



Evaluation of Some Phenotypic Indicators of Gastrointestinal Nematode Resistance in Garole Sheep

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ABSTRACT

Background: Sheep resistant to gastrointestinal nematodes (GIN) is preliminary selected based on faecal egg count (FEC) and in the present study some important phenotypic markers including FEC were evaluated in Garole sheep.

Methods: FEC, FAMACHA score and body condition score (BCS) of sixty Garole sheep of Sundarban delta were evaluated at monthly interval for one year. Some haemato-biochemical parameters (Hb, PCV, eosinophil count, total protein) were also measured and compared between the preliminary resistant and susceptible sheep.

Result: Twenty Garole sheep showing persistently low FEC were considered as preliminary resistant sheep and forty sheep showing variable EPG were considered as preliminary susceptible sheep. FAMACHA score and BCS were ($P < 0.05$) higher in resistant sheep. All the haemato-biochemical parameters were also ($P < 0.05$) higher in resistant sheep. One resistant Garole sheep did not have higher value of other phenotypic markers except low FEC. Whereas, three susceptible sheep showed higher values of other phenotypic markers instead of high EPG. Hence other phenotypic indicators should also be considered along with FEC while selecting GIN resistant and susceptible sheep.

Key words: Garole sheep, Gastrointestinal nematodes, Host resistance, Phenotypic indicators.

INTRODUCTION

Gastrointestinal nematode (GIN) infections cause severe production losses in small ruminants, particularly in sheep, worldwide. Many sheep breeds showed resistance to GIN infection and thus breeding of sheep for GIN resistance could be feasible (Bishop, 2012). Successful selection of resistant animals is an optional worm control strategy that can cope with anthelmintic resistance (Cunha *et al.*, 2024). However, a major problem with this approach is: how can resistant sheep be selected? (Gray *et al.*, 1992). The number, size and reproductive capacity of the parasites in the abomasum or small intestine of host, as well as faecal egg count (FEC), haemoglobin (Hb), packed cell volume (PCV), eosinophilia, levels of immunoglobulins (Ig), dag score and FAMACHA score are all indicators of resistance (Bishop, 2012; Bell *et al.*, 2019). Selection of Resistant sheep relies largely on the use of FEC (Karrow *et al.*, 2014). Under ideal circumstances, selection of sheep based on both FEC and PCV along with other phenotypic indicators are desirable (Vanimisetti *et al.*, 2004). Garole sheep of West Bengal showed resistance to GIN infection based on FEC (Brahma *et al.*, 2022). This study was conducted to identify resistant Garole sheep based on different clinico-parasitological and haemato-biochemical parameters as phenotypic indicators of GIN resistance.

MATERIALS AND METHODS

Based on phenotypic traits, 60 female Garole sheep, aged 3 to 6 months, were identified from the three villages of Sundarban delta of South 24 Parganas district in West Bengal, India. Garole sheep in those villages were reared

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by small and marginal farmers in a unit of 2-6 animals by semi-intensive system without routine deworming.

Over the course of one year (March 2023 to February 2024), FEC by modified McMaster technique (Soulsby, 1982), FAMACHA score by comparing the conjunctival colour of sheep using a FAMACHA chart (Kaplan *et al.*, 2004) and body condition score (BCS) were studied as per the procedure described by Russel (1984) and Phythian *et al.* (2012), with minor modifications for local adaptability for all the selected sheep. Based on FEC, FAMACHA and BCS for nine months the Garole sheep were classified as preliminary resistant (mean EPG <100) and susceptible (mean EPG >500).

Haemoglobin concentration, PCV% (Jain, 1993), peripheral blood eosinophil count (Dawkins *et al.*, 1989) and total plasma protein (TP; gm/dl) using a commercial kit, were estimated and compared between resistant ($n = 20$) and susceptible animals ($n = 20$) monthly for the last 3 months of the study.

All the parameters for each group on different post infection days were compared by Analyse-Compare means. The significance (P value) was recorded at 5% ($P < 0.05$) level and 1% ($P < 0.01$) level by separate analysis of parameters (between post-infection days) using Duncan method (One-way- ANOVA). The complete statistical analyses were done with the help of Statistical Package for Social Scientist (SPSS), Windows Version 22.0.

RESULTS AND DISCUSSION

The EPG data generally exhibits a skewed distribution and therefore it was log transformed to normalize the data. Out of 60 sheep, persistently low FEC were observed in twenty

(20) Garole sheep with monthly mean $\log_{10}$ EPG varying from 1.73 to 1.96 and those sheep were considered as preliminary resistant sheep (Fig 1). While in rest 40 Garole sheep, FEC value was not persistent during the study period and monthly mean $\log_{10}$ EPG were ranging from 2.57 to 2.88 and those animals were considered as preliminary susceptible sheep (Fig 1). The mean FEC of preliminary resistant sheep was significantly ($P < 0.05$) lower compared to preliminary susceptible sheep during the entire study period (Fig 1).

Faecal egg count (FEC) is the most important and widely accepted phenotypic indicator of host resistance against GI nematodes. In the present study, twenty out of 60 sheep demonstrated resistance to GIN infection based on FEC. Many authors reported about the heritability of FEC ranging from 0.12 to 0.44 (Miller and Horohov, 2006) indicating that based on low FEC, selection of animals could be possible.

Haemonchus contortus is the predominant nematode parasite in small ruminants in West Bengal, India (Jas *et al.* 2017)

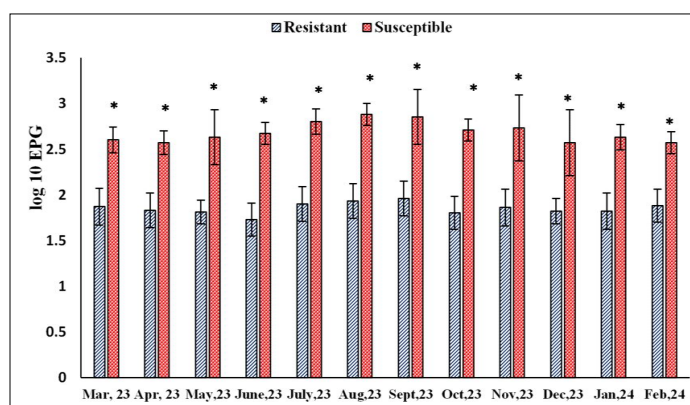


Fig 1: Monthly faecal egg count of resistant and susceptible Garole sheep.

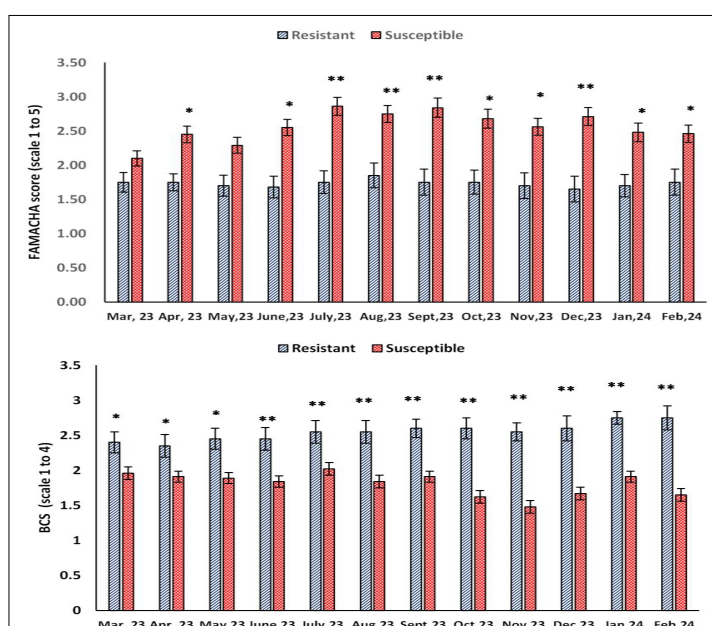


Fig 2: Monthly FAMACHA and body condition score of resistant and susceptible Garole sheep.

and therefore, FAMACHA score was evaluated along with FEC. Mean FAMACHA score (1.73) of resistant animals was significantly ($P < 0.05$) lower than the susceptible sheep (2.56) in the present study (Fig 2).

Resistant Garole sheep showed significantly ($P < 0.05$) higher body condition score (2.55) compared to susceptible sheep (1.81) (Fig 2). Gastrointestinal nematode infection is responsible for reduced weight gain in young animal and also causes reduction in body weight in adult animals (Jas and Ghosh 2009) and thus causing lower BCS in infected animals as observed in susceptible sheep of the present study. Therefore, FAMACHA score and BCS should be utilized to select resistant individuals along with FEC as non-invasive phenotypic indicators of host resistance.

Haemoglobin concentration (11.30 gm/dl) and PCV% (31.51%) of resistant sheep was significantly ($P < 0.05$) higher than the susceptible Garole (Hb - 9.52 gm/dl and PCV - 26.71%) during all the three occasions (Fig 3).

Peripheral blood eosinophils count (91.33 per μ l blood) and total plasma protein concentration (6.32 gm/dl) were significantly ($P < 0.05$) higher in resistant sheep compared to the peripheral eosinophil (37.49 per μ l blood) and total protein (5.76 gm/dl) content of susceptible sheep (Fig 4).

Out of twenty preliminary resistant sheep one sheep failed to maintain all the health parameters of resistance, as it had lower PCV, Hb and total protein. Thus, based on FEC, selection of resistant sheep was found to be 95% accurate in the present study. Meanwhile, among the 20 susceptible Garole sheep, four (4) sheep were found to maintain good production traits, such as BCS (3 or more), FAMACHA

(between 1 and 2), Hb (above 11.00) and PCV (above 32%), despite having high FEC (mean EPG > 500). Therefore, those four Garole sheep may be considered resilient. Although FEC can successfully select resistant and susceptible sheep, but other haematological and production parameters can be useful to identify resilient sheep, accounting for 20% (4 out of 20) among susceptible sheep in the present study.

For host resistance and / resilience against *H. contortus*, PCV is an important phenotypic marker and PCV has been shown as a heritable character for host resistance against *H. contortus* (Vanimisetti *et al.*, 2004). In the present study, significantly ($P < 0.05$) reduced value of Hb and PCV% was observed in susceptible sheep having comparatively higher level of infection compared to the resistant sheep.

Increased number of eosinophils locally or in the peripheral circulation have been reported to be correlated with host resistance against GIN infection (Shin *et al.*, 2009) and it is also considered as an important phenotypic marker of host resistance against GIN (Ortolani *et al.*, 2013). Significantly ($P < 0.05$) higher peripheral eosinophils count was also observed in resistant Garole sheep during the last three months of study period. Thus, the haematological parameters such as Hb, PCV and peripheral eosinophils count could be utilized as phenotypic marker for host resistance in Garole sheep.

Hypoproteinaemia due to reduced plasma protein concentration is a common clinical pathology in GI nematodosis in small ruminants due to continuous draining

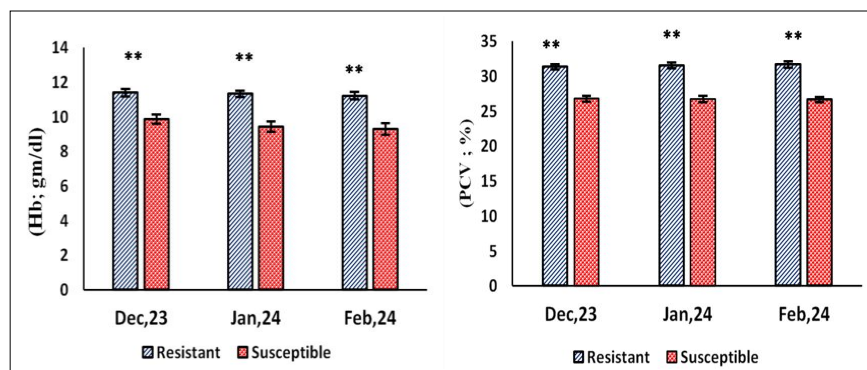


Fig 3: Mean haemoglobin and packed cell volume of resistant and susceptible Garole sheep.

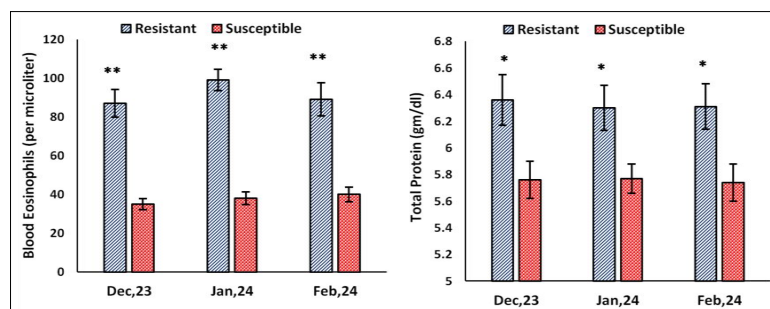


Fig 4: Peripheral eosinophils count and serum protein concentration of resistant and susceptible Garole sheep.

of plasma protein through the damaged GI tract (Soulsby, 1982). Plasma protein concentration was found to be significantly ($P<0.05$) higher in resistant sheep compared to susceptible sheep in the present study. Hence serum protein concentration can be considered as a valuable indicator of host resilience and / resistance against GIN infection in sheep.

CONCLUSION

Results of the present study indicated that, along with FEC, clinical parameters such as FAMACHA score and BCS and haemato-biochemical parameters should also be considered as phenotypic indicators for selection of resistant sheep.

Conflict of interest

The authors declare that there is no conflict of interest.

REFERENCES

- Bell, A., McNally, J., Smith, D.V., Rahman, A., Hunt, P., Kotze, A.C., Dominik, S., Ingham, A. (2019). Quantification of differences in resistance to gastrointestinal nematode infections in sheep using a multivariate blood parameter. *Veterinary Parasitology*. **270**: 31-39.
- Bishop, S.C. (2012). Possibilities to breed for resistance to nematode parasite infections in small ruminants in tropical production systems. *Animal*. **6**(5): 741-747.
- Brahma, A., De, T., Jas, R., Baidya, S., Pandit, S., Mandal, S.C., Kumar, D., Rai, S. (2022). Within breed resistance to naturally occurring gastrointestinal nematodosis in Garole sheep of West Bengal, India. *Indian Journal of Animal Research*. doi: 10.18805/IJAR.B-4936.
- Cunha, S.M.F., Willoughby, O., Schenkel, F., Cánovas, Á. (2024). Genetic parameter estimation and selection for resistance to gastrointestinal nematode parasites in sheep-a review. *Animals (Basel)*. **14**(4): 613. doi: 10.3390/ani14040613.
- Dawkins, H.J.S., Windon, R.G., Eagleson, G.K. (1989). Eosinophil responses in selected sheep for high and low responsiveness to *Trichostrongylus colubriformis*. *International Journal for Parasitology*. **19**(2): 199-205.
- Gray, G.D., Barger, I.A., Jambre, L.F. Le., Douch, P.G.C. (1992). Parasitological and immunological responses of genetically resistant Merino sheep on pastures contaminated with parasitic nematodes. *International Journal for Parasitology*. **22**(4): 417-425.
- Jain, N.C. (1993). *Essentials of Veterinary Hematology*. Lea and Febiger, Philadelphia. 76-250.
- Jas, R. and Ghosh, J.D. (2009). Economic impact of gastrointestinal nematodosis in sheep: enhanced meat production by anthelmintic treatment. *Indian Journal of Animal Sciences*. **79**(8): 3-5.
- Jas, R., Kumar, D., Bhandari, A., Pandit, S. (2017). Seasonal alteration in prevalence and intensity of naturally occurring gastrointestinal helminth infection in goats of New Alluvial zone of West Bengal, India. *Biological Rhythm Research*. **48**(6): 867-876.
- Kaplan, R.M., Burke, J.M., Terrill, T.H., Miller, J.E., Getz, W.R., Mobini, S., Valencia, E., Williams, M.J., Williamson, L.H., Larsen, M., Vatta, A.F. (2004). Validation of the FAMACHA® eye color chart for detecting clinical anemia in sheep and goats on farms in the southern United States. *Veterinary Parasitology*. **123**(1-2): 105-120.
- Karrow, N.A., Goliboski, K., Stonos, N., Schenkel, F., Peregrine, A. (2014). Review Genetics of helminth resistance in sheep. *Canadian Journal of Animal Science*. **94**(1): 1-9.
- Miller, J.E. and Horohov, D.W. (2006). Immunological aspects of nematode parasite control in sheep. *Journal of Animal Science*. **84**: 124 -132.
- Ortolani, E.L., do Rêgo Leal, M.L., Minervino, A.H.H., Aires, A.R., Coop, R.L., Jackson, F., Suttle, N.F. (2013). Effects of parasitism on cellular immune response in sheep experimentally infected with *Haemonchus contortus*. *Veterinary Parasitology*. **196**(1-2): 230-234.
- Phythian, C.J., Hughes, D., Michalopoulou, E., Cripps, P.J., Duncan, J.S. (2012). Reliability of body condition scoring of sheep for cross-farm assessments. *Small Ruminant Research*. **104**: 156-162.
- Russel, A. (1984). Body condition scoring of sheep. *In Practice*. **6**: 91-93.
- Shin M.H., Lee Y.A., Min D.Y. (2009). Eosinophil-mediated tissue inflammatory responses in helminth infection. *Korean Journal of Parasitology*. **47**: 125-131.
- Soulsby E.J.L. (1982). *Helminths, Arthropods And Protozoa Of Domesticated Animals*, 7th Edn. The English Language Book Society And Bailliere, Tindall.
- Vanimisetti, H.B. andre, S.L., Zajac, A.M., Notter D.R. (2004). Inheritance of fecal egg count and packed cell volume and their relationship with production traits in sheep infected with *Haemonchus contortus*. *Journal of Animal Science*. **82**: 1602-1611.