Scientific Report

Study on gastrointestinal parasitic infections of Raeini goats

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Summary

Raeini breed is the most productive Cashmere goat in Iran. Helminthes infections cause major economic losses globally to the livestock industries and farming communities. The objective of this study was to determine the seasonal prevalence and intensity of *Eimeria* and gastrointestinal helminth parasitic infections in Raeini goats in Iran. A total of 438 faecal samples were randomly taken from clinically healthy goats in Raeini Goats Research Center of Iran. Faecal samples were collected from each goat once and eggs per gram of faeces (EPG) and faecal oocysts counts (OPG) were estimated using the modified McMaster technique. Oocysts were found in 391 (89.27%) goats. Five species of *Eimeria* including, *E. arloingi*, *E. parva*, *E. ninakohlyakimovae*, *E. christenseni*, *E. faorei* and one *Eimeria* spp were identified in faecal samples. *E. arloingi* (92.07%) predominated in all categories and was followed by *E. parva*, *E. ninakohlyakimovae* and *E. christenseni*. *Trichuris* spp. egg was the only nematode egg which was found in 196 (44.75%) faecal samples. The prevalence of gastrointestinal helminthes infections during autumn and winter were significantly higher than summer ($P<0.05$). The association between the prevalence of *Eimeria* oocysts and gastrointestinal nematode infection and the age or sex categories was not significant ($P>0.05$).

Key words: Raeini goats, Gastrointestinal helminthes, *Eimeria*, Iran

Introduction

Traditionally goats are indeed important in Iran, especially for meat, milk and fibers. This country has more than 5,000,000 Cashmere producing goats, which produce approximately 1500 metric tones of raw Cashmere. Raeini goat is an Iranian Cashmere goat which is raised in large numbers in Kerman province of Iran where goat production contributes significantly to the agricultural economy. Raeini goat is one of the most famous Cashmere breeds in Iran (Rafat and Shodja, 2004). Research on environmental factors which have effects on Cashmere production is very vital to the economy of the country (Rafat and Shodja, 2004). Bergstrom *et al*. (1977) showed that there are significant differences between parasitism and wool fiber diameter.

It is recognized that helminthes infections cause major economic losses globally to the livestock industries and farming communities as a consequence of deaths of infected animals, reduced weight gains and production and the condemnation of affected organs after slaughter (Suarez and Busetti, 1995; Dorny *et al*., 1996; Miller *et al*., 1998; Abo-Shehada *et al*., 2002; Cabaret *et al*., 2002; Theodoropoulos *et al*., 2002; Tsotetsi and Mbati, 2003). Some reviewers have concluded that nutrition does influence Cashmere growth (McGregor, 1998).

Coccidiosis is an economically important disease of livestock. It can be a

very devastating disease in goats, as it is known to cause mortality and morbidity in a large number of herds every year (Matthews, 1991). Clinical coccidiosis of goats occurs mainly in young goats and has a higher prevalence under conditions of intensive husbandry. The disease may occur under stress factors such as weaning, dietary changes, inclement weather, or travel and regrouping (Urquhart *et al*., 1987).

The objective of this study was to determine the seasonal prevalence and intensity of *Eimeria* and gastrointestinal helminth parasitic infections in Raeini goats during a one year period.

Materials and Methods

Area description and animal management

Raeini Goats Research Center of Iran is located just a few minutes from Baft city of Kerman province, Iran where the average annual rainfall ranges from 80-120 mm and humidity and temperature varies from 25 to 45% and 12 to 42°C, respectively.

Samples collection and processing

The present survey took place between March 2008 and April 2009. Animals were categorized as kids (<1 year) and adults (>1 year). A total of 438 faecal samples (108 samples in spring, 110 samples in summer, 108 samples in autumn and 112 samples in winter) were randomly taken from clinically healthy goats in the Raeini Goats Research Center of Iran.

Parasitological measurement

Faecal samples were collected from each goat once and eggs per gram of faeces (EPG) and faecal oocysts counts (OPG) were estimated using the modified McMaster technique.

Identification of *Eimeria* species and Nematode eggs

Identification of oocysts species was carried out after sporulation of oocysts by incubating faecal samples with 1000 OPG in 2% w/v potassium dichromate (BDH, England) at room temperature for 2-5 days. Identification was based on the morphological features of the sporocysts (size, shape and presence or absence of a micropyle or polar cap) under the 100 × objective, with the aid of taxonomic keys (Levine, 1961; Soulsby, 1982). Nematode eggs present were identified using standard parasitological criteria (Soulsby, 1982, Hansen and Perry, 1994)

Statistical analysis

Data were analysed using chi-square (x^2) test.

Results

Eimeria infection

A total of 438 goats were sampled. Oocysts were found in 391 (89.27%) of goats (Table 1). The association between the prevalence of *Eimeria* infection and the age or sex categories was not significant (P>0.05). Five species of *Eimeria* and one *E*. spp were identified in the faecal samples. *E. arloingi* (92.07%) predominated in the affected goats and was followed by *E. parva*, *E. ninakohlyakimovae*, *E. christenseni and E. faorei* (Table 2).

The mean OPG varied from 214 ± 54 in *E. faorei* to 1247.75 ± 309 in *E. arloingi.* Mean *Eimeria* oocyst counts among age or sex groups were not significantly different (P>0.05).

Gastrointestinal helminthes infections

Trichuris spp. was the only helminth egg which was found in the faecal samples. The nematode eggs were found in 196 (44.75%) of the goats examined (Table 2). The association between the prevalence of gastrointestinal helminthes infections and the age or sex categories was not significant (P>0.05). The prevalence of gastrointestinal helminthes infections during autumn and winter were significantly higher than in summer (P<0.05).

Concurrent *Eimeria* and gastrointestinal helminthes infections

Oocysts were found in all of the goats that showed gastrointestinal helminth parasitic infections, therefore, concurrent *Eimeria* and gastrointestinal helminthes infections were found in 43.78% of the kids

Table 1: Seasonal prevalence of *Eimeria* oocyst according to sex and age in goats of Raeini Goats Research Center

Season	<1 year		>1 year		Male		Female		Total	
	No. of goats tested	No. of goats infected (%)	No. of goats tested	No. of goats infected (%)	No. of goats tested	No. of goats infected (%)	No. of goats tested	No. of goats infected (%)	No. of goats tested	No. of goats infected (%)
Spring	57	50 (87.71)	51	45 (88.23)	52	46 (88.48)	56	49 (87.50)	108	95 (87.96)
Summer	58	51 (87.93)	52	43 (82.69)	53	46 (86.79)	57	48 (84.20)	110	94 (85.45)
Autumn	57	54 (94.74)	51	44 (86.27)	55	50 (90.90)	53	48 (90.57)	108	98 (90.74)
Winter	61	58 (95.09)	51	46 (90.20)	58	53 (91.34)	54	51 (94.44)	112	104 (92.86)
Total	233	213 (91.42)	205	178 (86.83)	218	195 (89.45)	220	196 (89.09)	438	391 (89.27)

Table 2: Prevalence of *Eimeria* species and *Trichuris* sp according to season, age and sex in goats of Raeini Goats Research center (n/%)

Eimeria species	Seasons				Age		Sex		Total
	Spring	Summer	Autumn	Winter	<1 year	>1 year	Male	Female	
E. ninakohlyakimovae	62 (65.26)	62 (65.96)	50 (51.02)	77 (74.04)	137 (65.26)	114 (64.04)	127 (65.12)	124 (63.26)	251 (64.19)
E. faorei	25 (26.31)	11 (11.70)	40 (40.81)	33 (31.73)	57 (26.76)	52 (29.21)	47 (24.10)	62 (31.63)	109 (27.88)
E. christenseni	42 (47.92)	45 (47.70)	62 (63.26)	49 (47.11)	102 (47.89)	96 (53.93)	90 (46.15)	108 (55.10)	198 (50.64)
E. arloingi	86 (90.53)	80 (85.10)	95 (96.94)	99 (95.19)	183 (85.91)	177 (99.43)	178 (91.28)	182 (92.85)	360 (92.07)
E. parva	78 (82.10)	71 (75.53)	98 (100)	80 (76.92)	164 (76.99)	163 (91.57)	162 (83.03)	165 (84.18)	327 83.63)
E. sp	15 (15.78)	15 (15.95)	4 (4.08)	8 (76.92)	21 (9.86)	21 (11.79)	18 (9.23)	24 (12.24)	42 (10.74)
Trichuris sp	49 (45.37)	29 (26.36)	56 (51.85)	62 (55.36)	102 (43.78)	94 (45.85)	99 (45.41)	97 (44.09)	196 (44.75)

n: number of animals infected, and prevalence (%)

and 45.85% of the adult goats.

Discussion

Seventeen species of *Eimeria* are known to infect goats in the world so far. Five species of *Eimeria*, namely, *E. ninakohlyakimovae*, *E. faorei*, *E. christenseni*, *E. arloingi* and *E. parva* were identified in the Raeini Goats Research Center of Iran. Appropriate temperature in Baft city and low management quality in Raeini Goats Research Center may be the reasons for the high prevalence of the infection. Due to overcrowding and lowered immunity conditions, goat kids may also harbor a large number of coccidian parasites.

The overall prevalence of concurrent *Eimeria* and gastrointestinal helminthes infections in goats managed in the Raeini Goats Research Center was 43.78% in kids and 45.85% in adult goats. Concurrent *Eimeria* and gastrointestinal nematode infections in goats have been observed in Sri Lanka (Faizal and Rajapakse, 2001), the Netherlands (Borgsteede and Dercksen, 1996) and Kenya (Kanyari, 1993).

Presence of this sub-clinical level of *Eimeria* infection in clinically healthy goat flocks might be important for two reasons: Firstly, infected goats can be potential carriers and may act to increase the severity of infection precipitating the disease in the susceptible group of kids (Woji *et al*., 1994). Secondly, sub-clinical *Eimeria* infection alone or with concurrent gastrointestinal nematode infection may negatively influence the weight gain and production of goats (Kanyari, 1993; Rahman, 1994; Faizal *et al*., 1999).

The seasonal variations in oocyst and nematode faecal egg counts were consistent between the different age and sex classes of goats during each season of study, and they followed the seasonal rainfall patterns. The highest EPG was found during the rainy seasons when environmental conditions on pasture are favorable for the development and survival of the free-living stages of nematodes. The highest OPG was found during winter because the flock was being kept more compact.

The species of *Eimeria* observed in this study are similar to those observed in other studies and include *E. arloingi, E. ninakohlyakimovae* and *E. christenseni*, which are pathogenic in goats (Opoku-Pare and Chineme, 1979; Chhabra and Pandey, 1991, 1992).

In Nigeria, Anene *et al*. (1994) observed that adult goats (more than 9-month-old) showed higher worm burdens than younger goats. In Malaysia, with a humid tropical climate, Dorny *et al*. (1995) found a relationship between age and reduction of eggs passed in faeces to be statistically less ($P<0.05$) in 12–18-month-old animals. In the semi-desert climate of Mauritania, was reported that for goats the climate is a more important risk factor in gastrointestinal nematode infection than is age.

Based on the present results it seems that anti-parasitic treatment should be carried out in goats from 4-months of age. Animals of 1-2 months of age should be housed in pens to avoid infection because the levels of infection at that age can cause high economic losses.

The nematode infections can be carried over from one favorable season to another within the host animal which may explain the continued presence of the worms in the animals even during the dry season when environmental conditions of the study area preclude the development and survival of their preparasitic stages (Nwosu *et al*., 2007).

There was a definite seasonal sequence in the nematode burdens and faecal egg counts of the goats and this corresponded with the pattern of rainfall recorded at Baft during the present study. The rainy season began in November and lasted until May. Environmental conditions are usually favorable for the development, survival and translocation of pre-parasitic stages of parasitic nematodes during the rainy season. Therefore, there is a gradual build up of adult worm populations in grazing animals so that peak worm burdens are recorded at about the peak of the rainy season. Thereafter, worm populations declined with the lowest numbers being encountered about the peak of the dry season.

In conclusion, the present study reported that season was an important factor that influences risk of *Eimeria* and gastrointestinal helminthes infections in Raeini goats. These differences need to be taken into consideration when designing effective parasites control management systems for these animals.

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References

Abo-Shehada, MN; Jebreen, E; Arab, B; Mukbel, R and Torgerson, PR (2002). Prevalence of *Taenia multiceps* in sheep in northern Jordan. Prev. Vet. Med., 55: 201-207.

Anene, BM; Onyekwodiri, EO; Chime, AB and Anika, SM (1994). Gastrointestinal parasites in sheep and goats of southeastern Nigeria. Small Rumin. Res., 13: 187-192.

Bergstrom, RC; Kinnison, JL and Werner, BA (1977). Parasitism (*Trichostrogylus colubriformis* and *Eimeria ninakohlya-kimovae*) in sheep: relationship between wool fiber diameter and feed conversion efficiency. Am. J. Vet. Res., 38: 887-888.

Borgsteede, FHM and Dercksen, DP (1996). Coccidial and helminthes infections in goats kept indoors in the Netherlands. Vet. Parasitol., 61: 321-326.

Cabaret, J; Mage, C and Bouilhol, M (2002). Helminth intensity and diversity in organic meat sheep farms in centre of France. Vet. Parasitol., 105: 33-47.

Chhabra, RC and Pandey, VS (1991). Coccidia of goats in Zimbabwe. Vet. Parasitol., 39: 199-205.

Chhabra, RC and Pandey, VS (1992). Prevalence of coccidia in sheep in Zimbabwe. Small Rumin. Res., 8: 257-264.

Dorny, P; Batubara, A; Iskander, M and Pandey, VS (1996). Helminth infections of sheep in North Sumatra, Indonesia. Vet. Parasitol., 61: 353-358.

Dorny, P; Symoens, C; Jalila, A; Vercruysse, J and Sani, R (1995). Strongyle infections in sheep and goats under the traditional husbandry system in peninsular Malaysia. Vet. Parasitol., 56: 121-136.

Faizal, ACM and Rajapakse, RPVJ (2001). Prevalence of coccidia and gastrointestinal nematode infections in cross breed goats in the dry area of Sri Lanka. Small Rumin. Res., 40: 233-238.

Faizal, ACM; Rajapakse, RPVJ; Jayasinghe, SR and Rupasinghe, V (1999). Prevalence of coccidial and gastrointestinal nematode vs. weight gains in treated goats in the dry area of Sri Lanka. Small Rumin. Res., 34: 21-25.

Hansen, J and Perry, B (1994). *The epidemiology, diagnosis and control of helminth parasites of ruminants*. International Livestock Centre for Africa, Addis Ababa. International Livestock Centre for Africa (1979) Small Ruminant Production in the Humid Tropics *ILCA Systems Study 3*. ILCA, Addis Ababa. PP: 40-76.

Kanyari, PWN (1993). The relationship between coccidial and helminthes infection in developing countries of southeast Asia and Pacific. Int. J. Parasitol., 26: 963-970.

Levine, ND (1961). *Protozoan parasites of domestic animals and man*. 1st Edn., Minneapolis, Burgess Publishing Co., P: 189.

Matthews, JG (1991). *Outline of clinical diagnosis in the goat*. 1st Edn., London, UK, Longman Publication. PP: 202-204.

McGregor, BA (1998). Nutrition, management and other environmental influences on the quality and production of mohair and Cashmere: a review with particular reference to Mediterranean and annual temperate climatic zones. Small Rumin. Res., 28: 199-215.

Miller, JE; Bahirathan, M; Lemarie, SL; Hembry, FG; Kearney, MT and Barras, SR (1998). Epidemiology of gastrointestinal nematode parasitism in Suffolk and Gulf Coast native sheep with special emphasis on relative susceptibility to *Haemonchus contortus* infection. Vet. Parasitol., 74: 55-74.

Nwosu, CO; Madu, PP and Richards, WS (2007). Prevalence and seasonal changes in the population of gastrointestinal nematodes of small ruminants in the semi-arid zone of north-eastern Nigeria, Vet. Parasitol., 144: 118-124.

Opoku-Pare, GA and Chineme, CN (1979). Pathology of acute intestinal coccidiosis in young goats. Bull. Anim. Health Prod. Afri., 27: 269-273.

Rafat, SA and Shodja, D (2004). The effects of feeding levels on characteristics of fibers of Raeini Cashmere goats. Livest. Res. Rural Dev., 16: 1-3.

Rahman, WA (1994). Effect of sub-clinical *Eimeria* species infections in tropical goats subsequently challenged with caprine *Haemonchus contortus*. Vet. Res., 134: 235-237.

Soulsby, ELJ (1982). *Helminths, arthropods and protozoa of domesticated animals*. 7th Edn., London, Bailliere Tindall. P: 594.

Suarez, VH and Busetti, MR (1995). The epidemiology of helminth infections of growing sheep in Argentina's Western Pampas. Int. J. Parasitol., 25: 489-494.

Theodoropoulos, G; Theodoropoulou, E; Petrakos, G; Kantzoura, V and Kostopoulos, J (2002). Abattoir condemnation due to parasitic infections and its economic implications in the region of Trikala, Greece. J. Vet. Med. B Infect. Dis. Vet. Public Health. 49: 281-284.

Tsotetsi, AM and Mbati, PA (2003). Parasitic helminthes of veterinary importance in cattle, sheep and goats on communal farms in the northeastern Free State, South Africa. J. S. Afr. Vet. Assoc., 74: 45-48.

Urquhart, GM; Armour, J; Duncan, JL; Dunn, AM and Jennings, FW (1987). *Veterinary parasitology*. 3rd Edn., Burnt Mill, Harlow, UK, Longman Scientific and Technical. PP: 217-224.

Woji, AY; Little, DA and Ikwuegbu, OA (1994). Prevalence of coccidial infections in the West African Dwarf goat in the sub humid zone of Nigeria. Trop. Anim. Health Prod., 26: 1-6.