The Interaction Between Nutrition and Genetic Resistance to Parasitic Diseases

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Collaborators
Research links exist with other scientists within Glasgow University, in other British Universities and Research Institutes, and with Institutes in America, Australia and Europe. Major collaborative projects are ongoing throughout Africa with NARS and CGIAR Institutes. Related projects are held by participants in this ODA/DFID project, funded by the European Community, the Wellcome Trust, the BBSRC and the Leverhulme Foundation.

Executive Message

- This project helps fill the gap in our knowledge on the interaction between nutrition and genetic resistance on the susceptibility of sheep and goats to parasitic infection and disease.
- The findings offer an attractive option for many small-scale farmers to overcome a severe production constraint by using nutritional supplementation and the use of genetically resistant stock to enhance their livelihoods.
- Trials showed that supplementary feeding of sheep was most beneficial when animals genetically resistant to helminths were involved.
- If farmers wish to keep exotic sheep in high potential areas the sheep will require to be fed on adequate diets and be well managed.
- In semi-arid areas the researchers suggest farmers would benefit by using helminth-resistant breeds such as the Red Maasai.
- Kenyan scientists have validated the findings of this project under Kenyan conditions. This enables them to give rational advice on the choice of breed and diet in both the semi-arid and high production areas of Kenya.

Background

The livelihoods of small-scale livestock farmers, particularly women, who keep sheep and goats in developing countries, are severely constrained by the heavy parasitic infections that their animals usually suffer. Gastrointestinal nematodes are a particular problem especially in East Africa. There are a number of ways of reducing the severity of infection, including anthelmintic treatment, grazing management, nutritional supplementation, use of genetically resistant stock, vaccine development and the use of nematophagous fungi. Two very attractive options for small-scale farmers are nutritional supplementation and the use of genetically resistant stock. These two options use indigenous resources, do not require expensive technology and are compatible with the existing infrastructure.

Several research studies have already established the importance of host genotype and dietary supplementation on resistance of hosts to parasite infection. In a general sense the most efficient strategy is to use the best breed and the most appropriate diet for the local environment. Yet the importance of the interaction between genetic resistance and nutrition is not understood. It is possible that the benefits of genetic resistance are lost when a poor diet is fed or conversely, resistant animals could thrive on a level of nutrition that would be inadequate for susceptible stock. Genetically susceptible sheep may be...
unable to respond effectively to the relevant parasite molecules and nutritional supplementation could be uneconomic. Alternatively, susceptible sheep maybe in most need of supplementation. Such questions have major implications for livestock production in areas where nutrition is non optimal.

Objectives
To help fill this gap in our knowledge this project aimed to determine if there is an interaction between nutrition and genetic resistance or susceptibility to parasitic infection and disease. This study was designed to:
- Improve our understanding of the interaction between nutrition, host genetics and resistance to parasite infection.
- Develop improved methods for the control of helminth infection.

Highlights
This project involved researchers conducting two series of experiments. In the first helminth-naïve sheep were fed on either a normal diet or an enriched one. The diet was supplemented with either protein (soya) or non-protein nitrogen (urea). Two thirds of the sheep in each diet were then infected with *Haemonchus contortus*. The sheep were either 'genetically resistant' Scottish Blackface or a 'genetically susceptible' Hampshire Down. The results confirmed that the supplementation improved the performance of both genetically susceptible and resistant sheep but the effect was greater in the susceptible breed.

In the second series of experiments naturally infected sheep were monitored for five months, then divided into genetically susceptible and genetically resistant groups, fed with normal or enriched diets and then deliberately infected with *Ostertagia circumcincta*. The results from these experiments matched those from the first series and confirmed that an enhanced diet improved the ability of animals to minimise infections and their ability to withstand the effects of an infection.

The research results confirmed the importance of nutrition on resistance to infection and an interaction between genetic resistance and nutrition, so enhancing our understanding of gastrointestinal nematode infection.

Impact
The results from this project make it possible to give more rational advice on the choice of breed and diet to small-scale farmers in both the semi-arid and high production areas of Kenya. For example, resistant breeds such as the Red Maasai are preferable to Dorper sheep in semi-arid areas where nutrition is poor or parasite exposure is severe. If farmers wish to keep exotic sheep in high potential areas the sheep will require to be fed on adequate diets and be well managed.

The dissemination pathway is through Kenyan scientists/advisors who will in turn advise Kenyan farmers. Kenyan scientists under the National Agricultural Research Programme at the Kenyan Agricultural Research Institute (KARI). They validated the UK findings with similar experiments carried out under Kenyan conditions using local breeds and local feedstuffs. Such work strengthens the capacity of the National Veterinary Research Centre and the local Veterinary Investigation Centres to undertake future research work in this area.

Dissemination
Selected Publications


Meetings/Presentations
- **Czech Republic**: International Society for Animal Genetics, Prague, 1994.