



Seroprevalence of foot and mouth disease in the wildlife-livestock interface and non-interface areas in Tanzania

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Abstract

A cross sectional study was conducted in the Serengeti ecosystem (wildlife-livestock interface) and central part of Tanzania (non-interface) area to determine the prevalence of foot and mouth disease (FMD) in Serengeti, Bunda, Kongwa and Iramba Districts. Seroprevalence investigation using 3ABC–ELISA technique indicated that the overall prevalence of antibodies against FMD virus was 66.3%. Significantly high prevalence was recorded in wildlife-livestock interface areas (71.5%) compared to non-interface areas (61.0%). District-wise, higher prevalence was recorded in Kongwa district (89.0%) followed by Serengeti (78.0%), Bunda (65.0%) and Iramba (33.0%). Species-wise, higher prevalence was found in bovines (69.8%), ovines (52.4%) and caprines (11.1%). From various risk factors, ecosystem distribution ($X^2 = 4.9308$, $p = 0.0264$) and species distribution ($X^2 = 28.3236$, $P = 0.0001$), the results indicated that FMD is highly prevalent in wildlife-livestock interface areas than in non-interface areas. However, uncontrolled livestock movement in Kongwa District resulted into much higher FMD prevalence than in districts where there is wildlife-livestock interface. The presence of antibodies against FMD virus in species other than cattle revealed that there is a need to consider other species in planning for FMD control.

Keywords: Interface; seroprevalence; foot and mouth disease

To cite this article: Mdetele D, C Kassanga, M Seth and K Kayunze, 2014. Seroprevalence of foot and mouth disease in the wildlife-livestock interface and non-interface areas in Tanzania. *Res. Opin. Anim. Vet. Sci.*, 4(4): 208-211.

Introduction

Foot and mouth disease (FMD) is an acute, febrile, systemic disease of domestic and wild cloven-hoofed animal species and is caused by Foot and Mouth Disease Virus (FMDV). The FMDV virus is classified within the genus *Aphthovirus* in the family *Picornaviridae* (Racaniello, 2001). The virus exists in the form of seven serologically and genetically distinguishable types, namely, O, A, C, Asia1, SAT1, SAT2, and SAT3, but a large number of subtypes have evolved within each serotype (Pereira, 1977). Among domesticated species, cattle, pigs, sheep, goats and water buffalo are susceptible to FMD. Species of

cloven-hoofed wildlife may become infected, and the virus has occasionally been recovered from other species as well (OIE, 2009). According to World Organization for Animal Health (OIE), FMD ranks first among noticeable infectious diseases of animals (OIE, 2000). The main constraints in controlling this disease and why it is considered as the most dreadful viral disease are its high contagiousness, wide geographical distribution, broad host range, ability to establish carrier status, antigenic diversity leading to poor cross-immunity, and relatively short-lived immunity. The epidemiology of FMD in Tanzania is complicated by presence of a big population of wildlife that may harbour FMDV, in particular SAT in African buffalo

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(*Syncerus caffer*) (Dawe et al., 1994). Buffaloes are known to harbour FMD viruses (Radostis et al., 2000), and are probably the major source of cattle infection in Tanzania. A single buffalo can become infected with all three of the endemic serotypes of FMD virus SAT-1, SAT-2, and SAT-3, posing a threat to other susceptible cloven-hoofed animals (Vosloo et al., 2001). Thus, the large population of such wildlife present in Tanzania serves as FMDV reservoir, with potential spill-over into domestic livestock. On the other hand, it is well documented that domestic cattle are efficient maintenance hosts for FMD viruses if control is not maintained (Radostis et al., 2000). Poor surveillance and diagnostic facilities as well as inadequate control programmes are major problems in control of this disease in Tanzania and elsewhere (Kivaria, 2003). Effective vaccination and stringent control measures have enabled FMD eradication in most developed countries, which maintain unvaccinated, seronegative herds in compliance with strict international trade policies. However, the disease remains enzootic in many regions of the world, posing a serious problem for commercial trade with FMD-free countries (Carrillo et al., 2005). Interaction between wild and domestic animals pose a great threat in implementing control measure against FMD. This study was conducted in order to determine seroprevalence of FMD in the wildlife-livestock interface and non-interface areas and propose control strategies for FMD in Tanzania.

Materials and Methods

This study was conducted in the wildlife-livestock interface areas of Serengeti ecosystem, which included areas around Serengeti National Park (Serengeti and Bunda districts) and non-interface areas in the Central part of Tanzania (Kongwa and Iramba districts) (Fig. 1). The study was conducted between March and November 2013.

Study design

Study animals were selected from wildlife-livestock interface and non-interface areas in the districts named above. Two hundred (200) animals were selected from wildlife-livestock interface areas and 200 from non-interface areas with 100 animals being selected randomly from each District. All the sampled animals had not been vaccinated against FMD.

A cross-sectional epidemiological study was conducted. The sample size (n) was estimated using estimated prevalence of 45.3% (Chepkwony et al., 2012) and the formula is according to (Dohoo et al., 2003); $n = Z^2 P (1-P) / d^2$ where n = required sample size, Z = 1.96 (95% confidence level of significance level), P = expected prevalence (45.3%), (1-P) = probability of having no disease, d = precision level or allowable error (5%) and the design effect of 10%. Using this formula, a minimum

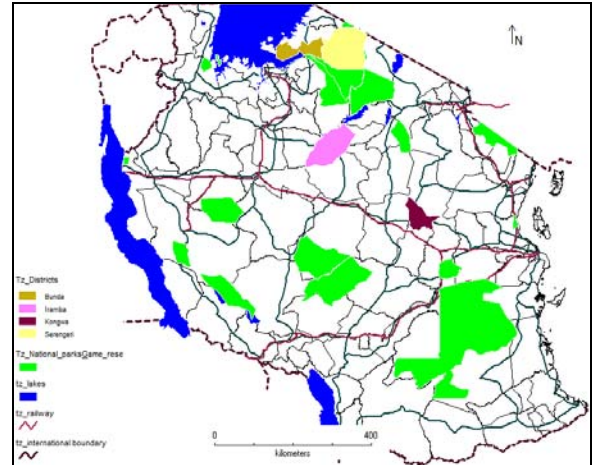


Fig. 1: Map of Tanzania showing study areas and FMD risky factors

sample size of approximately 400 animals was considered sufficient to provide sufficient power for the study. Blood samples were collected and transported under cold chain to the laboratory where serum was separated and stored at -20°C until testing.

The PrioCHECK® foot and mouth disease virus 3ABC-Ab ELISA kit manufactured by Prionics Lelystad B.V of Netherland designed to detect FMD specific antibodies in sera samples was used according to manufacturer's instructions. Optical density (OD) was measured at 450 nm. According to the principle of this test, the percentage inhibition (PI) value increases with more FMDV antibodies, therefore, where PI was ≥ 50 that serum sample was regarded as a positive sample and where PI was < 50 as an FMD negative sample.

The data collected was analyzed using statistical package SAS. Variation of the prevalence between the two different ecosystems; wildlife-livestock interface and non-interface, was determined using chi-square χ^2 test. In all analyses, confidence level was at 95% and $P < 0.05$ set for significance.

Results

Out of 400 sera samples tested for the presence of antibodies to the 3 ABC non-structural protein of FMDV 66.3% (265/400) were positive. The highest prevalence was recorded in wildlife-livestock interface areas; it was significantly different ($X^2 = 4.9308$, $P = 0.0264$) from the prevalence recorded in non-interface areas where the prevalence was 61.0% (122/200) (Table 1). Higher FMD prevalence was recorded in Kongwa District (89%, 89/100) than in Serengeti (78%, 78/100), Bunda (65%, 65/100) and Iramba (33%, 33/100) (Table 2). The difference in FMD prevalence between districts was found to be statistically significant ($X^2 = 78.8372$, $P < 0.0001$). Comparing species seroprevalence, the study

Table 1: Seroprevalence of FMD in study area

Location	Number of samples		Serological status		Prevalence
	N	%	Negative	Positive	%
Interface	200	50	57	143	71.50
Non-interface	200	50	78	122	61.00
Total	400	100	135	265	

$\chi^2 = 4.9308$; $P = 0.0264$

Table 2: Seroprevalence of FMD in the study districts

District	Number of samples		Serological status		Prevalence
	N	%	Negative	Positive	%
Serengeti	100	25	22	78	78.00
Bunda	100	25	35	65	65.00
Kongwa	100	25	11	89	89.00
Iramba	100	25	67	33	33.00
Total	400	100	135	265	

$(\chi^2 = 78.8372$; $P < 0.0001$)

Table 3: Seroprevalence of FMD among species

Species	Number of samples		Serological status		Prevalence
	N	%	Negative	Positive	%
Bovine	361	90.25	109	252	69.81
Caprine	18	4.5	16	2	11.11
Ovine	21	5.25	10	11	52.38
Total	400	100	135	265	

$(\chi^2 = 28.3236$; $P = 0.0001$)

revealed a higher prevalence in bovines (69.8%, 252/361) followed by ovine (52.4%, 11/21) and caprine (11.1%, 2/18) (Table 3). The difference among prevalence in species was found to be statistically significant ($\chi^2 = 28.3236$, $P = 0.0001$).

Discussion

The overall prevalence of FMD in the wildlife-livestock interface areas and in non-interface areas was found to be high at 45.3%. A similar study by Lembo et al. (2012) in the northern zone wildlife-livestock interface area found a prevalence of 68% in Serengeti. Seroprevalence of FMD among different species in Serengeti was found to be 77%, 59% and 47% in bovine, caprine and ovine animals respectively, which was slightly different from what was found in this study where FMD prevalence was 69.8% (bovine), 52.4% (ovine) and 11.1% (caprine).

Although high prevalence was found in wildlife-livestock interface areas, Kongwa District not in wildlife-livestock interface area showed higher prevalence of FMD than Districts found in interface areas. This is mainly due to presence of large livestock market bringing animals from various places. Animals from pastoral society are grazing on maize leftovers after harvesting, Kongwa animals grazing in pastoral areas with pastoralists during cropping season as most areas of the district used for maize-growing resulting shortage of land for grazing. On top of that, presence of two major roads crossing the district and the district having favourable

environment for resting transported animals make the district to be at high risk of the disease. Allepuz et al. (2006) also described the association between the risks of FMD occurrence and distance to main roads, railway lines, wildlife parks, international borders and cattle density.

In Tanzania, the highest prevalence of FMD has been recorded on pastoral herds (Lembo et al., 2012). The high prevalence can be attributed to lack of effective control measures under-reporting of FMD cases, absence of systematic disease surveillance and control measures like periodic vaccination. FMD is one of the major causes for considerable economic losses of the rural communities in Tanzania. In endemic countries, vaccination is the best control strategy that may be applied with controlled man-made animal movement. Vaccines should be formulated in considering circulating virus serotype and topotypes. However, vaccination programme must cover more than 80% of the susceptible population (OIE, 2000).

In conclusion, the study showed that foot and mouth disease is prevalent in Tanzania. Uncontrolled livestock movements resulted into higher prevalence of FMD in Kongwa district compared to districts found in wildlife livestock interface areas. The disease is highly prevalent in the country because of not investing in control of foot and mouth disease. With such higher FMD prevalence, FMD is a serious impediment to livestock production in Tanzania. Therefore, vaccination and controlled man-made animal movement is the best strategy for control of FMD in Tanzania.

Acknowledgement

The study was supported by Southern African Centre for Infectious Disease Surveillance (SACIDS) and Ministry of Livestock Development and Fisheries, both of which are highly thanked for the support. Moreover, willingness and cooperation of animal keepers and local Government Authorities and all their contributions and supports are gratefully acknowledged.

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