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Asian Pacific Journal of Tropical Biomedicine

journal homepage: www.elsevier.com/locate/apjtb

Original article http://dx.doi.org/10.1016/j.apjtb.2016.07.001

Prevalence of gastrointestinal nematodiasis and coccidiosis in goats from three selected farms in Terengganu, Malaysia

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ARTICLE INFO

Article history:
Received 14 Mar 2016
Received in revised form 8 Apr 2016
Accepted 22 May 2016
Available online 26 Jul 2016

Keywords:
Age
Coccidia
Goat
Nematodes
Terengganu

ABSTRACT

Objective: To reveal the prevalence of gastrointestinal nematodiasis, *Trichostrogylus*, *Haemonchus*, *Strongyloides* and *Trichuris* and coccidiosis, mainly *Eimeria* in kids, yearlings and adult goats.

Methods: A total of 287 goat faecal specimens were randomly collected from three farms in Kuala Terengganu, Setiu and Besut.

Results: Prevalence of coccidiosis (89.2%) was significantly higher ($P < 0.05$) than gastrointestinal nematodiasis (52.3%). Gastrointestinal nematodes (GINs) were found in 37.0% kids, 63.5% yearlings and 53.3% adults. Identification of GINs revealed the predominance of *Strongyloides* (45.6%) followed by *Trichostrogylus* (12.9%), *Haemonchus* (11.8%) and *Trichuris* (8.7%) in all groups whereby the adult goats recorded the highest infections of *Trichostrogylus* (20.5%), *Haemonchus* (10.6%), *Strongyloides* (51.5%) in all groups. The age-specific intensity for *Eimeria* was in following order: kids (92.6%), adults (86.6%) and yearlings (51.5%) and the difference was not significant ($P > 0.05$). The concurrent infections between GINs and *Eimeria* were 67.94% in all groups. Polyparasitisms of *Trichostrongylus* (17.4%), *Haemonchus* (15.15%) and *Strongyloides* (40.4%) with *Eimeria* had infected most adult goats. Dual infections of *Trichostrongylus* with *Eimeria* and *Trichuris* with *Eimeria* were significantly higher in adults than yearlings and kids ($P < 0.05$).

Conclusions: GINs and *Eimeria* were widely distributed in the goats leading to higher risk of morbidity and mortality.

1. Introduction

In recent years, the global goat population has exhibited a rapid growth over 875.5 million heads of which Asia is observed to have the largest goat population [1] mostly in developing countries including China, India, Malaysia and Pakistan [2,3]. As a result of this huge expansion, the growth rate of goat population in Malaysia has also consistently increasing from 2010 to 2013 with a total of 482 280 goats nationwide [4]. Malaysians' preferences for goat meat have gradually increasing as an alternative to other red meats [5] due to its low total and saturated fat compared to beef, pork, lamb and chicken [6,7]. Year by year, the levels of mutton production in Malaysia are estimated to increase from 8.99% to 35.00% with the increasing of the goat population to 1.5 million heads [5].

However, gastrointestinal nematodes (GINs) have becoming an important helminth group that causes direct damages to the livestock. They remain as one of the main constraints to ruminant productions especially goats, since they can cause several

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All experimental procedures involving animals were conducted in accordance to Department of Veterinary Services (DVS), Terengganu and approved by the Department of Veterinary Services (DVS), Terengganu.

Foundation Project: Supported by Ministry of Higher Education, Malaysia under the grant of Research Acculturation Grant Scheme (RAGS) (Grant No. 13-010-0073).

Peer review under responsibility of Hainan Medical University. The journal implements double-blind peer review practiced by specially invited international editorial board members.

subclinical effects such as hypoproteinemia, growth depression, reduction in milk yield, loss of appetite and digestive inefficiency [6,7]. In Malaysia, gastrointestinal nematodiasis, referring mainly to haemonchosis was classified as one of the most important causes of mortality and morbidity in small ruminants [8]. In the past two decades, a study conducted in seven farms in Penang Island [9] had revealed *Haemonchus contortus* (*H. contortus*) as the most prevalent nematode species infected the studied goats. Years afterwards, Chandrawathani *et al*. [10] also reported that *H. contortus* had predominated the goats in Peninsular Malaysia. Besides that, there were reports from many countries worldwide on prevalence of GINs including *H. contortus*, *Oesophagostomum* spp., *Cooperia* spp. and *Trichostrongylus* spp., which had caused massive decline in milk and meat productions leading to severe economic losses in the goat industry [11–14].

Another important parasitic infections in small ruminants that prevail widely in many parts of the world either clinically or subclinically is coccidiosis. It is caused by coccidian parasites of the genus *Eimeria* which contribute to enteric disease especially in young or stressed goats under poor farm management that leads to high mortality in goat kids [15]. Other than that, studies in many countries such as Czech Republic [16], Jordan [17], Malaysia [18], Poland [19] and Sri Lanka [20] have indicated that goat coccidiosis has a great economic importance to the livestock productions due to the clinical disease (diarrhea) and sub-clinical disease (poor weight gain) caused by the parasite especially goats kept in large numbers under various management systems. Furthermore, GINs and coccidia infections among goats are also closely associated with other several factors including poor farm management, ingestion of contaminated food and water, nutritional deficiencies, age of the goats and also climate factor [21].

In the previous year, 40 goats from two farms in Kuala Terengganu, Terengganu were examined for endo- and ectoparasites. This study only compared the prevalence and intensity of parasitic infections between the two farms [22]. Unlike the present study, it evaluated the prevalence of coccidian and GINs associated with different age groups in three different farms from three different districts of Terengganu (Kuala Terengganu, Setiu and Besut). More importantly, there is a no established data available on the prevalence of concurrent GINs and *Eimeria* spp. infections in Terengganu with relation to the three different age groups of goats. Thus, the present study aimed to determine the prevalence of gastrointestinal nematodiasis and coccidiosis from three age groups of goats and provided information on the predominance of concurrent GINs and *Eimeria* spp. in goats from three farms in Terengganu. The results obtained should provide a foundation for the improved control of both GINs and coccidia infections in goats.

2. Materials and methods

2.1. Ethics statement

The present study had been approved by the Department of Veterinary Services, Terengganu dated 18th May 2014 (Ref. JPV.TR 03/03/13). All experimental procedures involving animals were conducted in accordance to Department of Veterinary Services, Terengganu and approved by the Department of Veterinary Services, Terengganu.

2.2. Study areas and subjects

This study was conducted in three commercialized farms in Terengganu (a) Farm 1: Kuala Terengganu, (b) Farm 2: Setiu and (c) Farm 3: Besut. The farms were rearing more than 100 goats mainly for milk and meat productions. A total of 287 goats including 81 goat kids, 74 yearlings and 132 adult goats were sampled once between February and April 2015. The weather across these three districts were uniformly warm and rainy with average rainfall ranging between 200 mm and 400 mm. The animals were catergorised according to guidelines provided by the Department of Veterinary Services, Terengganu [(a) kids: age below 12 months, (b) yearlings: 12 months but under 24 months old, (c) adults: above 24 months old]. The kids had received colostrum for the first 2–3 days of life and kept together with their dams only in the morning whereas most yearlings and adult goats were turned out for grazing during the day and penned separately according to age group at night.

2.3. Faecal sample collection

Faecal samples were collected directly from the rectum of randomly selected animals using sterile disposable plastic gloves and placed in a faecal container. For each animal, the date of sampling, age, animal identification number and sex were recorded. The samples were transported on the same day of each sample collection in an airtight box cooler with dry ice packs to the Laboratory of Parasitology, Integrated Centre for Animal Care and Use, International Islamic University Malaysia and then kept at 4 °C for a maximum of 48 h before analysis.

2.4. Examination of faecal samples

Three grams of each faecal sample were mixed with 45 mL of floatation fluid, sodium chloride (1.2 specific gravity) to recover the intestinal eggs and oocysts from the faecal debris [23]. The presence of parasite stages (eggs or larvae of helminths, oocysts of coccidian) was identified on based on their morphological characteristics [24,25] using 10× and 40× magnification.

2.5. Statistical analysis

The overall prevalence was calculated as a percentage of number of animals infected in the total number of animals examined. Relative prevalence for different species of parasites, respectively, was calculated and stratified by three age groups (kids, yearlings and adults). In all analyses, confidence level was held at 95% and P value of ≤ 0.05 was set as the level of significance. The analysis was performed using SPSS software for Windows version 22.0 (SPSS Inc., Chicago, USA).

3. Results

A total of 287 goats from three farms in Besut, Setiu and Kuala Terengganu were successfully examined. The present study revealed that the overall prevalence of GINs in all three age groups was 77.7% (223/287) while 89.2% (256/287) goats examined were found to be infected with coccidian (Table 1). The prevalence of coccidia was significantly higher than GINs (χ^2; $P < 0.05$).

Table 1
Overall prevalence of GINs and coccidia infections in kid, yearling and adult goats [*n* (%)].

Age group	No. of examined	GINs	Coccidia
Kid	81	43 (53.1)*	75 (92.6)
Yearling	74	65 (87.8)*	68 (91.9)
Adult	132	114 (86.4)*	113 (85.6)
Total	287	223 (77.7)	256 (89.2)*

*: *P* value of less than 0.05 was considered statistically significant.

As summarized in Table 1, the highest prevalence of GINs infection was observed in yearlings (87.8%), followed by the adults (86.4%) and kids (53.1%). The association between the prevalence of GIN infections and the age groups was identified to be significant (χ^2; $P < 0.05$). Generally, coccidia oocysts were detected in 256 of 287 faecal samples (89.2%), including 75 samples originating from goat kids (92.6%), 68 samples from yearlings (91.9%) and 113 samples from adult goats (85.6%). Contradicting to nematode infections, there was no significant association between the prevalence of coccidial infection and the age groups (χ^2; $P > 0.05$).

A total of four genera of GINs were found in the studied goat including *Trichostrogylus* spp., *Haemonchus* spp., *Strongyloides* spp. and *Trichuris* spp (Table 2). The most prevalent GINs observed was *Strongyloides* spp. (45.6%) followed by *Trichostrogylus* spp. (14.3%), *Haemonchus* spp. (9.0%) and *Trichuris* spp. (8.7%). Coccidia oocysts belonging to the genus of *Eimeria* spp. (89.2%) was the only coccidian parasite identified in this study.

Table 2
Prevalence of different species of GIN and coccidia in three age groups [*n* (%)].

Parasite	Kids	Yearling	Adult
Nematode			
Trichostrogylus spp.	4 (4.9)*	10 (13.5)*	27 (20.5)*
Haemonchus spp.	5 (6.2)	7 (9.5)	14 (10.6)
Strongyloides spp.	28 (34.6)	35 (47.3)	68 (51.5)
Trichuris spp.	6 (7.4)*	14 (18.9)*	5 (3.8)*
Coccidia			
Eimeria spp.	75 (92.6)	68 (91.9)	113 (85.6)

*: *P* value of less than 0.05 was considered statistically significant.

The adult goats were observed to have the highest infections of *Trichostrogylus* spp., *Haemonchus* spp., *Strongyloides* spp. among all three age groups of goats. However, only the prevalence of *Trichostrogylus* spp. was significantly higher in adult goats than in yearlings and kids (χ^2; $P < 0.05$). The prevalence of *Eimeria* spp. oocysts in kid, yearling and adult goats were 92.6%, 91.9% and 85.6%, respectively, and the difference was not significant (χ^2; $P > 0.05$).

Table 3 demonstrates the concurrent *Eimeria* spp. and four species of GINs infections (*Trichostrongylus* spp., *Haemonchus* spp., *Strongyloides* spp. and *Trichuris* spp.) in the studied goats. Mixed infections were generally present in all age groups but the frequency of multiple infections varied substantially among those groups. Overall prevalence for mixed infection rate of nematodes and *Eimeria* spp. was 68.29% (196/287) whereby cases of co-infection between *Strongyloides* spp. and *Eimeria* spp. (38.33%; 110/287) were the highest among the mixed infections.

Table 3
Concurrent *Eimeria* spp. and GINs.

Mixed infections	Total	Kid	Yearling	Adult
Trichostrongylus spp. & *Eimeria* spp.	31 (10.80)	2 (2.77)*	6 (8.11)*	23 (17.42)*
Haemonchus spp. & *Eimeria* spp.	32 (11.15)	5 (6.17)	7 (9.46)	20 (15.15)
Strongyloides spp. & *Eimeria* spp.	110 (38.33)	26 (32.10)	30 (40.54)	54 (40.91)
Trichuris spp. & *Eimeria* spp.	23 (8.01)	6 (17.41)*	14 (18.92)*	3 (2.27)*

*: *P* value of less than 0.05 was considered statistically significant.

Among the dual infections in three age groups, pairs of *Trichostrongylus* spp., *Haemonchus* spp. and *Strongyloides* spp. with *Eimeria* spp. had predominated the adult goats with prevalence of 17.42%, 15.15% and 40.91%, respectively. Meanwhile, polyparasitism of *Trichuris* spp. with *Eimeria* spp. had infected most in the yearlings than in kids and adults with percentage of 18.92%. Statistically, there were significant differences between concurrent infections of *Trichostrongylus* spp., *Trichuris* spp. with *Eimeria* spp. with different age groups (χ^2; $P < 0.05$).

4. Discussion

In Malaysia, the detection of GINs in cattle and sheep have been widely reported. However, there is a conspicuous lack of relevant data focusing on gastrointestinal nematodiasis isolated from goats in Malaysia. Current finding showed that 77.7% of studied animals were positive with GINs, predominated by *Strongyloides* spp. (45.6%) and least predominant GINs was *Trichuris* spp. (8.7%). The finding was closely related to the result reported by Hassan *et al.* [26] in Bangladesh who found 51.74% of goats were infected with *Strongyloides* spp. However, this result differs from studies done in Penang Island [9] and Selangor [27], Malaysia that revealed the most prevalent nematode species infected the goats was *Haemonchus* spp. with percentage of 45.7%, 46.3%, respectively. Likewise, the predominance of *Haemonchus* spp. in goats has also been reported in Nigeria (87.3%) [28], South Africa (54%) [21] and Sri Lanka (90%) [20]. On the other hand, the result of low occurrence of *Trichuris* spp. in present study corroborates the observations of goats in Nigeria (2.43%) [28]. The high infection rate of GINs might due to goat grazing activities on pastures contaminated with third stage infective larvae of parasitic nematodes [29]. The goats were allowed to graze for long hours (4–6 h) in the grazing land, thereby increasing the exposure to infections through ingestion of larvae that freely lived in the grazing land [30]. Additionally, sufficient humidity and favorable temperature, create an environment that enhances the development of GINs and sustains the survival of the infective stage of larvae, leading to high pasture contamination [19].

In the present study, the overall prevalence of coccidian oocysts in goats was 89.2%. The finding was in agreement with reports made in different states of Malaysia (Selangor, Terengganu, Perak and Pahang) [18,22,29,31] whereby the infection rates were 85% (n = 81), 92.57% (n = 162), 89% (n = 815) and 100% (n = 40), respectively. On the contrary, a study conducted by Chandrawathani *et al.* [32] in Perak has revealed

a lower total prevalence of coccidiosis with percentage of 48.77% (n = 203). Similar to our findings, a relatively high prevalence of coccidiosis from various studies conducted around the globe was reported. The frequency rates were 83.43% (n = 350) in Iran [33], 98.6% (n = 144) in Portugal [34], 97% (n = 277) in the USA [35], 80.35% (n = 173) in Western Poland [19], 87.94% (n = 175) in China [36], but in Southern Botswana [37], India [38] and Pakistan [39], 13.3% (n = 143), 42.86% (n = 144) and 43.87% (n = 310) goats were positive for coccidian infection, respectively, indicating a lower prevalence of infection compared to present study.

The prevalence coccidial oocysts from genus of *Eimeria* was the highest in kids (92.6%) compared to yearlings (91.9%) and adult goats (85.6%) which were consistent with the previous observations [34,36,37]. This has been attributed to underdeveloped and lower immunological resistance towards coccidian infection in goat kids compared to older goats [36,38]. Nevertheless, the well-developed resistance observed in adult goats appeared to be relative rather than absolute since adults continued to harbor *Eimeria* spp. oocytes in faeces, which contributed as source of infection for younger goats [35].

We noted that 68.29% (196/287) studied animals had concurrent infections of *Eimeria* spp. and GINs in this study. In comparison with previous studies, the prevalence of concurrent infections was much lower than Sri Lanka (78%; n = 203) [20] but higher than India (17.22%; n = 273) [38] and Korea (29.3%; n = 241) [40]. Additionally, concurrent infections in all three age groups were observed in this study complementary to reports by Radfar *et al.* [41] and Faizal and Rajapakse [20]. Polyparasitisms in this study perhaps are due to repeated exposure to infections of both GINs and *Eimeria* spp. [20].

In conclusion, the present study indicated that both GINs and *Eimeria* spp. as single or concurrent infections are prevalent in goats of these three farms in Terengganu. The parasitic loads pose a great economic impact and constraint to the goat industry in Terengganu in achieving better and sustainable productions. Therefore, these findings suggest for a need of well-coordinated, sanitary monitoring of goat farms by field veterinarians and dissemination of knowledge on GINs and *Eimeria* spp. to animal handlers and farmers to minimize the occurrence of infections.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

The authors would like to express our gratitude to the owners of the farms and logistic support by the Department of Veterinary Services, Terengganu. The study was funded by the Ministry of Higher Education, Malaysia under the grant of Research Acculturation Grant Scheme (RAGS) (Grant No. 13-010-0073).

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