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HERITABILITY ESTIMATION AND THE FACTORS INFLUENCING RESISTANCE TO GASTROINTESTINAL NEMATODES IN GOATS

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Abstract: The present work envisages the factors influencing resistance to gastrointestinal nematodes in goats and heritability of this resistance. Native goat breeds of Kerala (Southern state of India, Latitude: 10°00'N, Longitude: 76° 25' E) namely, Malabari and Attapady black goats and a group of Malabari crossbreds formed the material for study. Gastrointestinal nematodes (GIN) encountered during the study belonged to Strongyle and *Strongyloides* sp. The heritability estimate for Faecal Egg Count (FEC) was 0.39. Least-squares analysis was carried out to find out the effect of different factors on FEC. Sex, type of birth, age, season of sampling, birth weight and breed had no significant effect on FEC. Center had significant effect on FEC.
Keywords: Goat, gastrointestinal nematode, resistance, heritability, Malabari, Attapady black.

1. Introduction

Goat is a multi-functional animal and plays a significant role in the economy and nutrition of small and marginal farmers in India. One of the major problems faced by the farmers is the retarded growth in goats due to internal parasitism. Parasitic infection results in 26.57 per cent of total economic loss caused by all diseases in goats of Kerala, the southernstate of India. Among these, Strongyle infection (74 per cent) forms the major part (Animal disease surveillance scheme, 2006).

Current control methods focus on reducing the contamination of pastures through anthelmintic drug treatment and/or controlled/rotational grazing. The effectiveness of these methods are limited because of high costs of anthelmintics, increasing frequency of drug resistance and limited scope for controlled/rotational grazing in thickly populated areas. Thus it is the need of the hour to find an alternative method for controlling GINs in goats.

An attractive, sustainable solution to control worm burden is to select goats which are resistant to gastrointestinal nematodes producing genetically superior stock. The degree of

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resistance to GIN is usually assessed in terms of worm counts at necropsy or FEC. It is important to assess the genetic and nongenetic factors affecting FEC, to learn about the scope for genetic selection against nematodes in goats.

2. Materials and Methods

One hundred and fifty goats of three genetic groups namely-Malabari, Attapady Black and Malabari crossbreds formed the material for investigation. The centers selected for study were University Livestock Farm, Mannuthy and two field centers under All India Co-ordinated Research Project (AICRP) on goats, namely Tellichery in Kannur district (Centre 1) and Badagara in Kozhikode district (Centre 2) of Kerala, India. Faecal samples were collected directly from rectum to estimate FEC. It was measured at two different ages, namely, at one month and around one year. These animals were not dewormed before. FEC was assessed based on Modified McMaster Technique (Zajac and Conboy, 2006) with modifications to suit the McMaster counting chamber (J.A. Whitlock and Co., Australia) used.

FEC was logarithmically transformed (LFEC) as ln (FEC+2000) (Vanimisetti *et al*., 2004). To find out the effect of genetic and non-genetic factors on FEC, logarithmically transformed data were subjected to least-squares analysis (Harvey, 1966).

The model used was

$$Y_{ijklmnop} = \mu + S_i + E_j + Z_k + A_l + M_m + X_n + V_o + e_{ijklmnop} \quad (1)$$

where, $Y_{ijklmnop}$- Observation of p^{th} kid of i^{th} sex, j^{th} type of birth, k^{th} age, l^{th}season of sampling, m^{th} birth weight, n^{th} center, o^{th}breed.

μ- Overall mean, S_i - Effect of i^{th}sex (i = 1,2), E_j - Effect of j^{th}type of birth (j = 1,2,3)

Z_k - Effect of k^{th} age (k = 1,2), A_l- Effect of l^{th} season of sampling (l = 1,2,3)

M_m -Effect of m^{th} birth weight (m = 1,2,3), X_n -Effect of n^{th} center (n = 1,2,3)

V_o -Effect of o^{th}breed (o = 1,2,3), $e_{ijklmnop}$ – Random error

The random errors were assumed to be normally and independently distributed with mean $[E(e_i)]$ zero and variance σ^2_{ei}.

Duncan's multiple range test was used to compare means. After comparing, the least-squares means were back-transformed. After determining the confidence intervals for least square means according to the formula (Olsson, 2005) given below, those were also back-transformed.

$$\text{Lower or Upper limit of confidence interval} = \text{Mean} \pm (2.02 \times \text{Standard Error}) \quad (2)$$

The calculation of heritability for FEC was done by SPAB 2.0 (Statistical package for Animal Breeding (Sethi, 2002)). The data adjusted for the effect of non-genetic factors were used for the estimation of heritability. The minimum numbers of progeny to qualify for inclusion was assumed to be four per sire. Heritability was estimated by paternal half sib correlation method.

3. Results

GIN encountered during the present study belonged to Strongyle and *Strongyloides* sp. The FECs belonging to GIN species ranged from 0.00 to 16700 epg (eggs per gram) and average was 764.39 epg. Least-squares means according to sex, type of birth, age, season of sampling, birth weight, center, and breed with their confidence intervals, after back-transforming are presented in table 1. Sex, type of birth, age, season of sampling, birth weight and breed had no significant effect on FEC. Center had significant effect on FEC. University Goat & Sheep farm, Mannuthy recorded the least FEC. The heritability estimate for FEC was 0.39.

Table 1 Results of LSA of Genetic and Non-genetic Factors on FEC (Least square means expressed in epg with their confidence interval)

Effect	Mean FEC	Lower limit of Confidence interval	Upper limit of Confidence interval
Sex			
Female	722.40[a] *	218.00	1341.51
Male	807.03[a]	275.38	1462.89
Type of Birth			
Single	968.46[a]	358.77	1735.73
Twin	650.62[a]	127.19	1302.85
Triplet	684.84[a]	-126.67	1847.90
Age			
1 month	924.27[a]	323.68	1680.09
1 year	613.25[a]	86.23	1273.40
Season			
Winter	887.14[a]	64.02	2038.51
Summer	1008.02[a]	234.56	2049.19
Pre-monsoon	445.21[a]	15.61	966.38

Birth weight			
Low	763.31[a]	224.54	1432.59
Medium	717.15[a]	60.22	1583.54
High	813.55[a]	76.52	1812.18
Center			
Farm	51.42[a]	-281.08	448.24
Thalassery	1297.53[bd]	442.15	2452.51
Badagara	1122.87[cd]	304.09	2232.62
Breed			
Crossbred	507.95[a]	-41.97	1212.31
Malabari	545.69[a]	68.60	1132.81
Attapady Black	1308.82[a]	272.73	2817.24

*The categories of each effect differing among them are given different superscripts

4. Discussion

In this study FEC ranged between non-infective and highly infected levels. Animal is said to be moderately infected with nematodes if the unspeciated GIN count is between 1000 to 2000 epg (Kassai and Heinemann, 1999).

Least square analysis (LSA) revealed that sex, type of birth and birth weight of the kid had no significant effect on FEC. This result was comparable with the result obtained by Miller *et al.* (2006) in sheep. According to Kahn *et al.* (2003), Torres-Acosta *et al.* (2004), Hoste *et al.* (2005), Burke and Miller (2008), Arsenos *et al.* (2009) and McClure (2009), nutrition affected resistance to GIN in animals. The management conditions in the University farm assure adequate milk to all the kids either directly from dam or through pail feeding. Equal availability of nutrients to kids belonging to all birth type, sexes and birth weight, under similar environmental, management and climatic conditions might be the reason for non-significant effect of these factors. On the contrary Rege *et al.* (2002) and Khusro *et al.* (2004) found a significant effect of sex and type of birth on FEC. This effect of birth type on FEC might be due to the reason that these studies were done in large flocks where individual care for kids is not possible.

LSA revealed no significant effect of age on FEC. Rege *et al.* (2002), Mugambi *et al.* (2005) and Khusro *et al.* (2004) reported age related changes in FEC. In the present study the non-significant effect of age could be due to the reason that only two age groups were selected and faecal samples were collected before deworming in both the groups.

Season of sampling did not have any significant effect on FEC. Studies by Miller *et al.* (1998), Rege *et al*. (2002) and Mugambi *et al.* (2005) revealed a significant effect of season on FEC at different ages. The seasonal differences provide favorable or unfavorable environmental conditions for the survival and development of the parasite during each season. Though categorizations of seasons were made during the period of study, clearly defined demarcations between seasons could not be appreciated. During summer and pre-monsoon periods, Kerala encountered showers and temperature recorded during winter was not as low as North Indian states. This might be the reason for the non-significant effect of season on FEC.

Center had significant effect on FEC with University farm showing a least square mean of 51.42, Thalassery showing 1297.53 and Badagara 1122.87 epg. This statistically significant difference might be due to the improved health status of animals in the farm, which can be accounted to careful selection among breeding stock leading to better germplasm. This may also be attributed to the regional differences as they are located in three different districts of Kerala and due to the differences in the herd management and resources. This result was comparable with those obtained by Khusro *et al.* (2004), Pollott *et al*. (2004) and Good *et al.* (2006) in different sheep breeds.

The mean FEC did not vary between breeds, which was in accordance with the results of Costa *et al.* (2000) where FEC varied within goat breeds but not between goat breeds. Non-significant effect of breed might be due to the reason that Malabari bucks were used for breeding Malabari purebred and Malabari crossbred females and hence the level of Malabari inheritance in selected kids was more than 50 per cent in both the genetic groups. Also data regarding the third genetic group i.e., Attapady Black kids were relatively less in this study. This observation was in contrary to those by Bahirathan *et al.* (1996), Romjali *et al.* (1996), Mugambi *et al*. (1997), Miller *et al.* (1998), Rege *et al.* (2002), Baker *et al.* (2003) and Good *et al*. (2006) in different sheep breeds and by Baker *et al*. (2001) in Galla and Small East African goat breeds, where they found significant breed differences for FEC.

The heritability estimate for FEC was 0.39. Heritability estimate in the studies by Baker *et al.* (2001), Mandonnet *et al.*(2001), Gauly *et al.* (2002), Rege *et al.* (2002), Khusro *et al.* (2004), Vanimisetti *et al.* (2004) and Miller *et al.* (2006) were low to moderate. While the heritability observations by Rout and Chauhan (2004) and Miller and Horohov (2006) were moderate to high. Overall heritability estimates for FEC from various studies ranged between 0.14 and 0.63.

5. Conclusion

This study concludes that careful selection combined with proper management would result in reduction of gastrointestinal nematodes in goats. Moderate heritability estimate for FEC, denotes that there is significant genetic variation within the population for the trait, which makes selection for GIN resistance possible. Sex, type of birth, age, season of sampling, birth weight and breed had no significant effect on FEC. The study shows that though there is difference in weight at birth in kids, if similar nutrition and other management conditions were given, they do not show difference in parasite resistance status. Center had significant effect on FEC. The results on factors affecting FEC have shown that the FEC of goats under farm conditions was significantly lower than that under field conditions. This might be due to the improved immune status of the animal, which can be accounted to careful selection among breeding stock leading to better germplasm.

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