

## Research Paper

# Research for Peste des Petits Ruminants (PPR) Virus Antibodies in Goats, Sheep and Gazelle from Bauchi and Gombe States, North Eastern Nigeria

A. M. Bello<sup>1</sup>, J. R. Lawal<sup>1\*</sup>, J. Dauda<sup>2</sup>, Y. Wakil<sup>1</sup>, Y. M. Lekko<sup>1</sup>, E. S. Mshellia<sup>1</sup>, K. U. Ezema<sup>3</sup>, S. Y. Balami<sup>3</sup>, I. Waziri<sup>4</sup> and A. U. Mani<sup>1</sup>

<sup>1</sup>Department of Veterinary Medicine, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B 1069, Maiduguri, Borno State, Nigeria.

<sup>2</sup>Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B 1069, Maiduguri, Borno State, Nigeria.

<sup>3</sup>Veterinary Teaching Hospital, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B 1069, Maiduguri, Borno State, Nigeria.

<sup>4</sup>Ministry of Nomadic Affairs and Animal Husbandry, Gombe, Gombe State, Nigeria.

\*Corresponding author E-mail: [rabanajallailudeen@yahoo.com](mailto:rabanajallailudeen@yahoo.com)

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The study aimed to determine the prevalence of Peste des petits ruminants (PPR) in small ruminants of domestic and wild origin from Bauchi and Gombe States, Northeastern Nigeria, PPR virus antibodies were tested in unvaccinated goats, sheep and gazelles using competitive Enzyme Linked Immunosorbent Assay (c-ELISA), and risk factors related to PPR were analyzed. A total of 4223 (3218 goats, 988 sheep and 17 gazelles) serum samples were tested. cELISA resulted positive for 61.1% (2579/4223) animals (60.4% from Bauchi and 61.7% from Gombe). The frequency of the disease was found to be more in gazelles (76.5%) and goats (73.8%) whereas sheep (19.4%) are less infected. Sex and age were found to be associated with PPR seroprevalence ( $p \leq 0.05$ ) in this study. PPR seroprevalence was higher in females 70.4% as compared to male 51.4% which is statistically significant ( $p$ -value  $< 0.0001$ ) at 95% CI and

1.368 odd ratio. Moreover, the disease was found to be more frequent among young ruminants 68.2% than in adult ruminants 51.6% and was statistically significant ( $p$ -value  $< 0.0001$ ) at 95% CI and 0.7568 Odds ratio. It was concluded that when wild ruminant are reared along with domesticated ones, they can serve as a potential threat in the transmission of the disease in susceptible animals. Therefore free routine PPR vaccination campaign in small ruminants should be carried out in Bauchi and Gombe states with more emphases targeting the female and young ones to block the epidemic cycle of the virus.

**Key words:** Frequency, cELISA, small ruminants, Peste des petits ruminants, Northeastern Nigeria

## INTRODUCTION

Peste des Petits Ruminants (PPR) is an acute, highly contagious and, infectious, frequently fatal and trans-boundary febrile viral disease of major economic importance. The disease has high morbidity and high

mortality rates in small ruminants (sheep and goats), especially in endemic countries (Sibel and Harun, 2010; Abdalla *et al.*, 2012) and it has been reported in wild ungulates from families of Gazellinae (*Dorcas gazelle*),

Caprinae (*Nubian ibex* and Laristan sheep) and Hippotraginae (gemsbok) and other wild sheep and goats (Abubakar *et al.*, 2011; Baron, 2011; Munir *et al.*, 2013; Lembo *et al.*, 2013). PPR virus (PPRV) has also been detected in cattle and camels (Roger *et al.*, 2001; Khalafalla *et al.*, 2010; Kwiatak *et al.*, 2011). This virus is a member of genus Morbilli virus, family Paramyxoviridae that primarily infects sheep and goats, and is closely related to *Rinder pest* virus (RPV), canine distemper virus, and human measles virus (Barrett, 2001; Amitha *et al.*, 2007; Baron, 2011). PPR is a disease of major economic importance and it imposes a significant constraint towards successful sheep and goat production owing to its high mortality rate (Salih *et al.*, 2014). It is reported that goats are more susceptible than sheep and younger animals in both the species are more vulnerable than the adults (Saritha *et al.*, 2014).

PPRV infection causes acute and highly contagious disease characterized by fever, anorexia, ulcerative/necrotic stomatitis, diarrhea, purulent oculo-nasal discharges, and pleuropneumonia, resulting in respiratory distress, cough and pneumonia (OIE, 2000; Zahur *et al.*, 2009; Shadmanesh, 2014). PPRV can be shed in nasal and ocular secretions, saliva, urine, feces and probably occurs in milk. Fomites such as water, feed troughs and bedding can also probably transmit PPRV for a short time, but do not remain infectious for long periods (Shadmanesh, 2014). Both crowding of animals in market places and close housing/tethering can increase risk of transmission if virus is introduced (Rahman *et al.*, 2015). The wet season can also predispose to secondary bacterial infections, exacerbating the viral pneumonia (Abubakar *et al.*, 2009).

Presence of infection in a country in one year does not imply endemic infection (OIE, 2012). However, the risk of trans-boundary spread of this disease is high because sheep and goats are easily transported and trade across borders is difficult to control (OIE, 2011). The number of countries in Africa reporting Peste des petits ruminants (PPR) outbreaks to the African Union–Interafrican Bureau for animal resources has increased from 19 in 2008 to 20 in 2009, 25 in 2010 and 27 in 2011 (AU-IBAR, 2011). The top three countries with highest number of outbreaks in descending order are Benin (285), Ghana (184) and Nigeria (126), all in West Africa (OIE, 2009, 2012). PPR is a list A disease of the OIE, and thus member states are required to inform the OIE of the occurrence of the disease in their territory (OIE, 2011). In order to control the disease, various options had been identified as control measures which include strict biosecurity and vaccination (OIE, 2011). Vaccination has remained the only feasible option because of the inability to maintain the zoo-sanitary control measures (Al-Afaleq *et al.*, 2004; Diallo, 2004; Luka *et al.*, 2011). Despite routine annual vaccination campaigns against the disease pockets of outbreak still occur (Luka *et al.*, 2011, OIE, 2012). In Nigeria, El-Yuguda *et al.* (2009) reported outbreak of the

disease on a small ruminant farm in Maiduguri, Borno State, but the status of the disease is yet to be reported in Bauchi and Gombe State, Northeastern Nigeria. Therefore, this study aimed to determine the frequency of PPRV antibodies in goats, sheep and gazelles in Bauchi and Gombe state, Nigeria.

## MATERIALS AND METHODS

### Selection of Study Animals

The study was conducted from September, 2014 to February, 2015. Unvaccinated small ruminant species of domesticated (sheep and goats) and wild origin (*Dorcas gazelles*) from Veterinary clinics, livestock markets, households and ruminant farms from Bauchi and Gombe states were sampled. The animals were randomly grouped based on the evidence of clinical signs, and previous surveys reaching PPRV antibodies. G1 included 1382 animals (1030 goats, 346 sheep and 6 gazelles) reported to present clinical signs of PPR by the State Veterinary clinics authorities. Blood samples were collected into plain sample bottles (for serum) and heparinized bottles (for whole blood). G2 consisted of 2841 animals (2188 goats, 642 sheep and 11 gazelles) randomly selected from livestock markets, major abattoir and farms.

### Sample procedures

Using sterile 5ml syringes and 23 gauge needles, blood samples were aseptically collected from the jugular-vein puncture into a plain sample tubes (without anticoagulant). The sample tubes containing blood were appropriately labeled and left in a slanted position for some minutes to allow the blood to clot. To avoid hemolysis, blood samples were maintained refrigerated at 4°C, transported to the laboratory and centrifuged in a centrifuging machine. Sera samples were collected and tested for PPRV antibodies.

### Tests for PPRV specific antibodies

All serum samples were tested for PPRV antibody using the competitive enzyme linked immunosorbent assay (cELISA) using a cELISA kit (collectively produced by Biological Diagnostic Supplies Ltd, Flow Laboratories and Institute for Animal Health Pirbright, Surrey, England) according to the instructions of the manufacturer as described by the Office International des Epizooties Manual of Standards (OIE, 2000) and Singh *et al.*, (2004). The test is based on the competition between the anti-H protein of PPR virus monoclonal antibodies and specific immunoglobulin in serum samples, which will

bind the PPR antigen (OIE, 2009). The results were obtained using an enzyme labeled anti-mouse conjugate and chromogen solution. The negative and positive cut-off values were used based on the controls (Shadmanesh, 2014).

### Data analysis

The data obtained from the study were stored and coded accordingly using Microsoft Excel-2007. The collected data were analyzed by the Statistical Package for Social Sciences (SPSS) version 17.0. and analysis by using 2-tailed Chi-square test was conducted to find out the association between the investigated risk factors and the ELISA positive and negative animals. The prevalence was expressed in percentage. Significance was determined when  $p < 0.05$ . Calculation of the lower and upper limits of the 95% confidence interval for a proportion was done according to the methods described by Newcombe (1998).

### RESULTS

The overall seroprevalence for PPR in the tested sera samples collected from Bauchi and Gombe states was 61.1% (2579/4223), being 1262/2090 (60.4%) samples from Bauchi State and 1317/2133 (61.7%) samples from Gombe State. Frequency of PPR in small ruminants from Bauchi and Gombe states were considered not statistically significant ( $P$  value = 0.6738) at 95% CI: 0.9271 to 1.128 Odds ratio= 1.023.

Related to the species of small ruminants in both states, 73.8% (2374/3218) goats, 19.4% (192/988) sheep and 76.5% (13/17) gazelles resulted positive for PPRV antibody testing. Individually by species and by State, 73.1% (1163/1592) goats, 19.3% (95/493) sheep and 80.0% (4/5) gazelles resulted positive in Bauchi State, and 74.5% (1211/1626) goats, 19.6% (97/495) sheep and 75.0% (9/12) gazelles in Gombe State (Table 1).

Table 2 shows the results of risk factors associated with the occurrence of PPRV in goats, sheep and gazelles in Bauchi and Gombe State, Nigeria. The result shows that gazelles (76.5%) and goats (73.8%) are more seropositive to the PPRV testing, although the association is not statistically significant ( $P$  value = 0.9225), Odds ratio= 1.037, 95% CI is 0.5024 to 2.139. But comparing the frequency of PPRV testing in gazelles to sheep (19.4%), the association is statistically significant ( $P$  value = 0.0005). Odds ratio= 3.935, 95% CI: 1.880 to 8.237. However, the frequency of PPRV testing in goat and sheep is statistically significant ( $P$  value < 0.0001). Odds ratio= 0.2634; 95% CI is 0.2237 to 0.3102.

PPR is more frequent in female small ruminants (70.4%) as compare to male (51.4%). The frequency of

PPRV in small ruminants in this study based on sex is statistically significant ( $P$  value < 0.0001). Odds ratio= 1.368; 95% CI: 1.240 to 1.511. The result also shows that the young (68.2%) small ruminants are significantly more seropositive to PPR than the adults (51.6%). The frequency of PPRV based on age is statistically significant ( $P$  value < 0.0001). Odds ratio= 0.7568; 95% CI is 0.6842 to 0.8371.

### DISCUSSION

Sero-surveillance and assessment of risk factors is important step towards effective control and eradication of PPR in developing countries in Africa where the disease is still endemic. Seroprevalence and outbreak of the disease have been reported to occur in North-eastern Nigeria (El-Yuguda *et al.*, 2009, 2013). It has been reported that climatic factors, seasonal and geographical variations influence PPR outbreak (Abubakar *et al.*, 2009; Salih *et al.* 2014). The overall frequency of PPR positive animals observed in this study (61.1%) was similar to the observed by Abdalla *et al.* (2012) (61.8%), and Saeed *et al.* (2010) (62.8%), but higher compared to Salih *et al.* (2014) (45.6%), and 50.6% by Osman *et al.* (2009). The PPR frequency was found to be significantly higher;  $P$  value = 0.6738 at 95% confidence interval: 0.9271 to 1.128; Odds ratio is 1.023, in Gombe (61.7%) followed by Bauchi (60.4%) states in North-eastern Nigeria. This state similarity of PPR frequency might be due to the fact that the two states share similar rainfall, humidity, other climatic factors and they share wide range of borders because Gombe State was carved out of Bauchi State. It has been reported that some climatic conditions such as harsh weather and wind plays vital roles in PPR spreading as described by Elnoman *et al.* (2011).

The finding of this work shows the sero-frequency of PPR in Dorcas gazelle to be 76.5% which is higher than 73.8% and 19.4% in goats and sheep respectively. The result of this research shows that gazelles (76.5%) and goats (73.8%) are more seropositive to the PPRV testing, although the association is not statistically significant ( $P$  value = 0.9225), Odds ratio= 1.037, 95% confidence interval is 0.5024 to 2.139. But comparing the frequency of PPRV testing in gazelles to sheep (19.4%), the association is statistically significant ( $P$  value = 0.0005). Odds ratio= 3.935, 95% confidence interval: 1.880 to 8.237. However, the frequency of PPRV testing in goat and sheep is statistically significant ( $P$  value < 0.0001). Odds ratio= 0.2634; 95% confidence interval is 0.2237 to 0.3102.

This high variation between the PPR frequency rates among small ruminants of wild and domestic origin may be an indication of cross transmission. The seroprevalence of PPR in wild ungulates have been previously reported (Abubakar *et al.*, 2011; Baron, 2011; Munir *et al.*, 2013). These animals play significant role in

**Table 1.** Frequency of PPRV antibodies in goats, sheep and gazelles from Bauchi and Gombe states, Nigeria.

Parameters	Bauchi State				Gombe State			
	Alkali	Bauchi	Darazo	Ningi	Akko	Dukku	Gombe	Yamaltu Deba
N	396	411	391	394	409	434	408	375
n	291	300	281	291	306	321	318	266
Seroprevalence in goats (%)	73.5	73.0	71.9	73.9	74.8	74.0	77.9	70.9
95% CI	0.6892- 0.7759	0.685- 0.7706	0.6722- 0.761	0.6931- 0.7794	0.704- 0.7878	0.6963- 0.7787	0.7367- 0.8169	0.6614-0.753
N	120	125	120	128	126	132	119	118
n	27	26	21	21	28	27	21	21
Seroprevalence in sheep (%)	22.5	20.8	17.5	16.4	22.2	20.5	17.6	17.8
95% CI	0.1595- 0.3076	0.1461-0.2873	0.1174-0.2528	0.1099- 0.2379	0.1584- 0.3024	0.1445- 0.2812	0.1184- 0.2548	0.1195-0.2568
N	1	3	1	0	2	0	8	2
n	1	2	1	0	2	0	5	2
Seroprevalence in gazelles (%)	100	66.7	100	0	100	0	62.5	100
95% CI	0.2065- 1.000	0.2077- 0.9385	0.2065- 1.000	-----	0.3424- 1.000	-----	0.3057-0.8632	0.3424-1.000
N = 4223	517	539	512	522	537	566	535	495
n = 2579	319	328	303	312	336	348	344	289
Overall Seroprevalence (%)	61.7	60.9	59.2	59.8	62.6	61.5	64.3	58.4
95% CI	0.5744- 0.6579	0.5667- 0.6488	0.5487- 0.6335	0.5551- 0.6389	0.584- 0.6656	0.5741- 0.654	0.6015- 0.6824	0.5399-0.6264

Legend: N, number of animals sampled; n, number of positive animals; 95% Confidence interval;  $p \leq 0.05$  was considered as significant.

**Table 2.** Risk factors associated with the occurrence of PPRV in Goats, Sheep and Gazelles in Bauchi and Gombe State, Nigeria.

Species	N	n	Percentage (%)	Lower Limit	Upper Limit
Goats	3218	2374	73.8(2374/3218)	0.7222	0.7526
Sheep	988	192	19.4(192/988)	0.1708	0.2201
Gazelle	17	13	76.5(13/17)	0.5274	0.9044
Sex					
Male	2073	1066	51.4(1066/2073)	0.4927	0.5357
Female	2150	1513	70.4(1513/2150)	0.684	0.7226
Age					
Young	2418	1648	68.2(1648/2418)	0.6628	0.6999
Adult	1805	931	51.6(931/1805)	0.4927	0.5388
Total	4223	2579	61.1(2579/4223)	0.5959	0.6253

p-value = statistically significant (P<0.05).

the transmission of the infection to domestic ruminants (Gopilo, 2005;Zahur *et al.*, 2008), and indicates that goats and sheep from the two studied states may be at high risk of infection especially where reared in farms closer to

susceptible wilds ruminants.

In this present study, the overall frequency of PPR in young small ruminant (68.2%) is higher than in adult ruminants (51.6%). The frequency of PPRV based on age is statistically significant (P

value < 0.0001); Odds ratio= 0.7568; 95% confidence interval is 0.6842 to 0.8371. These results are in support to the findings of Sarker and Islam (2011) who reported the highest PPR prevalence in young animals. This may be

connected to the poor immunity and poor nutrition status of young ruminants which may subject this age group vulnerable to the PPR infection. This study revealed that females (70.4%) small ruminant were more affected as compared to males (51.4%) and the difference was statistically significant ( $P < 0.05$ ) which agree with the report by Shuaib, (2011) and Abdalla et al. (2012). The livestock breeding system in Northern Nigeria where female animals were usually kept longer in a flock for the purpose of reproduction purpose while the males are either sold out for meat used in festivals and sacrifices could be the reason connected to the wide spread of the infection in this gender of small ruminants in the study areas. Although, this findings contrast with Sarker and Islam, (2011) who reported that males ruminants are mostly affected by PPR which might be due to genetic variation of the animals.

## Conclusion

The present study confirms the circulation of PPRV in domestic and wild ungulate animals from Nigeria. Gazelle and goats seem to be more susceptible than sheep, as well as female and young animals in the studied areas.

## Recommendation

It is recommended that ruminant pastoralist should be encouraged to enhance participation in PPR surveillance and control program to better control the disease. Routine PPR vaccine administration and awareness campaign should be organized in Northeastern Nigeria where pockets of outbreaks are still recorded annually.

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## Authors` declaration

We declare that this study is an original research by our research team and we agree to publish it in the Journal.

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