Prevalence and risk factors for gastrointestinal parasitism in traditionally maintained goat flocks of South Gujarat

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Abstract A total of 360 faecal samples of goat belonging to Ahir community were collected randomly from eight villages on monthly basis. On same day, collected samples were subjected to qualitative faecal examination and positive samples were categorized into mild, moderate and heavy infected groups. The risk factors considered for study were age, pregnancy, lactation, seasons, wet land grazing and hygiene in housing. Overall 41.11 % animals were found positive for helminth eggs and among them 24.17, 10.56 and 6.39 % of goats were mildly, moderately and heavily infected, respectively. The helminths recorded were strongyles (26.9 %), amphistomes (18.1 %), *Trichostrongylus* spp. (8.1 %) and *Nematodirus* spp. (3.9 %). Similarly, 72 (20 %) animals were found positive for presence of coccidia oocysts in which 13.06, 4.17 and 2.78 % were having mild, moderate and heavy infection. The Chi square test revealed that the housing quality, seasons and body condition scores (BCS) were having significant effects on helminths prevalence. The Chi square values indicated that age, hygiene of houses, seasons and BCS have significantly associated with prevalence of coccidiosis. The helminths

prevalence was having significant positive correlation with lactation status and housing quality whereas it was significantly negatively correlated with prevalence of coccidia. Kendall's Correlation coefficients among various risk factors reveals that age and housing quality has significant negative correlations with coccidia infection. The gastrointestinal (GI) parasites incidence was significantly high during the monsoon than the summer/winter season. The correlation of GI- parasitic prevalence with pregnancy status and age was not found.

Keywords Coccidia · Correlation · Lactation · Parasite · Prevalence · Risk factors and Season

Introduction

The traditional goat farming is profitable enterprise among Ahir tribal population of South Gujarat. They used to rear 25–40 Surti goat/flock exclusively on browsing (Sorathiya et al. 2013). However, heavy monsoon, more rainy days, perennial canal irrigation facility and village ponds are the major risk factors associated with parasitic infection in this region. Hence, many farmers advocating dewormer to their flocks injudiciously that may lead to drug resistance problem and also it is uneconomical. Therefore, researchers have developed sustainable and eco-friendly, integrated parasite management (IPM) approach to minimize the parasites population below the disease threshold level. To develop IPM, it is necessary to study all the risk factors associated with prevalence of parasites in particular geographic region (Odoi et al. 2007). So, study of parasitic prevalence and the risk factors associated with them is planned in two districts of heavy rainfall region.

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Materials and methods

The study was conducted on goats belonging to 4 randomly selected villages each from Valsad and Navsari district of South Gujarat, India. The average rainfall of the selected area is 1800–2200 mm with 55–60 rainy days. In winter season the temperature may fall down to 10 °C, in summer temperature may raise up to 41 °C. The May–June months are characterized by hot-humid season with relative humidity of about 70 % in both districts.

The parasitic prevalence was studied by monitoring the selected flocks for the presence of parasitic ova/oocysts for one year. From each village about 200 goats (2–4 flocks) were selected randomly that were not dewormed during last 2 months. The faecal sample was collected from 10 adults, 3 yearlings and 2 kids from one village in one season and one lot. Two villages were monitored in 1 month by collecting 30 faecal samples, thus, 120 samples/season or 360 samples/year and analyzed as per the set schedule. On same day, the samples were subjected to qualitative faecal examination as per the method described by Soulsby (1982). By qualitative judging, the parasites positive samples were classified into mild (<4 eggs/ <40 oocysts/field), moderate (5–10 eggs/ 50–100 oocysts/field) and heavy (>10 eggs/ >100 oocysts/field) group. The basic information like age, sex, pregnancy, lactation, history of deworming etc. was also recorded during sample collection.

The risk factors considered for study were age group (adult, yearling and kid), pregnancy status (pregnant or non pregnant), in-milk or dry, seasons (summer, rainy and winter), wet land grazing (yes or no) and housing (good or bad). In the studied area, 4 villages were measured as of wet land grazing (having either canal or pond irrigation facility) and other 4 as of non- wet land grazing risk. The shelter facility possessed by respondents, to house the goats was visually ranked based on adoption level of several parameters like site selection, floor space, floor height, roof height, provision of overhang, feeding space, drainage facility, gap in slates, cleanliness of floor and ventilation. The full, partial and low adopter respondents were categorized as excellent (score 2), medium (score 1) and poor (score 0), respectively. The house scored 10 or more was categorized as good while remaining others as bad house. To find correlations the bad and good houses were assigned score 1 and 2, respectively in SPSS data sheet for analyzing correlations with parasitic infection. The BCS is the reflection of nutritional status of animal and can be used indirectly, to measure the effect of nutrition status on parasitic prevalence. As per standard protocol, the BCS is assigned to each goat included in the experimentation (Yilmaz et al. 2014).

The collected data was distributed and tabulated as per standard statistical method (Snedecor and Cochran 1994).

The tabulated data was analyzed by various suitable techniques in IBM® SPSS® Statistics Version 20.0. The descriptive analysis in nominal data was analyzed by frequency distribution by cross tabulation. The Chi square test was used to test significance in the data. The correlations were analyzed by using Kendall's tau b test in bivariate correlations.

Results and discussion

Prevalence of GI- helminths

The data of helminths prevalence of 360 faeces is presented in Table 1, based on frequency distribution by considering all risk factors under the studied area. Total 41.11 % animals were positive for parasitic eggs and among them 24.17, 10.56 and 6.39 % were having mild, moderate and heavy infection, respectively (Table 1). The Chi square test revealed that housing quality, seasons and BCS were having significant effects on parasitic prevalence. The parasitic prevalence was not affected by age, lactation and pregnancy status in goats. Generally, it is considered that the younger are more susceptible to parasitosis than the adults animals (Dagnachew et al. 2011), but it was not true in present study, that may be due to selection of less number of kids. Nabi et al. (2014) observed that the parasitic prevalence was not affected by pregnancy status and BCS of goats, which is contradictory with the finding of present study. Total 12.93 and 1.88 % parasitic prevalence was found in animals with low (<2.75) and high BCS (>2.75), respectively (Table 1). The space provided and hygiene parameters in housing are very important for parasitic infection in in-house animals (Kantzoura et al. 2012). Higher parasitic infections were detected during the warm rainy season than dry cold season, was in accordance with Sutar et al. (2010) and Dhara et al. (2015), might be due to longer grazing time (Pathak and Pal 2008). Moreover, the infection was not affected by wet land grazing risk. It may be due to the good absorbance power in the soil of selected area and knowledge of herders in selecting grazing area.

Species wise prevalence of GI- helminths

The species wise distribution of helminths positive cases in three seasons is depicted in Table 2. The nematodes found were strongyles (26.9 %), *Strongyloides* spp., *Trichuris* spp. (8.1 %) and *Nematodirus* spp. (3.9 %). The nematodes eggs in some cases were unable to identify based on morphology; hence, it was classified as other nematodes. The amphistomes (18.1 %), *Fasciola* spp. and *Scistosoma*

Table 1 Effects of various risk factors on prevalence and severity of parasites

Names of risk factors	Positive cases		Severity of parasitic infestation						Total	Chi square test	
			Mild		Moderate		Heavy			Value	Sig.
	n	%	n	%	n	%	n	%			
Pregnancy status											
Non-Pregnant	109	40.22	64	23.62	26	9.59	19	7.01	271	1.91	NS
Pregnant	39	43.82	23	25.84	12	13.48	4	4.49	89		
Category of goat											
Kid	27	56.25	19	39.58	4	8.33	4	8.33	48	10.51	NS
Yearlings	25	34.72	17	23.61	5	6.94	3	4.17	72		
Adults	96	40.00	51	21.25	29	12.08	16	6.67	240		
Lactation status											
Dry	120	44.61	71	26.39	30	11.15	19	7.06	269	5.51	NS
Lactating	28	30.77	16	17.58	8	8.79	4	4.40	91		
Wet land grazing											
Yes	79	43.89	47	26.11	18	10.00	14	7.78	180	2.25	NS
No	69	38.33	40	22.22	20	11.11	9	5.00	180		
Housing quality											
Poor	81	48.50	46	27.54	23	13.77	12	7.19	167	7.73	$p < 0.05$
Good	67	34.72	41	21.24	15	7.77	11	5.70	193		
Location											
Navsari	79	43.89	47	26.11	21	11.67	11	6.11	180	1.50	NS
Valsad	69	38.33	40	22.22	17	9.44	12	6.67	180		
Season											
Monsoon	92	76.67	48	40.00	26	21.67	18	15.00	120	99.51	$p < 0.01$
Winter	27	22.50	18	15.00	6	5.00	3	2.50	120		
Summer	29	24.17	21	17.50	6	5.00	2	1.67	120		
BCS ranges											
Low (<2.75)	75	51.02	34	23.13	22	14.97	19	12.93	147	25.45	$p < 0.01$
Good (>2.75)	73	34.27	53	24.88	16	7.51	4	1.88	213		
Total	148	41.11	87	24.17	38	10.56	23	6.39	360		

N Number, Sig. significance, NS non-significant

spp. were the trematodes found in the samples. Only *Moniezia* spp. of cestodes was observed in the screened faecal samples. Table 2 revealed that monsoon had higher number of positive cases than the other season, was in agreement with Khajuria et al. (2013) and Varadharajan and Vijayalakshmi (2015). The strongyle group was the main nematode identified by Odoi et al. (2007), Pathak and Pal (2008), Gadahi et al. (2009), Sutar et al. (2010) and Dhara et al. (2015) at Kenya, Chhattisgarh, Pakistan, Maharashtra and West Bengal, respectively. While, Agrawal et al. (2010) and Hassan et al. (2011) recorded *Trichostrongylus* spp., and *Strongyloides* spp., respectively as main parasites. Another important parasites identified in this study was amphistomes which was in accordance with Pathak and Pal (2008). Moreover, Gadahi et al. (2009) reported the presence of *Nematodirus* spp. in the faecal samples.

Prevalence of GI- coccidia

Total 72 (20 %) goats were positive for coccidiosis in which 13.06, 4.17 and 2.78 % having mild, moderate and heavy infections, respectively (Table 3). Coccidia infection was very less during dry spell of the year, winter (11.67 %) and summer (5.83 %) and significantly heavy during monsoon (42.50 %), same pattern of incidence was also observed by Kantzoura et al. (2012) and Rahman (2007). Moreover, it was also affected by nutrition level as the goats having low BCS were having more prevalence, ranging from moderate to heavy infection (Table 3), this finding was in concurrence with the observation noted by the Khan et al. (2011). Kids had significantly higher prevalence (41.67 %), with more numbers of heavy infested cases, was also according to Khan et al. (2011) and Rahman (2007). Significantly higher prevalence, 28.74 %

Table 2 Species wise prevalence of GI-helminths

Name of helminths	Prevalence						Total		Chi square test	
	Monsoon		Winter		Summer					
	n	%	n	%	n	%	n	%	Value	Sig.
Strongyles	66	55.0	15	12.5	16	13.3	97	26.9	72	0.000
<i>Strongyloides</i> spp.	16	13.3	4	3.3	6	5	26	7.2	10.28	0.006
<i>Trichuris</i> spp.	20	16.7	4	3.3	5	4.2	29	8.1	18.08	0.000
<i>Nematodirus</i> spp.	10	8.3	1	0.8	3	2.5	14	3.9	9.6	0.007
Other nematodes	10	8.3	6	5	4	3.3	20	5.6	2.96	0.227
Amphistomes	40	33.3	11	9.2	14	11.7	65	18.1	28.65	0.000
<i>Fasciola</i> spp.	5	4.2	1	0.8	2	1.7	8	2.2	3.32	0.190
<i>Scistosoma</i> spp.	7	5.8	6	5	0	0	13	3.9	6.82	0.032
<i>Moniezia</i> spp.	2	1.7	5	4.2	7	5.8	14	3.9	2.82	0.244

N Number, Sig. significance

Table 3 Effects of various risk factors on prevalence and severity of coccidia

Names of risk factors	Positive cases		Severity of parasitic infestation						Total	Chi square test	
			Mild		Moderate		Heavy				
	n	%	n	%	n	%	n	%		Value	Sig.
Pregnancy status											
NP	55	20.30	36	13.28	12	4.43	7	2.58	271	0.39	NS
Pregnant	17	19.10	11	12.36	3	3.37	3	3.37	89		
Category of goat											
Kid	20	41.67	14	29.17	3	6.25	3	6.25	48	19.38	$p < 0.01$
Yearlings	15	20.83	11	15.28	2	2.78	2	2.78	72		
Adults	37	15.42	22	9.17	10	4.17	5	2.08	240		
Lactation stat											
Dry	58	21.56	38	14.13	12	4.46	8	2.97	269	1.63	NS
Lactating	14	15.38	9	9.89	3	3.30	2	2.20	91		
Wet land grazing											
Yes	41	22.78	27	15.00	10	5.56	4	2.22	180	3.46	NS
No	31	17.22	20	11.11	5	2.78	6	3.33	180		
Housing quality											
Poor	48	28.74	31	18.56	9	5.39	8	4.79	167	15.87	$p < 0.01$
Good	24	12.44	16	8.29	6	3.11	2	1.04	193		
Location											
Navsari	34	18.89	25	13.89	5	2.78	4	2.22	180	2.13	NS
Valsad	38	21.11	22	12.22	10	5.56	6	3.33	180		
Season											
Monsoon	51	42.50	26	21.67	15	12.50	10	8.33	120	73.43	$p < 0.01$
Winter	14	11.67	14	11.67	0	0.00	0	0.00	120		
Summer	7	5.83	7	5.83	0	0.00	0	0.00	120		
BCS ranges											
Low (<2.75)	38	25.85	21	14.29	11	7.48	6	4.08	147	9.43	$p < 0.05$
Good (>2.75)	34	15.96	26	12.21	4	1.88	4	1.88	213		
Total	72	20.00	47	13.06	15	4.17	10	2.78	360		

N Number, Sig. significance, NS non-significant

Table 4 Correlations between associated risk factors and prevalence of GI parasites

Prevalence	Age	Pregnancy (1 = NP; 2 = P)	Lactation status (1 = in milk 2 = dry)	Wet land grazing risk	Housing quality (1 = bad; 2 = good)	Prevalence of coccidia
Coccidia	−0.181**	0.013	−0.067	−0.069	−0.203**	1.000
Parasites	0.044	−0.022	0.119*	0.051	0.145**	−0.390**

NP Non-pregnant, P pregnant

* Significance at $p < 0.05$; ** significance at $p < 0.01$

was found in goats housed in poor hygienic houses, was in agreement with the findings of Khan et al. (2011) and Dawid et al. (2012). The prevalence was found not associated with wet land grazing risk, was contradictory with the findings of Khan et al. (2011) in sheep flock, might be due the difference in the grazing behavior. The prevalence were similar in two districts under study might be associated with similar housing, grazing and management practices prevailed in both districts.

Correlations between risk factors with severity of GI-parasitic infection

Kendall's Correlation coefficients among various risk factors i.e. age, pregnancy, lactation, wet land grazing, housing quality and prevalence of parasitic infection is presented in Table 4. The age and housing quality had significant negative correlation with coccidia infection, accordance with Khan et al. (2011). The GI- parasitism was not correlated with age, in accordance with Dagnachew et al. (2011) and contradictory with Nabi et al. (2014). Soliman and Zalat (2003) also found correlation of age and body size with severity of coccidia infection. There was significant positive and negative correlation between prevalence of helminths and coccidia infection, respectively with lactation status and housing quality. The GI-parasitism was not correlated with pregnancy, also observed by Nabi et al. (2014).

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