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Common Infectious Diseases of Small Ruminants and Their Prevention

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Abstract

Small ruminants (sheep and goat) are considered as the backbone of the poor farmers and play a major role in the agricultural economy of India. They provide livelihoods to numerous small and marginal farmers. Some common infectious diseases severely constrain the health status of these animals thereby adversely affecting the production and indirectly the livelihood of the farmers. While small ruminant farming help generating income for the poor and marginal farmers, the husbandry and management practices along with preventive healthcare strategies could make it more efficient in poverty alleviation. The present article intends to highlight the common infectious diseases of small ruminants prevalent in our country and their prevention with a hope that it can create awareness among the farming community and may indirectly support their livelihood through improving and safeguarding the health of their animals from such important diseases.

Introduction

Small ruminants *e.g.*, sheep (*Ovis aries*) and goat (*Capra hircus*) were among the first animals to be domesticated. Sheep reportedly has its origin from four distinct wild sheep, *e.g.*, Urial, Argali, Mouflon, and Aoudad, while goats have been originated from only one wild type, the Bezoar of Asia Minor and the Middle East. More than 850 breeds of sheep and more than 500 goat breeds inhabit across the globe. Sheep and goats are often reared in marginal conditions with scanty grazing and unfavorable climatic situations. Both the species being naturally hardy survive by grazing on less endowed community pastures in unused lands and sufficiently protect themselves against diseases. They play a vital role in sustainable agricultural systems supporting and ensuring the livelihood and earnings of the rural poor in Indian sub-continent and several other parts of underdeveloped and developing countries. They are the dairy animals of the poor and hence popularly known as the poor man's cow as they provide milk to the poor under low or negligible capital investment. More than 90% of small ruminants are owned by landless and marginal farmers in India, where the average goat milk yield is nearly 165 kg year⁻¹. As per the most recent 20th Livestock Census conducted in 2019, the total sheep in India is 74.26 million and goat is 148.88 million. Several of the infectious disease like Peste des Petits Ruminants (PPR), FMD, goatpox, sheeppox, anthrax, enterotoxaemia *etc.* pose hurdle to small ruminant productivity in the country thereby affecting livelihood security to millions of families in the country.

Common Infectious Diseases in Sheep and Goats in India and Their Prevention

Foot and Mouth Disease (FMD)

FMD is a highly contagious viral disease of small ruminants with a significant economic impact. The cause is FMD virus, an *Aphthovirus* of the family *Picornaviridae*. There are seven serotypes globally circulating in different countries worldwide, among which O, A and Asia 1 are prevalent in India. Small ruminants play an important role in the epidemiology and transmission of FMD. There have been numerous examples in the past where small ruminants have been implicated for the introduction of FMD into previously disease-free countries (Kitching and Hughes, 2002).

All excretions and secretions from the infected animals contain FMDV. The virus can spread through contaminated sheds, where diseased animals are kept or animal transport vehicles; contaminated beddings, footwear or equipment used; infected animals newly introduced into a flock without the intervention of quarantine. FMD in small ruminants has an incubation period of about 3-8 days. Adult sheep and goats with FMD do not show clear and frank clinical signs, disease being frequently mild or unapparent for which it can easily be missed by the farmers or difficult to diagnose by the veterinarians.

In sheep and goats, the most frequent first observable clinical sign is lameness. FMD can cause high mortality in young animals due to myocarditis. The clinical signs in sheep and goats include high fever, salivation (not ropy as in cattle), decrease in food intake due to mouth lesions and drop in milk production, oral vesicles, interdigital spaces ulcers, lesions on the dental pad. Vesicles may also be observed on the teats especially of milking sheep and goats and rarely on the vulva and prepuce (Kitching and Hughes, 2002).

For control and prevention of FMD, vaccination is the only feasible option in developing country like India. The vaccination has been routinely taken up by the Government of India under National Animal Disease Control Programme (NADCP) of course, mostly in large ruminants. But the same inactivated FMD vaccine can be given to kid or lamb and above the age of 4 months and be used at regular intervals of 6 months to prevent the disease in sheep and goat population.

Peste des Petits Ruminants (PPR)

PPR is considered to be the disease of major economic impact in small ruminants and has to be notified to the World Animal Health Organization (OIE). In many areas of India, small ruminant production and indirectly the livelihoods of poor farmers are threatened by PPR. It is estimated that one billion small ruminants or about 62.5% of global domestic small ruminant population is at risk of

infection with PPR (Ahmed, 2020). More than 200 million small ruminants are at risk of PPR and the annual loss due to the disease has been estimated at approximately INR 1,800 million (Venkataramanan *et al.*, 2005) in India. An estimate says an average of 1 out of every 3 small ruminants in India has previously been infected with PPRV and has subsequently got recovered from the disease.

PPR was first described in Ivory Coast of West Africa in 1942 and named as Kata, pseudo-rinder pest, pneumoenteritis complex and stomatitis-pneumoenteritis syndrome. PPR in India was first reported in sheep at Arasur village, Villipuram district of Tamil Nadu during 1987. The disease is caused by RNA virus *e.g.*, PPR virus (PPRV), a small ruminant morbillivirus in the family *Paramyxoviridae*. Clinically PPR is observed in both sheep and goats; however, goats are more susceptible than sheep. Goats are severely affected while sheep undergo mild form sometimes. The virus is transmitted through direct contact between infected and healthy susceptible animals. Kids within 4 months to 1 year of age are most susceptible to the disease. Climatic condition is also a major factor and outbreaks are most frequent during the rainy season or the cold dry season. In subtropical areas, the occurrence of the disease is more common during winter and rainy seasons. Migratory small ruminants have been observed in the sub-Himalayan region as well as in dry land areas in the states of Rajasthan and Gujarat. Such infected migratory animals may further transmit the virus to other susceptible local sheep and goats. The movement of animals therefore plays an important role in the transmission and maintenance of PPRV.

The incubation period varies from 2 to 10 days and in most cases the clinical symptoms start in 2-6 days. PPR in most cases is acute with fever lasting for 5-8 days. The affected animals shed the virus in exhaled air, tears, nasal discharges, secretions and excretions from natural orifices, coughing and in feces of infected animal about 10 days after the onset of fever. Transmission through ingestion and conjunctival penetration, by licking of bedding, contaminated feed and water troughs are also not uncommon.

Typical clinical signs begin with a clear nasal discharge that gradually becomes greyish and sticky. Such discharge from the nose may remain mild or may progress to crusting exudates blocking nostrils inducing respiratory distress. Small erosive areas may be observed in nasal mucous membranes and the conjunctiva may be congested with matting of the eyelids. The oral mucous membranes may also be eroded due to necrotic stomatitis that starts as small necrotic focus on the dental pad/gum below the incisors. Subsequently, bronchopneumonia with coughing characterizes the later stage of PPR. At the height of development of oral lesions, most animals manifest severe diarrhea causing severe dehydration, emaciation and dyspnea followed by hypothermia and death occurs after 5 to 10 days of such clinical course. Recovered animals develop strong and long-lasting immunity to PPR.

Live attenuated homologous PPR vaccine was developed at ICAR-Indian Veterinary Research Institute (IVRI) and made available through commercial houses. Several homologous PPR vaccines with cell culture-attenuated strains are available globally. In India, PPR vaccines (Sungri/96 strain) and fool-proof diagnostics have been developed and available for field use since long (Singh and Bandyopadhyay, 2015). A sandwich-ELISA for diagnosis of PPR in small ruminants and monoclonal antibody based competitive-ELISA for detection and titration of antibodies to PPRV have been developed. The s-ELISA kit developed at Division of Virology, IVRI, Mukteswar, India uses a MAbs (4G6) directed against an epitope of N protein of PPRV (Singh *et al.*, 2006) that is routinely used for detection of PPRV antigen in clinical specimens in India. PPR vaccine sungri/96 strain is being used in the country for control and eradication of PPR through Government of India funded programme with a targeted eradication by the year 2030.

Sheeppox and Goatpox

Sheeppox and goatpox, two endemic capripox infections are notifiable and pose a significant threat to small ruminant sector in India. Their etiological agents are sheeppox virus (SPV) and goatpox virus (GPV) under *Capripox virus* genus of the *Poxviridae* family. The SPV and GPV are mainly found in oral, nasal, or ocular secretions. Transmission is facilitated either by direct contact through aerosols from infected hosts, or indirectly through the environment and infected vectors. Varying degree of severity has been reported in goats of same age and breed. The disease is more serious in young animals than in adults. Usual signs include fever, enlarged lymph nodes, oculonasal discharge and eruption in skin and mucous membranes. Skin lesions begin as erythematous macules that harden further to form papules. The papules subsequently become pustules and scabs following tissue necrosis. The lesions can ulcerate or necrose in the mucous membranes of mouth, nostrils and eyes. Lesions in the eyes and eyelids can cause conjunctivitis and blepharitis. Damage to the intestinal tract or respiratory system can lead to diarrhoea, emaciation, or coughing and pneumonia. Skin lesions heal slowly and can cause permanent scarring. A nodular form of skin lesion called 'stone pox' looking like nodules all over the skin has been implicated that further become necrotic, when the nodules break off and leave ulcerative lesions or scabs.

Live attenuated vaccines are mostly used to control goatpox and sheeppox. Several SPV/GPV strains attenuated by passages through different cell culture systems or on embryonated eggs are named on the basis of the place of isolation *e.g.*, Jaipur, Uttarkashi, Romania, Cairo, Chinese *etc.* Vaccination in India against goatpox is carried out with Uttarkashi strain of goatpox virus and Romanian Fanar strain of sheeppox virus. Animals above 4 months of age are vaccinated with the current homologous vaccines by intradermal or subcutaneous routes.

Enterotoxemia (Over-Eating Disease/ Pulpy Kidney Disease)

Sheep enterotoxemia is caused by *Clostridium perfringens* type D, while the situation is less clear in goats by virtue of its limited studies in the species. *C. perfringens* type D being a normal commensal is found in small intestine in relatively low number. Under certain circumstances, *e.g.*, sudden ingestion of protein and carbohydrate-rich feeds through various diets such as milk, milk replacers or green lush grasses permits more undigested starch to pass through the rumen to the abomasum and intestine where it helps in rapid proliferation of the bacterium.

The affected animal becomes lethargic and anorectic. It exhibits signs of stomach-ache *e.g.*, kicking the abdomen, frequent lying down and up, panting, lying on one side with frequent crying and diarrhoea. Due to the effect of the toxin produced by the bacteria affecting the brain the animal lies down on one side extending the legs and neck and head become extended turning towards the back. Kidney being one of the other target organs for epsilon toxin, the disease is called 'pulpy kidney' that has a diagnostic significance in ovine enterotoxaemia, while such renal involvement is not considered of diagnostic significance in caprine enterotoxaemia.

Vaccination is one of the most important tools to control any toxico-infectious disease and similarly for enterotoxaemia. The first dose of vaccination is given around 6-10 weeks of the age and then booster about 2 weeks later. Annual booster is recommended afterwards in order to maintain a higher immunity. Similarly, ewes are to be vaccinated 1-2 month prior to the lambing so as to avail higher antibodies levels in their colostrum.

Anthrax

Anthrax caused by *Bacillus anthracis* in small ruminants is manifested with septicemia, sudden death with characteristic oozing of tarry unclotted blood from the natural body openings. It has an incubation period of 3-7 days (ranging from 1-14 days). In herbivores, the clinical course ranges from peracute to chronic. The peracute form is characterized by sudden and rapid onset, staggering, dyspnea, trembling, collapse. A few convulsive movements may be observed in sheep or goat. Dark, tarry blood is evident from mouth, anus, nostrils and vulva of the affected animals due to the effect of fibrinolysin secreted by the bacteria. There is a sudden rise in body temperature and excitement followed by depression, respiratory or cardiac distress, convulsion and death in an acute form of anthrax. Blood gets discharged from natural orifices. The chronic form is characterized by localized subcutaneous edematous swelling, most often at the ventral neck, shoulders and thorax. As a mode of prevention and control of this fatal ailment, anthrax spore vaccine is administered to the susceptible animals at the age of 6 months for kid or lamb and followed subsequently once annually (in affected areas only).

Conclusion

Small ruminants are susceptible to many infectious diseases that adversely affect their health and indirectly the income source of the poor and marginal farmers. Such infectious diseases can only be prevented through an awareness of the public towards regular practice of vaccination along with sanitary and phytosanitary measures. As it has rightly been said that 'prevention is better than cure', the practice of vaccination can keep the animals protected against such dreaded diseases. The most important aspect is creating awareness among the farmers about the negative impacts of diseases through demonstration of advantages of vaccination in their animals. The benefits of vaccination can pave the way of control of the diseases with higher productivity and profitability to farmers. This can also help in doubling farmers' income including livelihood and nutritional security.

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