INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
23–0309/2024/31–2–111–115
DOI: 10.17957/IJAB/15.2121
http://www.fspublishers.org

Full Length Article

Seroprevalence and Risk Factors Assessment of Pest des Petits Ruminants in Goats in District Shaheed Benazirabad, Pakistan

Shahnawaz Unar[1], Dildar Hussain Kalhoro[1*], Shahid Hussain Abro[1], Ali Raza Nizamani[3], Abdullah Channo[2], Asmatullah Kaka[1], Muhammad Bakhsh[5], Ayaz Ali Parhiyar[1], Muhammad Saleem Kalhoro[1], Abdul Qadir Channo[4], Habibullah Janyaro[4] and Abdullah Sethar[6]

[1]*Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam 70060, Pakistan*
[2]*Pakistan Agricultural Research Council-Arid Zone Research Centre (PARC-AZRC), Umerkot 69100, Pakistan*
[3]*Central Veterinary Diagnostic Laboratory, Tandojam 70060, Pakistan*
[4]*Shaheed Benazir Bhutto University of Veterinary and Animal Sciences, Sakrand 67210, Pakistan*
[5]*University of Veterinary and Animal Sciences, CVAS Jhang 35200, Pakistan*
[6]*Livestock Breeding Service Authority (LBSA) Sindh, Livestock & Fisheries Department, Government of Sindh, Hyderabad 17000, Pakistan*
[*]For correspondence: dhkalhoro@sau.edu.pk
Received 19 August 2023; Accepted 09 November 2023; Published 24 January 2024

Abstract

In this study, the seroprevalence of Peste des Petits Ruminants (PPR) was assessed in goats from District Shaheed Benazirabad, Pakistan, using a seasonal and demographic analysis. Blood samples (n=100) were collected from suspected PPR-infected goats in Sakrand, Kazi Ahmad, Nawabshah, and Daur, and analyzed using competitive enzyme-linked immunosorbent assay (c-ELISA). The seroprevalence of PPR was found to vary across different locations within the district. The highest seroprevalence rates were observed in Sakrand (72%) and Kazi Ahmad (72%), followed by Nawabshah (64%) and Daur (48%). This indicates the presence of PPR in goats throughout the district, with some regional differences. Gender-wise analysis revealed a higher seroprevalence rate in female goats (70.76%) compared to males (51.52%). This suggests that female goats may be more susceptible to PPR infection. Age-wise analysis showed that goats aged 6–12 months had the highest seroprevalence rate (75.20%), while those above 12 months had a lower seroprevalence rate (63.37%). This indicates that younger goats are more vulnerable to PPR infection. Seasonal analysis demonstrated variations in seroprevalence rates throughout the months. August had the highest seroprevalence rate (62.50%), followed by September (67.75%) and July had the lowest rate (68.90%). In conclusion, this study provides insights into the seroprevalence of PPR in goats in District Shaheed Benazirabad, Pakistan. The findings suggest regional variations in PPR prevalence, with higher rates in certain locations. Female goats and younger age groups were more susceptible to PPR infection. Additionally, seasonal variations were observed, indicating fluctuating transmission rates throughout the year. These findings contribute to the understanding and valuable insights of PPR epidemiology in the region and highlight the importance of targeted control and prevention strategies for the livestock disease in goat populations. This will also help the livestock department, higher authorities, and researchers to take effective measures against this disease for the betterment of livestock health.

Keywords: Seroprevalence; Demographic analysis; PPR; Genus morbillivirus; Competitive enzyme-linked immunosorbent assay (c-ELISA)

Introduction

Peste des Petits Ruminants (PPR) is a highly contagious and viral disease primarily affecting goats and sheep, caused by the PPR virus (PPRV), which belongs to the genus Morbillivirus and the Paramyxoviridae family (Mdetele *et al*. 2021). PPRV was first time identified in the Ivory Coast in 1942 (Mdetele *et al.* 2021). The disease is characterized by a range of clinical signs, including pyrexia, lacrimation, serous nasal discharge, anorexia, diarrhea and pneumonia, with increased morbidity and mortality rates (Rahman *et al*. 2011; Enchery *et al*. 2019). The seroprevalence of PPR has been investigated in various regions and studies have highlighted the presence of PPRV-specific antibodies in both goats and sheep (SowjanyaKumari *et al*. 2021).

PPRV virions are morphologically enclosed particles

To cite this paper: Unar S, DH Kalhoro, SH Abro, AR Nizamani, A Channo, A Kaka, M Bakhsh, AA Parhiyar, MS Kalhoro, AQ Channo, H Janyaro, A Sethar (2024). Seroprevalence and risk factors assessment of pest des petits ruminants in goats in district Shaheed Benazirabad, Pakistan. *Intl J Agric Biol* 31:111–115

with a negative-strand RNA genome, and the virus is primarily spread through direct contact with infected animals' excretions or secretions (Banyard *et al*. 2014; Begum *et al*. 2021). PPR is endemic in many developing nations and has also entered developed European borders (Banyard *et al*. 2014). The disease poses a significant threat to food safety, environmental sustainability, and the well-being of humans and animals in Asia, the Middle East, and Africa (Couacy-Hymann *et al*. 2005). Effective control and eradication strategies for PPR require a strong regional coordination, as well as the availability of high-quality vaccinations and the maintenance of the cold chain (Banyard *et al*. 2014). The severity of PPR clinical symptoms and the mortality rate can vary depending on various factors, including the virus conditions, pressure, and the host's immune system (Kock *et al.* 2015; Ratta *et al.* 2016). The diagnosis of PPR involves serological testing, which can be challenging due to the difficulty in distinguishing between vaccinated and naturally infected animals (Sen *et al*. 2010). Various diagnostic methods, such as ELISA and reverse transcription polymerase chain reaction, are used for the detection of PPRV (Kwiatek *et al*. 2007).

In Pakistan, PPR is a significant concern, causing substantial economic losses to the livestock industry (Abubakar *et al*. 2015). The prevalence of PPR has been observed to vary across different regions and seasons, with higher prevalence rates reported in certain months (Khan *et al*. 2008). The vulnerability of goats to PPR infection has been noted, especially in younger animals (Saritha *et al*. 2014). Given the importance of PPR in the district Shaheed Benazirabad, this study aims to measure the seroprevalence and risk factors associated with PPR in goats. The main goal of this study was to enhance the understanding of the epidemiological status of Peste des Petits Ruminants (PPR). Additionally, the study aimed to evaluate the consequences of this disease on the economic well-being of small ruminant owners. By investigating these factors, valuable insights can be gained to develop effective control and prevention strategies against PPR in the region.

Materials and Methods

The study on PPR infection in goats in District Shaheed Benazirabad was conducted at the Central Veterinary Diagnostic Laboratory, Tandojam, Sindh and the Department of Veterinary Microbiology, Sindh Agriculture University Tandojam.

Sample collection

A total of one hundred (n = 100) blood samples were collected from goats in District Shaheed Benazirabad. The animals were categorized based on their age into three groups: 0–6 months (suckler), 6–12 months (young) and over 12 months (adults). The male and female goats were separated into different groups based on their sex. A 5cc syringe was used to draw 5 mL of blood from the jugular vein of each goat. Serum was separated by centrifugation at 100.00 rpm for 5 min. The samples were further confirmed and analyzed using the competitive enzyme-linked immunosorbent assay (C-ELISA) for the detection of PPR antibodies.

Questionnaire-based collection of information

A standardized proforma was used to collect data on the suspected animals, including information on sex, age, location and seasons. The animals were carefully observed for symptoms such as mucosal erosion, respiratory distress, discharge from the mouth, nose and eyes, as well as a coarse coat and filthy hindquarters.

C-ELISA (Competitive Enzyme Linked Immunosorbent Assay)

PPR was diagnosed using commercial C-ELISA kit by using manufacturer’s instructions (ID. Vet, 310, rue Louis Pasteur-Grabels-FRANCE) (Nizamani *et al*. 2015). Briefly, the samples and control were added to the micro-wells as per the instructions provided with the diagnostic kit. The PPR antibodies were diluted using 25 microliters of dilution solution in both the positive and negative control wells of the plate. The samples were then incubated at 37°C for 45 + 4 min and washed three times with 300 mL of wash solution. Following the washes, 100 microliters of conjugate were added to each well and incubated at 21°C for 30 min. The wells were washed again three times using the wash solution. Subsequently, 100 microliters of substrate solution were added to each well and the reaction was allowed to proceed. Finally, the reaction was stopped, and the optical density was measured at 450 nm in each well using the stop solution. Samples with positive PPR antibodies exhibited percentage inhibition values equal to or below 50%, while negative samples had percentage inhibition values equal to or above 60%.

Statistical analysis

The factors relevant to the prevalence of the PPR were examined using the Pearson Chi-square test using SPSS.

Results

In the present study, a total of one hundred (n = 100) serum samples were collected from different regions of District Shaheed Benazirabad, including 25 samples from Sakrand, 25 samples from Kazi Ahmad, 25 samples from Nawabshah and 25 samples from Daur. Among them, a total of 64 samples were positive for PPR in different regions of District Shaheed Benazirabad. The association of different

Table 1: Area wise sero-prevalence of peste des petits ruminants in goats

District Shaheed benazirabad	No. of samples	No. of positive	Positive (%)	*P*-value
Sakrand	25	18	72	*0.7119*
Qazi Ahmad	25	18	72	
Nawabshah	25	16	64	
Daur	25	12	48	
Total	100	64	64%	

Table 2: Sex wise sero-prevalence of peste des petits ruminants in goats

District Shaheed Benaizabad	Female			Male			*P*-value
Area	Sample	Positive	%	Samples	Positive sample	%	
Sakrand	19	14	73.68	6	4	66.66	*0.021*
Kazi Ahamd	17	13	76.47	8	5	62.5	
Nawabshah	14	10	71.42	11	6	54.54	
Daur	15	9	60	10	3	30	
Total	65	46	70.76	35	18	51.42	

Table 3: Age wise Sero-prevalence of peste des petits ruminants in goats at different areas of Shaheed Benazirabad district

Areas of Shaheed Benazirabad District	0–6 Month			6–12 Month			>12 Month			*P*-value
	Sample	Positive sample	%	Sample	Positive sample	%	Sample	Positive sample	%	
Sakrand	8	5	62.50	11	9	81.80	6	4	66.66	*0.7935*
Kazi Ahmad	6	3	50.00	9	8	88.88	10	7	63.63	
Nawabshah	8	3	37.50	10	7	70.00	7	6	85.71	
Daur	7	3	42.85	10	6	60.00	8	3	37.50	
Total	29	14	48.20	40	30	75.20	31	20	63.37	

Table 4: Seasonal sero-prevalence peste des petits ruminant in goats

Month	No. of sample	No. of sample positive	No. of sample positive (%)	*P*-value
July	29	20	68.90	*0.8373*
August	40	23	62.50	
September	31	21	67.75	
Total	100	64	66.40	

risk factors with occurrence of PPR in the study District has been elaborated below:

Area-wise sero-prevalence

The seroprevalence of Peste des Petits Ruminants Virus (PPRV) in goats across different areas of the district is presented in Table 1, 2 3 and 4. Among the sampled regions, Sakrand and Kazi Ahmad showed the highest seroprevalence of PPRV in goats, both at 72%. This was followed by a seroprevalence of 64% in Nawabshah and 48% in Daur. Notably, Sakrand had the highest sero-prevalence of PPRV among the studied regions. Statistical analysis exposed a non-significant difference ($P > 0.05$) in the seroprevalence of PPRV among the various age groups in goats.

Gender-wise sero-prevalence

The serum samples of were analyzed using c-ELISA to determine the sero-prevalence of Peste des Petits Ruminants (PPR) in goats. The results showed a higher occurrence of PPR infection in female goats, with a sero-prevalence of 70.76%. In comparison, male goats exhibited a lower sero-prevalence of 51.42%. Statistical analysis exposed a significant difference ($P < 0.05$) in the sero-prevalence of PPR among the various age groups in goats, indicating that the age of the goats influenced the likelihood of PPR infection.

Age-wise sero-prevalence

The sero-prevalence of Peste des Petits Ruminants (PPR) varied among different age groups of goats. The highest sero-prevalence was observed in goats aged between 6 to 12 months, with a rate of 75.20%. In contrast, goats older than 12 months exhibited a lower sero-prevalence of 63.37%. The lowest sero-prevalence of PPR, at 48.20%, was observed in goats aged 0-6 months. Statistical analysis indicated a non-significant difference ($P > 0.05$) among the various age groups in terms of PPR sero-prevalence. This suggests that age alone may not be a significant factor influencing the likelihood of PPR infection in goats.

Season-wise sero-prevalence

The sero-prevalence of Peste des Petits Ruminants (PPR) in goats was analyzed with respect to different seasons,

specifically July, August, and September. The serum samples collected from both male and female goats were tested using c-ELISA. Among the three months, the highest sero-prevalence of PPR was recorded in August, with a rate of 68.90%. On the other hand, the lowest sero-prevalence was observed in July, with a rate of 62.50%. Overall, a higher prevalence of PPR was observed in August compared to the other two months. Statistical analysis indicated a non-significant difference ($P > 0.05$) among the various seasonal groups in terms of PPR sero-prevalence. This suggests that the likelihood of PPR infection in goats does not significantly vary across the months of July, August, and September.

Discussion

The current study aimed to investigate the sero-prevalence of Peste des Petits Ruminants Virus (PPRV) in goats from different regions of district Shaheed Benazirabad. The findings of the study exposed varying sero-prevalence rates among different areas within the district. The maximum sero-prevalence was observed in Sakrand and Kazi Ahmad, with rates of 72% each, followed by Nawabshah with a sero-prevalence rate of 64%. These results are consistent with a earlier study conducted by Nizamani *et al.* (2015) in Pakistan's Dadu district, which reported a sero-prevalence rate of 69.3%. Additionally, other regions in Pakistan such as Chakwal, Bahawalpur, the Northern Area, Sahiwal, Azad Jammu and Kashmir (AJK) and Rawalpindi recorded varying sero-prevalence rates ranging from 60.32 to 76% (Nizamani *et al*. 2015). The higher sero-prevalence observed in Sakrand and Kazi Ahmad areas of Shaheed Benazirabad could be attributed to increased fodder production during the rainy season, which enhances the availability of nutrients for cattle. This, in turn, may contribute to increased disease resistance in animals unable to graze. Additionally, young goats require additional dietary support for proper body weight and sexual maturation, and a compromised immune system due to long-term malnutrition can increase the incidence of disease (Singh *et al*. 2004). The desert region of Shaheed Benazirabad, characterized by declined immune resistance caused by malnutrition, may have resulted in fewer immune animals being affected by the lymphotropic PPR virus, leading to an increase in disease incidence.

Furthermore, the presence of animal markets and the movement of small ruminants from the desert to the irrigated area during dry seasons may contribute to the higher sero-prevalence observed in the irrigated areas of Shaheed Benazirabad. The easy movement of animals and their grazing on open pastures in the irrigated areas provide opportunities for infected animals to spread the PPR virus to non-infected animals. These findings are in competence with previous studies highlighting the role of animal movement in the spread of PPR outbreaks (Khan *et al.* 2007). Regarding gender-wise sero-prevalence, the present study found a significantly higher infection rate in females (70.76%) compared to males (51.42%). This could be attributed to the stress experienced by females during pregnancy and milk production, which may weaken their immune system and make them more susceptible to PPR infection (Rahman *et al*. 2011). Parallel findings have been reported in Cholistan districts, where the highest sero-positivity (100%) was found in female goats (Khan *et al*. 2007). The age-wise sero-prevalence analysis revealed that the age group ranging from 6 to 12 months had the highest sero-prevalence (75.20%), while the older age group (> 12 months) had the lowest sero-prevalence (63.37%). These findings are in line with previous studies reporting higher prevalence in younger animals due to their increased susceptibility and compromised immune systems (Zahur *et al*. 2011). The nutritional status of young animals plays a crucial role in their immune response and long-term starvation can lead to immune system deterioration, making them more prone to PPR infection (Khan *et al*. 2007).

The seasonal analysis of sero-prevalence revealed that August had the highest rate of PPR infection (68.90%), while September had a slightly lower rate (67.75%) and July had the lowest rate (62.50%). Factors such as filthy wind and rain, high humidity and animals freely moving on open grassland during July may have contributed to the higher infection rate observed during that month. It is worth noting that viruses that can survive in low temperatures are more commonly associated with outbreaks in humid environments. These findings align with previous research that indicated seasonal prevalence of PPR in goats, with higher disease occurrence in the months of June, July, December and January (Sarker and Islam 2011). The inadequate dosage of vaccines poses a significant risk to caprine populations, with approximately 70 to 80% of goats being susceptible to PPR virus (Jones *et al*. 2021). The introduction of new animals into already stressed flocks, combined with long distances travelled during migration and inadequate nutritional availability, further contribute to the vulnerability of animals during these periods. The compromised nutritional status plays a central role in the increased incidence of PPR outbreaks (Singh *et al*. 2004). In conclusion, this study provides valuable insights into the sero-prevalence of PPR in goats from different regions of district Shaheed Benazirabad. The elevated sero-prevalence observed in specific areas may be attributed to factors such as increased fodder production, animal movement, and environmental conditions. Gender and age variations in sero-prevalence highlight the susceptibility of certain groups, with females and younger animals being more vulnerable to PPR infection. Seasonal variations further emphasize the influence of climatic factors on disease prevalence.

Conclusion

It can be concluded that PPR infection is widespread among goats in district Shaheed Benazirabad, with higher sero-

prevalence observed in certain areas, among female goats, and in the age group of 6 to 12 months. The season of August showed the highest sero-prevalence, indicating the impact of environmental factors on PPR transmission.

Acknowledgement

We would like to acknowledge the Sindh Agriculture University, Tandojam, 70060 and Central Veterinary Diagnosis for their valuable support and provision of resources throughout the course of this research.

Authors Contribution

SU, DHK, AC and SHA designed the research work. DHK and ARN assisted with laboratory findings. AC, SU, AK, and DHK contributed to the design of the manuscript. AC played a pivotal role in the overall write-up of the manuscript and data analysis. All other authors provided guidance throughout the research process.

Conflict of Interest

The authors declare no conflict of interest.

IBR Approval

The research conducted in the study was approved in 146th meeting of Board of Advanced Studies and Research, having resolution no. [146th BASAR]-12(a) on 12th of September 2022 by the Directorate of Advanced Studies, SAU Tandojam.

Data Availability

Supporting data is available from corresponding author upon request.

Ethics Approval

This study was conducted in accordance with approved ethical policies and protocols of Department of Veterinary Sciences Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tanddojam and Central Veterinary Diagnostic Laboratory Tandojam.

Funding Source

This research was self funded.

References

Abubakar M, M Irfan, S Manzoo (2015). Peste des petits ruminants in Pakistan; past, present and future perspectives. *J Anim Sci Technol* 57:1–8

Banyard AC, Z Wang, S Parida (2014). Peste des petits ruminant's virus, eastern Asia. *Emer Infect Dis* 20:2176–2178

Begum S, M Nooruzzaman, A Hasnat, MM Parvin, R Parvin, MR Islam, EH Chowdhury (2021). Isolation of peste des petits ruminant's virus using primary goat kidney cell culture from kidneys obtained at slaughter. *Vet Med Sci* 7:915–922

Couacy-Hymann E, C Bodjo, T Danho, G Libeau, A Diallo (2005). Surveillance of wildlife as a tool for monitoring rinderpest and peste des petits ruminants in West Africa. *Rev Sci Tech Off Intl Épizoot* 24:869–877

Enchery F, C Hamers, O Kwiatek, D Gaillardet, C Montange, H Brunel, A Bataille (2019). Development of a PPRV challenge model in goats and its use to assess the efficacy of a PPR vaccine. *Vaccine* 37:1667–1673

Jones BA, M Mahapatra, D Mdetele, J Keyyu, F Gakuya, E Eblate, I Lekolool, C Limo, JN Ndiwa, P Hongo, JS Wanda, L Shilinde, M Mdaki, C Benfield, K Parekh, MM Neto, D Ndeereh, G Misinzo, MR Makange, A Caron, A Bataille, G Libeau, S Guendouz, ES Swai, O Nyasebwa, SL Koyie, H Oyas, S Parida, R Kock (2021). Peste des petits ruminant's virus infection at the wildlife–livestock interface in the greater Serengeti ecosystem, 2015–2019. *Viruses* 13:838–867

Khan HA, M Siddique, M Abubakar, MJ Arshad, M Hussain (2008). Prevalence and distribution of peste des petits ruminant's virus infection in small ruminants. *Small Rumin Res* 79:152–157

Khan HA, M Siddique, MJ Arshad, QM Khan, SU Rehman (2007). Sero-prevalence of peste des petits ruminants (PPR) virus in sheep and goats in Punjab province of Pakistan. *Pak Vet J* 27:109–112

Kock RA, MB Orynbayev, KT Sultankulova, VM Strochkov, ZD Omarova, EK Shalgynbayev, S Parida (2015). Detection and genetic characterization of lineage IV peste des petits ruminant virus in Kazakhstan. *Transb Emer Dis* 62:470–479

Kwiatek O, C Minet, C Grillet, C Hurard, E Carlsson, B Karimov, G Libeau (2007). Peste des petits ruminants (PPR) outbreak in Tajikistan. *J Compar Pathol* 136:111–119

Mdetele DP, E Komba, MD Seth, G Misinzo, R Kock, BA Jones (2021). Review of peste des petits ruminant's occurrence and spread in Tanzania. *Animals* 11:1698

Nizamani AR, ZA Nizamani, AP Umrani, P Dewani, MA Vandiar, JA Gandahi, NM Soomro (2015). Prevalence of Peste des petits ruminant's virus antibodies in small Ruminantsin Sindh, Pakistan. *J Anim Plant Sci* 25:1515–1519

Rahman MA, I Shadmin, M Noor, R Parvin, EH Chowdhury, MR Islam (2011). Peste des petits ruminant's virus infection of goats in Bangladesh: Pathological investigation, molecular detection and isolation of the virus. *Bang Vet* 28:1–7

Ratta B, M Pokhriyal, SK Singh, A Kumar, M Saxena, B Sharma (2016). Detection of peste des petits ruminant's virus (PPRV) genome from nasal swabs of dogs. *Curr Microbiol* 73:99–103

Saritha G, B Shobhamani, B Sreedevi (2014). Sero-prevalence of peste des petits ruminants in pastoral small ruminants with special reference on sensitivity to age and agro-climatic zone. *Anim Sci Rep* 8:103–107

Sarker S, MH Islam (2011). Prevalence and risk factor assessment of Peste des petits ruminants in goats in Rajshahi, Bangladesh. *Vet World* 4:546–549

Sen A, P Saravanan, V Balamurugan, KK Rajak, SB Sudhakar, V Bhanuprakash, RK Singh (2010). Vaccines against peste des petits ruminant's virus. *Exp Rev Vac* 9:785–796

Singh RP, P Saravanan, BP Sreenivasa, RK Singh, SK Bandyopadhyay (2004). Prevalence and distribution of peste des petits ruminant's virus infection in small ruminants in India. *Rev Sci Tech Off Intl Epiz* 23:807–819

SowjanyaKumari S, N Akshata, V Balamurugan (2021). Peste Des Petits Ruminants in Atypical Hosts and Wildlife: Systematic Review and Meta-Analysis of the Prevalence between 2001 and 2021. *Arch Razi Institute* 76:1589–1606

Zahur AB, A Ullah, M Hussain, H Irshad, A Hameed, M Jahangir, MS Farooq (2011). Sero-epidemiology of peste des petits ruminants (PPR) in Pakistan. *Prevent Vet Med* 102:87–92