

## **Vaccine research on Africa's cattle-killing East Coast fever: A short (somewhat potted but handsomely illustrated) history**

Tremendous research progress has been made over the last ten years to better control the deadly African disease of cattle known as East Coast fever. This disease is caused by a single-celled organism, *Theileria parva*, which is carried by some tick species. Cattle become infected when a tick carrying the parasite takes a blood-meal from the animal over several days.

The disease was named for its importation into southern Africa by cattle that originated from the East Coast of Africa at the start of the 20<sup>th</sup> century. The parasite was named after Arnold Theiler, a Swiss veterinary researcher who had emigrated to South Africa, where he became famous for co-developing the first safe vaccine against the rinderpest cattle plague, an accomplishment that ushered in systematic, mission-orientated veterinary research in that country. Theiler, whose youngest son Max would later win the Nobel Prize for developing the yellow fever vaccine, was first to distinguish East Coast fever, then entirely unknown to science, in 1903.

Cattle infected with the *T. parva* parasite develop a cancer-like disease manifested by high fever, swollen lymph nodes and lungs filled with excess fluid, which eventually literally drowns the animals, typically within just three weeks of infection. This remarkable protozoan has genes that enable it—within minutes of being injected into an animal—to attach itself to the surface of a cow's white blood cell, 'unzip' the cell membrane and slip into the cell. Once inside the bovine cell, the parasite is unseen and safe from attack by the cow's antibodies. *T. parva* then proceeds to take over the cell machinery. Activating the cow's cell division pathway, it multiplies along with its host cell, causing the cancer-like state.

Those animals that do not succumb to East Coast fever are thereafter immune to subsequent infections with the same strain of parasite. Such natural full recovery and immunity is what first piqued the interests of scientists, who reasoned that it must be possible to develop a vaccine that would provoke similar immune processes, thus providing cattle with life-long protection against the disease.

The sequencing of the genome of the *T. parva* parasite, completed in 2005, and its publication in the scientific literature enabled scientists to thoroughly characterize the protozoan's genetic makeup, including the diversity of the parasite's antigenic molecules that provoke the cow's immune system to generate protective antibodies and killer T cells that attack and clear the parasite from the host. This is the basis of an effective 'infection-and-treatment' (ITM) immunization method, in which live parasites are inoculated into cattle along with a long-acting antibiotic. A 'Muguga cocktail' ITM vaccine combining several parasite strains and providing broad-spectrum immunity to East Coast fever is now a registered product in three countries in eastern Africa. Effort today is being directed at improving and scaling up the production of this 'live

vaccine' to make it more widely and cheaply available to the millions of people whose livelihoods depend on livestock in the twelve countries of eastern, central and southern Africa where the disease remains endemic.

Meanwhile, research to develop a 'subunit' vaccine, which is based on bits of parasites rather than whole parasites, with the bits eliciting production of neutralizing antibodies and killer T cells, has been revived by a research consortium that is developing proof-of-concept for a next-generation East Coast fever vaccine. The pioneering genomic, molecular and immunological advances that are making this subunit vaccine work possible promise to finally and fully control this devastating disease within the next decade or so.

**Susan MacMillan**  
*International Livestock Research Institute*

## **Publication**

[The biology of \*Theileria parva\* and control of East Coast fever - Current status and future trends.](#)

Nene V, Kiara H, Lacasta A, Pelle R, Svitek N, Steinaa L

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