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Original Research

Outbreak of *Peste des petits* Ruminants (PPR) in Some Flocks of Sahel Goats in Maiduguri, Nigeria

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Abstract

In this study, four suspected PPR outbreaks in Sahel goat farms were investigated between the months of December 2017 and February 2018 in Maiduguri, Nigeria. Clinical and gross pathological presentations were used to evaluate the outbreaks and confirmed using antigen capture ELISA (ACE). There was an overall morbidity of 52.2%, mortality of 24.6%, and a case fatality of 47.2%. Flock distribution of morbidity rates (11.1% – 100%) and case fatality rates (20% – 35%) were recorded for flocks 1, 2, 3, and 4. PPRV antigen was detected using ACE from the pooled oral, rectal, ocular, and nasal swabs from live animals; and spleen, lymph nodes, lungs, and intestine from dead animals. The swab and tissue samples produced virus growth on Vero and BHK-21 cells after 5- and 4-blind passages, respectively. Out of the 40 swab samples collected from live animals, 14 (35%) were positive for PPRV; and 17/20 (85%) of the tissues were also positive.

Keywords: Antigen capture ELISA, Maiduguri, Nigeria, *Peste des petits* ruminants, Sahel Goats.

Introduction

Livestock is a major component of the economy of most parts of the world including Nigeria (Shamaki *et al*., 2004). Nigeria is blessed with abundant livestock resources with most of the animals being concentrated in the northern parts of the country (Williamson and Payne, 1984). The semi-arid zone of north-eastern (NE) Nigeria is reported to account for about 25% of the livestock population of the country (Egwu *et al*., 1995). Nigeria is currently estimated to have a population of 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs, 28,000 camels, 145 million chickens, 11.6 million ducks, 1.2 million turkeys and 974, 499 donkeys (Anon, 2016). The keeping of goats in any community is related to the value attached to their production mainly in the form of meat, milk, hides, and manure (Williamson and Payne, 1984), with goats providing about 35% of total animal protein consumption of the public (Mantip *et al.,* 2016). However, diseases like *Peste des petits* ruminants (PPR) have continued to threaten the food security and livelihoods of smallholders in Nigeria and prevent animal husbandry sectors from achieving their economic potential estimated at a total industrial value of about 40 billion Naira (Kozat and Sepehrizadeh, 2017; Mantip *et al.,* 2021). *Peste des petits* ruminant (PPR) is an acute and highly contagious viral disease of small ruminants, caused by peste des petit ruminants' virus (PPRV), a member of the genus *Morbillivirus* of the family *Paramyxoviridae* in the order *Mononegavirales*. PPRV infections with morbidity rates of 80–90 % and mortality rates between 50 and 80 % were previously reported (Abubakar *et al*., 2008; El-Yuguda *et al*., 2009). This disease is reported to severely affect small ruminants in over 70 countries in Africa, India, the Middle East, and parts of Asia that are home to over 80% of the world's small ruminants and to more than 330 million of the world's poorest people, many of whom depend on these animals for their livelihoods.

Materials and Methods

Study Area

This study was conducted in Maiduguri, the capital of Borno State, Nigeria. Borno state lies between latitude 10°N and 13°N, and 12°E and 15°E at an altitude of 354m above sea level in the north-eastern part of Nigeria (NPC, 2006). The state has a hot climate with ambient temperatures of 34°C and 45°C that peak in April and May. The state shares international boundaries with the Republics of Niger, Chad, and Cameroun, and borders Adamawa, Gombe, and Bauchi States. The inhabitants are predominantly farmers, animal herders, fishers, or those who combine together two or more of these occupations.

Sample Collection

Sterile swabs were used in taking swabs of the nasal, ocular, oral, and rectal mucosa from the animals exhibiting clinical signs of PPR from all four flocks examined. Also at necropsy, tissue samples of lungs, spleen, lymph nodes (mesenteric and bronchial), and intestines were aseptically taken from the carcasses. All samples were transported on ice to the Animal Virus Research Laboratory, University of Maiduguri, Nigeria for further serological and virus isolations.

Serology

The serological test employed in this study was PPR antigen capture ELISA (ACE). The ELISA technique was carried out according to the manufacturer's protocol. The ELISA kits were obtained from ID. Vet Innovative Diagnostics Grabels, France.

Suspected PPR Outbreak Investigation

The PPRV infection was investigated among flocks of Sahel goats in Maiduguri, Nigeria. The outbreaks were studied among Sahel bucks bought from Yobe state (flock 1), two institution-owned farms (flock 2 & 3), and individual flock (flock 4). The outbreaks were investigated, between the months of December 2017 and February 2018, using clinical presentations, gross pathological presentations, and antigen detection in swabs and tissues.

Data Analysis

Statistical analysis was performed using the GraphPad Prism version 6.0 (GraphPad Software, San Diego, CA,

United States) software. Descriptive statistics such as percentages and frequency distributions were applied to compute the data. A simple Student t-test was used to determine the statistical significance between the two groups. A value of $P < 0.05$ was considered to indicate statistical significance at a 95% confidence interval.

Results and Discussions

In the four flocks of Sahel, goats visited during a suspected PPR outbreak in Maiduguri, Nigeria, between the months of December 2017 and February 2018, there was overall morbidity (52.2%), mortality (24.6%) and a case fatality (47.2%) rate. Flock distribution showed flock one had 100% morbidity, 35% mortality, and 35% case fatality rates, while flock two had 58.8% morbidity, 29.4% mortality, and a case fatality of 20%, flock three had 55.6% morbidity, 11.1% mortality and case fatality rate of 20%, and flock four had morbidity rate of 52.2%, mortality rate of 24.6% and case fatality rate of 30.8% (Table 1).

Table 1: Flock distribution of morbidity, mortality, and case fatality rates in PPRV-infected Sahel goat flocks in Maiduguri, Nigeria

Farm	Number in flock	Morbidity rate (%)	Mortality rate (%)	Case fatality rate (%)
1	20	20 (100)	7 (35.0)	7 (35.0)
2	17	10 (58.8)	5 (29.4)	5 (20.0)
3	9	5 (55.6)	1 (11.1)	1 (20.0)
4	23	13 (56.5)	4 (17.4)	4 (30.8)
Total	69	36 (52.2)	17 (24.6)	17 (47.2)

An overall morbidity rate of 52.2%, a mortality rate of 24.6%, and a case fatality rate of 47.2% recorded in this study are similar to the finding of Zahur *et al*. (2014) who reported an overall morbidity and mortality rates of 68.8% and 29.45% respectively among goats in India. In addition, the variation within morbidity and the mortality rates observed in this study supports the reports of El-Yuguda *et al*. (2008), who reported a morbidity rate of 63% and a mortality rate of 17% among Sahel goats in Maiduguri Nigeria; and Ullah *et al*. (2014; 2015) who reported morbidity and mortality rates of 27.9 -100% and 6.4 – 31.4% respectively among goats of different ages in Pakistan. These findings were higher than the morbidity and mortality rates of 26.42% and 9.65 %respectively observed among PPRV-infected goats in India by Mahajan *et al*. (2017). The current finding is also lower than the 96% morbidity and 60% mortality reported by Adeola *et al*. (2017) among PPRV-infected West African dwarf goats in Ibadan Nigeria. This may be due to breed, seasonal/weather variations, and/or the presence of other concurrent secondary bacterial infections which may exacerbate viral pneumonia (Abubakar *et al.*, 2009; Jones *et al.*, 2016). The clinical presentations observed were those of coughing, dyspnoea, diarrhoea with pasted perianal region, tail and hind quarters (Plate 1A&B), copious nasal discharges (plate 1C), dehydration, recumbency and sunken eyes (Plate 1A), mucopurulent ocular discharge with matting of the facial hair and crusts on the lips.

Plate 1 A – E: Clinical presentations (A&B) recumbency and diarrhea, (C) mucopurulent nasal discharge (D&E) ulcers on the palate and gums of PPRV infected Sahel goats in Maiduguri Nigeria

At post-mortem, there were ulcers, diphtheritic materials, papules, and macules on the surface of the tongue and buccal mucosa (Plate 2A, B &C), ulcers on the palates (Plate 1B & C). There was also congestion of the trachea with mucous accumulation (Plate 3A). The lungs were congested and oedematous with cranioventral consolidation, especially the cardiac lobes (Plate 3 B&C), and there was pleural adhesion (Plate 2D). There were also haemorrhages on the intestine (ileum and caecal) and sloughing of the mucosal lining (Plate 3D).

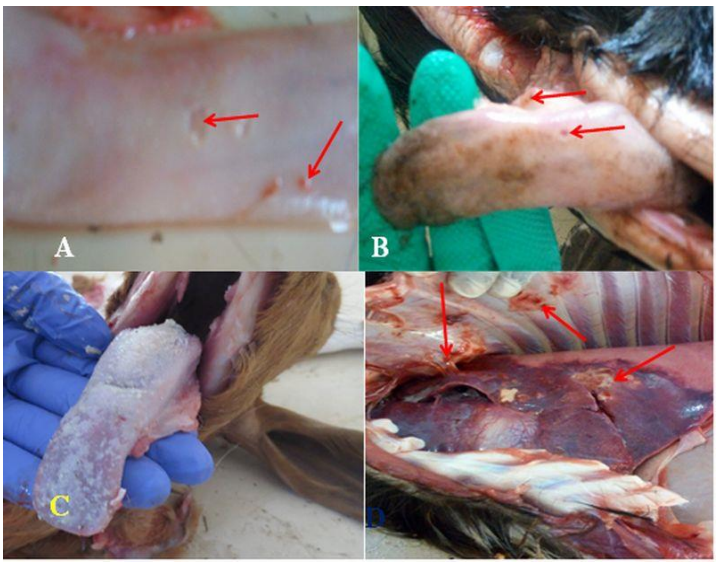

Plate2 A – D: Gross pathological lesions (A, B &C) tongues showing ulcers, papules and diphtheritic membrane, (D) congested lungs with areas of adhesion to the rib cage, in PPRV infected Sahel goats in Maiduguri Nigeria

The clinical and gross pathological signs observed in this study are consistent with the findings of El-Yuguda *et al*. (2008) in Maiduguri Nigeria; and Liu *et al*. (2017) in China. These findings are not consistent with the report of Haq *et al*. (2017) who did not observe mouth lesions among PPRV-infected goats in India. A typical form of PPR is associated with anorexia, pyrexia, ulceration, necrosis of mucous membranes, sores in the mouth, mucopurulent nasal and ocular discharges, bronchopneumonia, inflammation of the gastrointestinal tract (GIT) and diarrhoea (Roeder and Obi, 1999; Abubakar *et al*., 2011; Ullah *et al*., 2014).

In this study, the goats that manifested clear signs of PPR and/or died were mostly younger animals, 1-to-2 years old. The most plausible reason for that may be because the maternal antibodies have waned and the young animals have not been vaccinated or encountered field PPRV. This supports the report by Abubakar *et al*. (2018).

PPRV isolation rates were recorded at 85.0% positive for dead animals using tissue samples, and 35.0% for live animals using swabs (Table 2).

Table 2: Rate of isolation of PPRV from apparently healthy and dead Sahel goats in Maiduguri, Nigeria

Source of samples	Type of sample	Number tested	Number (%) positive
Live animals	Swabs	40	14 (35.0)
Dead animals	Tissues	20	17 (85.0)

PPRV antigen detection using ACE showed the oral swabs recorded the highest percentage OD values of 357% in 3 of the outbreaks, followed by the ocular swab (192.2%, 275.6% & 357%), spleen (357% x 2), lungs (160.7% & 357%), lymph nodes (268% & 231.5%), nasal swab (180.7% & 239.9%) and intestine (180.7% & 100.4%) (Table 3).

The finding of the higher viral load in the oral swabs as compared with the nasal, rectal, and ocular swabs did not agree with the report of Sharawi *et al*. (2010) who observed the nasal and ocular swabs yielding higher virus load in PPRV-infected goats. The detection of high PPRV load in the secretions and excretions of the PPRV-infected Sahel goats could mean that such animals can play a significant role in the dissemination of the virus.

The swab and tissue samples produced virus growth on Vero and BHK-21 cells after 5- and 4-blind passages

respectively. Out of the 40 swab samples collected from live animals, 14 (35%) were positive for PPRV; and 17/20 (85%) of the tissues were also positive (Table 3).

Table 3: Percentage OD values of PPRV-infected Sahel goat tissues and swabs using PPR Ag capture ELISA

Organ	**Date of outbreak**		
	Percentage Optical Density values		
	18/12/17	20/12/17	05/01/18
Spleen	357.0	357.0	NT
Lungs	160.7	357.0	NT
Lymph nodes	NT	268.0	231.5
Intestines	180.7	100.4	NT
Nasal swab	185.6	239.9	NT
Oral swab	357.0	357.0	357.0
Ocular swab	192.2	275.6	357.0
Rectal swab	NT	NT	281.9

The isolates failed to produce a cytopathic effect (CPE) on the cells following neutralization with PPRV-specific antibodies on Vero and BHK-21 cells. The PPRV in the present report was isolated on Vero and BHK-21 cells after 5- and 4-blind passages respectively, before an appreciable CPE was observed. Some workers (Anon, 2010) have earlier reported isolating PPRV on Vero cells after 3 blind passages. No plausible reason could be put forward as to the reason for the difference in the number of blind passages before CPE was observed.

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Contribution by Authors

Equal contribution

Conflict of Interests

There is no conflict of interest.

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