



SERO SURVEY OF FOOT AND MOUTH DISEASE VIRUS INFECTION IN CATTLE CROSSING SOME MAJOR BORDER STATES IN NORTHWESTERN NIGERIA

**Babangida, D.¹, Ibrahim, A. A.², Oladayo, F. O.³
Magaji, A. A.³, Alkali, B. R.⁴, Jibril, A. H.⁵**

¹Ministry of Animal Health, Husbandry and Fisheries, Birnin Kebbi State

²Ministry of Agriculture and Environment, Damaturu Yobe State

³Department of Veterinary Public Health and Preventive medicine

⁴Department of Veterinary Microbiology

⁵Department of Veterinary Physiology and Biochemistry
Faculty of Veterinary Medicine, Usmanu Danfodiyo University Sokoto,
Nigeria

jibrilah50@yahoo.com

ABSTRACT

Foot and mouth disease (FMD) poses a major constraint to international trade in animals and animal products in sub-Saharan Africa. A retrospective and serological survey was conducted in two major Border States of Sokoto and Kebbi in north-western Nigeria. This study was aimed at determining the sero-prevalence of FMD virus (FMDV) antibodies in cattle at international animal control posts and to examine cattle population movement across the border area for a period of one year (January to December 2014) from the available records. Eight hundred and eighty (880) sera samples were collected and screened for the presence of antibodies to FMDV using the competitive enzyme linked immunosorbent assay (ELISA) technique. The data were subjected to chi-square and relative risk to check for independence and association. An overall seropositive rate was found to be 55.2% (486/880). A 79.9% (359/450)

sero-positive rate was obtained from the Kamba border, while 29.5% (127/430) was found at the Illela border. Kamba showed a statistically significant ($P < 0.05$) higher sero-prevalence when compared with cattle that are crossing the Illela border (Relative Risk 2.70; 95% Confidence Interval 2.317—3.149). Retrospective data from the control posts revealed that an average number of 2019 and 2747 of cattle, respectively, crossed the Kamba and Illela international borders monthly. The highest influx of animals from the Niger Republic through the Illela international border was encountered between the month of March and April 2014. The magnitude of the presence of FMDV Non-structural protein (NSP) antibodies in the study areas is an indication of the infection and the presence of the virus in the study areas and the neighbouring countries.

Key words: border; foot and mouth disease virus; Nigeria; retrospective survey; sero-prevalence

INTRODUCTION

Foot and mouth disease (FMD), is a highly contagious viral disease of both domestic and cloven hoofed animals characterized by high morbidity and decreased livestock productivity, with affected countries being excluded from international animal trade [3]. FMD is caused by a virus of the genus *Aphthovirus*, family *Picornaviridae*. There are seven serotypes of the virus namely: A, O, C, SAT-1, SAT-2, SAT-3 and Asia 1. Infection with one serotype does not confer immune protection against another. Within serotypes many subtypes can be identified by biochemical and immunological tests [10]. Also, there are topotypic differences between one location and another. Within serotypes, many subtypes can be identified by biochemical and immunological tests [11].

FMD is endemic to most of sub-Saharan Africa, except in a few countries in Southern Africa, where the disease is controlled by the separation of infected wildlife from susceptible livestock as well as by vaccination [6]. In most parts of Africa, FMD outbreaks are often under reported either because of its endemicity as well as the fact that it is not associated with high mortalities in adult susceptible animals, as such it is not perceived as an important livestock disease among herdsmen [7]. Studies conducted by Lazarus et al. [7] in some selected states in Nigeria showed high level of antibodies to the virus in cattle (Yobe State; 82 %, Plateau; 80 %, Ogun; 77.77 %, Taraba; 73.50 %, Adamawa; 68 %; Borno; 67 %).

It is an important constraint to international trade in animal and animal products. It especially restricts world trade in the South-North direction. The endemically or sporadically infected countries, generally face total embargoes on the export of their live animals and fresh meat to many other countries of the world [4]. FMD is a trans-boundary animal disease and the consequences of FMD outbreaks include death, economic losses in terms of international trade, cost of control measures and other indirect losses.

This study determined the seroprevalence of FMD virus antibodies in cattle at animal control posts in Illela and Kamba International border of Kebbi and Sokoto States of Nigeria. It also examined retrospectively the cattle population movement across the border area for a period of one year (January to December 2014). The information obtained on the presence and current status of FMDV infec-

tion in cattle in the study area shall serve as baseline information for further epidemiological studies and control of FMD in livestock in Sokoto and Kebbi States.

MATERIALS AND METHODS

Study area

This study was conducted in two border towns of Illela in Sokoto State and Kamba in Kebbi State, Northwest Nigeria. Illela shares a border with Birnin Konni of Niger Republic to the North. It is located on latitude 13° 43' N and longitude 5° 18' E; it has an area of about 1,246 km² and a population of 150,489 as of the 2006 population census. Kamba is located in North-Western part of Kebbi State. It shares a border with the Republic of Benin and Niger republic to the West, and lies on latitude 12° 41' N and Longitude 8° 40' E. It has a total land mass of 2,003 km² and a population of 144, 273 as of the 2006 population census [8].

The Nigeria international livestock control posts are located within these border towns that serve the purpose of quarantine services. The major occupational activities of the people in these areas include mixed farming, livestock rearing, mining and trading. These borders serve as major route for pastoralist herds that transverse countries mainly within the African sub region including Niger and Benin Republic.

Ethical clearance

Ethical clearance was obtained from the Ministry of Animal Health and Fisheries Development of Sokoto and Kebbi State.

Study design

The two Border States were conveniently selected from the six north-western states of Nigeria. The study area was selected based on their geographical location, ruminant population density, movement pattern, as well as cattle trek route and international boundaries. A pilot study was conducted to determine the average number of cattle that passed through the border on a monthly bases. The study was a cross-sectional serological survey to detect antibodies to FMD virus in cattle using the competitive ELISA technique.

The available records of the number of cattle that crossed through the borders on a monthly basis between

January and December 2014 were obtained from the office of the international livestock control posts at both locations.

Sampling method

A systematic sampling approach was adopted after seeking the consent of the cattle owners for the collection of blood sample from representative animals as they moved through a chute across the border. The systematic sampling involved selection of units at equal intervals, the first animal being selected randomly. This sampling technique did not require knowledge of the total size of the study population and samples collected by this technique tends to be evenly spread in the population [14]. A total of 880 blood samples were collected from the two border towns for a period of 5 months (June to November, 2015).

Sample collection

Cattle congregated at the Niger Republic side of the border at Illela and Kamba. They were allowed to cross over to Nigeria through a chute. The chute is a fenced structure constructed of metal bars with a wide area at the entrance and a narrow area in front to allow passage of a single animal at a time. Within the chute, the age was determined by teeth eruptions [2], the sex by external genitalia and breed types by body type and head characteristics. Five millilitres of blood each was collected, from the jugular vein using a 10ml syringe, into sterile vacutainer tubes. The blood sample was then allowed to clot and later centrifuged at 10,000 rpm for 15 minutes at the General Hospital Kamba and a primary health care facility at Illela to obtain the sera. The sera were then transported in ice pack to the Central Research Laboratory of the Faculty of Veterinary Medicine Usmanu Danfodiyo University Sokoto and stored at -20°C until further processing.

Serological analysis

Serum samples were processed using ID Screen® FMD NSP (Foot and mouth disease non-structural protein) Competitive ELISA (Innovative Diagnostic, IDVet® France). The test is a competitive ELISA for the detection of anti-FMDV non-structural protein (NSP) antibodies in serum and plasma of bovine, ovine, caprine and porcine.

The principle of this technique is based on the formation of a colourless reaction following interaction of a positive test serum in a well, coated with FMDV NSP antigen

after addition of a chromogenic substrate. Optical density was read using an ELISA reader (Optic System IVYMEN® 210°C, USA) at 450 nm.

Data analysis

The data obtained were analysed using SPSS® package version 16, categorical variables (location, age, breed and sex) were evaluated using chi-square to check for associations, relative risk at 95 % confidence interval was used to measure strength of association between variables and sero-prevalence of FMD virus. Values of $P < 0.05$ were considered significant.

RESULTS

Retrospective data from the two control posts showed that an average number of 2019 and 2747 of cattle (respectively) crossed the Kamba and Illela international border monthly from January to December 2014 (Figure 1). From the available records, there are inadequate field officers to monitor; trade animal movement, disease outbreaks and vaccination status at the international livestock control posts. More so, no report on FMD or other transboundary animal diseases were recorded within the stipulated period.

From this study, an overall prevalence of 55.2% (486/880) of antibodies to FMD NSP was obtained from cattle crossing the two major borders in the north-western Nigeria. However, Kamba shows a statistically higher prevalence (79.9%: 359/450) of FMD NSP antibodies as compared to Illela (29.5%: 127/430), as indicated in Table 1. Based on sex specific prevalence, cows showed a higher statistically significance prevalence (60.5%, $P < 0.05$) of FMD virus as compared to bulls crossing Kamba and Illela borders as showed in Table 2. Red Bororo breed of cattle showed a higher prevalence (65.6%) of the virus when compared to Sokoto Gudali and White Fulani (Table 3). Young cattle less than two years of age showed a statistically higher level of circulating antibodies to FMD virus than older cattle crossing the two borders (Table 4).

DISCUSSION

From the retrospective records, no outbreaks of FMD or other diseases were reported from January to December,

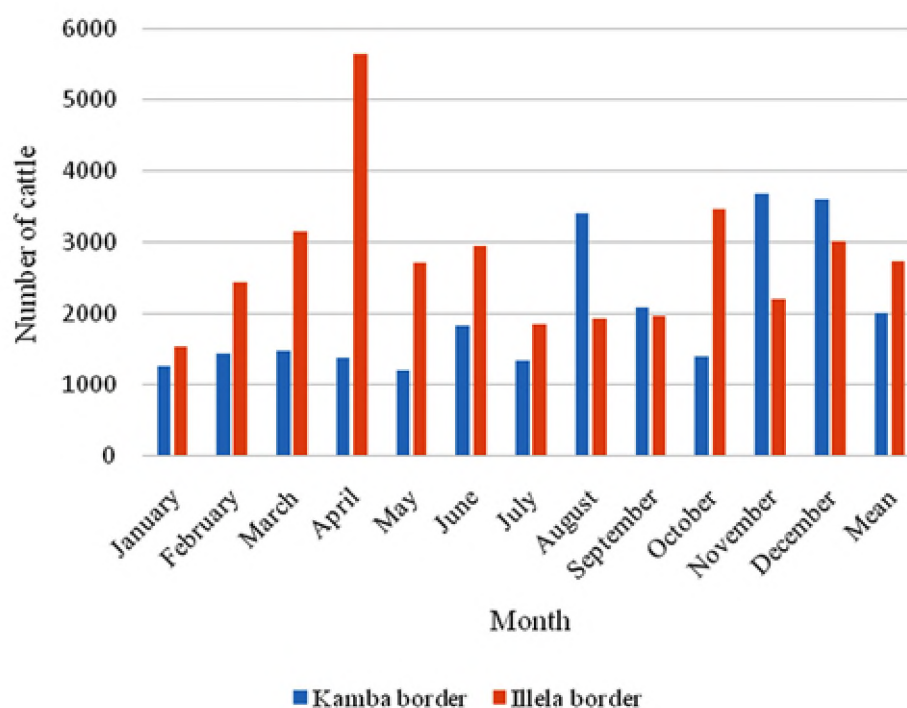


Fig. 1. Retrospective data on number of cattle that crossed Kamba and Illela borders in north-western, Nigeria between January and December 2014

Source: Federal Ministry of Livestock and Pest Control, Kebbi and Sokoto State

Table 1. Sero-prevalence of antibodies to FMDV at Kamba and Illela border towns in north-western Nigeria between January and December 2015

Location	Number of sample	Number of positive	Prevalence [%]	Relative risk	95 % CI
Kamba	450	359	79.9	2.70	2.317—3.149
Illela	430	127	29.5	1.00	
Total	880	486	55.2		

P < 0.005; CI – confidence interval; $\chi^2 = 222.45$

Table 2. Sex specific sero-prevalence of antibodies to FMDV at Kamba and Illela border towns in north-western Nigeria

Sex	Number of sample		Number of positive sample		Prevalence [%]		Total		
	Kamba	Illela	Kamba	Illela	Kamba	Illela	Sample	Positive	Prevalence [%]
Male	171	197	126	50	73.7	25.4	368	176	47.8
Female	279	233	233	77	83.5	33.0	512	310	60.5
Total	450	430	359	127	79.9	29.5	880	486	55.2

P = 0.0002; $\chi^2 = 13.502$

Table 3. Breed specific sero-prevalence of antibodies to FMD virus at Kamba and Illela border towns in north-western Nigeria

Breed	Number of sample		Number of positive sample		Prevalence [%]		Total		
	Kamba	Illela	Kamba	Illela	Kamba	Illela	Sample	Positive	Prevalence [%]
Red Bororo	263	138	225	38	85.5	27.5	401	263	65.6
Sokoto gudali	85	138	59	40	69.4	30.0	223	99	44.4
White fulani	102	154	75	49	73.5	31.8	256	124	48.4
Total	450	430	359	127	79.9	29.5	880	486	55.2

$$P < 0.05; \chi^2 = 32.758$$

Table 4. Age specific sero-prevalence of antibodies to FMDV at Kamba and Illela border towns in north-western Nigeria

Age	Number of sample		Number of positive sample		Prevalence [%]		Total		
	Kamba	Illela	Kamba	Illela	Kamba	Illela	Sample	Positive	Prevalence [%]
≤ 2 years	296	197	264	67	89.1	22.6	493	331	67.1
>2 years	154	233	95	60	61.7	25.8	387	155	40.1
Total	450	430	359	127	79.9	29.5	880	486	55.2

$$P < 0.05; \chi^2 = 63.248$$

2014. This might be due to inadequate field officers, lack of diagnostic facilities and virtually non-existing quarantine station at the border posts. Highest influx of animals from Niger Republic through the Illela international border was encountered between the month of March and April 2014. These months coincided with the peak of the hot dry season. Animals therefore move southward en-mass for pasture/feed, and may lead to increase in the off-take to reduce the cost of feeding and general maintenance of the herds [9].

The present serological study revealed the presence of circulating antibodies to FMDV at the two international control posts. An overall prevalence of 55.2% is an indication of a moderately high presence of the virus in the study population. Similar studies conducted by Lazarus et al. [7] in some selected states (Yobe State; 82%, Plateau; 80%, Ogun; 77.77%, Taraba; 73.50%, Adamawa; 68%, and Bor-

no; 67%) in Nigeria has shown consistency in high level of antibodies to the virus in cattle. This poses a threat to international animal trade between Nigeria and neighbouring countries. The high prevalence obtained in this study may be associated with an extensive movement of livestock, high rate of contact between animals at markets while on transit, common grazing places, as well as watering points along cattle routes [1], especially as these study areas are common points of entry for animals coming from Niger, and Benin Republic before onward distribution to other parts of Nigeria. The Kamba border shows a higher prevalence (79.9%; 359/450) of FMDV as compared with the Illela border (29.5% 127/430). This partly may be due to sampling ratio and largely due to the fact that the Kamba border serve as the first portal of entry for trade cattle from Niger, Benin Republic, Burkina Fasso and Mali into Nigeria.

Sex specific prevalence indicated that the seropositiv-

ity was higher amongst female 60.5% (310/512) than male 47.8% (176/368). There was a significant association between FMDV antibodies and sex. This is in agreement with Olabode et al. [13] who also recorded a higher prevalence of FMDV antibodies in females than in males. This may be attributed to the fact that older females are more likely to have been infected through longer association with other animals [12] as they are kept for longer for breeding purposes. It may also be attributed to immunosuppression associated with pregnancy which may predispose to infections.

The distribution of seropositive FMD carriers according to breed in this study showed that 65.6% of the Red bororo were positive which indicated the highest occurrence compared to the other breeds of cattle such as White fulani (48.4%) and Sokoto Gudali (44.4%). This finding could be associated with the predominance of Red bororo breeds over the other breeds in the study area at the time of sampling.

Sero-positivity of FMD according to age showed that young cattle at the age below 2 years had the higher occurrence (67.1%) compared to the adult group of more than 2 years (40.1%) with a significant association. This is in agreement with [5] and [12] who asserted that young cattle were more poised for trade as their heavy availability in the market could be associated with affordability by prospective buyers. This affordability and high turnover may also fast track migration and contact with other FMD exposed cattle that suffered infection from multiple serotypes thus producing antibodies against all serotypes of FMD. Low immunity in young animals can equally increase susceptibility to infectious agent such as the FMD virus [5]

CONCLUSIONS

The magnitude of the presence of FMDV NSP antibodies in the study area is an indication of infection and the presence of the virus in the study area and neighbouring countries. Sex, age and breed are factors associated with FMD infection. Adequate standard laboratories, clinics and quarantine units should be provided in the border posts to enable screening for FMDV infection and other transboundary animal diseases.

ACKNOWLEDGEMENTS

The authors appreciate the cooperation of the Federal Ministry of Livestock and Pest Control Services, Kebbi and Sokoto State offices and their staff at both border posts, laboratory staff of health facilities used as well as staff of Central Research Laboratory of Faculty of Veterinary Medicine, Usmanu Danfodiyo University for their technical supports.

REFERENCES

1. **Abegunde, A. A., Ezeokoli, C. D., Umoh, J. U., Addo, P. B., 1988:** Epidemiology of foot and mouth disease in Nigerian cattle viral diseases of animals in Africa. *OAU/STRC Scientific publication Lagos Nigeria*, 203—212.
2. **De-Lahunta, A., Harbel, R. E., 1986:** *Applied Veterinary Anatomy*. W. B. Saunders Company, 4—16.
3. **Domingo, E., Baranowski, E., Escarmís, C., Sobrino, F., 2002:** Foot-and-mouth disease virus. *Comp. Immunol. Microbiol. Infect. Dis.*, 25, 297—308.
4. **FAO 1997:** *Prevention and Control of Transboundary Animal Disease*. Production and Health Paper. Food and Agricultural Organization of United Nations (FAO/UN), Rome, Italy, 133, 59—60.
5. **Ishola, O. O., Wungak, Y. S., Olugasa, B. O., David, L. D., Ekong, P. S., 2011:** Serological survey of foot and mouth disease in cattle in Jos south Local Government Area of Plateau state. *Vom Journal of Veterinary Science*, 8, 16—21.
6. **Lazarus, D. D., Adamu, S. S., Shamaki, D., Fasina, F. O., 2010:** Foot-and mouth disease virus situation in Nigeria. In *Book of Abstracts EuFMD Week 2010*. European Commission for the Control of Foot-and Mouth Disease, Research Group of the Standing Technical Committee, Vienna-Austria, Sept. 28th—Oct. 1st., 139—140.
7. **Lazarus, D. D., Schienlens, W. J. G., Wungak, Y., Kwange, D., Fasina, F. O., 2012:** Seroepidemiology of foot and mouth disease in some border states of Nigeria. *African Journal of Microbiology Research*, 6, 1756—1761.
8. **National Bureau of Statistics 2007:** *Office Gazette* (FGP 71/52007/2,500 (OL24). Legal notice on publication of the details of the national and state provisional totals 2006 Census. <http://www.nigeriastat.gov.ng/Connections/Pop2006.pdf>. Accessed on May 30th, 2008.

9. **Ogundipe, G. A. T., 2002:** Role of veterinary quarantine services in monitoring animal movements and disease prevention in Nigeria. *Nigerian Veterinary Journal*, 23, 1—15.
10. **OIE 2004:** *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (mammals, birds, bees)*. 5th edn., OIE, Paris, France, 111—128.
11. **OIE 2009:** Foot-and-Mouth Disease, Chapter 2.1.5. In *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (mammals, birds and bees)*, Web Edition. Available at http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.01.05_FMD.pdf. Accessed on 27th June, 2011
12. **Olabode, H. O., Kazeem, H. M., Raji, M. A., Ibrahim, N. D., 2013:** Sero-prevalence of foot and mouth disease virus antibodies in trade cattle (*Bos Indicus*) in Kwara state-Nigeria. *Veterinary World*, 6, 828—832.
13. **Olabode, H. O. K., 2011:** *Molecular Studies of Foot and Mouth Disease Virus in Kwara State, North-Central Nigeria*. PhD. Thesis, Ahmadu Bello University, Zaria, Nigeria, 201 pp.
14. **Thrusfield, M., 2005:** *Veterinary Epidemiology*. 3rd edn., Blackwell Science, Oxford, 7—13.

Received May 18, 2017

Accepted June 30, 2017