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Evaluation of phenotypic markers in local goats from semi arid areas for resistance to natural infection with gastrointestinal nematodes

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Under free grazing systems, like those practiced in India, goats are consistently exposed to the larvae of gastrointestinal nematodes (GINs) causing substantial economic losses in terms of lower productivity, higher mortality and subsequent higher costs of deworming. Amongst these GINs, *Haemonchus contortus*, *Trichostrongylus columbriformis* and *Oesophagostomum columbianum* are the most significant parasites of small ruminants in India (Jaiswal *et al.* 2012). The parasitic control in ruminants in countries like India mainly relies on the use of anthelmintic agents and to some lesser extent on well planned grazing practices (Barger 1996, 1999). Indiscriminate use of anthelmintics has resulted in higher frequency of resistance in goats in India (Jaiswal *et al.* 2012). To add to the woes, the controlled grazing is practically impractical in developing countries like India due to non-availability and/or fragmented pasture lands. A relatively simple, feasible and economically friendly method of reducing the effects of nematode infection is the proper characterization and utilization of host genetic variations for resistance. Genetic variations lead to variations in the levels of resistance to gastrointestinal nematodes (Gray *et al.* 1995, Axford *et al.* 1999) and follow polygenic inheritance and can be measured quantitatively.

Resistance refers to ability of host to suppress the establishment or development or elimination of parasites, while resilience is the ability of the host to survive and be productive in the face of parasite challenge (Woolaston and Baker 1996). The degree of resistance can be directly assessed by measuring the faecal egg count (FEC) and resilience by packed cell volume (PCV) and haemoglobin (Hb). There are no published estimates of heritability for resistance or resilience to GI nematodes in goats of semi arid regions from India.

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Animal selection and topography of study area: Naturally infected 60 adult non-descript goats (> 9 month age), reared by local nomads, were allowed to graze freely following extensive system of management. The studied area of Mathura, India lying between the 27°41' North latitude and 77°41' East longitude, is located on the banks of river Yamuna at an average height of 187 m above the sea level. The average rainfall is around 593 mm with the summer temperature range between 22°C and 45°C and the winter temperature range between 14°C and 32°C.

Collection of samples: The faecal samples were collected aseptically in plastic bags directly from the rectum and faecal egg count (FEC) in terms of egg per gram (EPG) of faeces was estimated using modified McMaster method (MAFF 1977). The positive samples were pooled and subjected to copro-culture examination so as to obtain third stage infective larva, which were subsequently identified as per the standard morphological keys (Soulsby 1982). Blood samples (5 ml) were collected aseptically in vacutainers coated with anticoagulant (0.1% EDTA) from the jugular vein. The packed cell volume (PCV) and haemoglobin (Hb) were estimated using standard procedures (Jain 1993).

Statistical analysis: Repeatability for faecal egg count (FEC), packed cell volume (PCV) and haemoglobin (Hb) were estimated over time. Pearson's correlation (r) was obtained for blood parameters (haemoglobin and packed cell volume) with EPG using following statistical formula:

$$\rho_{X,Y} \quad \frac{\text{Cov}(X,Y)}{\sigma_X \sigma_Y} = \frac{E[(X-\mu_x)(Y-\mu_y)]}{\sigma_X \sigma_Y}$$

Where, $\rho_{X,Y}$ = Pearson correlation; X, haemoglobin or PCV; Y, EPG;E, expected value.

Estimates were tested for significance at 5% level.

The native goats in the studied semi arid area have resulted from long term natural and artificial selection by the nomadic community. These indegenous goats have extensive adaptability to temperate climate, relatively rapid growth and ability of resistance to certain diseases (Subramani *et al.* 2014). Several indigenous unimproved

Table 1. Correlations of EPG with Hb and PCV

	EPG	Hb		EPG	PCV
EPG Pearson correlation	1	-.830**	EPG Pearson Correlation	1	-.901**
Sig. (2-tailed)		.000	Sig. (2- tailed)		.000
N	60	60	N	60	60
Hb Pearson correlation	-.830**	1	PCV Pearson Correlation	-.901**	1
Sig. (2-tailed)	.000		Sig. (2- tailed)	.000	
N	60	60	N	60	60

** Correlation is significant at the 0.01 level (2-tailed).

breeds of small ruminants are significantly resistant or tolerant to parasitism in comparison with improved breeds (Charon 2004).

Haemonchus spp. (85%) was the predominant species throughout the year followed by *Trichostrongylus* spp. (7%), *Oesophagostomum* spp. (5%), *Bunostomum* spp. (2%) and *Strongyloides* spp. (1%). EPG, PCV and Hb were taken as phenotypic parameters in the study. The mean EPG, PCV and Hb of the infected goats in the studied area were 1121.6±175, 34.71±2.2 and 8.3±0.5, respectively (Table 1). The EPG, PCV and changes in body weight are the reliable phenotypic markers with very high correlation with higher responsiveness to infection (Behneke *et al.* 2006).

The authors did not find significant literature regarding set up of phenotypic markers for goats for the sake of discussion and/or criticism. Above all, selection does not adversely affect growth of lambs and fertility of ewes in similar types of production environment (Vanimisetti *et al.* 2004). In this study, the animals were divided statistically into 3 groups based on EPG values (<500, 500–1,000 and >1,000) studied over the period of time. Though the low EPG set for resilience/resistance in goats was <500, it is dependent upon species of strongyle infected, due to high level susceptibility of goats to GI parasitism in comparison to sheep (Subramani *et al.* 2014). FEC is a potent parameter reflecting the parasitological status of the sheep, and particularly in lambs, it can be very well correlated with adult parasitic burden (Douch *et al.* 1995, 1996).

In lower, medium and higher EPG groups, the average values of EPG, PCV and Hb were 485±42, 39.6±1.2, 12.22±0.98; 870±60, 37.4±1.1, 8.5±0.75 and 1375±92, 32.33±0.89 and 7.1±0.41, respectively. The overall percentages of lower, medium and higher EPG animals in the population were 30.1, 40.6 and 29.3%, respectively. The EPG showed a negative correlation (Pearson correlation) with both Hb and PCV that was highly significant (P<0.01). Similar results were reported in sheep, which showed a positive correlation of PCV with body weight and negative correlation with FEC in both ewes and lambs (Vanimisetti *et al.* 2004, Yadav *et al.* 2006).

In conclusion, a negative correlation was found between EPG values and the corresponding Hb and EPG values in the studied goats. The results are very much in accordance with that of the work done on sheep and a very little work has been done in Indian goats (Subramani *et al.* 2014). Hence, there is every possibility of exploring the genetic resistance of these animals using the Hb, PCV and EPG as the cheap and readily available markers. More studies are thereby warranted particularly on Indian goats, which have been ignored since long, so as to cope up the future goal to explore genetically resistant germplasm.

SUMMARY

The present study was designed to investigate the different degrees of genetic resistance and resilience in non-descript goats of semi-arid zone of Mathura to natural infections with gastrointestinal nematodes to introduce future breeding schemes. Animals were found to be naturally infected by *Haemonchus* spp. (85%) followed by *Trichostrongylus* spp. (7%), *Oesophagostomum* spp. (5%), *Bunostomum* spp. (2%) and *Strongyloides* spp. (1%). Faecal egg counts and blood samples were collected for the determination of indicator traits such as faecal egg count (FEC), packed cell volume (PCV) and haemoglobin (Hb). The mean EPG, PCV and Haemoglobin (Hb) were 1121.6±175, 34.71±2.2% and 8.3±0.5 g/dl, respectively. Based on EPG alone, goats were divided into 3 groups (<800, 900–2,000 and >2,000) and their EPG values were correlated with Hb and PCV. EPG showed a significant negative correlation with both Hb and PCV (P<0.01).

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