International Scholars Journals

International Journal of Animal Breeding and Genetics ISSN 2756-3650, Vol. 12 (5), pp. 001-006, May, 2023. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Sensitivity to natural gastro-intestinal nematode infection at various physiological phases in semi-arid tropical goats and sheep

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Accepted 12 April, 2023

The study was undertaken in Barbari, Jamunapari goats and Muzaffarnagari sheep to evaluate the variability in resistance during periparturient rise in faecal egg counts and the impact of periparturient rise on animal's weight at kidding and birth weights of their progenies. The investigation was carried out in 169 Barbari does, 107 Jamunapari does and 82 Muzaffarnagri ewes distributed over two breeding seasons. The individuals were monitored from dry period to late stage of lactation for faecal egg count (FEC) measurement. The rise in faecal egg count (FEC) was observed from dry period to early lactation and thereafter it decreased in both goat and sheep. The present study confirmed the periparturient rise in response to natural nematode infection in both sheep and goat in semi arid climatic region in India. The variability in resistance was observed as Jamunapari goats were more prone to infection as compared to Barbari and Muzaffarnagari breed during the late pregnancy and early lactation stage. A significant peri-parturient rise (P<0.01) in lamb fecal egg count (LFEC) occurred at 2 to 4 weeks before kidding/lambing (late pregnancy) and peaked at 4 weeks post-parturition (early lactation) in Barbari, Jamunapari and Muzaffarnagari breeds. The present study also showed that there was no significant effect of periparturient rise on birth weight of kids and dam's weight at kidding. Barbari goats were more tolerant to periparturient rise as compared to Jamunapari and Muzaffarnagari sheep.

Key words: Goat, sheep, peri-parturient rise, semiarid.

INTRODUCTION

Gastro-intestinal nematode (GIN) is a major problem for maintaining the small ruminant's productivity in the tropics (Over et al., 1992) and responsible for significant economic loss to the sheep and goat industry in the hot humid areas (Soulsby, 1982; Mandonnet et al., 2005). Worm infection occurs when the climatic conditions are favourable and parasite adversely affects the productivity of the infected animals (Albers et al., 1989). It has been observed that susceptibility to worm burden increases during pregnancy in ewes (Woolaston, 1992; Tembely et al., 1996; Baker et al., 1998). Moreover the parasitic load during the periparturient period has often been reported as the major source of pasture contamination in ruminants (O'Sullivan and Donald, 1970; Barger, 1993). Again, the parasitism during periparturient period is more acute in dairy goats than fiber goats (Morris et al., 1997). Therefore it is necessary to understand the epidemiology of helminth infection in small ruminants in similar climatic condition by which targeted anthelmintic treatment can be provided for increasing productivity of the flock. Genetic variability in periparturient rise has been established in sheep and goat and the breed difference during periparturient rise has been observed (Courtney et al., 1986; Woolaston et al., 1992; Baker et al., 1998; Morris et al., 1998; Bishop and Stear, 2001; Chauhan et al., 2003a; Yadav et al., 2006). The effect of periparturient rise on production parameter had been observed (Morris et al., 1997; Bishop and Stear, 2001; Madnonent et al., 2005, 2006). The effect of periparturient rise during pregnancy on individual's weight at kidding and

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the birth weights of the progenies has not been evaluated. Moreover periparturient rise has not been observed in sheep reared under the arid zone of India (Singh et al., 1997). Therefore the present study has been planned to analyse the periparturient rise in both goat and sheep as they are maintained under similar managemental condition in semi arid climate. Moreover, the effect of the parasitism during periparturient period will be compared between the diary goat breed (Jamunapari) with dual purpose goat breed (Barbari) and mutton purpose sheep breed (Muzaffarnagari). Secondly, the effect of parasitism (periparturient rise) on dam's weight at kidding and the birth weight of offspring's has been analyzed.

MATERIALS AND METHODS

Experimental animals and their management

The experiment was undertaken on two goat breeds, Barbari and Jamunapari, and in one sheep breed (Muzaffarnagari). Jamunapari is known for its milk production, Barbari is dual purpose breed and Muzaffarnagari is a mutton producing breed. Barbari and Jamunapari flocks are maintained at Central Institute for Research on Goats (CIRG), Makhdoom, Mathura. Selection for body weight and milk yield is being carried out since last 20 years. Muzaffarnagari sheep is also maintained at institute since last 25 years and selective breeding is carried out to improve the growth performance.

Jamunapari goat is a large size milch breed and has been used extensively for upgradation of local goats in neighboring Southeast Asian countries. Barbari goat is a medium size and dual-purpose breed and known for its adaptability over a wide range agro-climatic situation. Muzaffarnagari sheep is a large size breed and is known for its mutton production. The goats and sheep are maintained under semi-intensive system of management with 6 to 7 h of grazing and stall feeding with seasonally available green fodders *ad libitum*, supplemented with concentrate mixtures depending upon the status and age category of the animals. The animals were housed in different sheds according to their age groups and production status. No rotational grazing was practiced. Does were bred twice at each oestrus. Controlled breeding was practiced with the does being bred during May to June and October to November followed by kidding in the months of October to November and March to April, respectively. Recording of birth weight and live body weights was carried out after the kidding. Deworming was carried out twice annually in all the flocks except pregnant animals in the pre-monsoon season (May to June) and in the post-monsoon season (September to October).

CIRG, Makhdoom, Mathura, is located 169 m above mean sea level and 10ºN, and 78ºE with a semi-arid climate. The soil of this area is sandy and vegetation is composed of natural pasture and bush. The annual rainfall in the area is about 410 mm, scattered during the months of June to September and the temperature varies from 4.5 to 24.10ºC in winter and 27.5 to 44.4ºC in summer.

Faecal egg count (FEC) measurement

Faecal egg counts (FEC) were determined using saturated salt flotation technique and was estimated using the modified McMaster technique (MAFF, 1986). Faecal culture was carried out to identify the worms/larvae present in the faeces at L3 stage, which have distinguishable characteristics for each genus. The larval differentiation from bulked cultures revealed that predominant larvae were *Haemonchus contortus* (>90%), followed by *Strongyloides* spp. and *Oesophagostomum* spp. The similar observation in semiarid region has been reported in our earlier report (Chauhan et al., 2003b; Rout et al., 2002).

Data recording and analysis

The investigation was carried out on 169 Barbari does, 107 Jamunapari does and 82 Muzaffarnagri ewes distributed over two breeding seasons. The animals were monitored from dry period to late stage of lactation for FEC. The birth weight of all the kids and dam's weight were recorded after parturition. The traits recorded and analysed were faecal egg count during dry period, mating period, early stage of pregnancy (2.0 to 2.5 months after mating), late stage of pregnancy (30 to 45 days before parturition), early stage of lactation (45 to 60 days after parturition) and late stage of lactation (90 days of lactation or more). The skewed distribution of faecal egg counts implied a $\log_e$ (FEC + 100) transformation as it was found to be the most appropriate transformation to normalize the variance (Chauhan et al., 2003b). REML variance component analysis was carried out in GENSTAT package (Lawes Agricultural Trust, 2005) to observe the fixed effects of breed, parity, season, birth type (tob) on faecal egg count. Regression analysis was carried out to observe the effect of faecal egg count on kid's birth weight and dam's weight at kidding.

RESULTS AND DISCUSSION

Summary statistics for faecal egg counts in different physiological stages are shown in Table 1 for Barbari, Jamunapari does and Muzaffarnagri ewes. Egg counts were highest during the late pregnancy and early lactation stages in all the breeds, however the relative infection rate was highest in Jamunapari in comparison to Barbari and Muzarffarnagri breed. Figure 1 shows the predicted means of lamb fecal egg count (LFEC) during different physiological stages. Predicted means of LFEC indicated that the animals were highly susceptible to infection during late pregnancy and early lactation stages in all the breeds. Jamunapari goats were having highest egg count at all the stages as compared to Barbari and Muzaffarnagari sheep. Jamunapri goats were equally susceptible to nematode infection from late pregnancy to late lactation (<2.0%) stage (Table 1). However, LFEC showed decreasing trend from late pregnancy to late lactation stage in Barbari and Muzaffarnagari breed (Table 1). The present observation agrees well that the parasitism during periparturient rise was more acute in dairy goats (Morris et al., 1997).

Summary statistics for birth weight and dam's weight at kidding measured during periparturient period are presented in Table 2. Jamunapari and Muzaffarnagari breeds were heavier than Barbari breed.

The LFEC showed an increasing trend from mating to early lactation stage and decreasing trend from late lactation to dry period in all the breeds (Table 3). Breed had significant (P<0.01) effect on LFEC at all the physiological stages. The interaction of season by breed factor had significant (P<0.01) effect on LFEC at .early

Table 1. Summary of statistics for resistance traits (FECs) measured during periparturient period in Barbari goats, Jamunapari goats and Muzaffarnagari sheep.

Summary of statistics for resistance traits	Dry period	Mating	Early pregnancy	Late pregnancy	Early lactation	Late lactation
Barbari						
No.	169	169	169	169	169	169
Mean (LFEC)	5.377	5.868	6.315	6.833	7.139	6.247
SD	0.852	0.958	0.970	1.169	0.885	0.994
Proportion of Zero	0.497	0.284	0.148	0.124	0.029	0.172
Maximum (LFEC)	7.824	8.161	8.683	9.622	9.00	8.686
Jamunapari						
No.	107	107	107	107	107	107
Mean(LFEC)	5.924	6.548	7.044	7.560	7.679	7.068
SD	0.910	1.073	0.926	0.900	0.849	0.722
Proportion of Zero	0.262	0.168	0.046	0.019	0.019	0.009
Maximum (LFEC)	7.824	8.269	8.683	9.510	10.395	8.648
Muzaffarnagari						
No.	82	82	82	82	82	82
Mean(LFEC)	5.753	5.457	5.893	6.317	7.215	6.398
SD	0.883	1.005	0.960	1.081	1.313	1.207
Proportion of Zero	0.317	0.536	0.292	0.195	0.109	0.232
Maximum (LFEC)	7.313	7.741	7.650	8.319	9.00	8.465

pregnancy, late pregnancy, early lactation and dry periods. Season of kidding had significant effect ($P<0.05$) on LFEC in Barbari does at early pregnancy, late pregnancy, early lactation. Similarly season of kidding had significant effect on LFEC in Jamunapari goats at late pregnancy and early lactation stages. In Muzaffarnagari ewes, season of kidding had significant effect ($P<0.01$) on LFEC at early pregnancy, late pregnancy, early lactation and late lactation. Parity had significant effect on LFEC at early pregnancy and late pregnancy stage in Barbari goats. In Jamunapari goats, parity had significant effect ($P<0.01$) on LFEC at early lactation stage. Parity had no significant effect ($P>0.01$) on LFEC in different physiological stages in Muzaffarnagari ewes.

Peri-parturient rise in FEC was observed in both sheep and goats in this semi arid climate region. The sheep was equally susceptible as goats to nematode infection in semi arid climate in contrast to the earlier observation that peri-parturient rise was not observed in arid climatic region (Singh et al., 1997). Peri-parturient rise has been observed in sheep and goat from temperate to tropic in different breeds (Courtney et al., 1986; Woolaston et al., 1992; Morris et al., 1997, 1998; Bishop and Stear, 2001; Baker et al., 1998; Madnonent et al., 2005, 2006; Chauhan et al., 2003a). Breed differences in nematode infection during peri-parturient rise have been reported in both sheep and goat breeds (Courtney et al., 1986; Baker et al., 1998; Chauhan et al., 2003a).

The association of weight of dam at kidding and birth weight of kids with LFEC during periparturient rise was analysed by fitting all the fixed effect into model in general linear regression. In Barbari breed, the regression coefficients of LFEC on birth weight of kids during early pregnancy and late pregnancy stage were positive and not significant ($P>0.01$). In Jamunapari breed, season had a significant effect ($P<0.01$) on birth weight of kids and the regression coefficients LFEC on birth weight of kids were negative and not significant at early pregnancy and late pregnancy stage. Similarly, season had a significant effect ($P<0.01$) on birth weight and the regression coefficients of LFEC on birth weight of lambs were negative and not significant at early pregnancy and late pregnancy stage in Muzaffarnagari sheep. The regression coefficients of LFEC on birth weight of kids during early pregnancy and late pregnancy stage were negative in Jamunapari goat and Muzaffarnagari sheep, indicating that the increase in FEC may decrease the birth weight of kids. No significant effect of LFEC on birth weight was observed in all the breeds during pregnancy, however Jamunapari and Muzaffarnagri breeds were more likely to loose kid’s birth weight as compared to Barbari breed

The regression of LFEC on dam’s weight at kidding was positive and not significant in Jamunapari goat and Muzaffarnagari sheep. In Barbari goats, the regression of

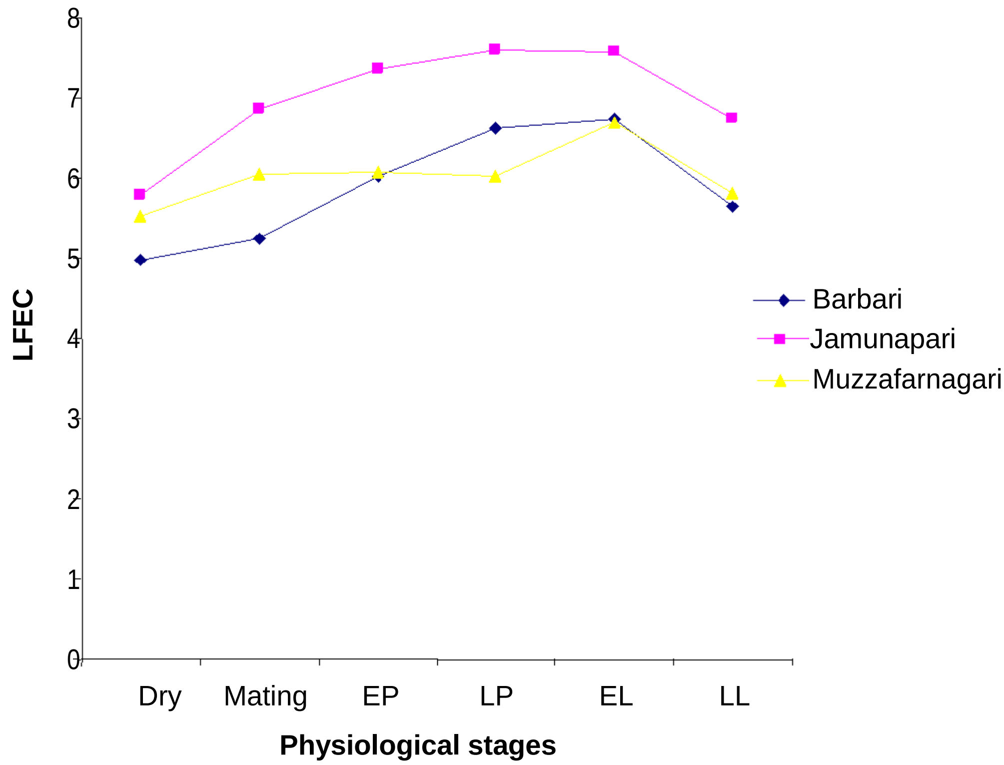

Figure 1. Predicted means of LFEC in different physiological stages in Barbari, Jamunapari goat and Muzzafarnagari sheep (Dry, dry period; mating, mating period; EP, early pregnancy; LP, late pregnancy; EL, early lactation; LL, late lactation).

LFEC on dam's weight at kidding was positive and significant (P<0.01) during mating and early pregnancy stage. It was observed that the dams having higher body weight were more prone to infection and showed higher FEC. The dam's weight at kidding and birth weight of kids were not affected by the high rise of FEC due to better feed supplementation during pregnancy. However periparurient rise in parasite had significant effect on kid growth (weaning weight) and milk yield in Cerole goats (Mandonnet et al., 2005).

The higher infection rate of the Jamunapari goats to GI (gastro-intestinal) nematode parasites in comparison to the Barbari goats and Muzaffarnagari ewes was particularly marked over the lactation period, which is similar to the observation of Baker et al. (1998), where the LFEC of lactating Galla does was about twice that of SEA does. Woolaston (1992) reported significant effect in LFEC between lactating ewes from the lines of Australian Merino. The peri-parturient rise in LFEC in ewes is a well-documented phenomenon and is generally thought to be the result of a depression in immune status of ewes during lactation (Brunsdon and Vlassoff, 1971). Tembely et al. (1996) revealed that pregnant and lactating genotypes had higher LFEC than their unmated counter parts in Ethiopian ewes. The breed differences for LFEC was significant in lactating ewes than non-lactating ewes in their counter part as the association of higher lactation intensity with a stress on the lactating ewes impairing immunity to a higher degree (Baker, 1998; Baker et al., 1998; Gruner et al., 2002).

The present study evaluates the peri-parturient rise in milk producing and dual purpose goat breeds and a mutton producing sheep breed in semi arid environment. The variability in resistance was expressed during the late pregnancy and early lactation in both sheep and goats. A significant peri-parturient rise (P<0.01) in LFEC occurred at 2 to 4 weeks before kidding/lambing (late pregnancy) and peaked at 4 weeks post-parturition (early lactation) in Barbari, Jamunapari and Muzaffarnagari breeds. Therefore, 30 to 45 days before and after kidding can be used for sampling and was most suitable time for genetic evaluation of goats and sheep and agrees well with earlier report (Bishop and Stear, 2001; Mandonnet et al., 2006). The present study also showed that there was no significant effect of periparturient rise on birth weight of kids and dam's weight at kidding.

Conclusion

The goat and sheep during pregnancy and lactation period should be grazed in a limited area to avoid the

Table 2. Summary statistics for birth weight and dam's weight at kidding measured during periparturient period in Barbari goats, Jamunapari goats and Muzaffarnagari sheep.

Summary statistics for birth		Barbari	Jamunapari	Muzaffarnagari
	No.	169	107	82
Weight of dam at kidding	Mean	27.88	40.44	38.42
	SD	4.71	5.37	4.40
	No	169	107	82
Birth weight	Mean	2.09	3.37	3.45
	SD	0.35	0.65	0.59

Table 3. Regression coefficient of faecal egg counts (LFEC) on birth weight of kids and dams weight at kidding in all the breeds during pregnancy stage.

Breed	FEC during physiological stages	Regression coefficient of LFEC on birth weight of kids	Regression coefficient of LFEC on dams weight at kidding
Barbari	Mating	0.031±0.028 NS	1.068±0.350**
	Early pregnancy (EP)	0.031±0.029 NS	0.806±0.363*
	Late pregnancy (LP)	0.020±0.027 NS	0.514±0.341 NS
Jamunapari	Mating	-0.083±0.049 NS	0.037±0.418 NS
	Early pregnancy (EP)	-0.091±0.036 NS	0.539±0.479 NS
	Late pregnancy (LP)	-0.096±0.059 NS	0.431±0.502 NS
Muzaffarnagari	Mating	0.016±0.063 NS	0.184±0.454 NS
	Early pregnancy (EP)	-0.018±0.068 NS	-0.104±0.499 NS
	Late pregnancy (LP)	-0.013±0.061 NS	0.035±0.441 NS

*P<0.05; ** P<0.01; NS- Not significant

pasture contamination. The dams should be targeted for better management during late pregnancy and early lactation period to reduce the worm burden. Moreover Jamunapari and Muzaffarnagari breed need more attention during pregnancy to avoid lower birth weight in progenies and subsequently avoiding kid mortality. Moreover selection for reduced FEC during peri-parturient period can increase productivity by increasing birth weight, milk yield and reducing pasture contamination.

ACKNOWLEDGEMENT

The authors are grateful to the Director, CIRG, for the facilities to carry out the research work.

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