become available.

Recent progress in ILRAD's research on developing a vaccine against East Coast fever

The current method of immunizing cattle against East Coast fever is to infect them with the causative parasite, *Theileria parva,* while at the same time treating the animals with tetracycline to prevent the development of severe clinical disease. The immunity induced using this method often breaks down when an animal is infected with stocks of the parasite that differ from the stock(s) used to immunize it. In addition, the existence of a wide diversity of parasite stocks in the field, the risks of disease transmission when administering live vaccines, and logistical problems associated with this immunization method have prevented its widespread use. For these reasons, ILRAD scientists have been conducting research aimed at developing an improved vaccine.

A team of scientists studying the sporozoite stage of *T. parva* has isolated and characterized a molecule, which appears on the parasite's surface, that is a promising candidate for the development of a vaccine against East Coast fever. The gene coding for this molecule, designated p67 because it is a protein with a molecular mass of 67 kilodaltons, has been cloned and expressed in bacteria. In recent experiments, the recombinant p67 molecule was inoculated into cattle, where it evoked high titres of antibodies. On subsequent parasite challenge, some of these animals were found to be immune. The immune responses to 67 are now being investigated. ILRAD scientists are also exploring vaccine delivery systems, such as recombinant attenuated *Salmonella typhimurium* and vaccinia virus, for delivering p67 to the host immune system.

The parasites that cause malaria—species of Plasmodium—behave in their mammalian host in a similar way to *T. parva (T. parva* causes disease by damaging white blood cells; *P. falciparum* damages red blood cells). Scientists working on malaria and East Coast fever are using similar approaches in their search for parasite antigens that will protect people and their domestic livestock against these debilitating and fatal diseases. ILRAD's promising work on the *T. parva* p67 antigen is therefore of interest to malarial researchers as well as to colleagues working on other protozoan parasites.

The carrier state in cattle infected with *Theileria parva* (PH.D.Thesis)

East Coast fever (ECF) is spread exclusively by ticks that have fed on cattle infected with the parasite *Theileria parva.* It was long believed that recovery from ECF confers on cattle a solid and sterile immunity—that once an animal recovers, the parasite disappears from the animal, no relapses of the disease occur and the animal is no longer a source of infection. Research over the last two decades, however, has shown that a high prevalence of antibodies against *T. parva* occurs in Kenyan cattle of all ages and in all districts where the tick vector of the parasite, *Rhipicephalus appendiculatus,* is found. The presence of antibodies indicates the cattle had earlier experienced and recovered from the disease and were now immune. In recent experiments, healthy cattle with antibodies against *T. parva* were demonstrated to infect clean *R. appendiculatus* nymphs, which subsequently transmitted the parasites to susceptible cattle, in which ECF developed.

Despite this evidence, however, many veterinarians remain unaware that a carrier state exists in endemic areas or in areas where sporadic outbreaks of ECF occur. For this reason, emphasis in ECF control is still being placed on the importance of twice-weekly dipping in areas where *R. appendiculatus* is found. At the same time, the

possibility that immunized cattle continue to carry parasites that can initiate new disease outbreaks has delayed the adoption in Kenya of the infection-and-treatment method for immunizing cattle against ECF. The purpose of this study was therefore to determine the frequency of the carrier state of *T. parva* in cattle that have naturally recovered from ECF and to investigate the carrier state in cattle that have been immunized by the infection-and-treatment method (a simultaneous inoculation of live parasites to cause infection and an antibiotic to reduce the severity of the infection).

Rhipicephalus appendiculatus ticks feeding on healthy cattle were collected from various parts of Kenya and experimentally applied to susceptible cattle. Most of these ticks induced clinical ECF, indicating that they were infected with *T. parva* or other *Theileria* parasites. Epidemiological studies also indicated that ticks could become infected from healthy *T. parva* carrier cattle.

Healthy adult cattle *(Bos indcius* and *Bos taurus)* with antibodies against *T. parva* schizont antigen were also brought to the laboratory, where under tick-free conditions they were shown to be carriers of *T. parva.*

Ten cattle *(Bos taurus)* were immunized against ECF using the infection-and-treatment method and their carrier status was subsequently investigated. Three and seven months after immunization, during which the cattle had been kept tick-free, the cattle were shown to be carriers of *T. parva.*

The high prevalence of anti-theilerial antibodies in cattle from areas where acaricides are applied twice a week indicates that ECF continues to occur in cattle despite frequent acaricide application. Cattle that have recovered from ECF are therefore immune but remain carriers of *T. parva* and provide a source of infection to *R. appendiculatus* ticks.

It is believed that carrier cattle help to maintain endemic stability in a herd. For this reason, the results of this study indicate that frequent application of acaricides should be reviewed. With the introduction of the infection-and-treatment immunisation method, farmers may be able to control ticks by dipping cattle at intervals much longer than the current norm of twice a week. Further research is necessary to determine the maintenance of *T. parva* under natural conditions so that cost-effective tick control programs can be developed that take into account other tick-borne diseases, which could threaten cattle once ECF is brought under control.

Dadson P. Kariuki,
Ph.D. thesis abstract submitted in 1991 to the Department of Biological Sciences,
University of Salford,
Manchester, UK.

This Ph.D. work was done at the National Veterinary Research Centre, at the Kenya Agricultural Research Institute, in Muguga, and was supported by the British Council (Overseas Development Administration). Some of the laboratory work for this thesis was done at ILRAD

ILRAD Reports is published quarterly by the International Laboratory for Research on Animal Diseases (ILRAD), in Nairobi, Kenya. The newsletter is written, designed and electronically laid out to camera-ready stage in house using a personal computer and laser printer. The newsletter is printed in Nairobi by Majestic Printing Works. It has a circulation of 3.500 English and 500 French readers and is available free upon request. Material in the Reports may be reproduced without prior permission, but we ask that credit be given and that two copies of the reprint be sent to ILRAD's Scientific Writer/Editor. Susan MacMillan:

telephone: + 254 (2) 632-311, telefax + 254 (2) 631-499. electronic mail 157:CG1017.