The prevalence of ovine *Eimeria* infection in Rudsar, North of Iran, (2011–2012)

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Abstract This study was undertaken to determine the prevalence of *Eimeria* infection in sheep in Rudsar, North of Iran, in period of 1 year (March 2011 to March 2012). The samples (approximately 3–5 grams of faeces) were collected from the rectum of 270 sheep and transferred to the parasitology laboratory. *Eimeria* species were identified following sporulation of faeces in a thin layer of 2.5 % potassium dichromate for one or 2 weeks at 27 °C. Out of 270 faecal samples examined, 170[(63.0 %; 95 % Confidence Interval (CI) 56.9–68.7)] were positive for *Eimeria* spp. Five species of *Eimeria*, including *E. ahsata*, *E. ovina*, *E. crandallis*, *E. parva* and *E. ovinoidalis* were identified in faecal samples by modified McMaster technique. The most frequent species was *E. crandallis*. Sheep were considered in four age groups (less than 1 year old, 1–2 years old, 2–3 years old and over 3 years old). The results also indicated that less than 1 year old sheep have greater infection ratio as compare with older animals. Female had significantly higher prevalence of *Eimeria* than male. Higher infection was seen in females

compare to males and in winter compare to summer. Parasitological gross and microscopic examinations revealed *Eimeria* infection is common in sheep of Rudsar, North Iran.

Keywords *Eimeria* · Sheep · Rudsar · Iran

Introduction

Coccidiosis is an important parasitic disease in small ruminants in Iran, and it has been reported worldwide (Skirnisson 2007; Kimbita et al. 2009; Gadahi et al. 2009; Wang et al. 2010). Coccidiosis of small ruminants is a protozoan infection caused by coccidia parasites of the genus *Eimeria* which develop in the intestine and abomasums and occurs mostly in young animals (Kaya 2004; Maratea and Miller 2007). Coccidia infection has great economic importance in the veterinary medicine field in sheep (Levine 1985). This disease leads to economic losses due to high mortality and morbidity, low growth performance; reduce in productivity and treatment costs (Kaya 2004; Temizel et al. 2011). Surveys based on the examination of ruminant faeces have shown that most animals are infected with a wide variety of *Eimeria* species from an early age (Vercruysse 1982; O’Callaghan et al. 1987; Amarante and Barbosa 1992). In sheep, several species of *Eimeria* have been recognized including *E. ahsata*, *E. bakuensis*, *E. crandallis*, *E. faurei*, *E. granulosa*, *E. gonzalezi*, *E. gilruthi*, *E. intricata*, *E. marsica*, *E. ovinoidalis*, *E. pallida*, *E. parva*, *E. punctata* and *E. weybridgensis*. (Platzer et al. 2005). *E. ovinoidalis*, *E. bakuensis* and *E. ahsata* are the most pathogenic species in small ruminants. All ages of sheep are susceptible to *Eimeria* infection but lambs are the most severely affected by clinical coccidiosis and disease outbreaks (Khan et al. 2011). Clinical coccidiosis in domestic animals becomes an economically important problem with the introduction of

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intensive rearing systems. Many factors affect occurrence of the disease such as: the climatic conditions, high stocking density, very poor weather conditions and the use of restricted areas to supplement the flock with extra food, kept under stressor factors such as dietary changes, weaning and transportation (Kaya 2004).

It seems coccidiosis is an important infection in north part of Iran, due to humid and temperate climate but based on best our knowledge there is no study of prevalence of this infection in this area. Therefore, we conducted this study to determine the prevalence of coccidiosis in sheep, and its risk indicators in Rudсар, North of Iran.

Materials and methods

The study was carried out in Rudсар city, north of Iran, from March 2011 to March 2012 during the wet and dry seasons. Rudсар city is located in Gilan province and has a continental type of climate with high humidity of average annual rainfall of 1,000–2,000 mm. Rudсар city located between latitude 36°42'N and longitude 50°18'E.

A total of 270 fresh faecal samples (between 3 and 5 g) were collected directly from the rectum of sheep randomly at the Rudсар and were stored at 4 °C until processing. Flotation in sucrose saturated solution was performed to demonstrate the presence of oocysts. Sporulation of oocysts was performed using submerging the faecal sample in a thin layer of 2.5 % potassium dichromate for 7–10 days at 27 °C. *Eimeria* species of each oocyst was determined according to the characteristics of oocysts (size, shape, color, presence or absence of micropyle and its cap, presence or absence of residual and polar and Stiedea bodies) described by Soulsby (1986), Maingi and Munyua (1994) and Eckert et al. (1995). The modified McMaster technique was performed to determine the number of oocysts per gram (OPG) of faeces. Prevalence of the infection during four seasons was evaluated according to the sex and age groups (less than 1 year old, 1–2 years old, 2–3 years old and over 3 years old).

For analysis of data, descriptive statistics for qualitative data with 95 % confidence interval (95 % CI) was used and Logistic regression was used to determine the effect of mentioned risk indicators on the prevalence of infection. *p* value less than 0.05 was considered as statistical significant. Data were analyzed using Stata, version 11.2.

Results

Among 270 sheep (116 male, 154 female) examined in the Rudсар city, *Eimeria* oocysts were found in 170 [63.0 %; (95 % CI 56.9–68.7)] out of 270 faecal specimens. Five different species of *Eimeria*, including *E. ahsata*, *E.*

Table 1 The prevalence of *Eimeria* infection in sheep in different sex and seasons in Rudсар, north of Iran, 2011–2012

Variable		Inspected	Infected (percent; 95 % CI)
Season	Spring	55	25 (45.5 %; 32.0–59.4)
	Summer	54	22 (40.7 %; 27.6–55.0)
	Autumn	76	52 (68.4 %; 56.7–78.6)
	Winter	85	71 (83.5 %; 73.9–90.7)
Sex	Male	116	60 (51.7 %; 42.3–61.1)
	Female	154	110 (71.4 %; 63.6–78.4)
Age group	<1	70	54 (77.1 %; 65.6–86.3)
	1–2	60	34 (56.7 %; 43.2–69.4)
	2–3	64	35 (54.7 %; 41.7–72.3)
	>3	76	47 (61.8 %; 50.0–72.3)
	Total	270	170 (63.0 %; 56.9–68.7)

The prevalence of infection with *Eimeria* species in less than 1 year old sheep was greater than other age categories ($P < 0.05$) (Table 1). Also, the infection rate between female (71.4 %) and male (51.7 %) showed significant difference ($P < 0.05$)

Table 2 The effect of risk indicators on the prevalence of ovine *Eimeria* infection in Rudсар, 2011–2012

Variable		Odds ratio	P value	95 % CI
Sex	Male	1	–	–
	Female	2.8	<0.001	1.6–4.9
Age group	<1 year	1	–	–
	1–2 years	0.4	0.03	0.18–0.91
	2–3 years	0.3	0.003	0.13–0.66
	>3 years	0.4	0.02	0.17–0.83
Season	Spring	1	–	–
	Summer	0.81	0.6	0.36–1.8
	Autumn	2.52	0.02	1.2–5.4
	Winter	7.4	<0.001	3.2–17.1

ovina, *E. crandallis*, *E. parva* and *E. ovinoidalis* were identified. Out of 170 infected sheep, 25 (45.5 %), 22 (40.7 %), 52 (68.4 %) and 71 (83.5 %) sheep were infected by *Eimeria* in spring, summer, autumn and winter, respectively (Table 1). Investigation of seasonal dynamic of infection with *Eimeria* species in Rudсар sheep showed that the proportion of infected sheep in winter was greater than summer significantly ($P < 0.05$). Mixed infections were found in 67.9 % ($n = 142$) of the positive specimens.

Table 2 shows the results of logistic regression on the effect of risk indicators (sex, age group and season) on the prevalence of *Eimeria* infection.

Discussion

Coccidia infection in sheep is a worldwide protozoan parasitic disease. On the whole, 15 species of *Eimeria* have

been identified in sheep. In the present study, the prevalence of coccidiosis was considerably high in sheep. Five *Eimeria* species were identified, including *E. ahsata*, *E. ovina*, *E. crandallis*, *E. parva* and *E. ovinoidalis*. In previous studies in Iran Kheirandish et al. (2012) recognized 7 *Eimeria* species (*E. crandallis*, *E. ovina*, *E. parva*, *E. ovinoidalis*, *E. faurei*, *E. ahsata* and *E. intricata*) in sheep of Kerman province, South-East of Iran. In other report from Tabriz, Iran, Yakhchali and Zarei (2008) studied coccidiosis in sheep and detected 6 *Eimeria* species (*E. intricate*, *E. ovina*, *E. faurei*, *E. parva*, *E. ahsata* and *E. pallida*). Heidari (2010) recognized 10 *Eimeria* species, including *E. ovinoidalis*, *E. ahsata*, *E. faurei*, *E. parva*, *E. crandallis*, *E. punctata*, *E. ovina*, *E. pallida*, *E. intricata* and *E. Weybridgensis* in Hamadan, Iran. In this investigation, number of *Eimeria* species was lowest than of Skirnisson (2007), Andrade Junior et al. (2012) and Dittmar et al. (2010), who reported 10, 9 and 12 *Eimeria* species in sheep in Iceland, Brazil and Germany, respectively. But, the number of *Eimeria* species identified in this study was nearly similar to that of other studies (Toulah 2007; Platzer et al. 2005). This disparity among the findings might be due the variations in the climate, temperature and amount of rainfall in different seasons, age, immune system of host, hygiene conditions and rearing systems. Balicka-Ramisz (1999), Kheirandish et al. (2012) and Kaya (2004) reported *E. crandallis* were the most predominant in less than 1 year old and lamb. Similar to the present study, *E. crandallis* was the most commonly species in affected sheep. In the study of Sisodia et al. (1997) the highest prevalence was recorded in animals aged between 6 months and 1 year, compared with older animals, similar to the present study. The significant difference in infection rates during winter and summer found in this study agreed with previous findings (Skirnisson 2007); (Yakhchali and Golami 2008). Coccidiosis was rarely observed in spring and summer, probably due to the early releasing of ewes and lambs to sparsely oocyst contaminated grazing areas.

Coccidial infection was observed in the all age groups which it was in accordance with the previously reported studies (Barutzki et al. 1990, Taylor and Catchpole, 1994). In South Africa, 6 *Eimeria* species (*E. crandallis*, *E. bakuensis*, *E. weybridgensis*, *E. ahsata*, *E. intricate*, *E. ovinoidalis*) were recovered from the sheep by Bakunzi et al. (2010) that the most frequently species in sheep were *E. crandallis* and *E. bakuensis*. In agreement with our results, the common pathogenic *Eimeria* species was *E. crandallis*. In this work, prevalence of *Eimeria* in female was greater than male. This result is in discrepancy with that of Maingi and Munyua (1994) they found no significant difference in prevalence between males and females. Demir (1997) reported that 97.7 % of the animals were found to have either single or mixed infections. In this study, mixed

infection with two or three *Eimeria* species was more commonly seen than infection with a single *Eimeria* species, similar to findings of other researchers (Toulah 2007; Yakhchali and Zarei 2008; Wang et al. 2010).

In conclusion, the findings of the present study revealed the prevalence of coccidiosis in sheep faecal samples from the Rudsar is significantly high. Further studies will be required to reveal more information about the economic effects of this parasite which would be useful for establishing control programs and evaluate infection potential.

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