

Current situation of Peste des petits ruminants (PPR) in the Sudan

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Abstract The current situation of PPR in Sudan was investigated. A total of 61 tissue samples were collected from various PPR suspected outbreaks in sheep in Sudan during 2008. Collected tissue samples were tested for PPR antigen using IcELISA, PPR antigen was detected in 26 out of 61 samples (42.6%). Highest antigen detection rate was in specimens collected from western Sudan. A total of 1198 serum samples were collected from sheep (n=500), camels (n=392), and goats (n=306) from different areas in Sudan (Khartoum, Gezira, Tambool, River Nile, Kordofan, White Nile, Blue Nile, Gedarif, Kassala, Halfa ElGadida, Port Sudan). Collected sera were examined for PPR antibodies using cELISA, a total of 336 (67.2%) sheep, 170 (55.6%) goat and 1 (0.3%) camel samples were found to be positive.

Keywords PPR · IcELISA · cELISA · Sudan

Introduction

Peste des petits ruminants (PPR) disease is a severe fast spreading disease of mainly domestic small ruminants caused by PPR virus (PPRV) that belongs to morbillivirus genus of paramyxoviridae family. The disease is characterized by sudden onset of depression, fever, discharges from the eyes and nose, sores in the mouth, disturbed breathing and cough, foul smelling diarrhoea and death (Roeder and Obi 1999).

The first outbreak of the disease in sheep and goats in Sudan was in three areas in south Gedarif (Eastern Sudan) in 1971 (El Hag Ali 1973); it was firstly diagnosed as rinderpest and later confirmed to be PPR (El Hag Ali and Taylor 1984). The disease was then reported in two caprine outbreaks in Central Sudan (Sinnar area) during 1971-1972 and in Mieliq in 1972; in sheep in Western Sudan (Rasheed 1992); in sheep and goats in Central Sudan (Hassan et al. 1994); in sheep and goats in Khartoum State (Zeidan 1994 and El Amin and Hassan 1998). PPR was detected and isolated from different parts of Sudan [Gezira State, White Nile State (Central), Khartoum state, North Kordofan State (Western) and River Nile State (Northern)] during 2000- 2002 (Intisar 2002). A serological survey of PPR in Sudan during 2002-2005 using cELISA revealed positive results in 70% of ovine sera collected from Kordofan state, 52.5% of ovine sera and 34.7 % of caprine sera collected from Darfur State (Intisar 2007). Nussieba (2005)

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reported the detection and isolation of PPR antigen in sheep and goat tissue specimens collected from different areas in Sudan. 519 sera of sheep and goats were tested for PPR antibodies using cELISA, collected from River Nile State (North), and Darfur (west) with 50.7% positives. Khalafalla et al (2005) reported a new emerging respiratory disease of camels in Eastern Sudan during Sep. 2004; PPR antigen was detected using IcELISA and PCR, PPR was supposed to be the main causative agent of that outbreak.

Continuous outbreaks of PPR occurred annually in Sudan; most of cases are under reported; this study is to investigate the current situation of PPR in Sudan during the year 2008 through serological study in sheep, goats and camels as well as detection of PPR antigen.

Materials and methods

Samples collection

A total of 61 tissue samples were collected from various PPR suspected outbreaks in sheep in Sudan during January to June 2008. Most of samples were collected from Western Sudan (Kordofan and Darfur, n=24), Khartoum State (n=23), then Central Sudan (Gezira, n=11). Only 2 samples were collected from Eastern Sudan (Gedarif, Kassala) while one sample was collected from Northern Sudan (River Nile). Samples were collected from areas with no previous history of vaccination against PPR or RP.

A total of 1,198 serum samples were collected from sheep (n=500), camels (n=392), and goats (n=306) at different areas in Sudan; Khartoum, Central Sudan (Gezira, Tambool, White Nile, Blue Nile), Northern Sudan (River Nile), Eastern Sudan (Gedarif, Kassala, Halfa El Gadida, Port Sudan) and Western Sudan (Kordofan) during the same period of tissue collection.

Detection of PPR antigen using immunocapture ELISA (IcELISA)

Collected tissue samples were tested for PPR antigen using IcELISA kits manufactured by CIRAD EMVT, Montpellier, France, distributed by BDSL, UK. It is a solid phase immunocapture ELISA (ICE) based on a technique described by Libuea et al (1994). A mouse monoclonal antibody (anti-Rp/PPR), which is attached

to the microplate, captures the virus present in supernatant of prepared tissue samples from sick animals. A second mouse monoclonal antibody (anti-RPV or anti-PPRV), which is biotinylated and directed against the nucleocapsid (N) protein of the respective virus, is used in conjugation with a streptavidin-horseradish-peroxidase conjugate to detect captured antigen. The degree of coloration was read by Immunoscan (Flow Laboratories, UK) reader with EDI 23 software programme using 492 nm filter. The test was performed according to the manual provided with the kits.

Detection of PPR antibodies using competitive ELISA (cELISA)

Collected sera were examined for PPR antibodies using cELISA kits manufactured by CIRAD EMVT, Montpellier, France, distributed by BDSL, UK. The test is based on the competition between antibodies in sera and monoclonal antibody (MAb) to bind to the antigen. Possible binding of the MAb was detected by adding a mouse-specific conjugate and its substrate. Absence of chromogenic reaction indicated the presence of circulating antibodies whose specificity was defined by the MAb in competition. When the tested sera did not interfere with the adherence of the MAb, the wells were coloured as described by Libeau et al (1995). The degree of coloration was read as described above.

Results

Detection of PPR antigen in tissue samples

PPR antigen was detected in 26 out of 61 sheep tested samples. Positive results were observed in samples from all areas, both samples from Eastern Sudan and the only one from Northern Sudan were positive (100%); however the highest prevalence was in Western Sudan (Kordofan) (62.5%) then Central Sudan (Gezira, 27.3%), the details are presented in Table 1.

Detection of PPR antibodies

A total of 336 sheep (67.2%), 170 (55.6%) goat and 1 (0.3%) camel samples were found to be positive. PPR antibodies were detected in sheep and goat sera from

Table 1 Detection of PPR antigen in tissue samples in Sudan during 2008 using IcELISA

Area	Total tested	No. of positives	No. of negatives
Khartoum	23	5	18
Northern Sudan	1	1	0
Central Sudan	11	3	8
Eastern Sudan	2	2	0
Western Sudan	24	15	9
Total	61	26 (42.6%)	35

Northern Sudan (River Nile)

Central Sudan (Gezira)

Eastern Sudan (Gedarif, Kassala)

Western Sudan (Kordofan, Darfur)

all localities; highest seroprevalence was seen in sheep sera of Khartoum (93.8%) then Eastern Sudan (Gedarif, Kassala 90.9%) while highest seroprevalence in goat sera was noticed in western Sudan (Kordofan, 63.6%), then Central Sudan (Gezira, White Nile, 58.1%). Only one camel sample from Eastern Sudan out of 392 tested was positive (0.3%) the details are shown in Tables 2 and 3.

Discussion

PPR is one of the most serious diseases of small ruminants, it occurs in many countries. PPR was found to be one of the major diseases affecting West African dwarf goats in Nigeria (Okoli 2003). Taylor et al (1990)

Table 3 Detection of PPR antibodies in camel sera in Sudan during 2008 using cELISA

Area	Total tested	No. of positives	No of negatives
Northern Sudan	11	0	11
Central Sudan	278	0	278
Eastern Sudan	71	1	70
Western Sudan	32	0	32
Total	392	1	391

Northern Sudan (River Nile)

Central Sudan (Tamboul)

Eastern Sudan (Port Sudan, Halfa Algadida)

Western Sudan (Kordofan)

stated that PPR seems to be endemic in Oman. Bazarghani et al (2006) reported the existence of PPR in Iran. Lefevre et al (1991) reported the disease in Jordan in 1987. In India, PPR was diagnosed in sheep and goats (Singh et al. 2004). In Saudi Arabia 43% morbidity rate and 100% case mortality rate due to PPR was reported in sheep and goats (Housawi et al. 2004).

PPR antigen detection was carried out in this study using IcELISA; the overall positive samples were 26 of 61 (42.6%). Nussieba et al (2008) using haemagglutination test (HA) detected PPR antigen in 92.5% of 40 tissue samples of sheep in the Sudan; this great difference could be due to the collection of samples during an active outbreak and most of samples (n=32) were from the same flock. The lower prevalence rate reported in the present work is probably due to that most of samples collected in this study were from

Table 2 Detection of PPR antibodies in sheep and goat sera in Sudan during 2008 using cELISA

Area	Ovine				Caprine				Total	
	Total tested	No. + Ve	No. -Ve	% + ve	Total tested	No. + Ve	No. -Ve	% + Ve	Total tested	% + Ve
Khartoum	16	15	1	93.8	160	90	70	56.3	176	59.7
Northern Sudan	60	32	28	53.3	12	5	7	41.7	72	51.4
Central Sudan	118	86	32	72.9	105	61	44	58.1	223	65.9
Eastern Sudan	55	50	5	90.9	7	0	7	0	62	80.6
Western Sudan	251	153	98	61	22	14	8	63.6	273	61.2
Total	500	336	164	67.2	306	170	136	55.6	806	62.8

Northern Sudan (River Nile)

Central Sudan (Gezira, White Nile, Blue Nile)

Eastern Sudan (Gedarif, Kassala)

Western Sudan (Kordofan)

Khartoum where there is increase in the awareness about PPR leading to its suspicion in all diarrhoea or respiratory infections as coccidia and *Pasteurella* were detected in most of PPR negative samples sent to the laboratory.

The results of this study showed that PPR is widely spread in the Sudan and its incidence seems to be increasing in most areas where sheep and goat are raised. The overall detected seroprevalence of PPR was 62.8% which is higher than that previously reported (50%) in Sudan (Haroun et al. 2002; Intisar et al. 2007). This is probably due to the cessation of rinderpest vaccination campaigns in the country during which sheep and goats were vaccinated with rinderpest vaccine.

Rinderpest (RP) Vaccine was used to control PPR in Sudan in the past. Recently RP vaccination campaigns were stopped in the process of declaring African countries as RP free (OIE pathway for RP in Sudan). Vaccination against PPR using a homologous locally produced vaccine was established in 2002 and planned to control the disease but organized vaccination campaigns are not practiced. PPR antibodies were found to be prevalent in sheep samples in Khartoum State (93.8%), Eastern Sudan (90.9%) then Central Sudan (72.9%).

Sheep was noticed to have higher percentage of seropositivity than goats (67.7%, 55.6%), similar finding was reported by Intisar et al (2007). However in this study much higher seroprevalence was detected in goats (55.6%) than in the previous report (32.2%). The higher prevalence of PPR in sheep than in goats has been previously documented which is mainly due to the high mortality observed in goats so lower percentages of survivors exist (Khan et al. 2008). High seroprevalence of PPR (80.6%) was noticed in Eastern Sudan (Kassala, Gedarif) followed by Central Sudan (Gezira, White Nile, 65.9%). This picture differ from that noticed in the previous report (Intisar et al. 2007) where the highest prevalence was seen in Western Sudan (Kordofan), this could be attributed to the continuous animal movements from Kordofan to Central and Eastern Sudan spreading the infection beside in this study; the collection of samples were during the dry season where animals are mostly kept apart in Kordofan. In Sudan due to the nomadic nature of most of animal herders the spread of infectious diseases depend on seasonality where during rainy seasons (July- October) most of animals are sharing water sources leading to spread of infectious diseases.

Massive vaccination of sheep and goats as well as surveillance for PPR in different localities particularly Khartoum, eastern and western Sudan is highly recommended.

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References

- Bazarghani, T. T., Charkhkar, S., Doroudi, J., Bani Hassan, E. (2006). Review on Peste des Petits Ruminants (PPR) with Special Reference to PPR in Iran. *Journal of Veterinary Medicine Series B*, 53(1) 17-18.
- El Amin, M. A. G. and Hassan A. M. (1998). The seromonitoring of rinderpest throughout Africa, phase III results for 1998. IAEA, VINNA, Food and Agriculture Organization/International Atomic Energy Agency.
- El Hag, Ali, B. and Taylor W.P. (1984). The isolation of PPR from the Sudan. *Research in Veterinary Science*, 36: 1-4.
- El Hag, Ali, B. (1973). A natural outbreak of rinderpest involving sheep, goats and cattle in Sudan. *Bulletin of Epizootic diseases of Africa*, 12: 421-428.
- Haroun, M., Hajer, I., Mukhtar, M., Ali, B., E. (2002). Detection of antibodies against peste des petits ruminants virus in sera of cattle, camels, sheep and goats in Sudan. *Veterinary Research Communication*, 26 (7): 537-541.
- Hassan, A. K. M., Ali, Y. O., Hajir, B. S., Fayza, A. O., Hadia, J. A. (1994). Observation on epidemiology of peste des petits ruminant in Sudan, *The Sudan Journal for Veterinary Research*, 13: 29-34.
- Housawi F.M.T., E.M.E. Abu Elzein, G.E. Mohamed A.A. Gameel A.I. Al-Afaleq A. Hegazi B. Al-Bishr. (2004). Emergence of Peste des Petits Ruminants in Sheep and Goats in Eastern Saudi Arabia. *Revue Élev Méd vét Pays trop*, 57 (1-2) : 31-34.
- Intisar, K. S. (2002). Studies on peste des petits ruminants (PPR) disease in Sudan. MSc Thesis, Faculty of Veterinary Science, University of Khartoum, Sudan.
- Intisar, K. S., Khalafalla, A. I., El Hassan, S.M., El Amin, M. A. (2007). Detection of peste des petits ruminants (PPR) antibodies in goats and sheep in different areas of Sudan using competitive ELISA. *Proceedings of the 12th International Conference of the Association of Institutions for Tropical Veterinary Medicine*. P 427. Montpellier, France 20–22 August 2007.
- Khalafalla, A. I., Intisar, K. S., Ali, Y. H., Amira, M. H., Abu Obeida, A., Gasim, M., Zakia, A. (2005). Morbillivirus infection of camels in eastern Sudan. New emerging fatal and contagious disease. *Proceeding of the International Conference on Infectious Emerging Disease*. AlAain, UAE, 26th March-April 1, 2005.
- Khan, H., A., Siddique, M., S ur-Rahman, Ashraf, M., Abubakar, M. (2008). The detection of antibody against peste des petits ruminants virus in sheep, goats, cattle and buffaloes. *Tropical Animal Health and Production*. 40: 521-527.
- Lefevre, P. C., Diallo, A., Schinkel, F., Hussein, S., Staak, G. (1991). Serological evidence of peste des petits ruminants in Jordan. *Veterinary Record*, 128: 110.

- Libeau G., Perhau C., Lancelot R., Colas F., Gurre L., Bishop D. H.L., Diallo A. (1995). Development of competitive ELISA for detecting antibodies to the peste des petits ruminants virus using a recombinant nucleoprotein. *Research in Veterinary Science*, 58: 50-55.
- Libeau, G., Dialo, A., Colas, F., Guerre, L. (1994). Rapid differential diagnosis of rinderpest and peste des petits ruminants using an immunocapture ELISA. *Veterinary Record*, 134: 300-304.
- Nussieba, A. O. (2005). peste des petits ruminants in Sudan: Detection, virus isolation and identification, pathogenicity and serosurveillance. MSc Thesis, Faculty of Veterinary Medicine, University of Khartoum.
- Nussieba AO, ER Mahasin-Rahman, AS Ali, MA Fadol (2008) Rapid detection of peste des petits ruminants (PPR) virus antigen in Sudan by agar gel precipitation (AGPT) and haemagglutination (HA) tests. *Tropical Animal Health and Prod.* 40: 363-368.
- Okoli, I. C. (2003). Incidence and modulating effects of environmental factors on trypanosomosis, peste des petit ruminants (PPR) and bronchopneumonia of West African Dwarf goats in Imo State, Nigeria. *Livestock research for Rural Development* 15 (9) 1-7.
- Rasheed, I. E. (1992). Isolation of PPRV from Darfur State. MSc Thesis, Faculty of Veterinary Medicine, University of Khartoum, Sudan.
- Roeder, P. and Obi, T. U. (1999). Recognizing of peste des petits ruminants. In: *FAO Animal Health Manual* (5). Publ. Food and Agriculture Organization of the United Nations, Rome, Italy.
- Singh, R. P., Saravanan, P., Sreenivasa, B. P., Singh, R. K., Bandyopadhyay, S. K. (2004). Prevalence and distribution of peste des petits ruminants virus infection in small ruminants in India. *Rev Sci Tech Off Int Epitz*, 23(3), 807-819.
- Taylor, W. P., Al Busaidy, S., Barrett, T. (1990). The epidemiology of peste des petits ruminants in the Sultanate of Oman. *Veterinary Microbiology*, 22: 341-352.
- Zeidan, M. (1994). Diagnosis and distribution of PPR in small ruminants in Khartoum State during 1992-1994. MSc Thesis, Faculty of Veterinary Medicine, University of Khartoum, Sudan.