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SEROEPIDEMIOLOGICAL STUDIES FOR THE DETECTION OF ANTIBODIES OF SIX INFECTIOUS DISEASES IN KENYAN DROMEDARY CAMELS

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ABSTRACT

A total of 136 dromedary camel sera were serologically tested for six different infectious diseases to investigate the dromedary camel disease situation in Kenya. The sera originated from different herds and areas of Kenya. Rift Valley Fever antibodies were found in 47% of the camels, followed by *Trypanosoma evansi* with 10.3%, Brucellosis with 7.4%, West Nile Fever with 23.5%, and Blue Tongue with 75.7%. No antibodies were detected for *Peste des Petits Ruminants*. The results found are discussed for every disease.

Key words: Dromedary, Kenya, infections, seroepidemiological studies

Members of the camelid family are robust animals and show a high resilience to many disease agents that cause ailments in domestic animals. A great number of seroepidemiological studies have been performed in camelids, which were summarised by Wernery *et al* (2007 and 2008). However, serological results have a limited predictive value, as they only confirm whether or not the animal has come into contact with an infectious agent and has produced antibodies. The results do not indicate whether the exposure has produced clinically evident disease or how severe the disease response may be. Despite this fact, serological tests are important to help diagnosing and monitoring infectious diseases.

We report here the seroprevalence of 136 dromedary camel sera from Kenya for six different infectious diseases.

Materials and Methods

In April 2025, CVRL received 136 dromedary sera originating from adult camels of both gender from different herds of the Rift Valley in Kenya. They were serologically tested for six infectious diseases. The test methods were as follows:

Rift Valley Fever (RVF)

The RVF inhibition ELISA is a competitive ELISA (c-ELISA) for the detection of antibodies in humans, domestic and wild ruminants. This c-ELISA uses an anti-nucleoprotein horseradish peroxidase (HRP) labelled conjugate which binds to the free nucleoprotein epitopes of RVFV. The conjugate is not directed against the animal species tested and therefore can be used for different animal species, including camelids (Paweska *et al,* 2005).

Typanosomosis (*Trypanosoma evansi*)

The Tryp ELISA used is an indirect in-house ELISA (i-ELISA) which uses a Protein A horse radish peroxidase from *Staphylococcus aureus*. The *T. evansi* parasites were raised in white laboratory rats, and the antigen was prepared according to Rae and Luckins (1984). Anti-camel IgGs are nowadays commercially available and have been produced in rabbits, guinea pigs and laying hens, extracted from egg yolk (Nikbakht Brujeni *et al,* 2009; Wernery *et al,* 2011).

Brucellosis

The brucellosis slide-test is a card agglutination test, also known as Rose Bengal Test (RBT). In the presence of Brucella-specific agglutinins (*B. melitensis, B. abortus, B. suis*), the buffered acidified antigen, stained with Rose Bengal is agglutinated.

West Nile Fever (WNF)

The IDScreen West Nile Indirect is a c-ELISA which detects antibodies directed against the PrME envelope WNV protein. The test uses a conjugate which is directed against the IgG of the WN virus (WNV). The conjugate is not directed against the

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animal species tested, and can therefore be used for different animal species including camelids.

Blue Tongue (BT)

The BT ELISA is a c-ELISA which can be used for any animal species, including camelids. The c-ELISA is designed to detect antibodies directed against the BT virus (BTV) vp7 protein. The conjugate is an anti-vp7-HRP conjugate.

***Peste des Petits Ruminants* (PPR)**

This ELISA has been developed for the detection of serum antibodies to PPR. It is a c-ELISA which uses rabbit anti-nucleoprotein peroxidase labelled polyclonal conjugate. The conjugate is not directed against the animal species tested, and can therefore be used for different animal species, including camelids.

Beside the positive and negative serum controls in each test kits, CVRL has additionally raised antibodies in CVRL dromedary camels using commercially available vaccines or infecting CVRL's dromedaries with the pathogen, as it was done with brucellosis (*B. melitensis*) and *T. evansi*. PPR antibodies could not be raised by artificial infection, as the dromedary camels did not produce any antibodies. These positive sera are also used in CVRL serological investigations and some of them are commercially available.

Results

Table 1 shows the serological results of 136 dromedary camel sera from Kenya tested for six infectious diseases. The chronological order of these six diseases presented in Table 1 follows a special pattern. The pathogens of the first three infectious disorders produce disease in dromedary camels, whereas WNF and BT produce antibodies, but no disease. PPR neither produced antibodies nor infection/disease in dromedary camels.

Discussion

When investigating sera for antibodies in dromedary camels, test kits commercially available or in-house preparations must be evaluated for their suitability, as camelids have a completely different immune system than other mammals. The evaluation studies have been recently performed on 17 different infectious disease agents (Wernery *et al,* 2007, Part I; Wernery *et al,* 2008, Part II). Excellent results are achieved with c-ELISAs, which can be used for any animal species being tested. However, special care should be taken, when direct or indirect ELISAs are in use. These ELISAs often offer anti-ruminant or anti-bovine conjugates and not anti-camel or anti-llama/alpaca-specific conjugates. In general, cross reactivities between anti-species immunoglobulins (IgG) polyclonal antisera exist. It had been shown that dromedary IgG has 74.3% sequence identity to porcine and 73.1% to both equine and bovine and therefore anti-bovine conjugates may be used for ELISAs to detect antibodies against diseases in camelid sera. Additionally, some researchers use with good success horseradish peroxidase-labelled A or G proteins as conjugate, instead. These proteins derived from the staphylococcal cell wall, are highly conserved and bind strongly also with camel IgGs (Wernery *et al,* 2014).

Rift Valley Fever (RVF)

RVF has been present on the African continent since its discovery in Kenya in 1931. It is a significant zoonotic disease which in humans may develop into an uncomplicated influenza–like illness, but can also take the form of haemorrhagic fatal disease. The *Phlebovirus* is transmitted by 23 mosquito species. Strikingly, all of the RVF epizootics described to date have followed unusually heavy rainy seasons, probably indicating a very large insect population as a vector prerequisite (Hübschle,1983). Immense livestock losses were reported during EL NINO in 1990. RVF is an acute to per acute zoonotic disease of domestic ruminants, predominantly in Africa, but globalisation of trade and changing weather patterns is a concern for the spread of RVF out of Africa, which occurred in 2000 to 2001 to Saudi Arabia and Yemen (Shoemaker *et al,* 2002). In recent years, it has become obvious that New World camels (NWCs) and Old World camels (OWCs) can contract RVF (Wernery, 2025; OIE (WOAH), 2018). Serological investigations during these outbreaks revealed high numbers of reactors which were also found with this investigations of nearly 50%. In the Mauritanian outbreak, the RVFV was isolated from diseased dromedary camels, too (EL Mamy *et al,* 2011, 2014). In adult dromedary camels the main clinical signs of RVF is abortion at any stage and young stock may develop a systemic disease. Since 1990 camel diseases were regularly reported from East Africa, mainly Kenya and Ethiopia until today. Some of these outbreaks have been attributed to a *Morbillivirus* similar to PPR (Roger *et al,* 2001; Roger *et al,* 1998; Roger *et al,* 2000) and Pasteurellosis (Bekele, 1999). Newest research, however, has shown that dromedaries are resistant to these two diseases (Wernery *et al,* 2014; Schulz *et al,* 2019). Camel disease

outbreaks in 2024 and 2025 in Kenya and Ethiopia occurred again after heavy rains and clinical signs observed in dromedary camels were similar to RVF as described by EL Mamy *et al* (2011), Khalafalla and Hussein (2021) in Mauritania in 2010. Currently, further investigations, especially virus isolation, are performed on tissue samples from Kenya.

Trypanosoma evansi (Tryps)

The most important protozoal disease of camels is trypanosomosis (named Surra) caused by *Trypanosoma evansi*. The protozoa is mechanically transmitted by blood sucking flies (tabanids) and causes severe losses. Three forms of the disease are known: acute, subacute and the chronic form, which can last months or even years if not treated. The camels become anaemic and anorexic. As the parasite is rarely found in blood in chronic cases, the development of an antibody ELISA was a major breakthrough in the eradication of this disease (Rae and Luckins, 1984). Many different drugs against Tryps are commercially available, but some are resistant due to over use and reduced volume application (Schuster *et al,* 2022).

Brucellosis

Brucellosis in camels is common and has been reported from many different camel rearing countries. It is one of the most severe zoonosis with 500,000 new human cases per year. Brucellosis in breeding camels is found in all known forms, whereby abortion is its most obvious manifestion (Wernery *et al,* 2014). Serological test methods are manifold and have been evaluated for use in dromedary camels (Soellner *et al,* 2018). With 7.4% of reactors in our study, the percentage is in the expected range.

West Nile Fever (WNF)

The West Nile Virus (WNV) was first isolated in the West Nile District of Uganda in 1937 from which it spread all over the world. The disease reached the United States in 1999. WNV can only be transmitted by mosquitoes which become infected when they take a blood meal from a bird carrying the WNV. Horses and humans can be infected by the mosquitoes but they are dead end hosts and can therefore not transmit the virus (Castillo-Olivares and Wood, 2004). The virus can be transmitted to many mammals including camelids and even to reptiles. So far, WNF has only been reported in NWCs as Whitehead *et al* (2006) attributed neurological cases in alpacas and llamas in the US to WNV IgG antibodies in their CSF, but no virus was isolated.

Antibodies against WNV have been detected in sera of dromedary camels in the Middle East, North Africa and Spain. Seroprevalence of Kenyan dromedaries for WNF was 23.5% and 38% in the United Arab Emirates (Wernery *et al,* Part I, 2007) which is a surprisingly high prevalence in an arid country. It is not certain, if the virus produces clinical signs in dromedary camels and therefore, it is important to test any dromedary camel with central nervous signs (CNS) for WNF. The virus, lineage 1a, was recently isolated from a healthy camel calf (Joseph *et al,* 2016).

Blue Tongue (BT)

BT is an acute arthropod-born viral infection of sheep, cattle and wild ruminants with extreme manifestation variability, not only between different ruminant species but also between different breeds of sheep. More than thirty serotypes of the virus have been identified and especially BTV-8 had entered Europe some years ago with severe consequences. Our investigation showed a 75.7% seroprevalence for BT of 136 dromedary camel sera from Kenya. Similar prevalences of BT were reported from NWCs and OWCs and only 2 statements from Fowler (1998) and Henrich *et al* (2007) reported respiratory distress followed by abortion in a llama and alpaca. No disease has been reported in OWCs caused by BT.

Table 1. Serological investigations of antibodies to six diseases in 136 dromedary camel sera from Kenya.

	Disease	Results		Test Details	Manufacturer
		Positive	Percentage		
1.	Rift Valley Fever (RVF)	64	47.1	Competitive c-ELISA	ID Vet, France
2.	*Trypanosoma evansi*	14	10.3	In-house direct i-ELISA	Central Veterinary Research Laboratory, UAE
3.	Brucellosis	10	7.4	Rose Bengal Test (RBT)	Linear Chemicals, Spain
4.	West Nile Fever (WNF)	32	23.5	Competitive c-ELISA	ID Vet, France
5.	Blue Tongue (BT)	103	75.7	Competitive c-ELISA	ID Vet, France
6.	*Pestes de Petits Ruminants* (PPR)	0	0	Competitive c-ELISA	BDSL, UK

Peste des Petits Ruminants (PPR)

No PPR-antibodies were found in Kenyan camel sera. Newest research by Schulz *et al* (2019) showed that camelids developed no clinical signs, no viraemia after artificial infection using the Kurdistan/2011PPR strain.

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