

Nutrition and Genetic Resistance in Trypanotolerant Cattle

Interactions between nutritional status and genetic resistance to trypanosomosis in trypanotolerant cattle were explored with a view, in the longer term, to applying the findings to underpin the development of feeding systems for animals in areas infested by the tsetse fly.

Background

For a number of years now it has been known that certain breeds of West African cattle – most notably the N'Dama and Baoule – show some tolerance to trypanosomosis, a serious disease caused by trypanosomes and spread by the bite of the tsetse fly. These breeds have enormous potential for enhancing cattle productivity in areas of sub-Saharan

Africa where the disease is endemic. Despite observations that the severity of the disease is often most marked at times of the year when cattle are under nutritional stress, systematic studies examining the influence of nutrition on trypanotolerance have, to date, been limited. The severity of trypanosome infection in N'Dama cattle grazing low quality pasture has been shown to be reduced by supplementation with small amounts of 'concentrates'. A study of the mechanisms of this interaction was required.*

Research highlights

This project investigated the interaction between nutrition and genetic resistance to trypanosomosis in West African cattle, and determined whether differences in digestive function and efficiency contribute to trypanotolerance in livestock. It also investigated the effects of nutrition on the pathogenesis of ruminants infected with trypanosomosis.

In experiments in The Gambia to compare trypanosensitive Zebu cattle with trypanotolerant N'Dama cattle, Zebus infected with *Trypanosoma congolense* lost weight, whilst pair-fed, uninfected partners continued to grow. Liveweight gain of N'Dama cattle decreased significantly in response to infection, although the difference was proportionally smaller than in the Zebu.

Infection also resulted in reduced packed cell volumes, increased parasitaemia and reduced mean corpuscular volume in all breeds but the effect was greater in the susceptible Zebu animals. Increasing the level of feeding of infected animals reduced the severity of the effects of infection. For all parameters recorded, the magnitude of these responses to supplementation was similar for both infected and control animals: the benefits of supplementation were not derived through an effect on the mechanism of resistance.

In detailed studies to look at some reasons for the decreased susceptibility of 'better fed' animals to trypanosomosis, feed intake decreased in most experiments following infection. Also where feed selection was possible, animals reduced intake of the more fibrous

**Natural Resources Institute
University of Greenwich**
Chatham, UK

D.L. Romney, E.M. Gill

**International Trypanotolerance
Centre (ITC)**

Banjul, The Gambia

A. N'Jie, D. Clifford, O.O. Akinbamijo

University of Glasgow

Glasgow, UK

P.H. Holmes, G.J. Wassink,

G. Fishwick, J.J. Parkins

**Centre de Coopération
Internationale en Recherche
Agronomique pour le
Développement (CIRAD)**

Montpellier, France

D. Richard

**Centre International de Recherche
et Développement sur l'Élevage en
zone Subhumide (CIRDES)**

Bobo-Dioulasso, Burkina Faso

A. Kanwe, P. Grimaud



Experimental animals receiving the supplementation treatments.

fraction of the diet. Interestingly, preliminary trials with sheep fed similar diets indicated that decreased intakes occurred with *T. vivax* but not with *T. congolense* infection, suggesting that

different strains of trypanosome may have substantially different effects.

Digestibility (the extent to which feed is digested) of organic matter and crude protein (CP) in cattle was inconsistent but did not contradict the findings of the more controlled sheep studies. The sheep studies suggested that infection reduced digestive efficiency in some way. No differences in dry matter (DM) digestibility were observed in response to infection of either N'Dama or Zebu cattle in The Gambia, although the passage time of feed through the rumen was significantly longer in infected Zebu animals. Similarly, in Burkina Faso, there were no observable differences in DM digestibility in either Baoule or Zebu animals infected with *T. congolense* although there were indications of lower CP digestibility in the Zebus following infection.

Uptake

This project made considerable progress in elucidating the mechanisms underlying the relationship between nutrition and responses to *T. congolense* infection that has been observed in the field. However, manipulation of diets and the provision of better quality feeds, for the trypanotolerant animals used in the trials, does allow the maintenance of productivity – in terms of weight gain – despite infection. This is of considerable practical significance and may provide a useful basis for the future design of more appropriate feeding and management strategies for cattle in tsetse-infested areas.

Impacts in institutional strengthening were also made, and trained staff at ITC assist in continued research

efforts. In addition, a number of publications were produced.

Linkages

A broader understanding of the priorities of farmers, and the factors that influence their decision-making, is needed to augment these findings. This will allow the design and implementation of new strategies to control disease on the ground and to identify where strategic supplementation could play a role in these. For example, in many cases, survival of the animal may be of much greater importance to farmers than maximising production. In these situations, a nutritional approach to management may be inappropriate and economically unfeasible when compared with therapeutic control. Ultimately, areas of endemic trypanosomosis will need decision support systems that can facilitate the integration and optimisation of genetic, therapeutic and nutritional practices for managing the incidence and impacts of the disease. Livestock Production Programme (LPP) Project R6358: *Management of trypanosomosis in N'Dama cattle* has subsequently developed a management decision tree for different levels of trypanosomosis risk. The outputs of LPP Project R6140: Improving the performance of trypanosome-infected smallstock are also relevant.

Relevance to sustainable livelihoods

Undernourished N'Dama and Baoule cattle can succumb to trypanosomosis. For low income livestock keepers the cost of therapeutic drugs would normally be too high even if they were available in more remote

areas. Simple feeding practices that draw upon local resources and can be used in a strategic manner to enhance natural levels of immunity have obvious advantages for the poor. LPP is supporting research that translates the more upstream findings of this project into practical feeding advice for low income livestock keepers in tsetse-infested areas of West Africa.

Selected project publications

- Romney, D.L., N'Jie, A., Clifford, D., Holmes, P.H., Richard, D. and Gill, M. (1997) The influence of plane of nutrition on the effects of infection with *Trypanosoma congolense* in trypanotolerant cattle. *Journal of Agricultural Science (Cambridge)*, **129**: 83–89.
- Wassink, G.J., Fishwick, G., Parkins, J.J., Gill, M., Romney, D.L., Richard, D. and Holmes, P.H. (1997) The pathophysiology of *Trypanosoma congolense* in Scottish blackface sheep: influence of diet on digestive function. *Animal Science*, **64**: 127–137.
- Akinbamijo, O.O., Bennison, J.J., Romney, D.L., Wassink, G.J., Jaitner, J., Clifford, D.J. and Dempfle, L. (1997) An evaluation of food intake, digestive physiology and liveweight changes of N'Dama and Gobra Zebu bulls following experimental *Trypanosoma congolense* infection. *Animal Science*, **65**: 151–158.

For further information on the Programme contact:
The Programme Manager
Livestock Production Programme
NR International
Park House, Bradbourne Lane
Aylesford, Kent ME20 6SN
<w.richards@nrnt.co.uk or lpp@nrnt.co.uk
www.nrnternational.co.uk