PREVALENCE OF *EIMERIA* INFECTION IN GOATS IN BEN TRE PROVINCE AND THE TREATMENT EFFICACY OF SOME DRUGS IN TREATMENT

Nguyen Thi Kim Quyen, Truong Van Hieu, Nguyen Van Vui and Le Thi Khanh Dung

Department of Animal Science and Veterinary Medicine, Faculty of Agriculture and Aquaculture, Tra Vinh University, Viet Nam

Corresponding author: Nguyen Thi Kim Quyen, Phone: 0355.346.504. Email: quyen@tvu.edu.vn

ABSTRACT

The study was conducted in 2 districts, Mo Cay Nam and Mo Cay Bac, in Ben Tre province from January 10, 2023, to September 15, 2023, to identify *Eimeria* infection in goats and make a choice of effective drugs. A total of 420 goats were in several stages of age, including less than 4 months old, from 4 to 12 months old, and more than 12 months old. The results showed that two survey districts were infected with *Eimeria* spp., with an overall infection rate of around 73.8%. Mo Cay Nam and Mo Cay Bac accounted for 71.4% and 76.2%, respectively. The infection rate decreased gradually with age: less than 4 months old (98.6%), peaking at 4-12 months old (81.4%), and more than 12 months old (41.4%). The coccidiosis intensity ranged from 1 (+) to 3 (+) in all goats, with the highest rate observed in severe intensity (3+). Five coccidia oocyst species with gradually decreased frequency, such as *Eimeria ninakohlyakimovae* (66.7%), *Eimeria arloingi* (58.6%), *Eimeria hirci* (39.8%), *Eimeria christensen* (29.3%), and *Eimeria alijevi* (10.2%). Watery feces had a greater rate of coccidia oocyst infection (96.7%) than solid feces (51.0%). Coccidial oocysts were found in goats of all ages, however goats infected with two types of coccidioid oocysts per faeces sample accounted for a high rate (45.5%). The treatment of goats afflicted with coccidiosis with two medications, Amprolium and Sulfachlopyrydazine, was completely successful. Neither medicine had any adverse effects during the testing.

Keywords: *Goats, Eimeria, Prevalence, Ben Tre province.*

INTRODUCTION

Ben Tre is a province in the Mekong Delta region with a natural area of 2360 km^2, tropical climate, suitable for livestock development. According to Vietnam Livestock (2022), Ben Tre had a total goat herd of 189560 in 2021 and 202195 in 2022, increase 12635 goats. Goats are easy to raise, have low investment costs, advantage of local food, and bring more stable income than other livestock. Goats can eat many types of leaves that cattle and buffalo cannot eat, so they can take advantage of locally available food sources. However, regarding to veterinary hygiene and parasite disease prevention, 55.6% of farmers had not dewormed (Truong et al., 2020). Although parasite illnesses that cause coccidiosis in goats typically cause mass mortality, they can cause major economic losses. Coccidiosis caused by *Eimeria* spp. was one of the most widespread and deadly infections in goats, resulting in significant economic losses during the goat sector's development (Liang et al., 2022). Young calves and goats were particularly vulnerable to viral and parasitic diseases. As a result, we conducted the study to provide a scientific basis for preventing coccidiosis and to contribute goat farmers in understanding the situation of coccidiosis in goats with effective prevention.

MATERIALS AND METHODS

Reagents and chemicals

Saturated sodium chloride solution, Amprolium and Sulfachlopyrydazine are purchased from reputable domestic companies, these two drugs are allowed to be circulated and manufactured and sold in Viet Nam.

Time and location

The study was conducted from January 10, 2023 to September 15, 2023. A total of 420 goats,

crossbreed (Boer x Bach Thao), in several stages of age consist of less than 4 months-old, from 4 to 12 months-old and more than 12 months-old (Dien et al., 2022). Goats were live in the cage all time, in Mo Cay Nam and Mo Cay Bac districts, Ben Tre province.

Research objective

The study aimed to evaluate the prevalence of *Eimeria* infection in goats in Ben Tre province and the treatment efficacy of some drugs in treatment.

Study design

Clinical performance of coccidian oocyst was found by the method with NaCl (Willis) according to Luong and Le (1997). The modification Mc Master (Nguyen et al., 2008) was used to determine the rate of coccidia infection in goats (subclinical infection 1 (+): less than 1000 oocysts/1gram of feces; moderate infection 2 (+): number from 1000-5000 oocysts/1gram of feces; severe infection 3 (+): more than 5000 to 20000 oocysts/1gram of feces; very severe infection rate 4 (+): more than 20000 oocysts/1gram of feces). Coccidial oocyst species in goats were identified based on shape, size, and color of oocysts described by Coudert (1992) and Eckert et al. (1995).

After confirmed the goats infected with coccidiosis. Goats < 4 months old with severe coccidiosis rate 3 (+) was selected and used Amprolium and Sulfachlopyrydazine based on the manufacturer's recommended doses. Normally, the experiment was conducted as follows: treatment 1: control (no drug) with 20 goats; treatment 2: Amprolium dose 1 gram/50kg body weight/day, given to 20 goats for 5 consecutive days; treatment 3: Sulfachlopyrydazine dose of 10 grams/70kg body weight/day, given to 20 goats for 5 consecutive days.

The feces were taken for testing before giving medicine. After using medicine, goats were monitored, recorded side effects and evaluated the effectiveness of the medicine by taking feces samples to check again after these medicines were use for 7, 14, and 21 days to assess accurately the effectiveness of the medicines.

Statistical analysis

The data were compiled and statistically analyzed using Excel 365 software (Microsoft Corporation, USA) and processed by Minitab version 16.0. The statistical significance of the positivity rate between the two methods in each sample type was performed by Pearson Chi-square. If the minimum expected count value was less than 5%.

RESULTS AND DISCUSSION

***Eimeria* infection in goats in Ben Tre province**

Table 1. Infection rate and intensity of *Eimeria* in goat by month-old

Age (month)	Number of samples	Infected samples	Infectivity (%)	Infection intensity (%)		
				1 (+)	2 (+)	3 (+)
< 4	140	138	98.6^{a}	15.9^{c}	21.0^{bc}	63.0^{a}
4-12	140	114	81.4^{b}	13.2^{c}	27.2^{b}	59.6^{a}
> 12	140	58	41.4^{c}	60.3^{a}	24.1^{b}	15.5^{cb}
Total	**420**	**310**	**73.8**	**23.2^{cb}**	**23.9^{b}**	**52.9^{a}**

Values with different letters a,b,c are statistically significant differences with P<0.05 in the same column.

The current finding in Table 1 revealed that the prevalence of oocyst infection in goats reached 73.8%. The result was lower than the finding of Dien et al. (2022) *Eimeria* oocyst infection prevalence in Vinh Long province and Can Tho city about 82.37%. In addition, Tyrell et al. (2013) showed that coccidiosis infection rate in Florida was 97%; also, with Reza et al. (2014) indicated that infection rate in Iran was 89.91% of the total oocysts identified. In Kathmandu valley in Nepal, a high prevalence of oocyst infection (92.4%) was found in some areas, but in general the infection rates were slightly lower than that described on the South of Portugal (98.61%). The prevalence in this study was higher than the study of Saw et al. (2020) in Myanmar around 60%. High prevalence and distribution of *Eimeria* species may be attributed to factors related to differences in management and hygienic conditions. Small scale of housing system has some limitations such as: low barn floor, wet barn, often cutting grass around the barn and naturally available plant feed sources, creating favorable conditions for goats easily come into contact with pathogens from the environment. Goat farmers did not regularly clean and disinfect their farms or periodically prevent coccidiosis in goats. This was one of the factors that increased the likelihood of goats being infected with coccidial oocysts.

The rate of coccidial oocyst infection in goats was declined with age, the results were described in Table 1. Goats under 4 months of age had the highest infection rate of 98.6%, followed by goats from 4-12 months of age with 81.4% infection, and goats less than 12 months of age with 41% infection. Statistical analysis revealed that the age difference in infection rates was statistically significant ($P<0.05$). The findings of this study were comparable with those of other authors who have examined the condition of coccidiosis in goats. For example, Tauseefur et al. (2011) investigated the situation of coccidiosis in goats in Pakistan and observed that mature goats had a lower rate of *Eimeria* spp.. Young goats were more likely to get coccidiosis than adult goats, so it was necessary to pay more attention in young goat. The study from Alok et al. (2020) was evaluated coccidiosis in goats in India and found that 100% of young goats were infected, whereas adult goats were only 84.61% infected. According to Le (2005), the disease may occur in goats at any age, although coccidiosis was most common in young goats since young goats under 5 months of age were typically severe because they had not completely developed immunity. Cepeda et al. (2015) investigated the prevalence of coccidiosis in goats in California and discovered that both adult and young goats were infected with a variety of coccidia. The study from Dinh et al. (2000) found that most coccidiosis was developed during the weaning stage, in goats younger than 6 months of age.

This can be explained as follows: Post-weaning goats less than 4 months old, the immune system remained low and could not stimulate a strong defense, thus resistance was generally weak, and coccidiosis oocysts had a favorable condition that allow pathogens to enter the body and cause illness. Goat had to relocate to a new location and obtained their own food and water. Young goats were at a stage of rapid development; therefore, they require more food, increasing the danger of disease exposure. Furthermore, goats aged 4-12 months and goats over 12 months were mature and have stronger resistance since the immune system was fully developed resulting in a lower risk of coccidiosis.

Goats of all ages had coccidiosis with intensities ranging from 1 (+) to 3 (+) as shown in table 1. According to the findings of the tests, no goats were infected with very severe coccidial oocysts 4 (+). Goats infected with coccidiosis with severe infection intensity 3 (+) had the

highest rate of infection (52.9%), followed by average infection intensity 2 (+) at 23.9% and lowest infection intensity 2 (+) at 23.9%. The prevalence of mild infection level 1 (+) was 23.2%. Statistical analysis revealed that the difference in infection intensity rate was statistically significant ($P<0.05$). At severe infection intensity 3 (+), the older the goats are less infected with coccidial cysts. This shows that adult goats were still got sick with coccidiosis, although the severity of the infection had decreased. At mild infection intensity 1 (+), goats older than 12 months accounted for a significant proportion (60.3%), while at medium infection intensity 2 (+), goats older than 12 months declined. The findings of this study were comparable with those of Koudela et al. (1998) discovered that adult goats had mild coccidia infection whereas young goats had a more severe infection when testing fecal samples from goats in the Czech Republic. Aleksandra et al. (2012) investigated that adult and young goats were affected with the illness. In Western Pomerania, the amount of coccidial oocysts/1 gram of feces in young goats was higher (1800-28000) than in mature goats (0-2500). The infection intensity of young goats in Western Ukraine was higher than adult goats from 2600 to 120000 and from 50 to 4500 respectively. Moreover, Zuzana et al. (2004) evaluated coccidiosis in goats in Slovakia had larger quantity of oocysts per gram of feces in young goats (160-31920) than older goats (80-7920). This results demonstrated that young goats were frequently vulnerable to coccidial oocyst infection and were infected at a greater intensity than adult goats. Therefore, taking care of coccidia prevention and therapy in young goats were necessary.

Table 2: Prevalence of *Eimeria* infection in goats in 2 districts

Districts	Number of samples	Infected samples	Infection rate (%)
Mo Cay Nam	210	150	71.4
Mo Cay Bac	210	160	76.2

Table 2 showed that both survey locations had goats infected with coccidiosis with 76.2% raised in Mo Cay Bac district and 71.4% of goats raised in Mo Cay Nam district infected with coccidia oocysts. Statistical analysis showed that the difference in infection rate between the two survey locations is not statistically significant ($P>0.05$). This was consistent with Dien et al. (2022) when surveying the situation of coccidia infection in goats in Vinh Long province (83.49%) and in Can Tho city (81.19%) showed no significant differences. In fact, the survey indicated that people raising goats in the two districts had the same hygienic and care conditions. The goats would be infected with coccidian cyst when the environment is dirty, poorly hygienic, and containing many oocysts, Goat in households had poor veterinary hygiene procedures, the barn was still damp, feces and urine remain for many days, the barn floor had no drainage ditches for feces and urine, creating conditions for pathogens to localize, developed and cause disease. Goat-raising in household did not priorities disease prevention and instead focus on treating disease clinical signs emerge. As a result, the rate of coccidiosis infection in goats remained high at both survey sites. As a result, additional study on coccidiosis in goats in Ben Tre province is required to develop more suggestions for preventing this disease in goats while enhancing production and providing high economic efficiency in goat farming in Ben Tre province.

Table 3. Prevalence of *Eimeria* infection in goats by species (n=420)

Species	Oocysts characteristics	Number of infected samples	Infection rate (%)
Eimeria christensen	Ovoid shape, thick shell, yellowish, micropyle, size 34.5-41.2x23.1-28.2µm	123	29.3[d]
Eimeria alijevi	Elliptical or ovoid shape, yellowish or colorless, micropyle, size 20.06-22.80x14.55-22.65µm	43	10.2[e]
Eimeria ninakohlyakimovae	Elliptical shape, thin shell, colorless, no micropyle, size 20.06-22.86x14.03-22.86µm	280	66.7[a]
Eimeria arloingi	Ovoid shape, thick shell, yellowish, micropyle, size 34.53-41.23x23.12-28.23µm	246	58.6[ba]
Eimeria hirci	Oval shape, bluish color, micropyle, size 18-7x14-20µm	167	39.8[c]

Values with different letters a,b,c are statistically significant differences with P<0.05 in the same column.

Goats in Ben Tre were infected with 5 species of coccidia oocysts, as shown in Table 3. Specifically, *E. ninakohlyakimovae* was the highest infection rate (66.7%), followed by *E. arloingi*, *E. hirci*, *E. christensen* and *E. alijevi* species at 58.6%, 39.8%, 29.3% and 10.2% respectively. Statistical analysis showed that the infection rate between coccidial oocyst species was statistically significantly different (P<0.05). Alok et al. (2020) revealed that there were 5 species of coccidia in goats in India. This result was lower than the findings of Saw et al. (2020), who discovered three types of coccidia infecting goats in Myanmar. This study was higher than the result of Khodakaram et al. (2017) who identified 16 *Eimeria* species in goats; Eckert (1995) with 9 species of *Eimeria*; Ghimire et al. (2022) with 15 species of *Eimeria*; Liliana et al. (2014) surveyed 9 species of coccidia in goats. Tyrell et al. (2013) was investigated 9 species of coccidiosis in goats in Florida, while Serdar et al. (2003) was identified 9 species of coccidia in goats. Reza et al. (2014) was investigated 9 coccidial species in goats in Iran. These findings were corresponded with the results reported by Phan et al. (2004), who found that coccidia species that parasitize and cause disease in goats include *E. arloingi*, *E. christenseni*, *E. ninakohlyakimovae*..., with the last two species accounting for a higher proportion than the others. These were two potentially dangerous species to goats, causing typical signs in young goats such as diarrhea, weight loss, and hair loss, as well as reducing productivity and causing damage to goat farmers.

Table 4. Infection rate of *Eimeria* oocyst in 2 types of feces

Types of feces	No. of samples	No. of infected samples	Infectivity (%)
Watery feces (diarrhea)	210	203	96.7[a]
Solid feces (no diarrhea)	210	107	51.0[b]

The prevalence of coccidial oocyst infection in watery feces was 96.7%, significantly higher than 51.0% in non-diarrheal feces (P<0.05). During the survey, the number of co-infections with 2-3 coccidial species was higher in goats with diarrhea than in goats without diarrhea. According to Koudela et al. (1998), the two species *E. arloingi* and *E. ninakohlyakimovae* were the reason for clinical signs such as watery feces with mucous clumps and color changes from brown to yellow or black, weight loss, and dehydration. Lam et al. (2003) showed that *Eimeria* spp. was a primary factor that created conditions for other opportunistic bacteria to invade and cause diarrhea in livestock. The barn was not cleaned every day, manure on the ground for many days and form a thick layer of manure. Goats had diarrhea and feces sticking to the floor which was not cleaned. The floor made of wood that was always wet, creating favorable conditions for oocysts to develop into infectious oocysts, which was a high-risk factor for coccidiosis. Consequently, it was very necessary to advise goat farmers to clean their barns and keep the floor dry. The majority of agricultural households have not yet built manure ponds. The majority of manure ponds were positioned near the barn. When it rained, goat feces typically got dumped onto a mound and ran out onto the pasture or becoming fertilizer. As a result, cleaning and disease prevention for goats were quite difficult, especially during the rainy season. Farmers should be encouraged to construct barns and properly dispose of trash in order to maintain environmental cleanliness and disease safety for goats.

Table 5. Coinfection rate of some *Eimeria* spp. in goats

Age (month)	No. of samples	No. of infected samples	Infection rate (2 species /fecal sample) (%)	Infection rate (3 species /fecal sample) (%)	Infection rate (>3 species /fecal sample) (%)
< 4	140	138	47.1[a]	31.2[b]	13.0[c]
4-12	140	114	50.9[a]	35.1[b]	10.5[c]
> 12	140	58	31.0[b]	46.6[ab]	5.2[c]
Total	**420**	**310**	**45,5[a]**	**35,5[b]**	**10,6[c]**

Values with different letters a,b,c are statistically significant differences with P<0.05 in the same column.

In this survey, goats of all ages had coccidial oocyst infection, details were shown in Table 5. Specifically, goats infected with two species/fecal sample accounted for the highest rate of 45.5%, followed by goats infected with three species/fecal sample accounting for 35.5% and goats infected with more than three species/fecal sample accounted for the lowest rate of 10.6%. Goats < 4 months old were infected with 2 species/fecal sample at a high rate (47.1%), followed by infection with 3 species/fecal sample (31.2%), and infection with 3 species/fecal sample (13.0%). The infection rate in goats 4-12 months old decreased similarly to goats 4 months old. Goats >12 months old are mostly infected with 3 species/fecal sample (46.6%),

followed by 2 species/fecal sample (31.0%), and >3 species/fecal sample (5.2%). These results suggested that young goats were capable of being infected and suffering the harmful effects of many species of coccidial oocysts at the same time. According to Mohammed et al. (2000), when goats were infected with many coccidial species at the same time, it caused significant intestinal damage, created a favorable environment for bacteria to proliferate and cause illness, increased food intake, and reduced weight gain. Alternatively, in severe cases, badly infected goats died, reducing manufacturers' economic efficiency. As a result, effective prevention and treatment strategies were required to assist goat herds in growing and developing properly, boosting economic efficiency in goat farming.

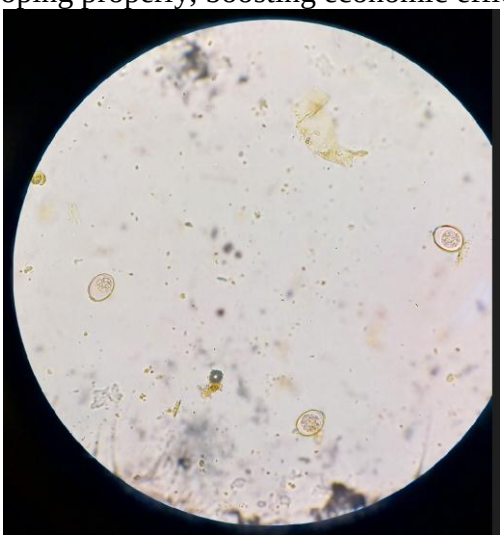

Figure 1. Infected with one *Eimeria* oocyst species

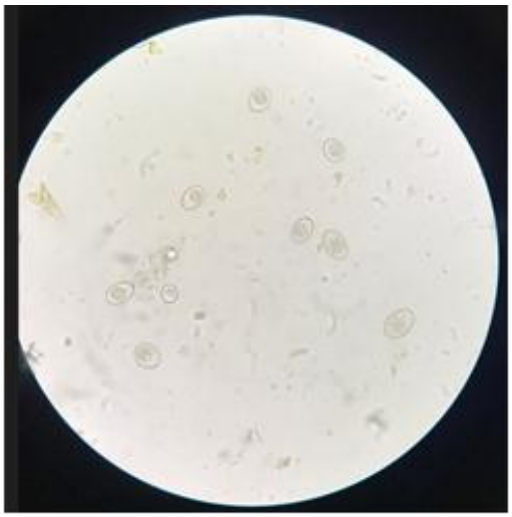

Figure 2. Co-infected with many *Eimeria* oocyst species

Table 6. The results of anticoccidial drugs use in goats

Treatment groups	**No. of goats**	**Feces testing time**	**No. of animals successfully treated**	**Efficacy (%)**
1. Control group (no drug usage)	20	After 7 days	0	0
		After 14 days	0	0
		After 21 days	0	0
2. Amprolium group (1 gram/50kg body weight/day)	20	After 7 days	17	85.0
		After 14 days	20	100
		After 21 days	20	100
3.Sulfachlopyrydazin group (10 gram/70kg body weight/day)	20	After 7 days	18	90.0
		After 14 days	18	90.0
		After 21 days	20	100

Results of coccidial drug testing in treatment 1: control group (no drug) goats infected with coccidial oocysts at severe infection intensity (3+) did not recover. Treatment 2: Amprolium dose of 1 gram/50kg body weight/day, the effect after 7 days of administration was 85.0%; after 14 and 21 days of administration were both 100%. Treatment 3: Sulfachlopyrydazine dose of 10 grams/70kg body weight/day was 90.0% effective after day 7 to day 14 and 100% after day 21. This result was similar with the findings of Dien et al. (2022), which found that treating coccidiosis in goats with Amprolium provided successful results. Tauseefur et al. (2011) found no oocysts in the feces of goats treated with Amprolium at a dosage of 2g/40 kg body weight after 7 days of treatment when monitoring the condition of coccidiosis in goats in Pakistan. This finding suggests that Amprolium was successful in treating coccidiosis in goats. Both medications were completely safe during the testing, with no side effects.

CONCLUSION

Coccidia oocysts were found in both districts of Ben Tre province, with an overall infection rate of 73.8%. The infection rate was significantly declined with age: less than 4 months old (98.6%), 4-12 months old (81.4%), and more than 12 months old (41.4%). Coccidiosis intensity was varied from 1 (+) to 3 (+) in all goats, with severe severity (3+) having the greatest rate. Five coccidia oocyst species were found with a steadily decreasing frequency, including *E. ninakohlyakimovae* (66.7%), *E. arloingi* (58.6%), *E. hirci* (39.8%), *E. christensen* (29.3%), and *E. alijevi* (10.2%), with *E. ninakohlyakimovae* and *E. arloingi* accounting for the greatest rate. Watery feces were shown to have a higher risk of coccidia oocyst infection than solid feces. Goats were infected with *Eimeria* spp. at various ages. The treatment of goats was afflicted with coccidiosis with two medications, Amprolium 10mg/50kg bodyweight/day and Sulfachlopyrydazine 10mg/70kg bodyweight/day after 21 days, completely successful and no adverse effects during the testing.

REFERENCES

Aleksandra Balicka-Ramisz, Alojzy Ramisz, Stach Vovk and Volodymir Snitynskyj. 2012. Prevalence of coccidia infection in goats in Western Pomerania (Poland) and West Ukraine region. Annals of Parasitology, 58(3), 167-171.

Alok Kumar Singh, Daya Shanker, Pramod Kumar Rout, Ashok Kumar and Pradeep Kumar. 2020. Studies on *Eimeria* species in goats of mathura region, uttar Pradesh, India. Haryana Vet 59(1), 131-132.

Cepeda-Palacios, Ramon, Gonzalez, Angelica, Lopez, Alberto, Ramirez-Orduna, Juan M, Ramirez-Orduna, Rafael, Ascencio, Felipe, Dorchies, Philippe, Angulo and Carlos. 2015. Identification and characterization of *Eimeria* spp. during early natural infection in goat kids in baja California Sur, Mexico. Tropical and Subtropical Agroecosystems, 18: 279-284.

Coudert P. 1992. *Eimeria* species from the goat. In: Proceedings of the Fourth Conference COST-89. Tours, INRA, October.

Dien Thai Son and Nguyen Huu Hung. 2022. Survey on coccidiosis infection in goats and evaluate the treatment effectiveness of Amprolium and Toltrazuril in Vinh Long province and Can Tho city. Journal of Veterinary Science and Technology. Volume XXIX, 1, p73-79.

Dinh Van Binh and Nguyen Quang Suc. 2000. Goat farming techniques. Agriculture Publishing House, Hanoi, p103-106.

Eckert J., Braun R., Shirley M. W and Coudert P. 1995. EUR 16602-Guidelines on techniques in coccidiosis research. Office for Official Publications of the European Communities. Luxembourg, 306.

Eckert.J. 1995. Biotechnology Guidelines on techniques in coccidiosis research.

Ghimire T., Adhikari R., and Bhattarai N. 2022. Diversity and prevalence of *Eimeria* species in goats of Nepal. Journal of the Hellenic Veterinary Medical Society, *72*(4), 3299-3306.

Khodakaram-Tafti A and Hashemnia M. 2017. An overview of intestinal coccidiosis in sheep and goats. Revue Med. Vet, 167, 1-2, 9-20.

Koudela B and Bokova A. 1998. Coccidiosis in goats in the Czech Republic. Vet. Parasitol, 76, 261-267.

Lam Thi Thu Huong. 2003. Situation of *Eimeria* and Cryptosporidium infection in dairy calves raised in Ho Chi Minh City and Dong Nai province. Journal of Veterinary Science and Technology, Volume XIII, pages 29-35.

Le Dang Danh. 2005. Goat farming. Agriculture Publishing House, Hanoi.

Liang, G., Yang, X., Liu, D.,Li, Y., Wang, J., Chen, X., Zhao, G and Song, J. 2022. Molecular Characterization of 18S DNA, ITS-1, ITS-2, and COI from *Eimeria christenseni* and *Eimeria arloingi* in Goats from Shaanxi Province, Northwestern China. Animals, 12, 1340.

Liliana Machado Ribeiro da Silva, Maria Joao Martins Vila-Viçosa1, Telmo Nunes, Anja Taubert, Carlos Hermosilla and Helder Carola Espiguinha Cortes. 2014. *Eimeria* infections in goats in Southern Portugal. Braz. J. Vet. Parasitol., Jaboticabal, v. 23, n. 2, p. 280-286.

Luong Van Huan and Le Huu Khuong. 1997. Parasites and parasitic diseases in livestock and poultry. Agriculture Publishing House, City. Ho Chi Minh, p369 - 375.

Mohammed, RA., Idris, OA., El Sanousi, SM and Abdelsalam, EB. 2000. The effect of coccidian infection on the gut microflora of Nubian goat kids. Dtsch. Tierarztl. Wochenschr. 107: 389-428.

Nguyen Thi Kim Lan, Nguyen Thi Le, Phạm Sy Lang and Nguyen Van Quang. 2008. Curriculum veterinary parasiticiology. Agriculture publishing house, Ha Noi, p105-106.

Phan Dich Lan, Nguyen Thi Kim Lan and Nguyen Van Quang. 2004. Parasitic diseases in Vietnamese goat herds. Agriculture Publishing House, Ha Noi, p100-105.

Reza Kheirandish, Saeid R and Nourollahi-Fard Zeinab Yadegari. 2014. Prevalence and pathology of coccidiosis in goats in southeastern Iran. J Parasit Dis 38(1):27–31.

Saw Bawm, Tay Zar Bhone Win, Shwe Yee Win, Lat Lat Htun, Ryo Nakao, and Ken Katakura. 2020. First detection of *Eimeria* species in Myanmar domestic goats with both microscopic and molecular methods. published by EDP Sciences Parasite *27*, 38.

Serdar Deer, Abdurrahman Gul, Erol Ayaz and Kamile Bcek. 2003. The Prevalence of *Eimeria* Species in Goats in Van. Turk J Vet Anim Sci 27, 439-442.

Tauseef-ur-Rehman, M., N. Khan, A.K. Izhar and A. Mansoor. 2011. Epidemiology and economic benefits of treating goat coccidiosis. Pakistan Veterinary J, 31(3): 227-230.

Truong Van Hieu, Huynh Van Tuan, Nguyen Thi Kim Quyen and Ho Quoc Dat. 2020. Current status of goat farming in Tra Vinh province. Journal of Livestock Science and Technology, No. 110, p75-84.

Tyrell B. Kahan, Ellis C and Greiner. 2013. Coccidiosis of Goats in Florida, USA. Journal of Veterinary Medicine, 3, 209-212.

Vietnamese livestock. 2022. Vietnam livestock statistics 01/01/2022 on the number of heads and livestock and poultry products. http://channuoivietnam.com/thong-ke-chan-nuoi/tk-chan-nuoi/.

Zuzana Vasilkova, Ivan Krupicer, Jaroslav Legath, Natalia Kovalkovicova and Branislav Petko. 2004. Coccidiosis of small ruminants in various regions of Slovakia. Acta Parasitologica, 49(4), 272-275.

Received date: 24/11/2024

Submitted date: 05/12/2024

Acceptance date: 30/12/2024

Opponent: Prof. Nguyen Van Thanh