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# Epidemiology and Economic Importance of Sheep and Goat Pox: A Review on Past and Current Aspects

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## Abstract

Sheep and goat pox is highly devastating viral systemic disease of sheep and got. This disease is manifested by skin and internal lesions, fever, conjunctivitis, with oculonasal discharge and excess salivation. The objective of this paper was to review epidemiology and economic importance sheep and goat pox with special emphasis on both the past and currents aspects. The causative agent of Sheep and goat pox is sheep and goat pox virus of family poxoviaride, genus capripoxvirus. The poxviruses of Sheep pox and goat pox viruses are distinct, but hard to differentiate and Recombination can occur. Sheep and goat virus can survive in the environment for prolonged time. Today, Sheep and Goat Pox is found in most parts of Africa (mainly north of the equator), portion of India, central Asia (including south Russia and western China) and the Middle East. In Ethiopia, the disease is distributed in all regions and in endemic areas the disease are economically important due to production losses because of decreased weight gain, milk yield, damage to wool and hides, cause abortion, and increased susceptibility to other disease, while also being a direct cause of death. The diseases are more severe in young animal then adults. Infected animals can acts as the main cause of spreading SGP viruses. Since these diseases have no effective drug the treatment should be directed at preventing secondary bacterial infection. Furthermore, the animal should be vaccinated with commercially available attenuated vaccine as the main control measure in endemic regions.

**Keywords:** Sheep and goat pox; Epidemiology; Economic importance; Vaccination

## Introduction

Ethiopia is believed to have the largest livestock population in Africa with sheep and goat populations exceeding 49 million, which is one of the largest populations of small ruminants in Africa [1]. Small ruminants (sheep and goats) have a unique role in smallholder agriculture as they require small investments; faster growth rates, have shorter production cycles, and greater environmental adaptability as compared to large ruminants. They are important protein sources in the diets of the poor and help to provide extra income and support survival for many farmers in the tropics and sub-tropics [2,3]. In Ethiopia, sheep are the second most important livestock species next to cattle [4]. Sheep and goat play an important economic role and make a significant contribution to both domestic and export markets through provision of food (meat and milk) and non-food (manure, skin and wool) products [5,6]. Although sheep and goat plays a significant role in national economy of the country to date the benefit obtained from these livestock are hampered by different constrains. Livestock diseases are among the important technical constraints that have hindered the development of the sector by decreasing production and hampering trade in animal and animal products [7,8]. Of which infectious disease like Sheep and goat pox are major and widely distributed in all region of the country [9].

Sheep pox and goat pox (SGP) are a group of viral disease that causes highly infectious disease in sheep and goats. Generally the disease is less commonly seen in indigenous breeds in area where it's endemic as compared with exotic breeds. Indigenous animals are more likely infected from the disease in areas where it has been not found or dormant for a period of time, when intensive husbandry methods are introduced, or in association with other disease agents such as or Foot and Mouth disease or Peste des Petits Ruminants [10]. The virus that causes sheep and got pox is Sheep and goat pox virus of family poxoviaride, genus capripoxvirus, one of the largest (170-260 nm by 300-450 nm), enveloped double stranded DNA viruses [11]. Mostly the disease is transmitted by direct contact, but indirect contact with infected object and mechanical insect can also transmit. Aerosol and nasal secretions can also spread sheep and got pox virus [12]. Sheep and goat pox (SGP) highly devastating viral systemic of sheep and goats characterized by widespread skin eruption, fever, generalized papules or nodules, vesicles (rarely) on non wool skin, internal lesions in the lungs, respiratory and gastrointestinal mucosa and cause death [13,14].

In Middle East, Africa, the Indian subcontinent, and much of central Asia Egypt, Turkey, Iraq, Iran, Afghanistan, Africa north of the equator, and in South-Eastern Europe, sporadic outbreaks occur [13]. Recently outbreaks have been recorded in Kazakhstan, Mongolia, and Azerbaijan and in Turkey, Greece and Bulgaria. Although the gene sequence of Mongolian goat pox (GP) virus in 2008 P32 was distinct as compared to sequences of several other GP viruses originated from China, it has not been identified the source of Mongolian outbreak [15].

Regarding the Ethiopian situation sheep and goat pox is found all region of the country [10]. Sheep and Goat Pox (SGP) is a disease that results in a substantial loss in the production and productivity of sheep and goats in Ethiopia. This disease is comparably more serious in lowland arid areas than in midland and highland agro ecologies [16]. According to Woldemeskel and marsha [17], of 1432 sheep and 1128 goats examined the prevalence of pox (22% in sheep and 18% in goats).

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In recent study around Gonder a total of 1296 ruminants studied for skin disease, the prevalence of sheep and goat pox is 77(48.12%) or 64(40%) or 13(8.12%) respectively [18].

Generally, Sheep and Goat pox result in economic losses due to high morbidity and mortality rate, decrease production, damage to the quality of skins and other production losses [10]. Despite the huge economic loss of sheep and goat pox in endemic area there is paucity of information. Therefore, the objective of this paper is to review the epidemiology, economic impact and control technique of sheep and goat pox.

## Literature Review

Sheep and goat pox (SGPX) are serious, fatal viral systemic diseases. Characterized predominantly by skin lesions extending all over the skin, but are most obvious on face, eyelids and ears, perineum and tail and internal lesions [19]. Sheep and goat pox in endemic areas are associated with significant production losses because of reduced milk yield, decreased production, abortion, damage to wool and hides, and increased susceptibility to other disease, while also being a direct cause of mortality [20].

### Etiology

The disease is result from infection caused by sheep pox virus (SPV) or goat pox virus (GPV), of family poxoviaride, Subfamily *Chrodopoxvirinae*, genus capripoxvirus. Is DNA virus. The poxviruses of sheep and goats (capripoxviruses) are closely related, both antigenically and physicochemically. We have unable to distinguish poxvirus from each with serological techniques (including serum neutralization), and were once thought to be strains of a single virus. SGP viruses are usually species specific; however, strains do exist that can infect both sheep and goats. Genetic sequencing has now confirmed that these viruses are distinct, but recombination can occur between them, however some capripoxivirus are not host specific. Kenya sheep and goat pox virus and Yeman and Oman infect both sheep and goat [12].

capripoxvirus are highly stable in normal environment condition and can survive for prolonged time, with or without susceptible animal. They are inactivated by sun light and heat, but can survive in cool dark environment for up to 6 month [21]. The sheep pox and goat pox viruses are generally considered host specific, but some strains affect both species [22].

Family poxoviride contain, Entomopoxvirinae, the poxviruses of insects, and Chordopoxvirinae, the poxviruses of vertebrates. The subfamily Chordopoxvirinae is comprised of eight genera, namely orthopoxivirus, parapoxvirus capripoxvirus, avipoxvirus, Leporipoxvirus, Suipoxvirus, Molluscipoxvirus and Yatapoxvirus. Genetic recombination within genera results in extensive serological cross-reactions and cross-protection [23] (Figure 1).

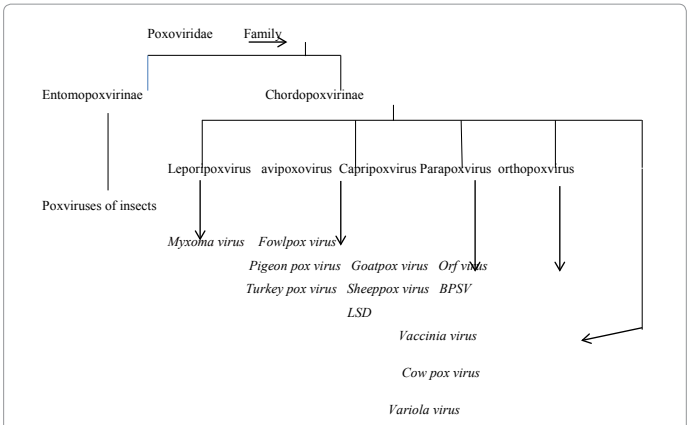


**Figure 1:** Classification of poxviruses with emphasis on those which affect domestic animals [23].

## Epidemiology

### Distribution and transmission

Sheep and Goat Pox are prevalent in parts of, central Asia, Africa except in South Africa, and the Middle Eastern countries. Goat pox is first reported in 879 in Norway and was later observed in Macedonia during the First World War. Capripoxvirus is found in the middle east, in Africa north of equator India, Pakistan, Turkey and Iran. Recent outbreak was occurred in 2008 and 2009 in Mogolia. Other outbreak have occurred in 2008 and 2009 is in Greece and Kazakhstan and Azerbaijan respectively. In Vietnam goat pox has been introduced in 2005. The outbreak of goat pox was occured in Chinese Taipei in 2008 and in 2010 the disease reoccurred and was declared endemic [24]. In Ethiopia, the disease is distributed in all regions [25].

The virus of sheep and got pox is highly contagious. Virus enters via respiratory tract and transmission is mostly by aerosol through contact with infected animal or fomite. Vectores like, stomoxys calcitrans and tsetse flay can transmite virus mechanically [25]. Most experimental transmission and pathogenesis studies have used intradermal inoculation of the virus. Disseminated infection of the skin following either experimental intradermal inoculation or after respiratory infection is the result of viraemia and subsequent systemic viral spread to the skin [26,27].

The virus can survive for several weak in oral and nasal secretion after infection and also can live in scabs that have fallen off the animal for several months. Spread can also occur from contact with contaminated materials and through skin abrasions produced iatrogenically or by insects [28-30].

## Risk Factor

**Pathogen risk factor:** The poxviruses are thought to have prolonged survival in environment and inactivated by drying, freezing, thawing, and remain viable for months in the lyophilized state. But its sensitive to 1% of formalin and extreme PH. can remain infectious for up to six months in sheep pens, and may also be found on the wool or hair for as long as three months after infection [31]. Capripoxvirus are highly stable in normal environment condition and can survive for prolonged time, with or without susceptible animal. They are inactivated by sun light and heat, but can survive in cool dark environment for up to 6 month [21].

**Host risk factor:** Group of Sheep and goat of all age, breed and sex are susceptible to sheep and goat pox. In areas where sheep pox is enzootic, imported breeds such as Merinos or some European breeds may show greater susceptibility than the native stock. Sheep and goat pox infect only sheep and goat and have no zoonosis. Wild ungulate is not reservoir for this disease [10]. Capripoxvirus can affect sheep, goat and cattle. Virus of goat pox is highly host-specific, infecting only goats, but from isolate to isolate host specificity varies. It is possible that the host preference shown by different strains is due to their adaptation to the presence of either sheep or goat alone in a limited geographical area. Isolates of Capripoxvirus are not host-specific; cattle, goats, and sheep who have recovered from infection with Capripoxvirus isolates

from a heterologous host hav immune to any challenge with a virulent homologous virus [32].

There are two types of sheep pox virus [33], in which, one affects both sheep and goats (Kenyan sheep and goat (KSG) strain while the other is host specific. Recent records indicate that strains of sheep pox do pass between sheep and goats, although most cause more severe disease in sheep. Recombination also occurs between strains of SPV producing a spectrum, showing intermediate host preferences and a range of virulence [34].

**Environment risk factor:** Environmental determinants play a great role in the occurrence of sheep and goat pox. It had impact on the agent, host and vectors as well as interaction between them. These predisposing factors have a great role in maintenance of Stomoxys calcitrans and the tsetse fly to susceptible animals which are the vectors for transmission of disease [25].

## Pathogenesis

Incubation period of sheep pox is 4-8 of that of goat pox is 4-15 days. After it inters, goat pox virus replicates locally in the tissues. Since the virus is epitheliotropic, it will infest the epithelium tissues of the organism. On the 7$^{th}$ day post-inoculation, the virus titer reached to its peak. The virus spread to the regional lymph nodes, after 3-4 days of primary viremia. The viremia spread in the body, and affected spleen, lungs and liver. The virus inhaled may also cause lungs lesions. In skin nodules from 7 to 14 days after inoculation, the virus titers persisted and decreased with the development of serum antibodies. Within 24 hours of the appearance of generalized papules, affected animals develop conjunctivitis, rhinitis and enlargement of all the superficial lymph nodes, in particular the prescapular lymph nodes. Excessive salivation can also occur after infection [24].

There are five stages in the development of pox infection. Roseola stage is stage in which Skin lesions typically begin with small red spots with in three days of infection which is followed by papules**.** The affected animals are febrile at this stage. The second stage of pox lesion is Papules wich develops after 3 days of roseola stage. Nodular skin lesions that are developed from roseola stage (red spots) those are hard during palpation. Papules with in 5-6 days are changed to vesicles and known as vesicular stage. Pustular stage develops after 3 days of vesicular stage. The last stage of pox lesion is scab. Quantitative analysis using real-time PCR and isolation of the pathogenesis of Sheep pox virus and Goat pox virus in their respective hosts revealed high viral loads in skin [35].

## Clinical Sign and Finding

Both sheep and goat pox have similar clinical sign [22]. The incubation of SGP is between 4-15 Days in field condition [36]. The clinical sign of sheep pox can be either malignant or benign. The malignant form of sheep pox is mostly common in lamb. Affected lambs may die without observable pox lesion. Fevers which peak at 40-42°C, dyspnea, and occulonasal discharge and pox lesion on unwooled skin are manifested in malignant form of sheep pox. The diseases are more severe in young animals than adults. In benign form of sheep pox only skin lesions occur particularly under the tail. This form of sheep pox is common adult. There is no systemic reaction and the animal recovers in 3-4 weeks. Abortion and secondary pneumonia are complications. In young the mortality rate may reach 100% while the overall mortality may be 50% of the flock. Lesions may be seen on the vulva, prenium, nostril and mucous membranes of the mouth. If lesion is present in the lung acute respiratory distress occurs [37] (Figures 2 and 3).

Post mortem Lesions of sheep and goat pox can develop in lung, spleen, lymph node and other internal organs. Lesion may also present in the mouth, nares, eye or eyelid. Affected mucous membranes may become ulcerate or slough and necrotic. Nodules occur in digestive, respiratory and urogenital system. Animals with lung lesions may have respiratory signs including coughing, nasal discharge and dyspnea. Nodules in the digestive system can cause diarrhea. Depression and emaciation may be seen in some animals. Abortions can occur but are not common. In acute disease some breeds of sheep can die before the characteristic skin lesions develop [12]. At necropsy, skin lesions have congestion, hemorrhage, edema, vasculitis, and necrosis and will be seen to involve all layers of the epidermis, dermis, and, in severe cases, extend int the adjacent musculature. Histologically, pox lesions have extensive inflammatory, necrotic and proliferative changes. The presence of Borrel cells, and intracytoplasmic inclusion bodies similar to the inclusions found with all poxviruses, are characteristic of Sheep and goat pox. Poxvirus of sheep and got pox can be seen under electron microscope and can be readily differentiated from the virus particles of contagious pustular dermatitis, but indistinguishable from the orthopoxviruses [37].

## Diagnosis

Sheep and goat Pox can be diagnosed based on observable clinical sign like, fever, dyspnea and pox lesion in different parts of the unwoolen skin. Clinical pathology and species of affected host are also important in the diagnosis of this disease. Epidemiology of the disease is also important in diagnoses of sheep and goat pox. As the virus of sheep and goat pox are very closely related it's indistinguishable by serologically. It appears that the host preference shown by these viruses with respect to either sheep or goats, accompanied by the case history, may be regarded as partially affirmative for either sheep pox or goat pox, but confirmatory diagnosis requires laboratory studies. It is also known that heterologous diagnostic reagents tend to be less efficient than homologous reagents for confirmatory diagnosis [38].


**Figure 2:** Malignant form of sheep pox.


**Figure 3:** Benign form of sheep and goat pox.

Before collecting or sending any samples, the proper authority's samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease. Samples for virus isolation must be sent to the laboratory as soon as possible. They should be kept cold and shipped on gel packs. If these samples must be shipped long distances without refrigeration, glycerol (10%) can be added; tissue samples must be large enough that glycerol does not penetrate into the centre of the tissue and destroy the virus. Sheep and goat antigen can be detected using routine laboratory procedure. Direct fluorescent antibody test using edema fluid, Agar gel immuno Diffusion (AGID) using biopsies of lymph nodes using specific immune sera and ELISA are used to detect sheep and goat pox antigens. Other laboratory diagnoses of sheep and goat pox include observation of the virus using electron microscope, virus isolation, and indirect fluorescent antibody and detection of antibody by virus neutralization test [27], or both; and characteristic histopathologic lesions [21].

Sheep and goat pox may have similar clinical sign with contagious ecthyma (orf), bluetongue, Parasitic pneumonia, caseous lymphadenitis, Insect bites, Sheep scab, Mange and Photsensitization, Peste des petits ruminants [10].

## Economic Importance

Sheep and goat pox is highly devastating viral systemic disease of sheep and got. Sheep and goat pox are among the commonest disease of sheep and goat entailing a huge economic loss of the country. These two diseases are limiting international trade of animals and animal product [13,14]. This disease is fatal in newly introduced animal, but may be mild in indigenous breeds from endemic region. The outbreak of sheep and goat pox may cause serious stock and economic loss in sheep and goat industries [39].

In endemic areas the disease are economically important due to production losses because of decreased weight gain, milk yield, damage to wool and hides, cause abortion, and increased susceptibility to other disease, while also being a direct cause of death. In naïve animal's mortality and Morbidity rates can be very high, approaching 100% [40]. In India mortality rate had been 49.5 and took 6 years to recover from an outbreak [41].

Sheep and goat pox (SGP) disease can affect trade, import, export and intensive production of animals. Flock size, number of adult animals and number of days of illness play significantly in influencing the economic losses due to Sheep Pox [42,43].

## Management Strategies

Sheep and goat pox has no effective treatment so treatment of sheep and goat pox should be directed to control secondary bacteria infection. So parenteral administration of abroad spectrum antibiotic is important to control secondary bacterial infection. Clean, well ventilated enclosure and balanced diet should be provided. If Animals are unable to feed 100/o glucose saline should be given parentally. To limit secondary bacterial complication all diseased animal should be treated with antibiotics. Wash and clean the nostril with weak solution of potassium permanganate (1:10000) to relieve respiratory related sign. Topically applying antibiotic ointment is important for skin lesion [42]. Heating at 56°C (133°F) for 2 hours, or to 65°C (149°F) for 30 minutes are reported to destroy Capripoxviruses. Although some strains are resistant to ether, capirpoxvirus are generally inactivated by chloroform, formalin and ether 20%. Capripoxviruses are generally sensitive to ether (20%), formalin and chloroform [12].

Vaccination with commercially available live attenuated vaccines has been applied as the main control measure for SPP/GTP in endemic regions. Annual vaccinations using live attenuated SPP vaccines provide good protection and are able to control the outbreaks when the minimal coverage of 75 % is reached and maintained. Experience obtained from the FAO Regional Animal Disease Surveillance and Control Network for SPP eradication programme in 2000 within Maghreb countries demonstrated that a considerable reduction in SPP cases was achieved when the goal for vaccination coverage was set between 75 and 90 % [44]. To control loss from sheep and goat pox vaccination is an effective means of controlling in area where disease is endemic. As they do not provide long lasting immunity, killed vaccine have not yet proven to be practical under field condition. For protection of sheep and goat pox modified live vaccine can also used. Roman strain vaccine has been used effectively for many years for the control of sheep and goat pox [45,46].

As per the guidelines OIE, eradication of sheep and goat pox can be adopted the same strategy as followed incase of rinder pest. This can be applied after serological surveillance for a period of 2 years and cessation of vaccination program followed by an initial mass vaccination. In general, to declare a country free from SGP about ten years is required [47-49].

## Conclusion

Sheep and goat pox are the most serious viral disease of sheep and goat. It is economically important disease as it causes high morbidity and mortality rate in sheep and goat industries. These diseases are widely distributed in Middle East, Africa, central Asia and Indian content. Direct or indirect contact with infected animal or fomite, and vectors are some important means of this disease. Since these diseases have no effective drug the treatment should be directed at preventing secondary bacterial infection. Movement of animals and animal products should be restricted during disease outbreak. Carcass and any skins, wool or fiber which may have been contaminated should be either burned or buried. Furthermore, insects that are potential vectors to transmit virus should also be controlled and animal should be vaccinated with commercially available attenuated vaccine as the main control measure in endemic regions.

### References

1. CSA (Central Statistic Authority) (2013) Agricultural sample survey Volume II, Central Statistic Authority, Addis Ababa, Ethiopia.
2. Tibbo M, Philipsson J, Ayalew W (2006) Sustainable sheep breeding programmes in the Tropics: Framework for Ethiopia.
3. Nottor DR (2012) Genetic Improvement of reproductive efficiency of sheep and goat. Animal reproduction Science. 130: 147-151.
4. Gizaw S, van Arendonk JAM, Komen H, Windig JJ, Hanott O (2007) Population structure, genetic variation and morphological diversity in indigenous sheep of Ethiopia. Animal Genetics 38: 621-628.
5. Alvarez I, Traore A, Tamboura HH, Kabore A, Royo LJ, et al. (2009) Microsatellite analysis characterizes Burkinafaso as a genetic contact zone between Sahelian and Djallonke sheep. Anim Biotechnol 20: 47-57.
6. Duguma G, Mirkena T, Haile A, Iñiguez L, Okeyo AM, et al. (2011) Identification of smallholder farmers and pastoralists' p references for sheep breeding traits: choice model approach. Animal 5: 1984-1992.
7. Jilo K, Abdela N, Adem A (2016) Insufficient Veterinary Service as a Major Constrants in Pastoral Area of Ethiopia: A Review. Journal of Biology, Agriculture and Healthcare 6: 94-101.
8. Abdela N (2016) Important Cattle Ticks and Tick Born Haemoparasitic Disease in Ethiopia: A Review. Acta Parasitologica Globalis. 7: 12-20.

9. Tsegaye D, Belay B, Haile A (2013) Prevalence of Major Goat Diseases and Mortality of Goat in Daro-Labu District of West Hararghe, Eastern Ethiopia. Journal of Scientific and Innovative Research 2: 665-672.

10. Sheep, Ethiopian (2009) Goats Productivity Improvement Program (ESGPIP), "Common defects of sheep and goats skin in Ethiopia and their causes". Technical Bulletin 19.

11. Matthews RE (1982) Classification and nomenclature of viruses. Intervirology. 17: 1-99.

12. CFSPH (2008) The Center for Food Security Public Health, Iowa State University, College of Veterinary Medicine and Institution of International cooperation in Animal Biologics, an OIE collaborating center.

13. OIE (2008) Peste Des Petits Ruminants. Terrestrial Manual. Pp: 1036-1046.

14. OIE (2008). Sheep Pox and Goat Pox. Terrestrial Manual. Pp: 1058-1068.

15. Beard PM, Sugar S, Bazarragchaa E (2010). A description of two outbreaks of capripoxvirus disease in Mongolia. Vet Microbiol. 142: 427-431.

16. Sileshi Z (2009) Sheep and goat pox: causes, prevention and treatment. In: Technical bulletin no.29 sheep and goat pox: causes, prevention and treatment.

17. Woldemeskel M, MarshaG (2010) Study on caprine and ovine dermatophilosis in Wollo, Northeast Ethiopia. Trop Anim Health Prod. 42: 41-44.

18. Daniel T (2016) Prevalence of Major Skin Diseases in Ruminants and its Associated Risk factors at University of Gondar Veterinary Clinic, North West Ethiopia. Austin J Vet Sci Anim Husb. 3: 1019.

19. Bhanuprakash V, Moorthy ARS, Krishnappa G, Srinivasagowda RN, Indrani BK (2005) An epidemiological study of sheep pox in Karnataka state, Révue Scientific et, Technique (Office International des Epizooties). 24: 909-920.

20. Yeruham I, Yadin H, Van Ham M, Bumbarov V, Soham A, et al. (2007) Economic and epidemiological aspects of an outbreak of sheeppox in a dairy sheep flock. Vet Rec. 160: 236-237.

21. Davies FG (1981) Sheep and Goat pox. In: Virus diseases of food Animals. London: Academic Press. pp: 733-748.

22. Kitching RP, Taylor WP (1985) Clinical and antigenic relationship between isolates of Sheep and goat pox viruses. Tropical Animal Health and Production. 17: 64-74.

23. Quinn PJ, Markey BK, Carter ME, Donnelly WJ, Leonard FC (2002) Veterinary Microbiology and Microbial Disease. Black well publishing company: Blackwell Science, London, UK, pp: 137-143.

24. OIE Terrestrial Manual (2012). Chapter 2.7.14 Sheep pox and goat pox.

25. Webbs G (1980) Sheep and goat pox, transmission of capripox viruses by various flies indicated the need for a reassessment of the methods of controlling this disease. *Annual Report, Institute for Animal Health, Pirbright, UK*.

26. Afshar A, Bundza A, Myers DJ, Dulac GC, Thomas FC (1986) Sheep pox: Experimental studies with a west african isolate. Canadian Veterinary Journal 27: 301-306.

27. Davies FG, Otema C (1978) The antibody response in sheep infected with a Kenyan sheep and goat pox virus. J Comp Path. 88: 205-210.

28. Swanepoel R, Coetzer JAW (2004) Rift valley fever. *Infectious diseases of livestock* 2: 1037-1070.

29. Radostits OM, Gay CC, Hinchcliff KW (2006) Veterinary Medicine. 10th edn. Saunders, pp: 1430-1431.

30. Animal Health Australia (AHA) (2011) Disease Strategy Sheep pox and goat pox, Available at: www.animalhealthaustralia.com.au/programs/emergency-animal Disease preparedness/ausvetplan

31. Sharma B, Negi BS, Pandey AB, Bandyopadhyay SK, ShankarH, et al. (1988) Detection of goat pox antigen and antibody by the CIE test. Tropical Animal Healtb and Production 20: 109-113.

32. Kitching RP, Bhat PP, Black DN (1989) The characterization of African strains of capripoxviruses. Epidemiology and Infection. 102: 335-343.

33. Singari NA, Moorthy AS, Rama Rao P (1990) Sheep pox. Livest Adviser 15: 40-42.

34. Manual OIE (2000) Manual of standards for diagnostic tests and vaccines. 4th edn.

35. Bowden TR, Babiuk SL, Parkyn GR, Copps JS, Boyle B (2008) Capripoxvirus tissue tropism and shedding: A quantitative study in experimentally infected sheep and goats. Virol. 371: 380-393.

36. House JA (1992) Sheep and goat pox. In: Veterinary Diagnostic Virology: Practitioners Guide, Mosby Year Book, pp: 217-219.

37. AUSVETPLAN (1996) Australian Veterinary Emergency Plan. Disease Strategy, Lumpy skin disease.

38. Pandey R, Singh P (1972) Soluble antigens of sheep pox and goat pox viruses as Determined by immunodiffusion inagar gel. Acta Virologica16: 47-46.

39. Garner MG, Lack MB (1995) Modelling the potential impact of exotic diseases on regional Australia. Australian Vet J. 72: 81-87.

40. Bhanuprakash V, Indrani BK, Hosamani M, Singh RK (2006) The current status of sheep pox disease. Comp. Immunol Microbiol Infect Dis. 29: 27-60.

41. Garner MG, Sawarkar SD, Brett EK (2000) The Extent and Impact of Sheep Pox and Goat Pox in the State of Maharashtra India. Tropical Animal Health and Production 32: 205-223.

42. Senthilkumar V, Thirunavukkarasu M (2010) Economic losses due to sheep pox in sheep farms in Tamil Nadu. Tamil Nadu Journal of Veterinary and Animal Sciences 6: 88-94.

43. Nandi S, Rao TVS, Poonam M (1999) Sheep pox - a scourge to sheep industry in India. Indian Farming 49: 29-31.

44. FAO (Food and Agriculture Organization) (2001) RADISCON workshop on sheep pox eradication programme. EMPRES Transboundary Animal Diseases Bulletin 18/13.

45. Ramyar H (1965) Studies on the immunogenic properties of tissue culture sheep pox virus. Zentralbl. Veterinar Med. 123: 537-540.

46. Sabban MS (1957) The cultivation of sheep pox virus on the chorioallantoic membrane of the developing chicken embryo. AJVR 18: 618.

47. Kitching RP (1986) The control of sheep and goat pox. Revue Scientifique et Technique de l'OIE (France) 5: 503-511.

48. Rweyemamu MM, Roeder PL, Taylor WP (2006) Towards the global eradication. In: Barret T (ed). Cambridge: Institute of Animal Health, Biology of Animal.

49. Bhanuprakash V (2011) Prospects of control and eradication of capripox from the Indian subcontinent: A perspective. Antiviral Research 91: 225-232.

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