

The Role of Biosecurity in Preventing Caseous Lymphadenitis in Small Ruminant Herds

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ABSTRACT

Caseous Lymphadenitis (CLA), a contagious disease caused by *Corynebacterium pseudotuberculosis* (*C. pseudotuberculosis*) threatens animal and economic health of small ruminants' population worldwide. The disease is complicated by abscesses formation on lymph nodes and internal organs and results in lower productivity, low veterinary costs due to the necessity of removing affected animals. This is because several measures need to be put in place to avoid introducing and spreading CLA within herds. This review focuses on several aspects of biosecurity measures to provide protection from disease through immunization. Biosecurity preventing CLA relies on early diagnosis, other ways of isolation of infected animals and strict management of the environment. The review also explains the difficulty of applying these measures in areas with limited resources and emphasizes raising awareness and stepping up education and collaboration among the staff of veterinary offices, farmers and other stakeholders to control CLA in small ruminants.

Keywords: Small ruminants, *C. pseudotuberculosis*, herd health, disease prevention, vaccination

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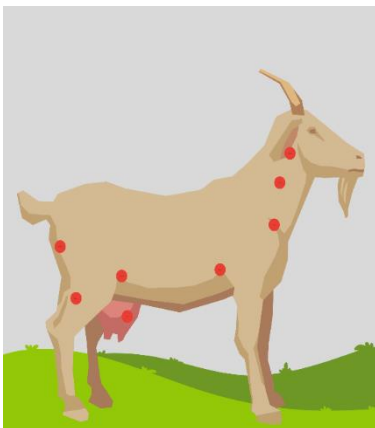
Introduction

CLA is a chronic bacterial disease of small ruminants, caused by *C. pseudotuberculosis* (1). It is equally a major problem in sheep and goats' production systems all over the world that causes losses in terms of decreased wool and meat production, poor reproductive efficiency and high rates of culling. CLA is localized in formation of abscesses in the internal organs that can reduce the production of animals. The disease is fatal and easily communicable comparing with others affecting the animal and spreads easily among the herds via contact with affected animals or with the equipment and surfaces that came into contact with the affected animals (2). Preventing entry and spread of CLA is one of the prime focuses through which biosecurity measures are implemented in small ruminant farms. Biosecurity is a range of practices proved to decrease the likelihood of pathogen spread, such as putting newly arrived or diseased animals in isolation, cleaning farm spaces, providing vaccinations to animals, and monitoring their health status. However, the control of these diseases in the developing countries either due to the limited availability of the diagnostic and even preventive tools or due to lack of sensitization to disease.

It focuses the epidemiology, routes of transmission and risks associated with the pathogen and also the theoretical and applied aspects of biosecurity. The review also outlines the challenges faced by producers, and researchers, in the implementation of biosecurity measures as well as offering potential research avenues for improving disease prevention measures in small ruminant production systems. In addressing these issues, this review brings to pass the major issues of concern in biosecurity touch with health, welfare and productivity of animals (3).

Caseous Lymphadenitis: An Overview

C. pseudotuberculosis is gram positive bacteria that secrete a toxin, phospholipase D that injures the host tissues and facilitates the bacteria spread to the lymph nodes and target organs to form abscesses. CLA manifests in two forms: Cutaneous, with external lesions are observed in the form of abscesses in superficial lymph nodes, visceral, with abscesses in organs such as the lungs (4), liver, and kidneys causing generalized signs and symptoms as shown in figure 1.



CLA is transmitted via direct contact with pus and indirect contact with infective agents from contaminated equipment and the environment. It is widespread in intensive farming systems that employ it as a management

practice in farms with compromised biosecurity. CLA lowers production, increases levels of culling, increases costs of veterinary services, and creates chances for trade-barriers (5). Conventional and non-conventional biosecurity measures are required to avoid the incidence of the disease and to check its spread.

Principles of Biosecurity in Livestock Management

Biosecurity is a concept in disease control which mainly focuses on measures aiming at minimizing infectious disease introduction and further spread in susceptible animals (6). In the care of livestock, biosecurity act as a central base towards the protection of the health, productivity and profitability of the animals can be measured. Measures of biosecurity are overall preventive, monitoring as well as control measures kept as a strategic plan with respect to the existing hazards.

Quarantine Protocols

One of the most efficient ways of avoiding CLA is by quarantining new or sicker animals, before they are incorporated into the rest of the animals. Quarantine protocols should be followed rigorously for:

- **Newly Acquired Animals:** The new animals must be confined in the quarantine section of the farm for at least thirty-one days. At this time, they should go for medical checkup especially for CLA infection through cultures to see if they are negative for *C. pseudotuberculosis* (7).
- **Sick Animals:** Clinically affected animals which are suspected of harboring CLA infection should be quickly separated from the rest of the healthy animals to avoid spread of infection within the group.

Hygiene and Sanitation Practices

Prolonged detectable existence of *C. pseudotuberculosis* in the environment can be a common predisposing factor for CLA hence adherence to public hygiene practice is crucial in preventing CLA. Regular cleaning and disinfection of facilities and equipment help reduce the risk of pathogen transmission:

Cleaning and Disinfection of Facilities

Cleaning should be done properly between the animal groups in all barns, pens and handling areas (8). Odor less disinfectants which have bactericidal effects to gram-positive bacteria, for example iodine based or phenolic disinfectants should be preferred.

Equipment Hygiene

Feeder's water troughs, shearing tools, as well as grooming brushes that many animals come into contact with should be equally cleaned often to minimize round about transmission of the bacteria (9). Particular attention should be paid to instruments that may be used on abscesses or infected tissue.

Footbaths and Disinfectant Stations

This reduces chances of bringing pathogens into the farm through people coming the farm as visitors, staff, or with vehicles (10). Washing shoes, tyres of vehicles that may be used in the transfer of animals, or those

equipment's that get into direct contact with the animals or the surfaces they come into contact with.

Vaccination Strategies

Vaccination of cattle against CLA could be advantageous where it forms part of a biosecurity program. The increasing degree of CLA pathogenicity suggests that immune prophylaxis can decrease the number of CLA infections and the severity of CLA disease. Vaccination strategies should focus on:

- **Routine Vaccination:** Vaccination should therefore form part of the normal management strategies for herds that are either at high risk of CLA or those that are in the endemic zones (11). Vaccines do not guarantee immunities; however, they lessen the clinical presentation of the disease and formation of abscesses that can spread the disease's occurrence.
- **Timing and Administration:** Prevention and treatment should be provided to sheep and goats. It takes time to get the immunity response, and it could take time to wane too; booster shots may be needed.
- **Targeting High-Risk Groups:** Other than that, animals already infected with the pathogen may require revaccination to reinforce their immunization status (12).

Regular Health Monitoring and Surveillance

CLA is a condition that requires constant health checkups in order to identify it at an early stage so that it can be treated promptly. Early detection allows for the isolation and treatment of affected animals, preventing further spread of the disease within the herd:

- **Clinical Inspections:** The animals should be routinely inspected for the clinical signs of CLA that include raised abscesses in the lymph nodes (13). Domesticated animals that exhibit signs of the disease should be quarantined, and other tests need to be run.
- **Diagnostic Testing:** Apart from clinic inspections, routine screening for CPI through PCR, culturing or serological testing serve as useful diagnosis to identify the asymptotically carrier of the bacterium. Animals that are brought into the herd and those that show signs of infection should be tested.
- **Record Keeping:** Detailed records with respect to disease history, vaccination history, and animals under quarantine should also be kept so that results of disease control measures are as optimal as possible (14). To put it in other words, CLA can be identified at the early stages and relevant interventions can be developed based on detected patterns.
- **Pasture Rotation:** Rotation of pastures should be initiated to minimize the accumulation of the infectious agents in the surroundings. Since animal's grazing is done in circular motion, the number of hours the animals spend on the contaminated pastures is less.
- **Manure Management:** Reducing the risks of contamination of the environment makes proper disposal of manure and carcasses a necessity (15). Manure and mortality have to be risk of pathogen transmit to animals while carcasses have to be buried or disposed of by the local set requirements.
- **Minimizing Animal Density:** This is because overcrowding causes close contact that enhances the spread of pathogen causing infections among staff and patients (16). Another crucial thing that farmers need to achieve is the management of the congregate density so that the animals do not infect each other as shown in figure 2.



Fig. 2: Clinical signs (development of abscesses) in goat

Education and Training for Farmers and Staff

Active animal as well as people involvement is therefore a key factor for an effective biosecurity measures in the herd (17). Educating farmers, farm workers, and veterinarians about CLA, its transmission, and the importance of biosecurity is essential for success. As a result, employees, volunteers and visitors on the farm receive refresher courses in the tools of biosecurity, hygiene and disease diagnosis to avoid contracting CLA. The cooperation between farmers, veterinarians and extension services helps to create the commonality of understanding of the recommended practices and promoting compliance with biosecurity standards. Quarantine and isolation manners are hard to put in to practice in extensive farming systems since animals are raised in large pastures, and it is challenging to monitor animals (18). Environmental transmission of *C. pseudotuberculosis* of poor waste disposal and contaminated pastures remains a major source of the organism's survival and increases the chance of transmission.

Future Direction and Challenges

The only view towards controlling CLA in small ruminants is improvement in diagnostic tools, vaccines which are not available currently, selective breeding for animals with genetic resistance to the disease and environmental management coupled with strict biosecurity measures. Molecular diagnostic tools will improve early detection, including in asymptomatic individuals, when better diagnostic platforms, such as the portable PCR-based tests, are employed (19). Antiviral research for superior vaccines includes nanoparticle based or DNA based vaccines which guarantees wider and long-standing protection. Perhaps, molecular genetics could aid in finding suitable genes for resistance and thus carry out the breeding of animals that were more resistant to biotic stresses. *C. pseudotuberculosis* ecology needs to be improved to enhance biosecurity measures since certain aspects remain unidentified by existing knowledge (20). The solutions have to be inexpensive and designed to fit into low resource settings as this will go a long way to promoting a wider uptake.

Conclusion

CLA poses a huge effect on the small ruminants and its impact across health, production and well-being of the animals. A crucial role belongs to biosecurity systems, which should minimize chances of the introduction and further spread of *C. pseudotuberculosis*, the etiological agent of CLA. Areas like quarantine, sanitation and vaccination, and health monitoring are inevitable parts of the combating approach that needs to be taken for the disease. Yet several barriers including, economic, lack of knowledge, absence of veterinary services, and environmental aspects limit the management of proper bio-security measures. Thus, further action should be directed to eliminate these barriers with the help of scientific investigations and developments. There is an optimism on the new diagnostic tools, new vaccines and genetic information which can be used to prevent or control diseases. Moreover, the concerns to socio-economic and cultural factors that define bio-security adoption will remain essential for the successive management of CLA.

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