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Seroprevalence of *Peste des petits ruminants* (PPR) viral antibodies in goats and sheep in Abia State, Nigeria

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Abstract

Peste des petits ruminants (PPR) is a contagious viral disease of goats and sheep, and a major constraint to small ruminant production because of the high morbidity and mortality associated with the disease. The present study determined the prevalence of PPR virus antibodies in goats and sheep in Abia State, Nigeria. The design was a cross-sectional survey. A total of 284 serum samples (209 from goats and 75 from sheep) were purposively collected from small ruminants in all the agricultural zones in the State (Aba, Ohafia and Umuahia). Competitive enzyme linked immunosorbent assay was used to detect the presence of antibodies against PPR virus in the sera. An overall seroprevalence of 57.7% was recorded, and seroprevalence values for the species were: 62.2% for goats and 45.3% for sheep. Seroprevalence in the various agricultural zones in decreasing order were: Umuahia – 65.2%, Ohafia – 64.0%, and Aba – 41.9%. The seroprevalence significantly ($p = 0.011$) varied across the three agricultural zones. Among various age groups, a higher seroprevalence was recorded in young animals between the ages of 6 to 12 months (70.6% in goats and 50.0% in sheep), when compared with the other age groups. Female goats had higher seroprevalence (67.9% in does) when compared to the males (55.7% in bucks). West African Dwarf goats had a higher seroprevalence (68.3%) than the Red Sokoto breed of goats (53.5%), but in sheep, a lower seroprevalence (36.8%) was obtained in the West African Dwarf breed of sheep when compared to the Yankassa breed (54.1%). There was significant association between breeds sampled and seroprevalence. This study showed that there is a high (57.7%) prevalence of PPR virus antibodies in goats and sheep in Abia State, Nigeria. Regular vaccination was recommended and PPR awareness programs were advocated.

Keywords: *Peste des petits ruminants*; Seroprevalence; Antibodies; Abia State, Nigeria; Goats; Sheep; Survey.

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Introduction

Small ruminant production contributes majorly to the agricultural economy of Nigeria. Small ruminants are a major source of animal protein, and among rural dwellers, a major source of income (Naveen *et al*., 2014). Goat and sheep production serve as major sources of revenue and means of livelihood for many farmers, especially those living in the rural areas. One of the constraints to a thriving small ruminant production, especially in Africa is disease, and *Peste des petits ruminants* (PPR) is a very important disease of goats and sheep that has been known to cause losses to farmers as a result of the high morbidity and mortality associated with the disease (Mdetele *et al*., 2021; Esonu *et al*., 2022)

Peste des petits ruminants (PPR) is a highly infectious and trans-boundary viral disease of both wild and domestic ruminants (Khan *et al*., 2007; Koshemtov *et al.,* 2014). The disease significantly hinders small ruminant production due to the high morbidity and mortality associated with its outbreak, especially in West Africa, where it is endemic (Kumar *et al.,* 2014; Khanal *et al*., 2021). It is caused by the PPR virus, an RNA virus and a member of the genus *Morbillivirus,* in the Paramyxoviridae family (Knipe and Howley, 2013). The disease affects small ruminants of all ages (Chukwudi *et al.,* 2021), and it is characterized by fever, sneezing, mucopurulent nasal and ocular discharges, cough, gastroenteritis with diarrhoea, ulcerative necrotic stomatitis and death (Balamurugan *et al*., 2006).

Vaccination has been a major control measure against PPR, though other measures such as control of animal movement and quarantine are also applied (Luka *et al*., 2011). However, despite the use of the homologous PPR vaccines, outbreaks of PPR have continued to occur (Woma *et al*., 2016). Crucial to the effective control of this disease is an adequate understanding of the epidemiology of the disease. The seroprevalence of PPR in different locations in Nigeria have been reported (El-Yuguda *et al*., 2013; Woma *et al*., 2016; Bello *et al*., 2016; Chukwudi *et al.,* 2020; Mantip *et al*., 2021), but there is paucity of information on the seroprevalence of PPR in Abia State, Nigeria. The present study determined the seroprevalence of PPR virus (PPRV) antibodies in sheep and goats in Abia State, Nigeria.

Materials and Methods

Sampling: Goats and sheep from all the agricultural zones in the Abia State, Nigeria (Aba, Umuahia and Ohafia) were sampled during the study. For each agricultural zone, two Local Government Areas (LGAs) were randomly selected. From each of the selected LGAs, goats and sheep at livestock markets and household herds were conveniently sampled based on traders/owner's consent. Blood samples for the survey were collected from these goats and sheep.

Sample Size: The sample size used for this study was estimated using the formula: $N = Z^2 Pq/d^2$ (Thrushfield (2005); where N = Sample size, P = Prevalence rate, Z = Standard normal deviation at 95% confidence interval (1.96), d = Precision allowance for error (0.05) and q = 1 – P. A prevalence of 23.16% according to Woma *et al.* (2016) was used for sample size calculation, giving a total sample size; N = 273.79. Blood samples were collected from a total of 284 small ruminants (209 goats and 75 sheep) in all the agricultural zones in the study area. Information on the species, breed, age and sex of the animals were recorded at the point of blood sample collection.

Ethical Approval: Approval for the use of the animals for the study was sought for and obtained from the Institutional Animal Care and Use Committee (IACUC) of the Faculty of Veterinary Medicine, University of Nigeria, Nsukka (Approval Reference number: FVM-UNN-IACUC-2023-09/120).

Blood sample collection and serum harvest: Four millilitre of blood was aseptically collected from the jugular vein of each animal and put into a plain glass test tube. The blood samples were allowed to clot for 45 minutes and serum separated by centrifugation. The clear supernatant serum was aspirated and stored in a clean labeled sample bottle for use in serology.

Serology: The sera were evaluated for the presence of PPR virus antibodies using a monoclonal antibody based competitive enzyme linked immunosorbent assay (c-ELISA) as described by Anderson and McKay (1994). The competitive enzyme linked immunosorbent assay test kit used for the detection of PPR virus antibodies was developed by the Shenzhen Lv shiyuan Biotechnology Co., Ltd (Version 2020-01). The test was performed according to the manufacturer's instructions. The optical density (OD) of the positive and negative controls met the validation criteria as indicated by the manufacturer (Libeau *et al.,* 1995). The competition percentage (CP %) for each sample was calculated with the following formulae: CP = Sample OD value / Average OD values of negative control. Samples with CP values less than or equal to 0.5 were considered positive, while CP values greater than 0.5 were regarded negative (as specified by the test kit manufacturer). The serology test used did not differentiate between vaccine antigen induced antibodies and disease-induced antibodies. It is possible that some of the seropositive samples may be from vaccinated animals; however majority of sampled animals were from our indigenous herds reared by local farmers who do not know of and did not vaccinate their animals.

Data Analysis: Data obtained from the study were subjected to descriptive statistics, using Microsoft Excel 2007. Chi-square test of independence and odds ratio (OR) were also done using Statistical Package for Social Sciences (SPSS) version 23.0. Results were presented in form of tables and bar charts.

Results

Out of the 284 serum samples collected and tested, 164 tested positive for PPR virus antibodies, having a competitive percentage (CP) of less than or equal to 0.5, giving an overall seroprevalence of 57.7% in the goats and sheep in the study area. The PPR virus antibody seroprevalence was higher in goats (62.2%) than in sheep (45.3%) (Table 1). The difference in the seroprevalence rates of PPRV antibodies in sheep and goats was found to be statistically significant ($p = 0.011$).

Sex-based distribution of the seroprevalence showed that 47.6% of male sheep (ram) and 42.4% of female sheep (ewe) were seropositive, while 55.7% of male goats (buck) and 67.9% of female goats (doe) were seropositive (Table 1). Higher proportion of younger goats and sheep of less than 12 months of age were seropositive (70.6% in goats and 50% in sheep) than in the older animals (Table 1). There were no significant associations ($p > 0.05$) between seroprevalence of PPRV antibodies and sex or age of goats and sheep studied (Table 1).

Antibodies to PPR virus were detected in goats and sheep in all the agricultural zones and Local Government Areas (LGAs) sampled. The highest seroprevalence was recorded in Umuahia agricultural zone (65.2%), followed by Ohafia (64.0%) and Aba (41.9%) (Figure 1). In all the LGAs sampled across these agricultural zones, the highest seroprevalence was reported in Umuahia South LGA (67.7%) followed in decreasing order of prevalence by Isuikwuato LGA (66.7%), Umuahia North and Bende LGAs (62.0%), Osisioma LGA (42.6%) and Aba South LGA (40.6%) (Figure 1). There was a significant difference ($p = 0.020$) in the seroprevalence recorded for the different agricultural zones.

Breed-based distribution of seroprevalence showed that 54.1% of Yankassa breed of sheep and 36.8% of WAD sheep were seropositive. The proportion of Red Sokoto goats and WAD goats that were seropositive were 53.5% and 68.3%, respectively. There was significant association (p = 0004) between seroprevalence and breed of goats and sheep studied (Figure 2).

Table 1. Seroprevalence of *Peste des petits ruminants* (PPR) virus antibodies amongst species, sex and various age groups of goats and sheep sampled in the three agricultural zones of Abia State, Nigeria.

	Total number sampled	Number of samples Positive	Percentage Prevalence
Species			
Goat	209	130	62.2
Sheep	75	34	45.3
Sex			
Buck	97	54	55.7
Doe	112	76	67.9
Ram	42	20	47.6
Ewe	33	14	42.4
Age (months)			
Goats			
< 12 months	17	12	70.6
13 – 24 months	128	79	61.7
> 24 months	64	39	60.9
Sheep			
< 12 months	2	1	50
13 – 24 months	36	18	50
> 24 months	37	15	40.5

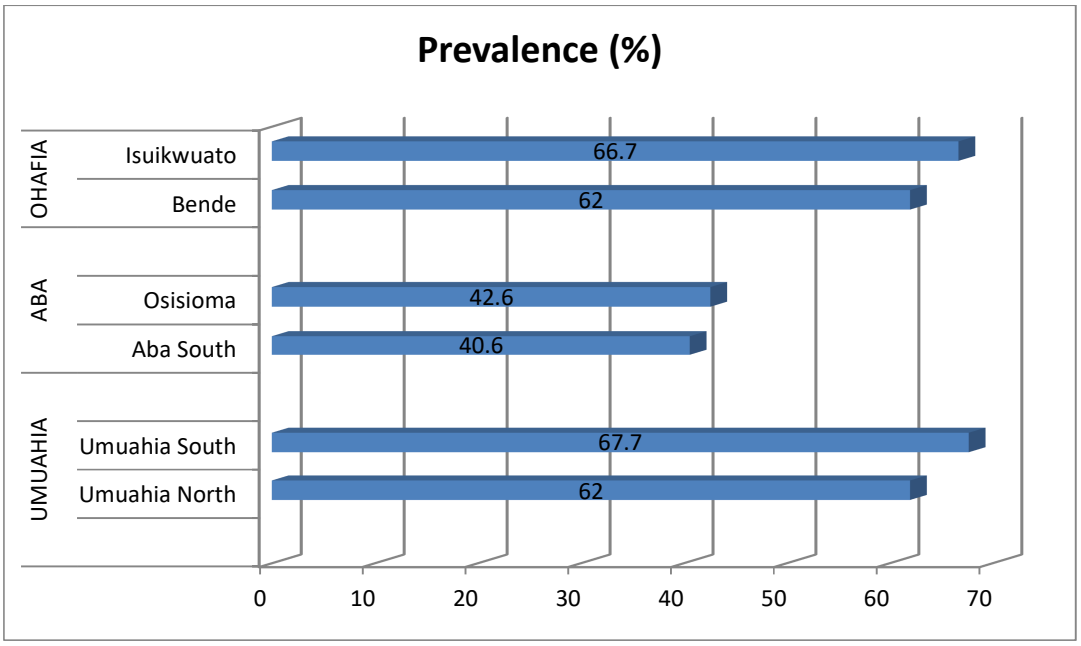

Figure 1. Seroprevalence of *Peste des petits ruminants* virus (PPRV) antibodies across Local Government Areas/Agricultural Zones in Abia State, Nigeria.

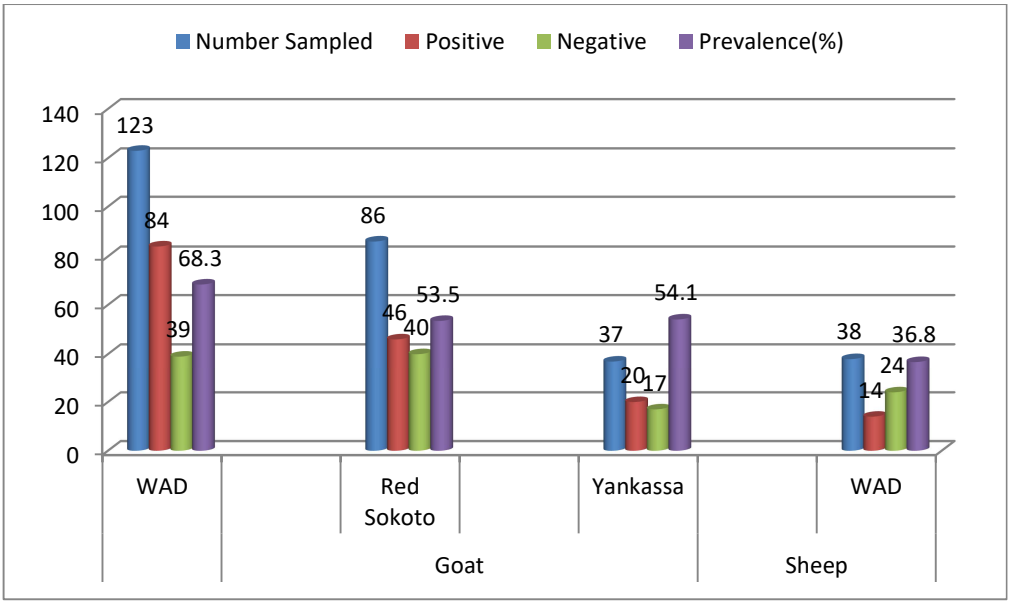

Figure 2. Distribution of *Peste des petits ruminants* virus (PPRV) antibodies amongst different breeds of goats and sheep sampled in Abia State, Nigeria.

Discussion

The overall prevalence of 57.7% for PPR virus antibodies recorded in the present study in small ruminants in Abia State, Nigeria, is closely comparable to the 56.5% and 55% reported by Majiyagbe *et al.* (1992) and El-Yuguda *et al. (*2013), respectively from small ruminants in Northern Nigeria. However, a higher seroprevalence of 62.2% and 61.7% was reported for small ruminants in Enugu and Gombe states of Nigeria by Chukwudi *et al.* (2020) and Bello *et al*. (2016), respectively. The relatively high prevalence of PPR viral antibodies recorded in the present study and also in other states of Nigeria could be attributed to nomadic movement of livestock, low awareness of PPR occurrence and poor management practices by farmers and butchers, and possibly pockets of vaccinated animals. Transportation of trade animals from a part of the country to the live animal markets in other parts in often overcrowded vehicles, may significantly contribute to the high and relatively comparable prevalence reported by several studies.

In the present study, goats had significantly ($p < 0.05$) higher prevalence (62.2%) than sheep (45.3%), with no significant association between the seroprevalence of PPR and sex of animals; this finding agrees with the reports of Abubakar *et al.* (2011), Nwobodo, (2012) and Maitilo *et al.*, (2017) who also recorded a significantly higher prevalence in goats than in sheep. The relatively higher population of goats sampled in this study may partly explain the significantly higher seroprevalence of PPR observed in goats than in the sheep, but could also partly be attributed to the breeding system; as bucks are not usually kept in the flock for long periods as they are often sold out for meat from about 1 year of age, while the does (female goats) remain longer in the flock for breeding purposes (Salih *et al.*, 2014). On the other hand, this finding in the present study is contrary to the reports of Chukwudi *et al*., 2020 and Shyaka *et al*. (2021) who recorded higher seroprevalence in sheep than in goats.

The relatively higher seroprevalence in younger goats and sheep when compared to those greater than 24 months of age (though not statistically significant) is in agreement with the reports of Abubakar *et al.* (2011) who recorded a higher prevalence of PPR virus antibodies in goats aged below 12 months compared to those aged 24 months and above, but it is contrary to the reports of lower seroprevalence in small ruminants below one year by Abubakar *et al.* (2009) and Luka *et al*. (2011). The relatively small number of young animals sampled may also have contributed to the high seroprevalence recorded in this category of animals.

In all LGAs and agricultural zones sampled, PPR antibodies were detected. This is a confirmation of the endemic nature of the disease in Abia State, Nigeria. Amongst the local government areas surveyed in this study from all agricultural zones, the highest prevalence of PPR virus antibodies was recorded in Umuahia South LGA (67.7%). This high seroprevalence of PPR obtained in this LGA might have been due to the fact that major livestock markets are situated there and that it hosts the highest trade of small ruminants from surrounding communities. The low prevalence of PPR virus antibodies reported in Aba zone may be attributed to the availability and access to veterinary services and interventions that can provide vaccination against the disease in the zone. These services are absent or rare in the rural communities.

In this present study, the West African Dwarf (WAD) goats had a relatively higher prevalence (68.3%) of PPR virus antibodies than Red Sokoto goats (53.5%). A contrary finding was recorded in the sheep where the West African Dwarf sheep had a relatively lower prevalence (36.8%) than the Yankassa breed (54.1%) of sheep sampled. This finding in the present study agrees with the findings

of Victor *et al*. (2017), who reported a high prevalence (69.7%) in West African Dwarf goats than in the Sokoto Red and also a higher prevalence in Yankassa breed than in the West African Dwarf breed of sheep, but is contrary to the findings of Chukwudi *et al*. (2020) who reported a significantly higher prevalence of PPR virus antibodies in Red Sokoto goats (87.6%) than in West African Dwarf breed of goats. West African Dwarf goats are the most predominant breeds of goats in Abia state, especially in the rural and semi-urban areas. Therefore, it is possible that since the disease is endemic in the State, most of the West African Dwarf goats (which predominate in the state) had already developed protective antibodies against the disease making the seroprevalence rate higher in that breed of goats. The movement of the Red Sokoto and Yankassa breeds from the northern part of the country and to and fro livestock markets in the state could increase transmission amongst the breeds of animals. The possibility that some of the breeds moved into the state from the northern parts of the country may have been vaccinated may have resulted in the high amount of circulating antibodies in these groups of animals. The high prevalence of PPR virus antibodies in West African Dwarf goats may be another confirmation of the endemicity of this disease in goats in the study area. Sheep are said to have higher survival rates against PPR and this may explain the low prevalence obtained in the sheep coupled with the genetic predisposition of West African Dwarf Sheep. This may also explain the higher seroprevalence rate of PPR in the breed.

Conclusions and Recommendation: Results of the study have shown that there is high prevalence (57.7%) of PPR viral antibodies in goats and sheep in Abia State, Nigeria. The prevalence was higher in goats than sheep, but there were no significant sex and age based differences. Aba agricultural zone had a lower prevalence when compared to Umuahia and Ohafia zones, and WAD goats had a higher prevalence than Red Sokoto, while Yankassa sheep had a higher prevalence than the WAD sheep.

Conflict of Interest

The authors declare no conflict of interest.

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