

OUTBREAK OF PESTE DES PETITS RUMINANTS' (PPR) AMONG VACCINATED BALAMI RAMS IN OGUN STATE: A CALL TO PROTECT VETERINARY VACCINES

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ABSTRACT

Peste des Petits Ruminants (PPR) is an endemic transboundary disease prevalent in Africa, the Middle East, and Asia. This paper outlined the outbreak investigation at a field farm in Imasai, Yewa North Local Government Area of Ogun State, Nigeria. The farm housed 391 rams, recorded 147 deaths, and 43 animals showed clinical signs such as fever, nasal discharge, oral ulcers, diarrhea, and sudden death. The animals had been vaccinated against PPR around 13th November, 2024, the index cases were recorded on 4th December, 2024, and case investigation began on 5th December, 2024. A structured outbreak investigation protocol was followed, epidemiological data were collected to estimate morbidity and economic impact. Comprehensive sampling included nasal, ocular, oral, and rectal swabs, as well as blood and tissue samples. A total of 75 samples were transported under cold chain to the National Veterinary Research Institute (NVRI), Vom, for laboratory analysis. Laboratory diagnosis utilized the competitive enzyme-linked immunosorbent assay (cELISA) technique to detect anti-Peste des Petits Ruminants' Virus (anti-PPRV) antibodies. The morbidity rate was 48.6% (n=190/391), the mortality rate was 37.6% (n=147/391), and the case fatality rate was 77.4% (n=147/190). The outbreak represented a vaccine break as the results, interpreted through Percentage Inhibition (PI) values, showed high PI ($\geq 50\%$), indicating the presence of anti-PPRV antibodies. The outbreak underscores the huge socio-economic impact of PPR, the importance of systems vaccinology, and the need to protect veterinary biologicals to enhance vaccine efficacy and reduce vaccine break. Appropriate control measures, have been instituted.

Keywords: Endemic, Investigation, Outbreak, Ruminants, Transboundary, Vaccination

INTRODUCTION

Peste des petits ruminants (PPR), is a highly contagious and lethal viral disease that primarily affects small ruminants like sheep and goats (Kamel & El-Sayed, 2019; Torres-Velez *et al.*, 2019; Newcomer *et al.*, 2020; Chakravarty, 2020; Seifudin, 2020). Peste des petits ruminants Virus (PPRV) is a Morbillivirus and a member of the Paramyxoviridae family. Other names for PPR include rinderpest, goat plague (Balamurugan *et al.*, 2021), or stomatitis-pneumoenteritis complex (Balogun *et al.*, 2017). PPR can be transmitted by inhalation, direct contact, or faecal contact and is disseminated by infected and susceptible animals through

aerosols, excretions, faeces, beddings, water, and feed troughs (Balogun *et al.*, 2017).

The incubation period of PPR is typically 4 to 6 days, but could vary from 3 to 14 days based on factors like virus strain virulence, host species, immune status, and environmental conditions (Mantip *et al.*, 2019; OIE, 2019). Clinical signs associated with PPR disease outbreak in small ruminants include fever, depression, and oculo-nasal discharges. Additionally, erosive lesions on mucous membranes, particularly in the mouth (stomatitis), can be observed. Primary bronchopneumonia or severe dehydration

from acute diarrhea are the main causes of death in majority of cases (Jones *et al.*, 2020; Esonu *et al.*, 2022).

The PPR is a notifiable disease on account of the rapidity of its spread, high morbidity and mortality (Balogun *et al.*, 2017; Fathelrahman *et al.*, 2021). Transmission is mainly through aerosols between animals living in close contact, and confinement seems to favour outbreaks, but it may also happen through the feeding of contaminated feed or water. Secretions and excretions of sick animals are the sources of infection, which can also occur during the incubation period (Balogun *et al.*, 2017; Fong, 2017; Mantip *et al.*, 2019).

The PPR outbreaks can lead to significant financial losses for farmers, particularly those with medium-scale farms, due to animal deaths, treatment costs, and reduced productivity (Aboah *et al.*, 2024). This study aimed to confirm the existence of an outbreak on the farm despite prior vaccination, to verify the diagnosis using standard laboratory techniques, to implement control and preventive measures, and to recommend long-term control strategies, thereby enhancing veterinary services.

MATERIALS AND METHODS

PRELIMINARY PREPARATION

Preliminary preparation involved the official notification by the farmer to relevant veterinary/public health authorities (the Director of Veterinary Services, DVS) an investigation team including veterinarians, Animal Health technologist, and data collectors was formed. A review of the background information on the farm was done. The farm was located in Imasai, Yewa North, Ogun State, Nigeria. Latitude: 7°3'13.03704" N; Longitude: 3°2'32.85708" E

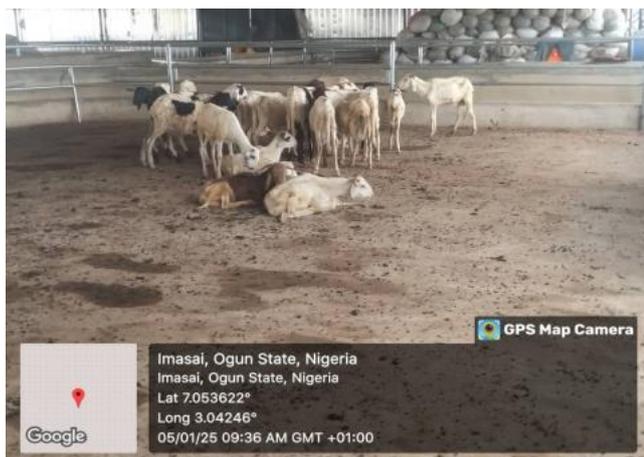


Figure I: GPS Coordinates of the affected herd and the date of the outbreak investigation. Photo Credits: GPS Map Camera App

CASE PRESENTATION

The farm housed 391 rams, recorded 147 deaths, and 43 animals showed clinical signs such as fever, nasal discharge, oral ulcers, diarrhea, and sudden death. The animals had been vaccinated against PPR around 13th November, 2024, the index cases were recorded on 4th December, 2024, and case investigation began on 5th December, 2024.

The Outbreak investigation commenced on January 5, 2025, following reports of increased mortality and morbidity on the farm. Data collection involved direct observation, clinical examination, and interviews with the farm owner. Information on animal species, age, number of affected animals, vaccination status, recent introductions, and movements was collected. Clinical signs observed, such as fever, nasal discharge, coughing, oral ulcers, diarrhea, and sudden deaths, were also documented.

PHYSICAL EXAMINATION

A systematic physical examination was conducted on the sick animals, and signs of illness, as well as estimated morbidity and mortality rates, were recorded. Initially affected animals exhibited serous ocular discharges, nasal discharge, mouth ulceration, diarrhea (with blood), weakness, and congested conjunctivae. Gross Post Mortem lesions observed were emaciation, foul smelling diarrhea, and mucopurulent discharges. There were ulcerations on the lips, gums, tongue, dental pad, and buccal mucosa. Zebra striping was also observed along the rectum (large intestine). There was congestion, edema, and hemorrhages along the abomasum. The respiratory tract was congested and there was obvious consolidation with frothy exudate. The mesenteric lymph nodes were enlarged.



Figure II: Sample collection during PPR outbreak investigation on a farm in Imasai, Yewa North Local Government Area, Ogun State. Photo Credits: GPS Map Camera App

SAMPLE COLLECTION

Nasal, oral and ocular swabs, blood samples were collected from animals showing clinical signs, Samples were labelled correctly with date, animal ID, and sample type. A total of 75 samples were collected, including sera (15), plasma (15), rectal swabs (15), oral swabs (15), and nasal swabs (15) for laboratory analysis. Samples were stored and transported under cold chain to the designated laboratory, National Veterinary Research Institute, Vom.

LABORATORY INVESTIGATION

Laboratory diagnosis was conducted at NVRI, using competitive enzyme-linked immunosorbent assay (cELISA) on serum samples to detect and identify specific antibodies against the PPR virus. The cELISA test was based on the competition between antibodies in the test serum and a monoclonal antibody (mAb) for a specific epitope on the PPRV antigen coated on a microplate. The antibodies against PPRV were present in the test serum; they bound to the antigen and inhibited the binding of the monoclonal antibody. Plates are pre-coated with purified PPRV antigen. Diluted test sera, along with positive and negative controls, are added to the wells. A defined quantity of enzyme-labeled monoclonal antibody was added to each well. This competed with the serum antibodies for binding to the viral antigen. The plate was incubated (typically 37°C for 1 hour) to allow competition and binding. Unbound components were removed by washing with buffer. TMB substrate was added, this reacted with HRP to produce a blue color. A stop solution (e.g., H₂SO₄) was added to halt the enzymatic reaction, resulting in a yellow color. Absorbance was measured at 450 nm using a microplate reader.

RESULTS

The outbreak was marked by typical PPR clinical manifestations, including fever (average 41.10C), nasal and ocular discharges. The farmer had earlier reported serous ocular discharges but at the time of investigation became had become muco-purulent in nature. Other clinical manifestations were oral ulcerations, respiratory distress, and watery diarrhea which was profuse, had greenish colouration and was foul smelling in nature.



Figure III: Lesions typical of PPR in the flock

Serous to slightly mucopurulent ocular discharge (blue arrow), Congested conjunctiva; Dull and sunken eye (yellow arrow).



Figure IV: Lesions typical of PPR in the flock

Crusty, scabby lesions around the mouth and nostrils (blue arrows); mucopurulent nasal discharge, skin erosion or ulceration around the lips and chin area (red arrow); moist dermatitis or exudation (yellow arrow).

The morbidity rate on the farm was 48.6% (n=190/391), the mortality rate was 37.6% (n=147/391), and the case fatality rate was 77.4% (n=147/190).

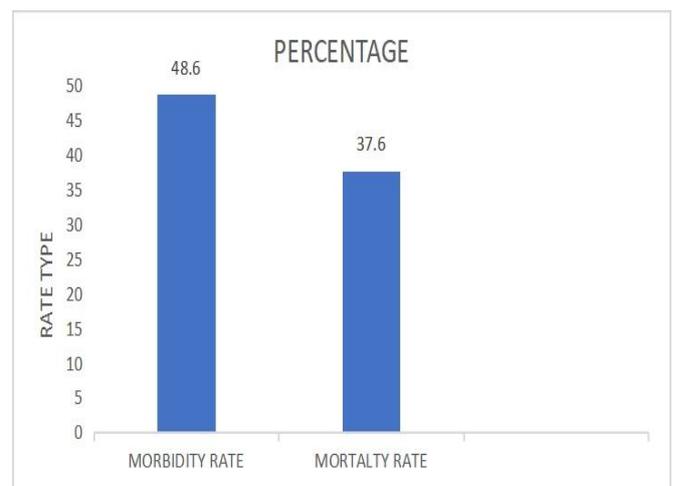


Figure V: Morbidity rate, mortality rate of the affected flock in Imasai, Yewa North Local Government Area, Ogun State

DISCUSSION

This case report documents an outbreak of Peste des Petits Ruminants (PPR) on a farm in Yewa North Local Government Area (LGA) of Ogun State, Nigeria, despite prior vaccination of the flock. This report is similar to the report of Okwelum *et al.* (2017) who recorded a similar outbreak of PPR in Goats in Abeokuta, another Local government in Ogun State. The occurrence of clinical

disease and mortality in a reportedly vaccinated population raises critical questions regarding vaccine coverage, effectiveness, cold chain integrity, and overall herd immunity. These findings align with the findings of Kumbe *et al.* (2024) here they randomly collected serum samples from sheep and goats in Ethiopia and examined them for the presence of PPRV antibodies using competitive enzyme-linked immunosorbent assay (c-ELISA).

The outbreak was marked by typical PPR clinical manifestations, including fever, nasal and ocular discharges, oral ulcerations, respiratory distress, and watery diarrhea. Similar reports have been documented by Kumar *et al.* (2014), Jones *et al.* (2020), and Merdja *et al.* (2024). Affected animals showed rapid disease progression, with several deaths recorded within days of onset. These findings are similar to the reports of previous scholars (Balamurugan *et al.*, 2014a; Kumar *et al.*, 2014; Barman *et al.*, 2024) where they all reported the rapid disease progression in different species of ruminants with PPRV. The morbidity rate on the farm was estimated at 48.6%, mortality Rate 37.6% and the case fatality rate (CFR) at 77.4 %, figures that fall within the range reported in endemic regions of West Africa (Mantip *et al.*, 2019, 2021; Esonu *et al.*, 2022; Mantip *et al.*, 2022; Walle *et al.*, 2024).

The speed of the disease progression and the clustering of clinical cases was likely facilitated by poor biosecurity measures and close contact among animals. This finding is similar to scholarly reports by Parida *et al.* (2016), Rahman *et al.* (2021), Fathelrahman *et al.* (2021) and Nkamwesiga *et al.* (2022, 2023) where they all posit that PPR outbreaks and the propagation of the PPR virus are caused by the movement of small ruminants across borders and across districts, which is made easier by longer road segments and animal comingling. The outbreak profile resembles previous reports of PPR in endemic regions, although outbreaks in vaccinated populations are less frequently reported and often indicate systemic challenges in vaccination delivery or immunity development (Mantip *et al.*, 2019; Balamurugan *et al.*, 2022). Although the exact source of infection remains undetermined, possible routes of introduction include the recent introduction of new stock without proper quarantine or contact with infected animals at nearby markets. The Yewa North LGA borders Benin Republic (Ufoegbune *et al.*, 2024), which raises concerns about transboundary transmission, especially in the context of informal livestock trade routes and limited veterinary surveillance at border crossings (Bouslikhane, 2015; Gao *et al.*, 2021; Mdetele *et al.*, 2021; Mai *et al.*, 2024).

Furthermore, vaccine failure or vaccine break may have contributed to the rapid spread and impact of the outbreak. This assertion aligns with other scholars who have reported that the rapid transmission of PPR is often exacerbated by

vaccine failure or vaccine breakage, resulting in low vaccination coverage relative to the at-risk animal population. (Kumar *et al.*, 2017; Yirga *et al.*, 2020; Savagar *et al.*, 2023). Discussions with the farm management revealed that there was a prior PPR vaccination but they were uncertain about the effectiveness of the vaccine.

Considering the date of prior vaccination, 13th November, 2024 and the date of first mortality onset, 4th December, 2024, there was an interval of about 20 days. The incubation period for PPR is normally 4 – 6 days; however, it can range from 3–14 days depending on the host species, immunological status, environmental factors, and the virulence of the virus strain (Mantip *et al.*, 2019; Eloiflin *et al.*, 2022). The 20-day interval between vaccination and mortality is longer than the typical PPR incubation period, suggesting the animals were not protected by the vaccine or were exposed before full immunity developed. This highlights the need for strict biosecurity, timely vaccination campaigns, and monitoring vaccine efficacy and coverage (Imanbayeva *et al.*, 2025).

Following diagnosis based on clinical signs and laboratory test using cELISA, the outbreak response included isolation of affected animals, symptomatic treatment. The outbreak response actions were in line with documented literature (Balamurugan *et al.*, 2014b; Mahmoud *et al.*, 2022; Ayebazibwe *et al.*, 2023). Although PPR is not zoonotic, its impact on rural livelihoods is profound. Small ruminants like sheep and goats are vital for income generation, nutrition, and socio-cultural practices in many Nigerian households (Roger *et al.*, 2021).

The PPR outbreak on this farm resulted in substantial financial losses due to animal deaths, treatment costs, and productivity decline, particularly for a medium-scale private farm. These financial impacts have been documented by several scholars (Jones *et al.*, 2016; Jemberu *et al.*, 2022; Aboah *et al.*, 2024). Affected animals were isolated, and new or at-risk groups were quarantined. We advised that the farm hygiene be improved, and there was a restriction on the movement of animals and personnel. Contaminated equipment and environment were also disinfected.

Several potential factors may explain the occurrence of PPR in this vaccinated population, such as inadequate vaccine coverage or dosing, the health status of animals before vaccination, and stress. Farm records indicated that vaccination was carried out, but details regarding the age at first vaccination, booster administration, and vaccine dosage were unclear. Incomplete or improperly timed vaccination may fail to induce protective immunity, especially in young or immunocompromised animals (El-Yuguda *et al.*, 2014; Chambers *et al.*, 2016; Dimitrov *et al.*, 2017; Kumar *et al.*, 2017; Asegid Yohannes, 2021). Another factor is cold chain breakdown. The PPR vaccines are heat-sensitive and require

strict cold chain maintenance (Balamurugan *et al.*, 2014b; Alders, 2015; Kumar *et al.*, 2017; Mariner *et al.*, 2017). In rural or semi-urban areas like Yewa, intermittent electricity supply and poor logistics could lead to vaccine degradation, rendering it ineffective by the time of vaccination. Affected animals were isolated, and new or at-risk groups were quarantined. We advised that the farm hygiene be improved upon and there was restriction of movement of animals and personnel. Contaminated equipment and environment were also disinfected.

Despite the new information generated by our study, which are the necessity for re-evaluation of vaccine efficacy, post-vaccination surveillance protocols and the need for pairing cELISA with molecular diagnostics like RT-PCR to confirm active infection, the findings of this study have the following limitations: There was no formal outbreak reporting to WAHIS at the time of the incident, reflecting gaps in local disease surveillance and reporting mechanisms, which undermine national and global efforts to monitor and eradicate PPR.

RECOMMENDATIONS

The following recommendations were made to the farmer: (1) immediate disease containment, management, isolation of sick animals, providing supportive antibiotic and anti-inflammatory therapy, nutrition, hydration, safe carcasses and waste disposal, as well as disinfection of equipment and pens. (2) The re-evaluation and reinforcement of the vaccination strategy which should involve assessing vaccine potency and cold chain integrity, re-vaccinating at-risk animals, and implementing an annual booster schedule. (3) Biosecurity and farm management enhancements to include the enforcement of strict protocols, the need to control animal movement, and preventing contact with wild ruminants or carriers.

The following recommendations were made to the government: (1) Capacity building, awareness and sensitization campaigns with training for farm staff and herdsman to recognize early PPR signs and periodic refresher training on disease notification, reporting, biosecurity, and vaccine handling. (2) Disease Reporting via the official disease reporting channel, as well as collaborating with local veterinary officers for outbreak response and herd health monitoring.

CONCLUSION

The study documents an outbreak on the farm despite previous vaccination efforts, revealing gaps in vaccine efficacy, coverage, and cold chain maintenance. Laboratory diagnostics validated clinical suspicions, prompting immediate control and preventive measures. Strategic recommendations for long-term disease management were proposed, emphasizing the need for strengthened

surveillance, improved vaccination protocols, and sustained veterinary engagement to enhance animal health services. This case also illustrates the broader burden of PPR in endemic areas and serves as a microcosm of national challenges in the control and eventual eradication of PPR, as targeted by the Global PPR Eradication Programme (PPR-GEP).

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