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# Tracking Rift Valley Fever Virus Exposure in Nigerian Livestock: A Call for One Health Action

**Bitrus Inuwa [1,*], Ismaila Shittu [1], Olayinka Asala [1], Ebere Roseann Agusi [1], Oluyemi Ogunmolawa [1], Judith Bakam [1], Olanrewaju Eyitayo Igah [1], Valerie Allendorf [2], Klaas Dietze [2], Anja Globig [2], Clement Meseko [1] and Maryam Muhammad [1]**

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**Abstract**

Rift Valley fever (RVF) is an acute, notifiable emerging arthropod-borne disease with epidemic and zoonotic potential. It poses a significant threat to public health, livestock, and food security in some African countries, including Nigeria. A *phlebovirus* causes RVF, a large group of RNA viruses of the family *Bunyaviridae* with potential for international spread and bioterrorism. RVF virus can infect several domestic and wild animals as well as humans. It is transmitted through direct contact with infected blood or body fluids, animal tissue, infected mosquito bites, etc. In humans, RVF is mostly associated with mild flu-like symptoms, which may develop into severe symptoms including encephalitis, hepatic disease, and hemorrhagic fever, while in animals, it causes high rates of abortion and perinatal mortality. Limited information is available in Nigeria on RVF. To gain a better understanding of the infection in livestock, we screened 368 sera collected at slaughter from cattle (*n* = 184) and camels (*n* = 184) at Kano abattoir between May and June 2022 for RVF virus antibodies. The sera were analysed using a commercial ELISA kit. Among the samples examined, female animals constituted the largest at 69.02% (254/368), compared to males at 30.97% (114/368). An overall seropositivity rate of 8.15% (30/368, CI*:* 5.67-11.29) was recorded. The seropositivity was higher in cattle, 8.69% (16/184, CI: 5.233-13.45), than in camels, 7.60% (14/184, CI*:* 4.396-12.15). Based on sex, seropositivity was slightly higher in female animals, at 8.27% (21/254, CI: 5.33-12.15), compared to males, at 7.89% (9/114, CI*:* 3.19-13.99). Our findings revealed that cattle and dromedary camels presented for slaughter in the Kano abattoir, northern Nigeria, have evidence of exposure to RVF virus. This may be a potential risk to humans working at the abattoir and other animal populations. A One-Health investigation is recommended to understand the risk factors, associated vectors, and human exposure to the virus to mitigate the health and socioeconomic threats posed by RVF in the region.

**Keywords:** Rift Valley Fever; one-health; seropositivity; public health risk; surveillance

## Introduction

Globally, zoonotic diseases, transmitted between animals and humans, pose a significant health risk to public, environmental, and animal health. Rift Valley fever (RVF) is an emerging, vector-borne viral zoonotic disease endemic in Sub-Saharan Africa and has been reported in the Arabian Peninsula and other African countries (Tigoi *et al*., 2020. RVF is caused by the RVF virus, a member of the *phlebovirus* genus in the *Bunyaviridae* (Adams *et al., 2017;* ICTV, 2024*).* Rift Valley Fever Virus (RVFV) is transmitted to humans through direct contact with infected blood, animal tissue, abortus foetus, birthing fluid, or infected mosquito bites belonging to the *Aedes* or *Culex* genera and possibly other

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biting insects like gnats and ticks (Tigoi *et al., 2020;* Socha *et al.*, 2022; Tinto *et al.*, 2023). Therefore, occupational groups like the abattoir workers, butchers, livestock handlers, breeders, dairy farmers, pastoralists, veterinarians and animal health workers are all at risk of infection (Mahendra *et al.*, 2021; Tinto *et al.*, 2023) as contact with diseased livestock is the primary way through which humans contract even though infected mosquito bites can also infect humans (Mansfield *et al.*, 2015). In humans, it is asymptomatic, causing febrile illness with flu-like symptoms, and in some cases, it can develop into severe symptoms such as encephalitis and hemorrhagic fever disease with high case-fatality rates. Ocular, liver, and kidney disease are also common complications (Tigoi *et al.*, 2020). In addition, a significant association between RVFV infections during pregnancy and an increased risk for miscarriage in humans has recently been demonstrated (Baudin *et al.*, 2016). In livestock, RVFV causes abortions and perinatal mortality which vary from 5-100% (WOAH, 2023) therefore leading to serious economic repercussions as result of risks to food and nutrition insecurity due to significant losses in animal production (meat and milk), expensive management expenses, closure of livestock markets and stringent trade restrictions (Fawzy and Helmy, 2019; Tinto *et al.*, 2023). This impacts negatively on affected communities' socio-economic livelihoods that can lead to increased poverty (Jansen *et al.*, 2018), and there is concern that RVF may emerge and spread to unaffected geographical regions due to international travel and livestock trade as a result of importation or exportation of disease-carrying insects or animals from endemic regions (Cêtre-Sossah *et al.*, 2012; Lapa *et al.*, 2024; Hestianah *et al.*, 2025). Therefore, the World Health Organization and many countries in Africa have prioritized it with respect to assigning it more urgent research and development for preparedness and response to public health emergencies (Faburay *et al.*, 2017; Petrova *et al.*, 2020; WHO, 2024) because of its high-consequence and ability to cause serious disease in both humans and animals during an outbreak, making it a major zoonotic disease that can transmit a list "A" disease internationally (Tomori and Oluwayelu, 2023). One-humped camels (*Camelus dromedarius)* have been associated with possible reservoirs and intermediate hosts for the transmission of potential zoonotic diseases as they are susceptible to several infectious diseases (Harrak *et al.*, 2011; Kandeel and Al-Mubarake, 2022; Khalafalla, 2023). Previous studies have provided insight into the virus occurrence in camels and other domestic animals slaughtered in abattoirs in Nigeria (Opayele *et al.*, 2019; Adamu *et al.*, 2021; Alhaji *et al.*, 2020). Poor disease reporting, surveillance, or monitoring systems have led to a scarcity of information on RVFV and other diseases status among camels in Nigeria, despite the high influx of camel trade and movement across porous borders into the country, which aids in the dissemination of disease. In Nigeria, camel meat and camel products consumption is on the increase due to poor economy, perceived nutritional value of camel meat, and a claimed curative property (Akpa *et al.*, 2017; Kadim *et al.*, 2018; Al Zahrani *et al.*, 2023). However, diseases from these animals can spill over to humans due to the close contact and interface. Therefore, our overall hypothesis is that livestock slaughtered for human consumption in abattoirs in northern Nigeria are carriers of RVFV, an emerging zoonosis, therefore posing a public health risk.

## Materials and Methods

*Study Area*

The study was carried out in Kano State, Nigeria, located in the Northwestern geo-political region of Nigeria (Figure 1). Samples were collected in the central abattoir, which is located at a longitude of 12.0144°N and latitude of 8.5184° E, respectively (Figure 2). It is well-known for slaughtering and meat processing of camels, cattle, sheep, and goats in the region.

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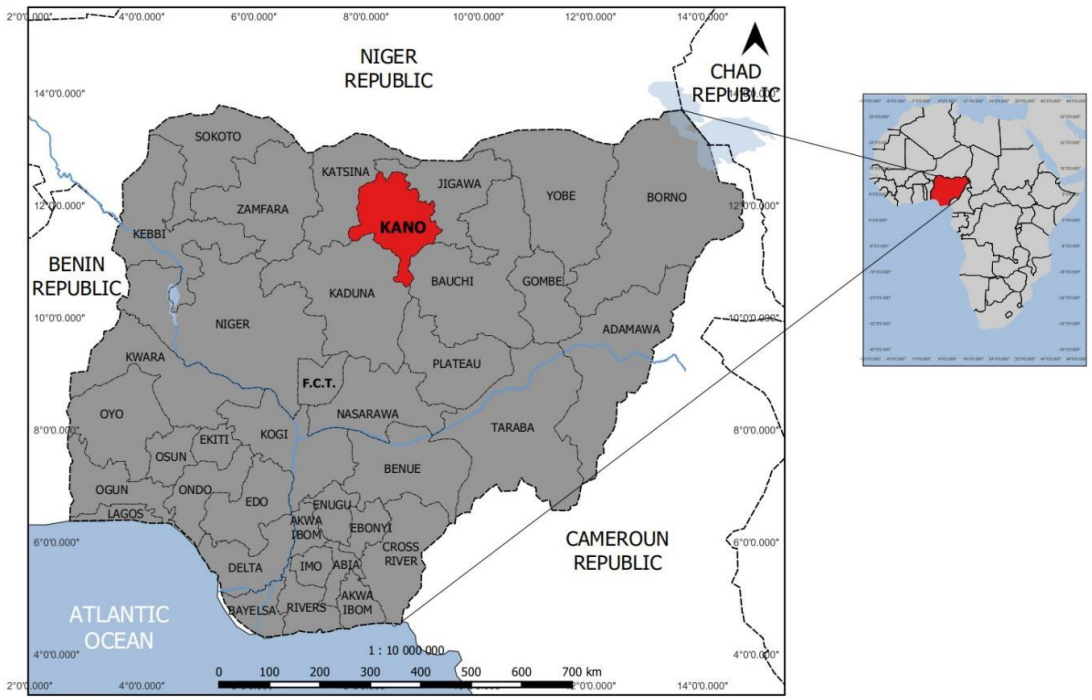


**Figure 1.** Map of Nigeria, showing Kano State (Red), Study area.

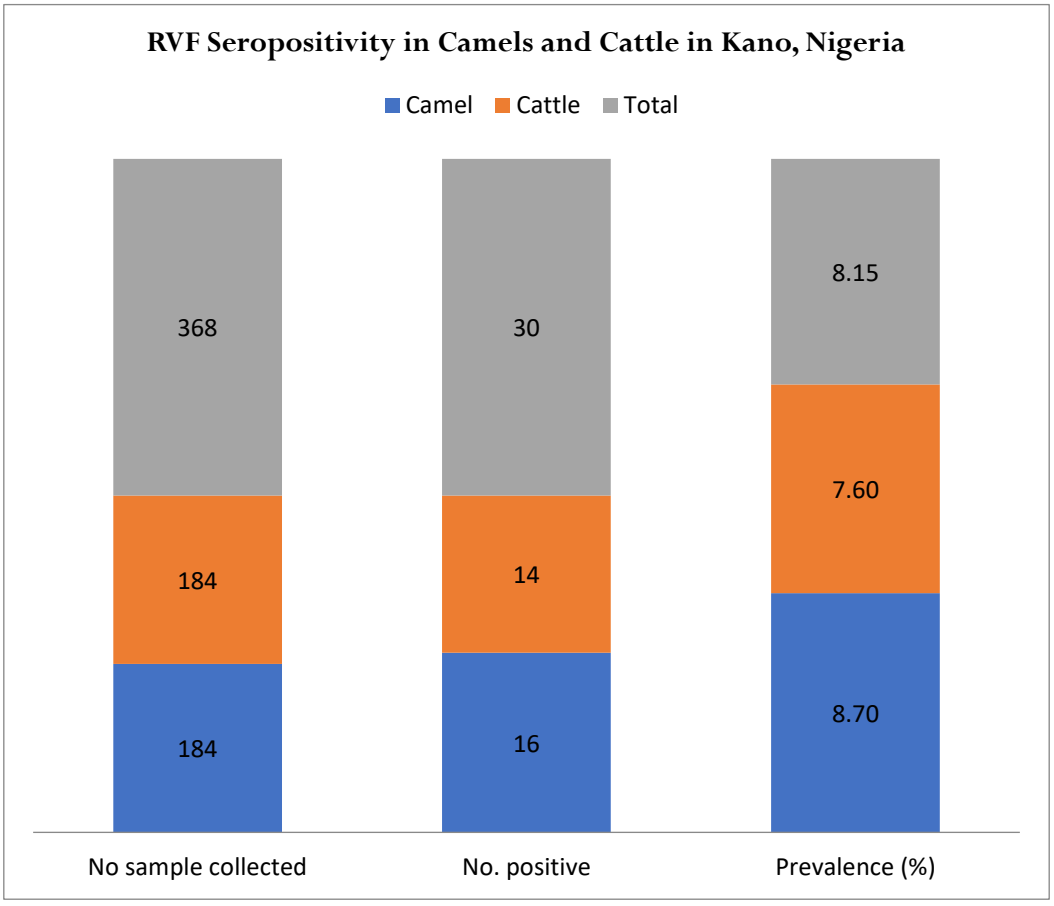


**Figure 2.** Seropositivity rate of RVF in Camels and Cattle in Kano, Nigeria.

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*Blood Sample Collection and Processing*

Between May and June 2022, blood samples were collected at slaughter from cattle ($n$ = 184) and camels ($n$ = 184) at Kano abattoir, in sterile, non-anticoagulant sample vials, and were inclined at 45º until clotted. Sera were then harvested from the clotted blood into sterile and properly labeled 1.5 ml cryotubes. The serum samples were transported under a cold chain to NVRI, Vom, Nigeria, and stored at –20 ◦C until further use.

*Antibody Detection by Competitive Enzyme-Linked Immunosorbent Assay (cELISA)*

The bovine and camel sera were analysed for RVFV-specific IgG antibodies using a commercial ID Screen® RVF competition multispecies ELISA kit (ID-Vet, Grabels, France). The ELISA has shown 100% specificity and sensitivity (Kim *et al*., 2015; Hassine *et al*., 2017; Pérez-Ramírez*et al*., 2020), showing excellent performance, better than the other commercial kit, as a relatively low-cost, easy-to-use surveillance tool for the African context (Bronsvoort *et al*., 2019; Pedarrieu *et al*., 2021). As described by the manufacturer's procedure, cELISA was performed as follows: Briefly, using a micropipette, 50 µl aliquots of test sera, as well as positive and negative control sera, were transferred undiluted to a 96-well RVFV antigen-coated microplate and were incubated for 45 min at 37°C. After incubation, the plates were washed three times with 300 µl of wash solution. Thereafter, 50 µl of diluted antibody-peroxidase conjugate was added to each well, incubated for 30 min at 21°C. The plates were then washed three more times with the wash buffer and 100 µl of the substrate solution was added. The reaction was stopped using 100 µl of the stopping solution added to each well. The results were read by using BioChek ELISA reader (Smart Vet Diagnostic, Reeuwwijk, Netherlands), and the optical density (OD) was determined at 450 nm. When test samples produced an optical density < 50 % of the mean of the negative controls were considered positive for RVFV antibodies, while if the optical density was ≥ 50 %, they were declared negative.

*Statistical Analysis*

Data were analysed using the SPSS version 20.0 statistics package. Positivity rate and Confidence intervals were calculated to summarize the variables. Levels of association between sero-positivity and sex, animal species were obtained using the chi-square test. Values of $p \leq 0.05$ were regarded as statistically significant.

## Results

The study recorded an overall seropositivity rate of 8.15% (30/368, CI*:* 5.67-11.29). Slightly higher seropositivity was recorded in cattle, 8.70% (16/184, CI: 5.233-13.45), compared to camels with 7.60% (14/184, CI*:* 4.396-12.15) (Figure 2). Taking both species together, based on seropositivity was slighlty higher in female animals, 8.27% (21/254, CI: 5.33-12.15), than in males, 7.89% (9/114, CI*:* 3.919-13.99), with no significant association between RVF and sex (p > 0.05) (Table 1).

**Table 1.** RVF Seropositivity rate in Nigeria based on sex.

| Sex | No. Sample Tested | No. Positive | % | Confidence Interval |
|---|---|---|---|---|
| Male | 114 | 9 | 7.89 | 3.19-13.99 |
| Female | 254 | 21 | 8.27 | 5.33-12.15 |
| **Total** | **368** | **30** | | |

p ≥ 0.05.

## Discussion

Rift Valley Fever is a viral emerging zoonosis that is considered a major veterinary and public health emergency. The importation and slaughtering of disease-carrying animals from endemic regions are contributing factors to the outbreaks (Hestianah *et al*., 2025). Therefore, the abattoir could

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be a strategic sentinel site to monitor unusual occurrences of zoonotic diseases (Falzon *et a*l., 2021; Gerken *et al*., 2022; Fevre *et al*., 2023), as contact with infected livestock is the primary route through which humans contract RVF (Mansfield *et al*., 2015). This study detected antibodies to RVFV in dromedary camels and cattle slaughtered at the Kano abattoir, Northwestern Nigeria. The overall seropositivity rate of 8.15% (30/368, CI: 5.67-11.29) recorded in this study was significantly lower than previous reports in Nigeria: 19.9% (Andrew *et al*., 2021) among one-humped camels in Northern Nigeria, 20.7% (Hassan *et al*., 2021) among one-humped camels slaughtered in Maiduguri abattoir, Borno State, Nigeria. Oragwa *et al*. (2024) reported 18.4% in cattle and sheep populations in parts of Northern Nigeria. In Niger State, 11.3% was also reported by Alhaji *et al*. (2018). Sixteen (16.0%) also reported by Anejo-Okopi *et al*. (2020) in Jos, Plateau State. Other reports in Nigeria include 11.3% reported by Atuman *et al*. (2022) in Bauchi State and 18.7% reported by Olaleye *et al*. (1996). Other RVF cases in camels with relatively higher seroprevalence include reports by El Mamy *et al*. (2011), Rissmann *et al*. (2017), and Cosseddu *et al*. (2021), all from Mauritania, which recorded 32%, 33%, and 45%, respectively. In Tunisia, Selmi *et al*. (2020) reported 37% seroprevalence in camels. Abdallah *et al*. (2016), in Sudan, reported 9.6% in camels. In the Niger Republic, a higher seropositivity rate of 47.5% and 36.56% was also reported in by Mariner *et al* (1995) and Kadja *et al*. (2025). However, our findings are higher than the 0.7% reported by Opayele *et al*. (2019) among livestock in the Bodija Municipal abattoir in Ibadan, southwestern Nigeria, and the 5.3% reported in livestock handlers (Opayele *et al*., 2018). Using the hemagglutination-inhibition test (HI), Olaleye *et al*. (1996a, b) and Ezeifeka *et al*. (1982) reported seroprevalence of 3.3% and 3.13%, respectively. Other lower seroprevalence reported in other countries includes 5.85% in camels reported by Mroz *et al*. (2017) and 1.3% recorded in Turkey by Gür S. *et al*. (2017). Kalthoum *et al.* (2021) and Hassine *et al.* (2017), both from Tunisia, found 0% seropositivity in camels. The disparity in seropositivity rate in these studies may probably be attributed to differences in sampling season, as an increase in vector population during the rainy season tends to increase RVF outbreaks. This finding could potentially reflect the seasonal trend of the disease (Hassan *et al.,* 2021). This might be the reason why a low rate of seropositivity was also recorded in this study, as samples were collected from May to June, which is still almost the dry season, which is not a suitable climatic period to provide optimal conditions for mosquito population blooms (Kortekaas, 2014; Chambaro *et al*., 2022; Tariku and Rebuma, 2024). Environmental factors, differences in sample size and sampling location, camel population dynamics together with seasonal movements and trade networks, and different diagnostic assays all could have also contributed to the different seropositivity rate, as previously reported (Rissmann et al., 2020; Kadja, 2025). Using ELISA, which is attributed to being more sensitive, 8.15% seroprevalence was recorded, which is higher than the 3.3% and 3.13% reported by Olaleye *et al*. (1996) and Ezeifeka *et al.* (1982) using HI. RVF is an arthropod-borne disease that occurs in specific ecologies, meaning that camels from different locations have varying exposure rates to different factors influencing the occurrence of the disease (Ikegami and Makiho, 2011). The antibodies against RVF recorded in these camels may suggest natural exposure to the RVF virus, as vaccination is not a common practice in camels, and all camels sampled were adult and without maternal antibodies. A higher seropositivity rate was recorded in female camels than in males. This might be attributed to differences in sample size, as more samples were collected from females than from males. This may also be due to the longer lifespan of females, which increases cumulative exposure, and the predominance of females in Saharan herds, as males are sometimes sold or slaughtered (Kadja *et al*., 2025). Hormonal factors may also increase susceptibility, which is in line with earlier findings that associate RVFV infection with increased incidence of female abortions (Sumaye *et al*., 2013; Hama *et al*., 2019). There is no statistically significant association between RVF antibodies and sex. This corroborates the findings of Hassan *et al*. (2021). However, this contrasts with the findings of Maturi *et al*. (2021) in Kenya, who reported a significant association between RVF and sex. This disparity may be attributed to the possible difference in animal husbandry practices and climatic zones of the study locations. This may also be a result of the small sample size collected, which failed to detect any association. A higher proportion of positive samples were

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recorded in cattle than in camels in this study, with no significant association between RVFV and breeds. This study provided evidence of RVFV in camels and cattle slaughtered in Nigeria using the cELISA method. The study was limited by a small sample size in both livestock. Samples were also collected for two months, May and June which coincide with the dry season in this study area when activity of the mosquito vector is less. Therefore, it is recommended that additional surveillance either passive or active should be conducted with a large sample size with sampling throughout the year or season and locations to understand the current status of RVFV in Nigeria. As establishing an active animal health surveillance system to detect new cases is crucial for providing veterinary and human public health authorities early warning because animal outbreaks of RVF precede human cases (Ishema *et al*., 2024). Creating awareness among abattoir workers on the importance of basic health precautions and the use of personal protective clothing when handling animals or during slaughter. A One-Health investigation was also recommended to understand the risk factors, associated vectors, and human exposure to the virus to mitigate the health and socioeconomic threats posed by RVF.

**Conflicts of Interest:** The authors declare no conflict of interest.

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