

R5577

Antigenic, Pathogenic and Virulence Factors of *Dermatophilus Congolensis*

Project Leader: N. Ambrose, Centre for Tropical Veterinary Medicine, University of Edinburgh, UK.
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Collaborative links:

- Department of Veterinary Services, Accra, Ghana
- Royal Veterinary College, London
- Murdoch University/ Dept of Agriculture, Perth, Western Australia

Executive Summary

- Dermatophilosis, caused by the bacterium *Dermatophilus congolensis*, is a major constraint to attempts at increasing milk production in West Africa because imported exotic breeds, needed to improve productivity are particularly susceptible. It also causes indirect losses to food crops where draught cattle are used for land cultivations.
- Improved control of dermatophilosis would enable smallholders and those cultivating crops with draught animals to raise their level of income or secure their sources of food.
- At present acaricides are the only effective control measure against ticks which carry dermatophilosis. The long-term use of acaricides is leading to drug resistance, and chemical residues in animal products and the environment.
- The project seeks to investigate alternative control methods. It has successfully identified and characterised several antigens and a group of pathogenic and virulence factors that could be involved in the production of a vaccine against dermatophilosis.
- The results indicate that vaccination is possible, using live bacteria, although the production of a vaccine against dermatophilosis is a long-term objective.



Draught animals are essential providers of cultivation power for many smallholders

Background

Dermatophilosis is a major constraint to attempts at increasing milk production in West Africa because imported exotic breeds, needed to improve productivity are particularly susceptible. It is also a potential problem in Eastern and Southern Africa.

The agent involved is the bacterium *Dermatophilus congolensis*. The severe chronic form of dermatophilosis is associated with infestations of *Amblyomma variegatum* ticks.

This skin disease causes scab formation in ruminants and is particularly important in humid tropical and sub-tropical countries of West and Central Africa and in some Caribbean islands. In these areas approximately 10% of cattle are affected, the result is considerable reductions in

the productivity and severe loss of income to smallholders or work output for those using animals to cultivate crops. As pressure on land increases with increasing human populations there is a need for livestock systems that incorporate more productive breeds and for small-holder milk production. The successful use of more productive cattle will depend on effective control of dermatophilosis. At present the only effective control measure is the use of acaricides to reduce tick numbers. The long-term use and mis-use of acaricides will lead to the development of acaricide resistance, acaricide residues in animal products and environmental pollution

Objectives

Control of ticks can reduce the prevalence of dermatophilosis even in exotic breeds of cattle. Alternatives to acaricides must be found to control dermatophilosis. These could include immunising animals against *D.congolensis*, ticks and tick saliva factors, new drug treatments and selecting resistant breeds. The design and implementation of these methods require detailed information on *D.congolensis* antigens that are relevant to host protection in immune and resistant cattle and bacterial enzymes that might be potential drug targets. Information on these subjects is scarce. This project addresses this need.

The specific objectives of this project were to identify and characterise antigens of *D.congolensis* that are associated with host protection and secondly to identify and characterise proteolytic enzymes of *D.congolensis* that have a role in the pathogenesis of the disease and which determine the virulence of the organism.

Highlights

- The project showed experimentally that an acquired protective immune response to *D.congolensis* develops in healthy tick free cattle. This indicates that under field conditions animals can develop immunity to *D.congolensis* following challenge with live bacteria which means that the development of a vaccine against dermatophilosis is possible based on live bacteria.
- Experimental infections of tick free and *A.variegatum* infested Friesian calves demonstrated immunity to infection in the former but aggravated the severity and duration of the lesions in the latter.
- *D.congolensis* has a complex life-cycle with several different potential sources of immunologically active components.
- The excreted-secreted products (ESP) of two *D.congolensis* isolates were examined in detail. Several components of the isolates were identified. Sera from animals infected with *D.congolensis* were then found to have antibodies against some of the components.
- There was positive correlation between the severity of infection and the number of ESPs that stimulate an antibody response.
- Experimentally infected, tick-free calves developed antibodies to at least one component following a second infection to which the calves were immune. The results show that ESP contain antigens that are common to

D.congolensis isolates from different hosts and distant locations.

The project produced detailed information on the characteristics of several antigens and one group of pathogenic and virulence factors. It is apparent that the serine proteases produced by *D.congolensis* fall into all three categories and may therefore be useful candidates for inclusion in a vaccine against dermatophilosis.

Impact

This project is part of a package of research projects that are striving for the long-term development of a safe, effective and cheap vaccine that protects livestock from dermatophilosis. If achieved this would relieve animal suffering and remove a considerable productivity barrier in the way of many poor African livestock farmers thereby allowing them to improve food security and boost their quality of life.

The information produced on antigens and pathogenic and virulence factors is another step towards identifying the critical components of a vaccine. The results indicate that vaccination against dermatophilosis is possible, using live bacteria, although the production of a vaccine against dermatophilosis remains a long-term objective.

Dissemination

Selected Publications

- Ambrose, N.C.** (1996) Pathogenesis of *Dermatophilus congolensis* infections. Proceedings of a Workshop on the control of *Amblyomma variegatum* Ticks and associated diseases. Accra, Ghana, Nov. 1994. *Tropical Animal Health and Production*, **28**, 295-375.
- Koney, E.B.M., Walker, A.R., Heron, I.D., Morrow, A.N. and Ambrose, N.C.** (1994) Seasonal prevalence of ticks and their association with dermatophilosis in cattle on the Accra plains of Ghana. *Revue d'Elevage et de Medicine des Pays Tropicaux*, **47**, 163-167.
- Morrow, A.N., Koney, E.B.M., Scott, G.R. and Ambrose, N.C.** (1993) The association between *Amblyomma variegatum* ticks and the occurrence of bovine dermatophilosis. Resistance or Tolerance of Animals to Disease and Veterinary Epidemiology and Diagnostic Methods, G. Uilenberg and R Hamers, eds., pp. 163-164. CIRAD-EMVT, Maisons-Alfort, France.

A PhD thesis 'Characterisation of *Dermatophilus congolensis* grown *in vitro*' M.A. El Jack, an MSc dissertation 'Characterisation of proteases produced by *Dermatophilus congolensis*' M.S. Mijinyawa and participation in the EU INCO-DC concerted action on 'Ticks and tick borne diseases' were also undertaken.

Links

Projects: (R5576) A Morrow 'The pathogenesis of *Amblyomma variegatum* associated dermatophilosis'; (R5574) T.W. Jones 'The identification and characterisation of protective antigens of *Trypanosoma evansi*' collaboration on techniques for characterising proteases from *T.evansi* and *D.congolensis*; (R5573) R. Boid 'Molecular and Biochemical studies on *Trypanosoma evansi*'.

Follow-up planned

The results of strategic research carried out under this project are encouraging. The DFID Animal Health Programme funded project '*Host-pathogen-tick interactions and immunoprophylaxis against Amblyomma variegatum associated dermatophilosis*' will carry out more of the strategic research that is required before results can be followed through to the adaptive phase when vaccines should be available for field testing.