RESEARCH COMMUNICATION

A comparison of serum biochemical changes in two breeds of sheep (Red Masai and Dorper) experimentally infected with *Fasciola Gigantica*

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ABSTRACT

WAWERU, J.G., KANYARI, P.W.N., MWANGI, D.M., NGATIA, T.A. & NANSEN, P. 1999. A Comparison of serum biochemical changes in two breeds of sheep (Red Masai and Dorper) experimentally infected with *Fasciola gigantica*. *Onderstepoort Journal of Veterinary Research*, 66:47–49

Twelve Red Masai and 12 Dorper sheep aged between 6 and 9 months, were acquired from a fluke-free area and sheep of each breed divided into two equal groups of six. Each animal in one group of each breed was experimentally infected with 400 viable metacercariae of *Fasciola gigantica*. The other groups acted as uninfected controls. Blood samples were taken at weekly intervals for the determination of serum bilirubin, albumin, and gamma glutamyl transferase levels. Following the establishment of infection, albumin levels declined in both breeds of infected animals without any significant difference between the two breeds. However, serum bilirubin and gamma glutamyl transferase (GGT) in the infected animals were elevated significantly more in the Dorper than in the Red Masai sheep. Based on these findings, it would appear that Dorper sheep are more susceptible to the infection than Red Masai sheep.

Keywords: Dorper, *Fasciola gigantica*, Red Masai, serum biochemical changes

INTRODUCTION

Fasciolosis is an important cosmopolitan disease of certain herbivorous domestic and wild animals caused by the trematode worms *Fasciola hepatica* and *Fasciola gigantica*. The mammalian hosts are infected by ingesting encysted metacercariae which then invade and develop in the livers of their hosts to cause great losses due to deaths, reduction in production and reproductive efficiencies, and condemnation in abattoirs of the livers as being unfit for human consumption (Ngategize, Bekele & Tilahun 1993).

Genetic resistance to fasciolosis measured by faecal egg outputs and percentage infection rate by metacercariae has previously been studied in several breeds of sheep (Boyce, Courtney & Loggius 1987; Wiedosari & Copeman 1990). The report of Boyce *et al.* (1987) concerned *F. hepatica* while that of Wiedosari & Copeman (1990) involved *F. gigantica*. Boyce *et al.* (1987) pointed out the possible usefulness of such resistant breeds in the control of the deleterious effects of this disease by selectively breeding for resistance.

Genetic resistance against gastrointestinal nematode helminths is relatively better documented as compared to that against fasciolosis. In East Africa, Preston & Allonby (1978; 1979) have reported on genetic superiority of Red Masai sheep when compared to that of Dorper sheep in resistance to haemonchosis.

Changes in the blood of animals suffering from fasciolosis include anaemia, bilirubinaemia, hypoalbuminaemia and elevation of serum liver enzyme levels (Dargie 1973; Coles 1986).

Hypoalbuminaemia is attributable to the loss of plasma protein via both the blood sucking activity of the

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Accepted for publication 2 December 1998—Editor

adult flukes and leakage through the hyperplastic biliary mucosa (Dargie & Berry 1979). The relationship between fluke burden and gamma glutamyl transferase (GGT) levels in serum has been demonstrated by Wyckoff & Bradley (1985) and Wiedosari & Copeman (1990). Since the degrees of these biochemical disturbances are dependent on the number of flukes resident in the liver they can be used as indicators of susceptibility of different animals to fasciolosis. This study was carried out to compare the serum levels of bilirubin, albumin and GGT in Red Masai and Dorper breeds of sheep experimentally infected with metacercariae of *Fasciola gigantica*.

MATERIALS AND METHODS

Twelve Red Masai and 12 Dorper sheep aged between 6 and 9 months were acquired from a fluke-free region in the Eastern Province of Kenya and their fluke-free status confirmed by examination of their faeces for the eggs of this trematode. The animals in each breed were then divided randomly into two groups of six sheep each.

One group of each breed was orally infected with 400 viable metacercariae of *F. gigantica* in gelatin capsules (Experimental group). The metacercariae had been raised in the laboratory by infecting *Lymnaea natalensis* snails with *F. gigantica* miracidia hatched from eggs obtained from the livers of infected animals collected at local abattoirs. The sheep in the other two groups served as uninfected controls.

During the study period of 18 weeks, the animals were bled on a weekly basis for serum preparation which was then stored at –20 °C until analyzed. Albumin and bilirubin serum levels were determined using the Biuret (Coles 1986) and Powell (Coles 1986) methods respectively. The levels of GGT were determined using Boehringer Mannheim calorimetric kits every 2 weeks while parameters for the other two were obtained weekly. The results of these parameters that were obtained for each animal were averaged on a group and weekly or fortnightly basis and were then compared between the breeds and groups.

RESULTS

In both infected and control animals, serum bilirubin levels were within the normal range (0–0,4 g/dℓ (Kaneko 1986) up to week 9 post-infection (PI). From then on, levels in the infected sheep of both breeds started rising to reach a peak of 0,5g/dℓ during week 10 in the Red Masai and week 13 in the Dorpers. After the peak, the levels fell gradually to reach 0,0 g/dℓ in the Red Masai and 0,2 g/dℓ in the Dorpers during week 15 PI. The levels rose again to 0,4 g/dℓ for the infected Dorpers and 0,35 g/dℓ for the infected Red Masai in week 18. Statistically, the Dorper sheep were found to have significantly higher levels of serum bilirubin than the Red Masai sheep ($P < 0,05$). The control animals had serum bilirubin levels considered to be within the normal range throughout the experiment.

Albumin levels in the infected sheep declined from a value of 3,2 g/dℓ on week 7 PI to 2,0 g/dℓ on week 17 PI in the Red Masai. Among infected Dorpers, the same parameter declined from a value of 2,9 g/dℓ at week 10 PI to 1,5 g/dℓ at week 17 PI. From week 12 PI, the values remained lower among the Dorpers but this difference was not significant. The control sheep of both breeds had albumin values within the normal range [2,4–3,0 g/dℓ (Kaneko 1986)] throughout the study period.

Levels of GGT rose above normal values [20–52 I/U (Kaneko, 1986)] among infected Dorpers from week 10 PI when they were 53,2 I/U and peaked to a value of 119,5 I/U at week 18 PI. In week 16 PI, infected Red Masai had a level of 27,0 I/U which rose to 65 I/U on week 18 PI. Statistically, the rise in serum GGT was significantly higher in the infected Dorper sheep than in the infected Red Masai sheep ($P < 0,05$). The control animals had normal levels of GGT throughout the experimental period.

DISCUSSION

There was a significant difference in the bilirubin concentration between the infected animals and the uninfected controls ($P < 0,05$). Total bilirubin levels were found to vary between 0–0,5 g/dℓ in the uninfected sheep and between 0,0–1,36 g/dℓ in infected sheep (Haroun, Haga & Gameel 1986). In this study bilirubin levels were higher in the infected Dorpers (0,2–0,56 g/dℓ) than those in the infected Red Masai sheep (0,0–0,55 g/dℓ). Progressive periductal fibrosis and blockage of bile ducts by mature flukes are the main causes of bilirubinaemia (Haroun *et al.* 1986); thus in these studies the higher values of bilirubin in the infected Dorpers could be due to greater degrees of these two factors. The establishment of the infection was confirmed by faecal examination and histological examination of infected livers (Waweru 1995). The latter confirmed that periductal fibrosis and blockage of bile ducts were more marked in the Dorper sheep than in the Red Masai sheep, hence the higher level of bilirubinaemia in the former.

The loss of albumin in the infected animals commenced after 10 weeks of infection coinciding with the entry of flukes into the bile ducts. This is in agreement with the findings of Dargie (1973). The major contributors to this loss in albumin are both the blood sucking activity of intrabiliary flukes and leakage of plasma through the inflamed bile ducts (Dargie 1973).

The highest mean elevation of GGT in the infected sheep relative to the uninfected controls for the Dorper in the present study was 91,5 IU/ℓ as compared to 45 IU/ℓ in the Red Masai. This interbreed difference was found to be statistically significant ($P < 0,05$). The timing of the elevation coincides with the presence of the adult flukes in the bile ducts. The main cause of elevation in this enzyme is cholestasis or damage of the bile duct epithelium by the flukes (El Sammani, Mohmoud, Fawi, Gameel & Harun 1985).

The differences in the elevation of serum bilirubin and serum GGT in the two breeds of sheep indicate variation in their susceptibility to the experimental infection. Thus from these findings, the Dorper sheep were more susceptible to the infection that the Red Masai sheep. It is possible that this genetic difference in susceptibility could be exploited to reduce losses caused by fasciolosis endemic areas, but further investigations are required before it can be categorically advocated.

ACKNOWLEDGEMENTS

This study was funded by the Danish International Development Agency (DANIDA) through the Royal Agricultural and Veterinary University, Copenhagen and the University of Nairobi, and we wish to acknowledge their support. Thanks are also due to Dr L.W. Wamae and his colleagues at the Kenya Agricultural Research Institute (KARI) who helped in the raising of metacercariae.

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