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

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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 parasites in Ukraine have always been and remain a separate, often significant, problem for veterinary specialists. Helminthiases are widespread. Stable parasitocenoses of helminths (gastrointestinal strongyles, 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 (Meenoo et al., 2019). In particular, Fasciola is common in Iran. There, the incidence of fascioliasis did not exceed 9.1% 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). It is proven that in cattle parasitocenoses are recorded more often than monoinvasions. The highest rates of prevalence of infection were observed when polynonisits included gastrointestinal strongyles, namely from the order Strongylida. Strongyles present in cattle are the most common taeniasis, 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; Trichuridae; Cestoda; Nematoda.

Introduction

Despite preventive measures, gastrointestinal helminthiases of ruminants are widespread. Stable parasitocenoses of helminths (gastrointestinal strongyles, 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 (Meenoo et al., 2019). In particular, Fasciola is common in Iran. There, the incidence of fascioliasis did not exceed 9.1% 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 (Ghahramanlou et al., 2019). Recent molecular genetic studies have not found any hybrid forms of Fasciola in southeastern Iran (Minaii 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 (Hennema et al., 2009; Kuepnick 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 León et al., 2019). Fascioliasis has been shown to cause significant economic damage to livestock farms (Jaja et al., 2017; Arbabi et al., 2018; Anis-Pacheco, 2020). Global livestock losses caused by fascioliasis are more than $ 3 billion per year (Rinaldi et al., 2015; Elelu & Atau, 2018). 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. Helminthiases are widespread. Stable parasitocenoses of helminths (gastrointestinal strongyles, fascioles, dicrocelia, paramphistomas, cestodes) and protozoa are recorded in Ukraine 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: Strongylodes papillosus, Nematodirus spathiger, Bunostomum spp., Oesophagostomum radiatum, Haemonchus contortus, Toxocara vitulorum, Trichuris toxi, 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 polynonisits included gastrointestinal strongyles, namely from the order Strongylida. Strongyles present in cattle are the most common taeniasis, 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.
2007; Ottaro 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 (Choug et al., 2019). In cattle, sheep and goats on farms in Iran, Dicrocoelium infection has also been recorded (Arbabi et al., 2011; Khajavi 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 (Albagani 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 superfamilies Paramphistomoidea in ruminants globally (Sanguanikiat 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 ramsayi and Ichthyocotyle elongata (Mitra et al., 2014). Also, Chaoufdiry et al. (2014) confirmed the parasitism of Paramphistomum cervi in sheep in the state of Gujarat, western India. Cytological studies have established the rates of prevalence in sheep (16.3%) and goats (13.6%) (Godana 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 (Ayalaw 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 Carneyetia spatiosa (2.7%) (Hajipour et al., 2021). The overall prevalence amongst domesticated animals did not exceed 9.7%. Also, cattle were found to be more prone to paramphistomiasis than sheep and goats. Similar results were obtained by scientists from Ireland. According to their research, cattle have a higher risk of paramphistomiasis 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 (Dhop 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 anoplocephalid 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 cirrata (38.7%), M. expansa (15.4%), Sialosia globopunctata (16.7%) and Thysaniezia ovilla (6.4%). The goats were infected with M. expansa (6.2%) and T. ovilla (2.1%) (Nidom et al., 2016).

In Sri Lanka, the recorded parasites of cattle include hookworms (Buonostomum spp.), whipworms (Trichurus spp.), digenetic trematodes (Paramphistomum spp.), cestodes (Moniezia spp.) (Gunathilaka et al., 2018). In South Africa, goats are parasitized by Trichuris spp., Strongylodes papillosus, Moniezia spp., and Strongylata spp. On average, prevalence rate did not exceed 37.1% (Mpolu 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 (Pavlovic et al., 2017). From May 2014 to April 2015, the parasitaemia of ruminants was studied in Soluq (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 Trichostrongyldiae (Al-Abody 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 of sheep was higher than 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 (Ruanu 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. Kruychenko and S. M. Mykhailutienko) 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, Strongylodes 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 ± z/2 √ p (1-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 I² = 100 × (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), I² 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 systematocity; 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.
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).

**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 goat | goats | microscopy post mortem   | 2200        | 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     | goat       | microscopy               | 760         | 415     | 54.6          |
| Melnychuk (2019)             | South       | sheep      | post mortem              | 214         | 142     | 66.3          |
| Melnychuk et al. (2020)      | Central, South-Eastern | sheep | microscopy post mortem   | 9787        | 4494    | 45.9          |
| 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   | 701         | 204     | 11.9          |
| Soroka et al. (2017)         | North       | cattle     | microscopy               | 770         | 442     | 57.4          |

Overall ($I^2 = 99.8\%, P < 0.001$) | 0.52 [0.39, 0.64]

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

**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) |
|-------------|--------------------------------------|-------------------|-------------------------------------|
| Trematodes  | Fasciola hepatica Linnaeus, 1758     | 2                 | 6796 [561, 747]                     |
|             | Dicrocoelium dendriticum (Rudolphi, 1819) | 5      | 10602 [8100, 11800]                  |
|             | Paragonimus westermani (Fischbecker, 1901) | 1      | 6660 [5800, 7500]                    |
| Cestodes    | Moniezia spp.                        | 2                 | 8384 [6461, 7467]                    |
| Nematodes   | Strongyloides papillosus (Weull, 1856) | 1                 | 98 [98, 100]                        |
|             | Strongyloides bukina worms (Oesophagostomum, Nematalloides, Chabertia, Cooperia, Trichostrongylus, Oesophagostomum, Haemonchus) | 7   | 19287 [12047, 20927]                  |
|             | Trichuris spp.                        | 2                 | 3607 [1541, 7211]                    |

Note: for helminths of the order Strongyloides, genera are given.
Dendriticum (2021). In Ireland, pathogens of the genus Paramphistomum constantly infected by other trematodes (Godara et al., 2014; Kahl et al., goats on Ukrainian farms. Sheep, goats and cattle grazing on pastures are No other data could be found on the parasitism of Dendriticum infection (Piven & Bogach, 2016) is also recorded in Odesa region. in sheep and goats (Bojko, 2015). Fascioliasis in sheep as a part of mixed infection (P < 0.001). Karshima et al. (2018) found the average prevalence of helminthiases in Nigeria was 7.5% between 1970 and 2016 (95% CI: 7.38–7.5%). The level of heterogeneity was $I^2 = 99.99\%$. 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 fasciolasis 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 fasciolasis among sheep and goats in Iran. At the same time, there are very few reports of fasciolasis 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 (Prén & 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 (Scalia 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 Dicrocelium lanceatum (18.9%).

Strongyloides 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 & Borydzyuk, 2017, 2019, 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 EL = 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 strongyloloses of digestive organs and Trichuris did not exceed 20% (Yevtystiav et al., 2020a). The prevalence of this infection in calves in the Masurwini 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, Skrjabinina and Oesophagostomum (Azmare 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 (EL 94.5%) of the Strongylata spp. (94.5%). The second place was taken by Strongyloides helminths (27.3%) (Ouswa 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 monieziais of sheep (5.7%). The pathogen Strongyloides spp. had the lowest rate (0.9%). The dominant species among nematodes in Kazakhstan 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 & Zarlanga, 2016).

On the island of Bali, Indonesia, the incidence in cattle was 9.3%. The following species have been identified: Paraphysodema spp., Fasciola spp., Bunostomum phlebotomum, Strongyloides papillosus, Trichostrongylus axei and Trichuris ovis. According to the coproscopic 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% (Yevtystiav 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% (Yevtystiav et al., 2018). Three species of Trichuris were found, T. skrjabini Baskakov, 1924, T. ovis Abildgaard, 1795 and T. globulosa Limstow, 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.

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