included in the meta-analysis were highly heterogenous, $I^2 = 99.9\%$ ($P < 0.001$). Karshima et al. (2018) found that the average prevalence of helminthiases in Nigeria was 7.5% between 1970 and 2016 (95% CI: 7.38–7.57%). The level of heterogeneity was $I^2 = 99.8\%$. *Fasciola gigantica* had the widest geographical distribution. According to the systematic analysis, the total prevalence of fasciolosis was 6.2% in Iran in 1999–2019 (95%, CI = 5.8–6.5%) (Khademvatan et al., 2019). Another group of scientists from Iran for the period of 2000–2016 indicate that the 2.6% prevalence of fascioliasis among animals. In Ukraine, the equivalent figure was 9.9% in 2015–2020. Soosaraei et al. (2020) also diagnosed high heterogeneity ($I^2 = 99.96\%$). The data of the meta-analysis showed a decrease of fascioliasis among sheep and goats in Iran.

At the same time, there are very few reports of fascioliasis in sheep and goats in Ukraine. One of the publications mentions the helminth fauna of sheep and goats of Dnipropetrovsk region, and notes only *F. hepatica* in sheep and goats (Bojko, 2015). Fascioliasis in sheep as a part of mixed infection (Piven & Bogach, 2016) is also recorded in Odesa region. No other data could be found on the parasitism of *F. hepatica* in sheep and goats on Ukrainian farms. Sheep, goats and cattle grazing on pastures are constantly infected by other trematodes (Godara et al., 2014; Kahl et al., 2021). In Ireland, pathogens of the genus *Paramphistomum* spp. affected 52.0% of cattle and from 14.0% in sheep. In sheep farms of Sardinia, *D. dendriticum* is on average found in 25.5% of animals (Scala et al., 2019). The pathogen is also registered in the Russian Federation. There, the prevalence of these helminths in cattle varied from 0.02% to 20.6% (Shmakova, 2019). Our work shows that, on average, cattle are infected in Ukraine with *Dicrocoelium lanceatum* (18.9%).

Strongyloidiasis is one of the most common helminthiases of ruminants. Development of *Strongyloides* spp. to the infective stage takes place in the environment. Animal hosts become infected with infectious larvae when consuming food and water, as well as percutaneously (Boyko et al., 2009, 2019; Boyko & Brygadyrenko, 2017, 2018, 2019a, 2019b, 2021; Ko et al., 2019). *Strongyloides papillosus* was the most common in Nigeria (30.2%) (Karshima et al., 2018), which is consistent with the data for Ukraine, where EI = 100%. According to studies in Poltava region, cattle were affected by trichuriasis and fascioliasis, with the average rate of parasite infection at 75.0%, and in sheep the prevalence of strongylatoses of digestive organs and *Trichuris* did not exceed 20% (Yevstafieva et al., 2020a). The prevalence of this infection in calves in the Mukurweini district of Kenya was 3.7% (Peter, 2015). According to the analysis conducted on the territory of Ukraine, the prevalence reached its peak. The causative agents of helminthiasis, according to the analysis of scientific publications, circulate mainly in developing countries, in particular in Africa. A review conducted in Ethiopia presents generalized data on the prevalence of gastrointestinal nematodes in small ruminants. The average prevalence of the infection was 75.8%. At the same time, high heterogeneity was established ($I^2 = 97.8\%$). Recorded nematode taxa were represented by eleven genera, including *Haemonchus*, *Trichostrongylus*, *Teladorsagia* / *Ostertagia*, *Strongyloides*, *Bunostomum*, *Nematodirus*, *Chabertia*, *Trichuris*, *Cooperia*, *Skrjabinema* and *Oesophagostomum* (Asmare et al., 2016). Sheep in Kumasi (Ghana, Africa) have been studied by a number of other scientists, who found that the most common among parasites were also nematodes of the gastrointestinal tract (EI 94.5%) of the Strongylata spp. (94.5%). The second place was taken by *Strongyloides* helminths (27.3%) (Owusu et al., 2016). The research data, collected in Burkina Faso, Africa, confirm a high level of prevalence of Strongylata spp. of the gastrointestinal tract (70.7%), with a lower rate of monieziasis of sheep (5.7%). The pathogen *Stronyloides* spp. had the lowest rate (0.9%). The dominant species among nematodes in Kazakh sheep were *H. contortus* (90.1%), *Trichostrongylus* spp. (68.5%) and *Ostertagia* spp. (48.9%) (Yan et al., 2021). Numerous publications confirm the circulation of the causative agent of haemonchosis in China (Britton et al., 2016; Hoberg & Zarlenga, 2016).

On the island of Bali, Indonesia, the incidence in cattle was 9.3%. The following species have been identified: *Paramphistomum* spp., *Fasciola* spp., *Bunostomum phlebotomum*, *Strongyloides papillosus*, *Trichostrongylus axei* and *Trichuris ovis*. According to the coprooscopic studies of sheep in the autumn-grazing period, in the Poltava region the prevalence of infection of animals by pathogens of parasites reached 100.0% (Yevstafieva et al., 2020b). The prevalence of nematodes of the genus *Trichuris* spp. among sheep in the central and south-eastern regions of Ukraine was 65.9% (Yevstafieva et al., 2018). Three species of *Trichuris* were found, *T. skrjabini* Baskakov, 1924, *T. ovis* Abildgaard, 1795 and *T. globulosa* Linstow, 1901. *Trichuris ovis* and *T. skrjabini* were more common (54.9% and 35.7%), whereas *T. globulosa* was relatively rare (9.4%).

Thus, gastrointestinal helminths have a significant geographical distribution, including in Ukraine, and we need to summarize the updated data on the distribution to prevent significant economic losses in livestock farms.

Conclusions

As a result of a meta-analysis of 15 scientific papers, it was found that helminths are quite common in Ukraine, the average prevalence of helminthiases reaching 56.8% (95% CI: 56.2–57.3%). Parasitocenoses are registered more often than monoinfections, and the highest rates of infection prevalence are observed when the species composition includes gastrointestinal strongyles of the order Strongylida. *Strongyloides papillosus* is the most common of all represented taxa, while *Fasciola hepatica* has the lowest prevalence.

The application of scientifically based veterinary and sanitary prevention measures on farms of Ukraine, ensuring the effective deworming of livestock, combined with thorough veterinary inspection at meat processing plants would reduce economic losses caused by helminths.

The current studies are the initiative of the authors and do not have any outside financial support. The research was carried out within the framework of the initiative topic for scientific work "Monitoring, improvement of diagnostics, treatment and prevention of invasive diseases of animals of the central part of Ukraine" (state registration No. 0112U001560).

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