Proc. 3rd All Africa Conf.Anim.Agric.& 11th Conf. Egyptian Soc. Anim. Prod., Alexandria, Egypt,6-9 November 2000: 401-405

INFLUENCE OF BREED AND PROTEIN SUPPLEMENT ON RESISTANCE OF SMALL EAST AFRICAN GOATS TO GASTROINTESTINAL NEMATODES

A. A. Gimbi[1], A. E. Kimambo[1], A. A. Kassuku[2], A. E. Pereka[3] and L.A. Mtenga[1]

1- Department of Animal Science and Production, Sokoine University of Agriculture, P.O Box 3004 Morogoro, Tanzania, 2-Department of Veterinary Microbiology and Parasitology, Sokoine University of Agriculture, P.O. Box 3019 Morogoro, Tanzania, 3-Department of Veterinary Physiology, Pharmacology, Biochemistry and Toxicology, Sokoine University of Agriculture, P.O.Box 3017 Morogoro, Tanzania

SUMMARY

Effect of protein supplementation on resistance of Small East African (SEA) goat types against natural gastrointestinal nematode infestaion was studied in Morogoro, Tanzania. Ninety (90) pregnant does from Dodoma, Kigoma and Mtwara regions were used in a 3x3 factorial experiment lasting for 5 months. The factors evaluated were three goat group types (Mtwara, Dodoma and Kigoma,) and three-protein level supplement (high protein supplement HPS, medium protein supplement MPS and low protein supplement LPS). All goat group types were grazing and every group was divided into three sub-groups. Each of the subgroups received one of the three levels of protein supplement. Faecal samples for parasitic egg count (FEC) and blood samples for determination of packed cell volume (PCV), eosinophil (EOS) counts, total serum proteins (TSP) and total serum immunoglobulins (TSI) were collected monthly. Live body weight (LBW) was taken fortnightly for all the experimental goats.

Significant variations were observed in PCV ($P<0.01$), TSP ($P<0.05$), TSI (0.01), logarithm transformed eosinophil counts (LEOS) ($P<0.01$) and LBW ($P<0.001$) among the goat types where Mtwara goat type had the highest TSP, TSI, EOS counts and LBW while Dodoma goat type had the lowest TSP, TSI and EOS counts. The Kigoma goat type was in between the two for TSP, TSI and EOS. No significant differences were observed in FEC. The goats on different protein supplement levels showed no significant variation in all the parameters measured except LBW ($P<0.001$) although the MPS had the highest TSI, TSP and LEOS.

Where the Trichostrongylus spp dominates, Mtwara group could be the most resistant and Dodoma the least resistant. Regarding the superiority of the MPS for LEOS, TSI and TSP, it is suggested that, this level of protein supplement could be the optimal level for improvement of the goats' resistance against GIT nematodes. It could, therefore be concluded that probably there is variation among the SEA goat groups for resistance against the gastrointestinal nematodes.

Keywords: Protein, African goats, gastrointestinal nematodes

INTRODUCTION

Goats in Tanzania play an important role in human nutrition and contribute to the income of a substantial human population especially small holders and pastoralists. The population of goats in Tanzania was estimated to be 9.7 million in 1995 (FAO, 1995). Majority of the goats in Tanzania consists of indigenous Small East African (SEA) goats.

Despite it's importance, the productivity of the SEA breed of goats is low and some of the constraints which contribute to the low productivity are diseases, poor nutrition, poor quality breeds and poor management (Kusiluka, 1995). It is becoming increasingly apparent that diseases and helminths infection in particular, play a significant role in losses in livestock productivity (Anon, 1991). There is growing evidence which suggests that animal production can be increased by improvement of local breeds, which are adapted to an area, readily available to a particular locality and already accepted by the local livestock keepers. The improvement can be achieved by improvement of nutrition among other environmental factors (WILRTS, 1977).

Dodoma, Kigoma and Mtwara goat types are three groups of the SEA goats that are found in different zones of Tanzania. Research involving physical (Madubi, 1997) and genetic (Challya, 1998) characterisation as well as genetic resistance to gastrointestinal nematodes (Keyyu, 1998) has been carried out on these three groups of goats. There is scant information on the effect of protein supplement on resistance of SEA goats to gastrointestinal nematodes. This study was conducted as a component of ongoing research at our university to evaluate the influence of improved nutrition (protein supplementation) on health parameters, particularly resistance to gastrointestinal nematodes in SEA goats.

MATERIALS AND METHODS

Source and management of animals

Does used in the study were the SEA type of goats from Dodoma, Kigoma, and Mtwara regions of Tanzania. Does were housed in a building with iron sheet roof and concrete floor. They grazed from 8:00 to 16:00 hrs. on contaminated communal SUA pastures. The grazing period consisted of a break (12:30-14:00hrs) when they were brought back to the house for water, supplement feeding and resting. All goats were drenched 10 days prior to commencement of experiment using 1.5%w/v Levamisole + Oxyclosanide (Milsan®, Interchem Pharma Ltd, Moshi Tanzania). Animals found to have reached FEC above 3000epg and/or PCV less than 18% were treated at any sampling day. The goats were sprayed with an acaricide, (Steladone® 300 EC), fortnightly for control of ectoparasites.

Experimental design and treatments

The study was carried out for 5 months using ninety (90) goats in a 3x3 factorial experiment. The factors were goat type and protein supplement. The goat types were the Dodoma, Kigoma and Mtwara types while the protein supplement levels were HPS, MPS and LPS. The feed supplement consisted of a mixture of hominy meal (HM), cotton seed cake (CSC) and minerals. The MPS was made to meet approximately the daily CP requirement for maintenance plus medium activity i.e. 33g CP and 55g CP for goats weighing 10kg and 20kg respectively (National Research Council, 1981). The HPS and LPS were obtained arbitrarily by either addition or subtraction of 40g from the MPS. A constant amount of 150g/day HM was added in the supplement diet. The mineral and vitamin mixture was added at the rate of 1% of the total supplement fed per animal per day.

Samples and parameters measured

Samples were collected monthly and consisted of faecal samples for determination of FEC and faecal cultures. Blood samples were collected for determination of PCV, EOS, TSP and TSI. Individual body weights were taken fortnightly.

The FEC was determined as number of eggs per gram (epg) using the modified McMaster method (MAFF, 1986). PCV was determined using the haematocrit centrifuge technique as described by MacLeod *et al.* (1981). EOS counts (cells/ml) were determined by mixing 100μl of blood with 900μl of Carpentier's eosinophil staining solution and cells counted on Fuch's Rosenthal counting chamber (Dawkins *et al.*, 1989). TSP was determined by refractometer method (Atago SPR-T2 refractometer) while TSI were determined by turbidimetric method using Zinc sulphate (McEwan *et al.*, 1970).

Statistical analysis

All sets of data were analysed using SAS System for Windows 3.95, Release 6.08 (Copyright ©, 1991, 1992 SAS Institute Inc. Cary, N. C. 27513, U. S. A.). The general linear model procedure was applied and corrections made for initial observations by incorporating a covariant of measurements taken before the start of the experiment in the analysis of variance. The data for FEC and EOS were transformed to their logarithmic form before they were analysed (LFEC and LEOS).

RESULTS

Haematological parameters, faecal parasite egg counts and live body weights

Effect of goat group types on PCV, TSP, TSI EOS counts, FEC and LBW are shown in table 1. The Dodoma goat type had the highest PCV while Mtwara and Kigoma goat type had the middle and lowest PCV respectively. There was a significant difference in mean PCV among the goat group types ($P<0.01$). Significant differences in TSP ($P< 0.05$) and TSI ($P<0.01$), among the goat group types were observed where Mtwara and Dodoma goat types had the highest and lowest means respectively, while Kigoma goats was in the middle. Goat variations were also significant for LEOS ($P<0.01$) and LBW ($P<0.001$) with Mtwara goats showing the highest mean while Kigoma and Dodoma goats had the middle and lowest means respectively. The differences observed among the goat group types for FEC were not significant ($P>0.05$) but Mtwara and Dodoma goats had higher means than Kigoma goats.

Table 1. Least square means (LSMs) by goat group types for PCV, TSP, TSI, LEOS, LFEC and LBWT in does

Parameter	Goat group type			P-value
	Dodoma	Kigoma	Mtwara	
PCV(%)	25.51 ± 0.26[a]	24.17 ± 0.25[b]	24.65 ± 0.26[b]	* *
TSP (g/100ml)	7.66 ± 0.08[b]	7.80 ± 0.07[ab]	7.96 ± 0.08[a]	*
TSI (ZST Units)	20.39 ± 0.19[b]	20.86 ± 0.18[ab]	21.38 ± 0.19[a]	* *
LEOS	1.61 ± 0.03[b]	1.63 ± 0.03[b]	1.76 ± 0.03[a]	* *
LFEC	2.41 ± 0.04	2.38 ± 0.04	2.41 ± 0.04	ns
LBWT (kg)	25.99 ± 0.07[b]	25.93 ± 0.07[b]	26.45 ± 0.07[a]	* * *

Means with different superscripts within each row are significantly different (P<0.05)

Table 2 shows the effect of protein supplementation levels on PCV, TSP, TSI EOS counts, FEC and LBWT. The observed differences in all the parameters were not significant (P> 0.05) except for LBWT (P<0.001) where the highest, middle and lowest means were observed for LPS, HPS and MPS respectively. The PCV and TSP values were highest, lowest and middle in MPS, HPS and LPS respectively.

Does receiving MPS, HPS and LPS had the highest, middle and lowest mean TSI respectively. Whilst does supplemented with MPS and LPS had the same mean LEOS value and were higher than the HPS. The FEC were highest, middle and lowest in MPS, LPS and HPS respectively.

Table 2. Least square means (LSMs) by protein supplement levels for PCV TSP, TSI, LEOS, LFEC and LBWT in does

Parameter	Protein supplement level			P-value
	HPS	MPS	LPS	
PCV (%)	24.62 ± 0.24	25.01 ± 0.26	24.71 ± 0.25	ns
TSP (g/100ml)	7.75 ± 0.07	7.86 ± 0.07	7.81 ± 0.07	ns
TSI (ZST Units)	20.91 ± 0.18	21.00 ± 0.18	20.72 ± 0.18	ns
LEOS	1.66 ± 0.03	1.67 ± 0.03	1.67 ± 0.03	ns
LFEC	2.35 ± 0.04	2.41 ± 0.04	2.37 ± 0.04	ns
LBW(kg)	26.07 ± 0.07[b]	25.94 ± 0.07[b]	26.36 ± 0.07[a]	* * *

Means with different superscripts within each row are significantly different (P<0.05)

Anthelmintic treatment and nematode species

26% of Kigoma goats and 6.7%, 10% and 10% of does receiving HPS, MPS and LPS were drenched because PCV were less than 18% and/or FEC greater than 3000 but none of Mtwara and Dodoma reached the critical values. *Trichostrogylus* and *Oesophagostomum* were the most dominant and least dominant species in faeces respectively, while the *Haemonchus spp* was in between the two.

DISCUSSION

Animals that are able to maintain high PCV and lower FEC during gastrointestinal nematode infestations where *H. contortus* is dominant have been considered more resistant to worm infestation than other animals. (Wanyangu *et al.*, 1997; Mugambi *et al.*, 1997). The Dodoma goats showed the highest PCV of all the goat group types but this was not accompanied by lowest FEC. This could be due to *Trichostrogylus spp* rather than *Haemonchus spp* being dominant in this case. The dominance of *Trichostrogylus* in the current study however is in contrast to findings by Keyyu (1998) and Mwenda (1997) who observed higher percentages of *Haemonchus spp* than *Trichostrongylus spp* in Morogoro.

The variation in dominant nematode species might be caused in part by seasonal variation that is sometimes accompanied by succession of parasite species (Morgan *et al.*, 1951)

It has been suggested that in combination with other factors, eosinophils play a role in expulsion of many intestinal helminth parasites (Kamiya *et al.*, 1985; Huntley *et al.*, 1987). Hence, the highest EOS counts in addition to highest TSI for Mtwara goats could indicate greater resistance than Kigoma and Dodoma goats groups against the gastrointestinal nematodes.

The highest LBW in Mtwara goats could be an indication of production superiority of the group compared to the others. The supremacy of Mtwara goat group type could be further substantiated by the highest TSP, TSI, and LEOS observed in this group.

The MPS and HPS supplement groups unexpectedly had the highest and lowest mean TSP while the LPS was in the middle. The observed trend could be due to unknown nutritional and/ or immunological effects of the feed consumed during grazing. It is also speculated that the levels of protein supplement used in this study, could perhaps have not been varying enough to exert the expected different nutrtional effects in goats.

Variable responses in TSI to protein supplementation levels have been reported in previous studies. Van Houtert *et al.* (1995) supplemented 50 or 100g fish meal per day to lambs infected with *T. colubriformis,* and like the present study, the immunoglobulins levels were not significantly affected by protein supplementation. These findings are, however, in contrast to findings in a study on fish meal supplementation in *N. battus* infected lambs in which there was an enhancement of serum IgG titres (Israf *et al.*, 1996). Hence the highest mean TSI for MPS in the present study could be of some importance as an indicator of best resistance among the different protein supplement groups.

Conflicting results have been reported for response of FEC to protein supplement levels. In a study where lambs were artificially infected (mixed infection of *H. contortus, O. columbianum, T. colubriformis* and *Strongyloides spp*) and fed 18gCP or 36gCP per day, the lambs supplemented with higher protein had higher FEC than the low supplemented group at weeks 2, 6 and 8 post infection (Abebe, 1998). Similarly higher FEC and worm burden were reported in lambs fed 170g CP/kg DM than those fed 88g CP/kg DM at 5 and 14 weeks after artificial infection with *H. contortus* (Abbot *et al.*, 1985). Taking into account only the MPS and LPS, the findings in the present study are in agreement with other studies in having higher FEC for higher protein supplement levels. In case for goats on HPS, the findings in the present study, give a picture contrary to other studies. This could be due to variation between studies in factors that are known to affect faecal parasite egg count such as type and level of nutrition, age, sex, physiological status and prior exposure of the animals to the gastrointestinal nematode parasites. The parasite species and the relative proportions involved could also contribute in variation between studies.

It has been established that gastrointestinal parasitism can impair among other aetiological factors live weight gain (Coop and Holmes, 1996). The lowest mean LBW in the MPS could be a result of high infection level as indicated by the highest LFEC. Moreover, the same group of animals had the largest percentage of animals de-wormed when PCV and/or FEC reached critical values.

CONCLUSION

There is probably a significant variation in worm resistance among the goat types in the present study indicating that selection for resistance to worms can be attempted. MPS had higher but insignificant values in most parameters studied. One could speculate that differences in protein levels in the supplement were not adequate to demonstrate adequately the effect of supplementation on these parameters. Furthermore the effect of energy in these diets was not adequately analysed. This is an area which needs further studies.

REFERENCES

Abbot E.M., J.J. Parkins and Holmes, 1985. Influence of dietary protein on parasite establishment and pathogenesis on Finn Dorset and Blackface lambs given a single moderate infection of *H. Contortus. Research in Veterinary Science.* 38, 6-13.

Abebe A.W., 1998. Effect of plane of nutrition on performance of lambs infected with gastrointestinal nematodes. MSc. dissertation. Sokoine University of Agriculture. Tanzania

Anon, 1991. *Report of the FAO Expert Consultation on the Helminth Infections of Livestock in Developing Countries.* Rome, 23-27 September,. FAO. Rome, AGA-815, pp 32.

Challya J.N., 1998. Physical and genetic characterisation of three strains of goats in Tanzania. MSc. dissertation. Sokoine University of Agriculture. Tanzania.

Coop R.L. and P.H. Holmes, 1996. Nutrition and parasite interactions. *International Journal for Parasitology.* 26, 951-962.

Dawkins H.J.S., R.G. Windon and G.K. Eagleson, 1989. Eosinophil response in sheep selected for high or low responsiveness to T.colubriformis. *International Journal for Parasitology* 19, 199-205.

FAO, 1995. FAO Production Yearbook. Vol. 49, pp 192

Huntley J.F., S. Gibson, D. Brown, W. D. Smith, F. Jackson and H.R.P. Miller, 1987. Systematic release of mast cell proteinase following nematode infections in sheep. *Parasite Immunology.* 9, 603-614.

Israf, D. A., Coop, R. L., Stevenson, L. M., Jones, D. G., Jackson, F., Jackson, E., MacKellar, A. and Huntley, J. F. 1996. Dietary protein influences upon immunity to *Nematodirus battus* infection in lambs. *Veterinary Parasitology.* 61, 273-286.

Keyyu, J.D., 1998. Genetic resistance of small East African goats to gastrointestinal nematode parasites. MSc. dissertation. Sokoine University of Agriculture, Tanzania.

Kusiluka, L.J.M., 1995. Management Systems and Health Problems of Goats in Morogoro District. MPhil thesis, Edinburgh, UK.

MacLeod W.G., A.C. Rowland and M.M.H. Sewell, 1981. *Handbook on Tropical Veterinary Diagnosis*. Section 2. General techniques. Centre for Tropical Veterinary Medicine, University of Edinburg, UK.

Madubi, M.A., 1997. Physical characterisation of three strains of Small East African goats in Tanzania. MSc. dissertation. Sokoine University of Agriculture, Morogoro.

MAFF, 1986. Ministry of Agriculture, Fisheries and Food. *Manual of Parasitological Laboratory Techniques*. Reference book no.418, 3rd edition. Her Majesty's Stationary Office, London. pp 160.

McEwan, A. D., E. W. Fisher and I. E. Selman, 1970. Observations on the immune globulin levels of neonatal calves and their relationship to disease. *Journal of Comparative Pathology*. 80, 259-265.

Morgan, D. O., Parnell, I. W. and Rayski, C. (1951) The seasonal variation in the worm burdens of Scottish hill sheep. *Journal of Helminthology*. 25, 177-212.

Mugambi, J. M., Bain,R.K., Wanyangu, S. W., Ihiga, J. L., Duncan, J. L., Murray, M. and Stear, M J. 1997. Resistance of four sheep breeds to natural and subsequent artificial *Haemonchus contortus* infection. *Veterinary Parasitology*. 69, 265-273.

Mwenda, G.E., 1997. Estimation of intake of gastrointestinal parasitic helminth larvae from pasture using oesophagus fistulated goats. BSc. special project. Sokoine University of Agriculture, Tanzania.

National Research Council, 1981. Nutrient Requirements of Goats: Angora, Dairy, and Meat goats in temperate and tropical countries. No. 15. National Academy Press, Washington, D.C.

Van Houtert, Barger, I. A. and Steel, J. W., 1995. Effects of dietary protein on the response of young sheep to infection with *T. colubriformis*. *Veterinary Parasitology* 56, 163-180.

Wanyangu, S. W., Mugambi, J. M., Bain, R. K., Duncan, J. L., Murray, M. and Stear, M. J. 1997. Response to artificial and subsequent natural infection with *Haemonchus contortus* in Red Maasai and Dorper ewes. *Veterinary Parasitology*. 69, 275-282.

WILRTS, 1977. *The role of sheep and goats in agricultural development*. Winrock International Livestock Research and Training Centre. Winrock. pp 29.