ANNALES UMCS
VOL. XXXIV(2) SECTIO EE ZOOTECHNICA 2016

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A comparison of the prevalence of gastrointestinal parasites in sheep from the indoor and outdoor management system

Porównanie częstości występowania pasożytów przewodu pokarmowego u owiec utrzymywanych w systemie alkierzowym i pastwiskowym

Summary. Gastrointestinal parasites are responsible for high economic losses to sheep production. Infected animals show developmental problems, reduced weight and a low quality of meat and wool. This study takes into consideration two different sheep management systems, indoor (n = 50) and outdoor (n = 50) ones, and their impact on the occurrence of gastrointestinal parasites. Coproscopic examinations of sheep were made three times during one season. Flotation, sedimentation and McMaster methods were applied to determine the parasite species, prevalence of infection and mean EPG/OPG of parasites. Sheep from indoor management carried only 3 parasite taxa (Trichostrongylidae spp., Capillaria spp. and oocysts Eimeria spp.) whereas, 4 parasite taxa were derived from individuals kept in the outdoor management system (Trichostrongylidae spp., Nematodirus spp., Trichuris spp., and Moniezia spp). The overall prevalence of G.I. parasites was 3.4-fold higher in sheep from the outdoor management system. Sheep kept outdoors showed significantly higher overall mean EPG/OPG values for all taxa. Results of this study show that sheep kept outdoors are subject to intensive parasite invasions as compared to individuals managed indoors.

Key words: gastrointestinal nematodes, indoor management system, outdoor management system, sheep

INTRODUCTION

Gastrointestinal parasites are a major problem in sheep production worldwide. For example in the UK, intestinal worms of sheep are responsible for an annual loss of £83 million to the industry [Nieuwhof and Bishop 2005].

Small ruminants are produced under different management systems: indoor management system (IMS) and outdoor management system (OMS). Usually, animals reared indoors are kept at high stocking rates (intensive rearing system), crowded conditions and heavily fecal contamination which predisposes animals to intensive invasions of parasites with direct life cycle. In our previous research, only coccidia and nematodes from taxa *Trichostrongylidae, Nematodirus, Capillaria, Strongyloides* were identified in ewes and lambs from IMS [Junkuszew *et al.* 2015]. Animals reared outdoors are kept at low or medium stocking rates (extensive rearing system) [Niżnikowski *et al*. 2006, Alvarez-Rodrigueza *et al*. 2008]. In OMS the main problems are helminthosis caused by parasites with indirect life cycle (*Fasciola hepatica, Moniesia* spp.) because animals are permanently exposed to contact with a large number of intermediate hosts [Alvarez-Rodrigueza *et al*. 2008].

Management practices determine the host's condition and susceptibility to parasite invasion. In addition, the immune status of the animal may be radically modified by changing management practices and indirectly influencing animal worm burdens [Sykes 1994, Alvarez-Rodrigueza *et al*. 2008].

The objective of the research was to compare the prevalence of gastrointestinal parasites in sheep from IMS and OMS systems with no parasitic prevention.

MATERIALS AND METHODS

The material for research was collected from sheep (n = 100) of similar age (mean age of herd 3.5 years) kept in two housing systems: indoor management system – IMS (n = 50) and outdoor management system – OMS (n = 50).

The first farm (IMS), located in the Experimental and Research Station in Bezek, University of Life Sciences in Lublin, was situated in the south-eastern part of Poland, where animals from two synthetic prolific-meat lines BCP and SCP were housed. Throughout the experiment, the animals were managed under the same environmental conditions, in the indoor housing system. The experimental animal groups were fed using the same feeding method with feeds that were available on the farm at the time. The feed was based on hay, haylage, and concentrate. The other farm (OMS) was located in Cieszyn, in the south-east of the Czech Republic. All animals, ewes and lambs (Suffolk breed and Suffolk crossbreed) were grazed on natural pastures, whereas additional feeding was provided only during the winter months of the year. In both management systems, no parasitic prevention of sheep was applied during the experimental period.

Parasitological analyses were performed to determine the occurrence of gastrointestinal parasites in the sheep. Coproscopic examinations of the sheep were made three times during one year, in March, June, and October. Each time, a total of 50 rectal fecal samples, taken individually, were obtained. The samples were analyzed using conventional coproscopical methods [Schnieder 2006]. In order to determine the presence of

parasite forms (eggs and oocysts) the following methods were applied: flotation with saturated sodium chloride and sucrose (specific gravity 1.25g/ml) and sedimentation [Tomczuk *et al*. 2014]. To estimate the actual parasite burden, OPG (oocysts per gram) and EPG (eggs per gram) were determined using a modified McMaster method [Raynaud 1970]. The method had a sensitivity of 50 eggs/oocyst per gram.

The prevalence values (percentage of animals infected) are shown with 95% confidence limits (95% CL), the latter having been calculated according to Rohl and Sokal [Rohlf and Sokal 1995]. All data were tested for normality using Kolmogorov-Smirnov test. The differences between the OPG and EPG and parasite prevalence were calculated using Mann–Whitney U test. All of the statistical analyses were conducted using the R version 2.12.0 (R Development Core Team, 2010) and MS Excel 2010.

RESULTS AND DISCUSSION

Indoor management system

Three parasite genera were found in sheep from IMS. Animals were infected with nematodes species – *Trichostrongylidae*, *Capillaria* and with coccidian of *Eimeria* spp. *Trichostrongylidae* and coccidia were the most prevalent species – 19.3% (10.7–32.5) and 14.0% (6.3–25.7), respectively. Prevalence of *Trichostrongylidae* and *Eimeria* species varied within the study period. *Capillaria* spp. occurred sporadically only in March and June, with overall prevalence of 2.0% (0.1–10.7) during the whole experimental period.

The EPG counted for *Trichostrongylidae* varied from 0 to a maximum value of 500 while the range of OPG values was from 0 to 3000. In the IMS sheep, the highest intensity of *Trichostrongylidae* was found in March after lambing, with a tendency to decrease. The lowest values of EPG and OPG on the IMS farm were observed in June, after the lactation period.

Outdoor management system

Compared to the indoor management system, more parasite taxa were found in the OMS sheep. Eggs of 4 helmint species were detected: *Trichostrongylidae*, *Nematodirus*, *Trichuris*, *Moniezia*. The highest mean prevalence of 86.7% (74.5–93.0) was found for *Trichostrongylidae*. Among the other helminthes, a similar overall prevalence of 28.0% (16.8–41.6) was found for genera *Trichuris* and *Nematodirus* 27.3% (16.6–41.2), while the lowest overall prevalence of 13.3% (6.5–24.1) was for *Moniezia* spp. The infestation of sheep with *Moniezia* spp. tapeworms occurred irregularly with a highest prevalence in October – 28% 16.1–40.9). In addition to the helminths, also coccidiosis was a significant problem in the sheep from the OMS. The overall prevalence of *Eimeria* spp. was 71.3% (38.9–57.4), but it varied during the study period. The highest prevalence of coccidiosis was in March – 92.0% (79.7–96.6) however, prevalence decreased until October 52% (36.9–65.1). Among the helminths found in the study, the *Trichostrongylidae* family showed the highest mean EPG values in each study month, ranging from 279 to 393, with maximum values of 1200.

In the March faecal samples, a spring rise of *Trichostrongylidae* eggs was observed, and it decreased significantly reaching its lowest value in October. From March to October, the mean values of OPG varied. A linear regression analysis showed a significant reduction in the OPG ($P < 0.05$) of the infected sheep. The minimum value of OPG was 0 while the maximum was 7000. However, only 13 examined samples of sheep faeces from the outdoor management system had OPG of up to 1000.

IMS vs. OMS

Management systems differed in the number of parasite taxa found in sheep. The overall prevalence of gastrointestinal parasite infestation was 3.4-fold higher in the OMS sheep of 97.3% (93.0–99.1) than those from the IMS 28.6% (21.6–36.9) ($U = 1354$; $Z = 11.7$; $P < 0.0001$). The overall prevalence of *Trichostrongylidae* and coccidiosis was significantly higher in the sheep from the OMS than those from the IMS (Fig 1. A, B).

There was a significant difference between the indoor and outdoor management system in overall mean EPG and OPG for all taxa ($U = 1938$; $Z = 12.4$; $P < 0.001$) (Tab. 1). G.I. nematode EPG varied significantly between IMS and OMS ($U = 3079{,}5$; $Z = 10.88$, $P < 0.0001$). Eimeria OPG varied significantly between IMS and OMS as well ($U = 4278$, $Z = 9.28$, $P < 0.0001$).

CONSLUSIONS

Our results confirm earlier studies on the influence of different management systems on the infection level of gastrointestinal parasites in sheep [Thamsborg *et al*. 1996, Nowosad *et al*. 2000, Pilarczyk *et al*. 2008]. Sheep management practices determine the occurrence of gastrointestinal parasites. In both study management systems, *Trichostrongylidae* spp. and *Eimeria* spp. were found to be the most predominant parasites, but a lower parasite prevalence was observed in the sheep from the IMS compared to those from the OMS. In addition, more eggs of helminths were found in the faecal samples of pastured sheep than in the samples of indoor managed sheep, which proves that grazing animals are more predisposed to parasitic invasions.

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Projekt nr 297267 „Kierunki wykorzystania oraz ochrona zasobów genetycznych zwierząt gospodarskich w warunkach zrównoważonego rozwoju" finansowany przez Narodowe Centrum Badań i Rozwoju ze środków Programu BIOSTRATEG.

Streszczenie. Pasożyty występujące w jelitach owiec powodują duże straty ekonomiczne w produkcji. Zakażone zwierzęta wykazują problemy w rozwoju, zmniejszenie masy ciała, a ich mięso i wełna mają niską jakość. Niniejsze opracowanie uwzględnia wpływ dwóch różnych systemów utrzymywania owiec – alkierzowego (n = 50) i pastwiskowego (n = 50) – na występowanie pasożytów w przewodzie pokarmowym. W trakcie sezonu dokonano kilkukrotnych badań koproskopowych owiec. Do określenia gatunków pasożytów, częstości występowania infekcji i oznaczenia EPG/OPG pasożytów wykorzystano metody flotacji, sedymentacji oraz McMaster. U owiec z systemu alkierzowego zidentyfikowano 3 taksony pasożytów (Trichostrongylus spp., Capillaria spp. i oocysty Eimeria spp.), natomiast u zwierząt z systemu pastwiskowego 4 taksony (Trichostrongylidae spp., Nematodirus spp., Trichuris spp. i Moniezia spp). Całkowita częstość występowania G.I. pasożytów była 3,4-krotnie wyższa u owiec z systemu pastwiskowego. Owce trzymane na zewnątrz wykazały znacznie większe ogólne i średnie wartości EPG/OPG dla wszystkich taksonów. Wyniki tego badania wskazują, że zwierzęta utrzymywane na pastwisku charakteryzują się intensywniejszą inwazją pasożytów niż osobniki z systemu alkierzowego.

Słowa kluczowe: nicienie żołądkowo-jelitowe, system alkierzowy, system pastwiskowy, owce