

R5579

# Pathogenesis and Epidemiology of Fasciolosis

**L.J.S. Harrison, Centre for Tropical Veterinary Medicine, University of Edinburgh, UK.**

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## Collaborators

- Kenya Agricultural Research Institute (KARI), Kenya.
- Institute for Animal Health, Pirbright, Woking, Surrey, UK.
- Instituto de Salud Carlos III, Madrid, Spain.
- National University of Mexico (UNAM), Mexico.
- University of Cayetano, Lima, Peru.
- University of Yucatan, Merida, Mexico.
- University of Liverpool, UK.
- PAC, Dhankuta, Nepal.
- Universidad de Carabobo, Venezuela.



This project worked closely with a sister project R5527 'The epidemiology, immunology and control of fasciolosis in dairy cattle in Cajamarca, Peru an area of high infection pressure' managed by Liverpool University.

Rice paddies are ideal habitats for the snails that act as vectors for *F.hepatica*

## Executive Message

- There is currently a lack of reliable information on the pathogenesis (development) and epidemiology (occurrence, distribution & control) of the parasitic flukes *Fasciola gigantica* and *F.hepatica*.
- This is needed to develop predictive models and Knowledge-based Systems that can be used to advise farmers and smallholders in developing countries on the most appropriate control strategy.
- This knowledge can help mitigate the huge losses farmers suffer through the death and lower productivity of their animals and the reduced value of carcasses.
- This project goes some way to providing the missing information by studying the situation in Peru, Kenya and Nepal.
- The snails acting as vectors for *F.hepatica* in Peru were successfully established maintained at CTVM and Liverpool as a project resource. A laboratory manual was produced.
- A study on *F.gigantica* was carried out in collaboration with KARI, Kenya and found that production losses due to fluke (fasciolosis) in both sheep and cattle varied between breeds.
- Immunochemical studies revealed differences in antigen recognition patterns between cattle and sheep. Target molecules were identified, which could help improve fasciolosis diagnosis if developed into assays could become potential components of a vaccine.

## Background

The parasitic flukes *Fasciola gigantica* and *F.hepatica* cause major veterinary and economic problems for cattle, buffalo, sheep and goats in a wide range of developing countries. Every year the Kenyan meat industry loses at least £7 million and Nepal £12 million though a combination of poor productivity, death of stock, condemnation of infected livers and reduction in carcass quality. Flukes are a real danger in areas of the tropics and sub-tropics, where conditions favour the survival of the snail vectors. Cost-effective control of these flukes or the snail vector

that carries them would have obvious developmental benefits.

Currently, there is a lack of well authenticated and reliable information and data on the pathogenesis (development) and epidemiology of these flukes. This is needed to develop predictive models, geographic information systems and for inclusion into future 'Expert or Knowledge-based Systems'. These systems would be used to advise farmers and smallholders on the most appropriate control

strategy. Improving the way control programmes are evaluated and then applied to particular areas would greatly enhance their effectiveness.

Pathogenesis studies involve monitoring the development of fasciolosis so that the effect the parasites have on the host can be assessed and quantified. The same parameters can then be used to monitor the effect of additional stress factors may have on the outcome of infection. Improved understanding of the epidemiology of fasciolosis would greatly aid decision making over mounting control programmes. Knowledge on the effects of flukes on local and exotic breeds of domestic ruminants and an understanding of the effect that local variations in strains of the parasite or snail vectors have on the epidemiology or the pathogenesis of fasciolosis is crucially missing.

This project looked at the pathogenesis and epidemiology of Fasciolosis in three areas, which have a liver fluke problem, where CTVM already had good collaborative links. These were Cajamarca, Peru, Eastern Nepal and Kenya

## Objectives

The overall aim of this project was to study the pathogenesis and epidemiology of *Fasciola gigantica* and *F.hepatica* flukes in order to provide much needed information and data to assist the development of predictive models, geographic information systems and for inclusion into future 'Expert or Knowledge-based Systems'. These systems would be used to advise the smallholders, farmers and animal health workers on the most appropriate control strategy.

The research aims included:

The maintenance of vectors and parasites in the UK to study all the life cycle stages of *F.gigantica* and *F.hepatica*.

- Immunochemical analysis of the parasites.
- Pathogenesis studies.
- Epidemiological studies including the development of diagnostic tools including DNA probes and ELISA based diagnostic assays to improve the efficiency of survey work.
- Gathering of source material for the development of predictive models and 'Expert Systems'.

## Highlights

### Vector/Parasite maintenance

This project worked closely with a sister project R5527 '*The epidemiology, immunology and control of fasciolosis in dairy cattle in Cajamarca, Peru an area of high infection pressure*' managed by Liverpool University. They were supplied with parasite and vector material by this project and training was given to Cajamarca project staff both at CTVM and in Peru. The snails acting as vectors for *F.hepatica* in Peru were successfully established maintained at CTVM and Liverpool as a project resource. A laboratory manual was produced. This close cooperation, between DFID sponsored projects, ensures the efficient use of resources and maximises the efforts of scientists trying to solve similar problems.

### Comparative pathogenicity and immunochemistry of fasciolosis in different breeds of young cattle and sheep

Production studies yielded useful quantitative information on the comparative losses caused by *F.gigantica* in different breeds of cattle and sheep. A study, on *F.gigantica* was carried out through in collaboration with KARI, Kenya found that production losses due to fluke (fasciolosis) varied between breeds. Trials showed that Friesians were less severely damaged than Boran cattle and Dorper less than Red Maasai sheep.

### Immunochemical analysis of excretions and secretions of *F.hepatica* and *F.gigantica*

Different species and breeds differed in their antibody responses and antigen recognition patterns to infection with *F.hepatica* and *F.gigantica*. The dramatic shift in antigen recognition patterns observed around the time of patency in cattle was further characterised and compared with sheep, which do not exhibit this response. A small-scale trial at CTVM involved infecting and then challenging Friesian cattle with *F. hepatica* (Peruvian strain). A second group of calves were simply given a single infection. Sera collected from these cattle were analysed at CTVM. The technology was also used on a larger number of infected cattle in Peru. Sequential immunochemical studies revealed differences in antigen recognition patterns between cattle and sheep. Target molecules were identified, which could be used to help diagnose fasciolosis if developed into assays or could become potential components of a vaccine. This detailed

information on the response to infection at the molecular level is a significant step forward in the search for accurate identification of fasciolosis and the eventual production of a vaccine to protect livestock.

### **Bovine IgE reagents**

Project time was spent on the development of reagents and tests previously unavailable but necessary to study cattle fasciolosis. Work progressed well on the characterisation of a bovine IgE reagent for use in diagnostic assays.

### **Impact**

The project has resulted in the gathering of a considerable amount of useful sequential data on cattle, sheep, buffaloes and goats infected with either *F.hepatica* or *F.gigantica*. Data were collected from Peru, Kenya and Nepal and will help scientists understand more about the distribution, occurrence and control of fasciolosis. In Nepal such information will be of immediate use in the implementation of control programmes, which have already started. Elsewhere the data will be of ultimate use in the development of predictive models and 'Expert Systems'. The progress on immunochemical analysis is of particular importance as this moves science forward towards a better and more accurate diagnosis of liver fluke. It also makes progress towards the eventual development of a vaccine which will give livestock in fluke areas resistance against a costly disease. This will have a significant impact upon the livelihoods of many animal owners and those involved in meat production and processing. Identifying and understanding that different species and different breeds react to infection in different ways is important. It may mean that keeping particular breeds or species that can tolerate challenges from particular types of parasites will reduce productivity losses and deaths and so improving income and livelihoods.

### **Dissemination**

The project staff prepared and published a large number of scientific papers of which a small selection are given here.

### **Selected Publications**

- Harrison, L.J.S., Hammond, J.A. and Sewell, M.M.H.** (1996) Studies on helminthosis at the CTVM. *Tropical Animal Health and Production*, **28**, 23-39.
- Mahato, S.N., Harrison, L.J.S. and Hammond, J.A.** (1994) Epidemiology of fasciolosis in Eastern Nepal. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **88**, 23.
- Onyango-Abuje, J.A., Harrison, L.J.S., Hughes, G., Nginyi, J.M., Opicha, M., Rugutt, M.K., Wright, S.H., Malenya, G., Olum, J., Omundi, G. and Odera, G.** (1993) Prevalence of helminths recorded at meat inspection and ELISA screening for *Taenia saginata* cysticercosis. *Progress Towards the Control of Helminthosis in Kenya*. Proceedings NARP Helminthology Project Workshop, 24th and 25th February 1992. (Eds. J.A. Onyango-Abuje, R.K. Bain, S.W. Wanyangu and M.A. Ihiga) Published by KARI, Nairobi, Kenya pp. 40-44.

### **Meetings/Presentations**

Presentations were given at the following meetings.

**UK:** Royal Society of Tropical Medicine and Hygiene, Edinburgh, July 1993

**UK:** World Association for the Advancement of Parasitology, Cambridge, August 1993.

**Peru:** Peruvian Congress of Microbiology and Parasitology March 1995, Lima.

**Mexico:** EU funded 'Application of biotechnology to the epidemiology and control of human and porcine *Taenia solium* infection in Mexico' Cuernavaca, January 1995&96.

A significant number of PhD, MPhil and MSc Dissertations were completed as part of this project.

### **Next Steps**

The feasibility study into forecasting and geographical information systems indicated that the further application of these procedures would be invaluable.