Actinobacillosis: Wooden Tongue Disease, Pathogenic Mechanism and Clinical Management in Livestock

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Abstract

Actinobacillosis is a disease caused mainly by *Actinobacillus lignieresii* – a bacterial infection that infects livestock and presents huge economic losses. Prevailed in cattle as "wooden tongue" the ailment affects soft tissues of the body such as the mouth and tongue, with granulomatous lesions and other system failures. Although an integral and entirely non-pathogenic bacterium in the normal flora of the oral cavity of ruminants, *A. lignieresii* becomes a pathogen due to mucosal damage triggered by indigestible feedstuffs or trauma. Transmission is from direct contact with infected animals or contaminated objects and articles, contact with infected environment and vectors. Histopathological examinations and molecular techniques such as PCR are used to diagnose the disease. Clinical manifestations are as follows: macroglossia, megaesophagus, and general signs and symptoms in severe stages of the disease. Antibiotics given for the treatment of the condition may include penicillin, streptomycin, and potassium iodide. Some of the control options applicable include biosecurity, appropriate husbandry, and vaccination. Economic effects include production loss, increased information condemnation, and medical costs, and several livestock industries claim heavy losses. Studies related to the immunogenic targets are relevant to enhancing the process of developing vaccines.

Keywords: Actinobacillosis, *Actinobacillus lignieresii,* Granulomatous Lesions, Livestock Infection, Wooden Tongue

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Introduction

Actinobacilli are the gram-negative aerobic coccobacilli belonging to the family Pasteurellaceae (Fenwick & Rycroft, 2022). These bacteria are facultative anaerobes and are commonly found in the respiratory and gastrointestinal tracts of various animals, including humans (Bisgaard et al., 2019). *Actinobacillus* species are known for their ability to cause a wide range of infectious diseases in both animals and humans (Gottschalk & Broes, 2019). In animals, these are primarily associated with infections in cattle, sheep, pigs, and poultry (Kempf et al., 2016). The most significant specie within the genus *Actinobacillus* is, *Actinobacillus pleuropneumoniae*, which causes porcine pleuropneumonia in pigs, leading to significant economic losses in the swine industry (Sassu et al., 2018). Other important species in animals include *Actinobacillus lignieresii*, which causes bovine actinobacillosis, and *Actinobacillus suis*, which causes infections in pigs (Caffarena et al., 2018).

Actinobacillosis is a rare disease, and we still don't fully understand the biological makeup of the agent. The pathogen's potential hosts are currently unknown, and they are typically only linked to granulomatous lesions in cattle and sheep. The mouth, tongue, and pharynx are the main implicated organs (Underwood et al., 2015). The first time *Actinobacillus lignieresii* was identified by Lignieres and Spitz in 1902, who reported it as the causative agent of bovine granulomatosis in Argentina. The bacterium is a well-known normal inhabitant of the oral cavity of ruminants and is an opportunistic infection bacterium (Salvaggio et al., 2023). Tongue tumorous abscesses, often known as wooden tongue, are brought on by a *A. lignieresii*. It mainly affects cattle, though it can also affect sheep, horses, pigs, and dogs. It is an uncommon factor in chicken diseases. The organism may also result in pyogranulomatous lesions in the subcutaneous, lungs, pleura, udder, and soft tissues connected to the head, neck, and limbs. The organism causes sickness, when it infects nearby soft tissue through penetrating wounds despite being a normal component of the upper GI tract's mucosal flora. It can spread to other tissues through the lymphatic system and results in localized infections (Pacchioni et al., 2022).

Overview of Actinobacillosis

This is an exceptionally close difference in this condition, normally causing demonstrative situations. Expansive basophilic colonies with long, slender transmitting clubs are formed by *A. lignieresi*. Actinomyces are filamentous, gram positive, microaerophilic to anaerobic microscopic organisms which are non-quick, that is, not vigorously acid. At present, actinobacillosis commonly appears in the tissue, and actinomycosis generally appears on the hard tissue (Sen *et al*., 2021). Aggravated gums, difficult and swollen tongue that could project from

the mouth, falling food caused by inability of the tongue to close properly, and parchedness and weight are the most visited clinical signs presented. Spread of the disease to the skin may form granulomas on other parts of the body (Kumar et al., 2021). However, the spread of *A. lignieresii* in the oropharyngeal or nasopharyngeal blood course and with nourishment of the body fluids (Salvaggio et al., 2023) is related with the localization of *A. lignieresii* in the gastric or respiratory tract. Actinobacillosis is an infection in the area of the parotid gland and throat. A singularly occurring nasal granuloma limited to the outside opening of a nostril caused by actinobacillosis of the nasal planum zone in cattle has been described. This contrasted to previously described cases in show dairy animals such as projecting granulomas were not noted in the show animal and the tissue response engulfed the whole nasal planum in a uniform manner. Clinically, it was a diffuse firm extension of the nasal planum, which came together in a step, an intemperate sum of sinewy connective tissue. The typical presentation of actinobacillosis of the head is believed to arise from injury that allows *A. lignieresii* into the subepithelial tissues, and, in fact, plant fabric can be seen histologically in the injury (Product et al., 2021).

Species

There are many species of genus *Actinobacillus*, Following are some notable species mentioned in table 1.

***Actinobacillus pleuropneumoniae*:** Porcine pleuropneumonia is a significant respiratory issue brought on by this pathogen in pigs. In affects herds, and leads to severe illness, characterized by fibrinous pleuropneumonia and high morbidity and mortality rates (Liu et al., 2020).

***Actinobacillus lignieresii*:** Bovine actinobacillosis, often known as wooden tongue or wooden jaw, is caused by *A. lignieresii*. It primarily affects cattle, causing abscesses to grow in the soft tissues of the mouth, throat, and lymph nodes. Swelling, pain, and trouble in eating and drinking are all symptoms of the condition (Turni et al., 2019; Salvaggio et al., 2023).

***Actinobacillus suis*:** *A. suis* has been linked to a variety of pig illnesses, including respiratory sickness, septicemia, and arthritis. It has a significant mortality rate, especially in young piglets. Humans can become infected with *A. suis* through contact with infected animals or contaminated animal products, humans are equally vulnerable when exposed to the bacteria sometimes spreading during the meat cooking process or on direct interaction with infected animals (Kulathunga et al., 2022; Abou Fakher, 2023).

***Actinobacillus equuli*:** This species is mostly responsible for disorders such as equine proliferative enteropathy and septicemia in foals, as well as opportunistic pathogen in horses. It can cause diarrhea, weight loss, fever, and even death in severe cases (Maul et al., 2020; Kamali et al., 2023).

***Actinobacillus hominis*:** *A. hominis* is a natural commensal found in the upper respiratory tract of humans. However, it can also be linked to opportunistic infections, especially in people with underlying health issues or impaired immune systems (O'Neill et al., 2016).

***Actinobacillus actinomycetemcomitans*:** This species is primarily linked to periodontal disease in humans. It is linked to aggressive forms of periodontitis, which can lead to gum tissue damage, bone loss, and tooth loss if left untreated (Amalina, 2023).

Table 1: Different species of *Actinobacillus*, their infected host and site of infection Kulathunga et al., 2022; Abou Fakher, 2023).

Species	Infected host	Site of Infection
Actinobacillus pleuropneumoniae	Pigs	Respiratory tract
Actinobacillus lignieresii	Cattles	Mouth, Throat and lymph nodes
Actinobacillus suis	Pigs, Humans	Respiratory tract
Actinobacillus equuli	Foals, Horses	Bony tissue
Actinobacillus hominis	Humans	Respiratory tract
Actinobacillus actinomycetemcomitans	Humans	Teeth and gums

Etiology

Zoonotic actinobacillosis with worldwide transmission is caused by *Actinobacillus lignieresii*, an organism that is commonly found in the upper respiratory and gastrointestinal tracts of ruminants. While the bacterium was initially first identified on South America in the early 20th century as a pathogen, it causes pyogranulomas in delicate sites such as the tongue, mouth, pharynx, forestomaches, lymph nodes, lungs, skin and subcutaneous tissue (Vereecke et al., 2023). Actinobacillosis in cattle is usually a tongue infection, with an indurative pyogranulomatous glossitis known as the “wooden tongue". Horning has been thought to be an atypical form, or cutaneous actinobacillosis, associated with other organs, chiefly, the skin or lymph nodes. It has been described in hamburger and dairy cows (Rana, 2024) as a common introduction of the infection coming about because of the depleting nodular pyogranulomas in the locale of the mandible and neck where the first damage is likely to occur in the virus hubs and then spread to subcutaneous tissue and skin eventually to ulceration. This shape of actinobacillosis has been referred to as bizarre or as cutaneous actinobacillosis., The brain of damage appears to be to the lymphatic system, therefore lymphatic actinobacillosis should be brain of redress for this frame of the malady. This is furthering a comparative localization of the injuries in the parotid, submandibular and retropharyngeal lymph hubs that has been noted in other stages of the disease at the abattoirs. In such skin lesion contaminated by *A. lignieresii*, the assignment of cutaneous actinobacillosis should be used particularly. Results were given by figures supplied from various slaughter houses and several written records indicating that the type of lymphatic actinobacillosis with which we are dealing is by far the most common form of the disease and may be at a very high rate. Based on the clinical sign, injuries and lack of manifesting injuries in the surrounding mucosa in many affected animals, one suggests that *A. lignieresii* invades the intaglio mucosa of the mouth and oropharynx and primarily disseminates in local lymph nodes (Bossé et al., 2022) . The spread occurs from the head and neck lymph hubs along the lymphatic channels to other lymph hubs, as seen to our study in one animal with an abscess in the prescapular lymph node and on few animals with small nodules in a row along the lymphatic vessels of the neck. The loss of piglets has an enormous budgetary impact for porcine actinobacillosis caused by the costs of medications and the increase in size of swellings, decrease in body mass gain and feeder to feed conversion ratio. Prescribed to reduce the economic losses of the illness by applying different anti microbials. However, *A. pleuropneumoniae* is considered

to have adapted to the respiratory tract, usually manifests damages in the lungs, but an operator can cause some systemic diseases (Tenk *et al*, 2024). In some cases of meningitis, nephritis, multifocal granulomatous hepatitis and necrotizing osteomyelitis and fibrinopurulent joint pain. *A. seminis* the microorganism has been described as one which ascends the epididymis when hormonal changes occur in the susceptible host. The prepuce microbiota of *A. seminis* is an artful pathogen for ruminants, however the role of an obligatory pathogen has been confirmed by vaccination in valuable animals (Puente et al., 2023).

Epidemiology

It is mostly the cattle affected, but there have been reports with sheep and horses. Granulomatous or pyogranulomatous injury of the tongue or subcutaneous tissues in the head and neck position is the most visit clinical introduction. The disease should most likely be developed on any site where epithelium is damaged and the living being gained access to subcutaneous tissues. Most of the infection is sporadic and associated with the practice of supplementing course or sharp feedstuffs. But incidents with up to 73 percent of the uncaptured cattle have been described in which there is shared exposure to a hazard figure including stemmy scavenge (Sen et al., 2021). *A. lignieresii*, commonly found in soil and frequently in the mouth of cattle, will penetrate the skin or mucous films by entering through cuts or scratched areas produced by unfortunate feed or malady injury. However, most cases are isolated but in a number of ranches, disease is relatively common. Inflammation of the gums, difficult tongue which protrudes from the mouth and cannot be moved, dryness and weight are the most visit clinical signs (Salvaggio et al., 2023). The disease may spread to the skin and form granulomas on other parts of the body. The head and neck region lymph nodes were always lengthened, atypical or cutaneous (skin impregnated lymph nodes) actinobacillosis (Scheid et al., 2020). Research was to examine Actinobacillus species that were isolated from 99 horses' clinical samples or necropsies between 1999 and 2011. Four young adults (6 months–2 years), 39 adults (>2 years), two aborted foetuses, eleven with unknown ages, and forty-three foals (<6 months) made up the cases. Signs, clinical history, identified bacterial species, and related lesions were recorded. 111 isolates of Actinobacillus species were made. Actinobacillus equuli subsp. equuli (38.7%) and haemolytic Actinobacillus spp. (24.3%) were the most frequently isolated bacteria. Actinobacillus lignieresii (5.4%), Actinobacillus pleuropneumoniae (1.8%), and unidentified Actinobacillus spp. (28.8%) were the remaining isolates (Layman et al., 2014

Pathogenesis and Transmission of Actinobacillosis

Pathogenesis

The pathogenesis of actinobacillosis is complicated by a number of variables, including bacterial virulence and host susceptibility. The disease often begins when the animal's mucosal barriers are breached, allowing germs to penetrate deeper tissues as shown in Figure 1(Bossé et al., 2022).

Entry and colonization: *Actinobacillus* spp. enters the body via wounds, abrasions, or mucosal surfaces, most notably in the oral cavity. Once within the host, they attach to the epithelial cells and colonize.

Invasion and spread: The bacteria have the ability to infiltrate neighboring tissues and spread throughout the lymphatic system. They can also enter blood vessels and spread to other parts of the body, resulting in systemic infections.

Tissue damage and immune response: *Actinobacillus* spp. produces virulence factors that cause tissue injury. Adhesins, exotoxins, and lipopolysaccharides (LPS) are examples of substances that cause inflammation and activate the immune system. The host immunological response, notably neutrophil infiltration, aids in the formation of abscesses and granulomatous lesions.

Transmission

Actinobacillosis is primarily transmitted through direct contact between infected and susceptible animals (Gottschalk & Broes, 2019). Bacteria are commonly found in the oral cavity and nasal discharge of infected animals, and transmission proceeds via direct contact with these fluids (Cantas & Suer, 2014). The following are the examples of common modes of transmission:

Animal-to-animal contact: Close interactions between affected and prone animals, such as scratching, biting, or exchanging feed and water bottoms, can help in propagation of the infection (Fenwick & Rycroft, 2022).

Contaminated environments: *Actinobacillus* spp. can only live in the surroundings for a short time. If susceptible animals come into touch with infected feed, water, and bedding, or tools, they can get infected (Watt et al., 2020).

Insects and vectors: *Actinobacillus* spp. can be mechanically transmitted by insects including flies and ticks. They can transfer bacteria to susceptible animals by carrying them on their skin or through their mouthparts (Otake et al., 2003).

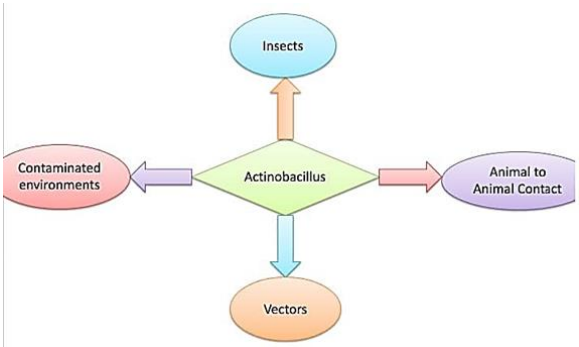

Fig. 1: Transmission of Actinobacillus

Clinical Signs and Symptoms

Actinobacillosis clinical signs and symptoms vary based on the site of infection and the degree of severity of the disease. These can be soft tissue infections (Bossé et al., 2022), Respiratory tract infection (Aper et al., 2020), gastrointestinal tract infections (Fenwick & Rycroft, 2022), and/or systemic infections (REF) (Lacouture & Gottschalk, 2020).

The clinical signs and symptoms include:

Soft Tissue Infections

- Swelling or abscess formation, usually in the head and neck region
- Firm, painless masses or lumps

- Ulceration or draining tracts from the infected site
- Tissue necrosis may occur in extreme situations

Respiratory Tract Infection
- Difficulty breathing
- Coughing
- Nasal discharge, which may be purulent or bloody
- Enlarged lymph nodes in the neck region
- Reduced appetite and weight loss

Gastrointestinal Tract Infections
- Reduced appetite and weight loss
- Diarrhea, which may contain blood
- Abdominal pain
- Enlarged lymph nodes in the abdomen

Systemic Infections
- Fever and generalized illness
- Lethargy and weakness
- Decreased milk production in lactating animals
- Enlarged lymph nodes in various locations

Diagnosis and Laboratory Techniques

Enzyme-linked Immunosorbent Assays (Jung & Won, 2019), nested Polymerase Chain Reaction (nested PCR) (Ferraz et al., 2020) and Quantitative real-time PCR (qPCR) have all been developed in recent years to detect strains/serotypes of *Actinobacillus* with higher specificity and efficiency (Wen et al., 2020). Biopsy samples from body tissues/masses suspected of being neoplastic or granulomatous may be very indicative of actinobacillosis based on gross and histological evaluation (Roussel, 2009). Existing procedures for disease diagnosis, including sample collection and identification followed by serotyping, serological typing, traditional PCR, real time PCR, and LAMP tests, are time consuming, costly, and unsuitable for fast field use. For all chemicals, incubation duration, and temperature against *Actinobacillus*, a unique isothermal polymerase chain reaction approach is used (Sarkar et al., 2022). The apxIVA-based CRISPR/Cas12a-assisted rapid detection platform (Card) for *A. pleuropneumoniae* has detection limit of 10 CFUs and has no cross-reactivity against other widespread swine conditions as shown in figure 2. (Luan et al., 2022).

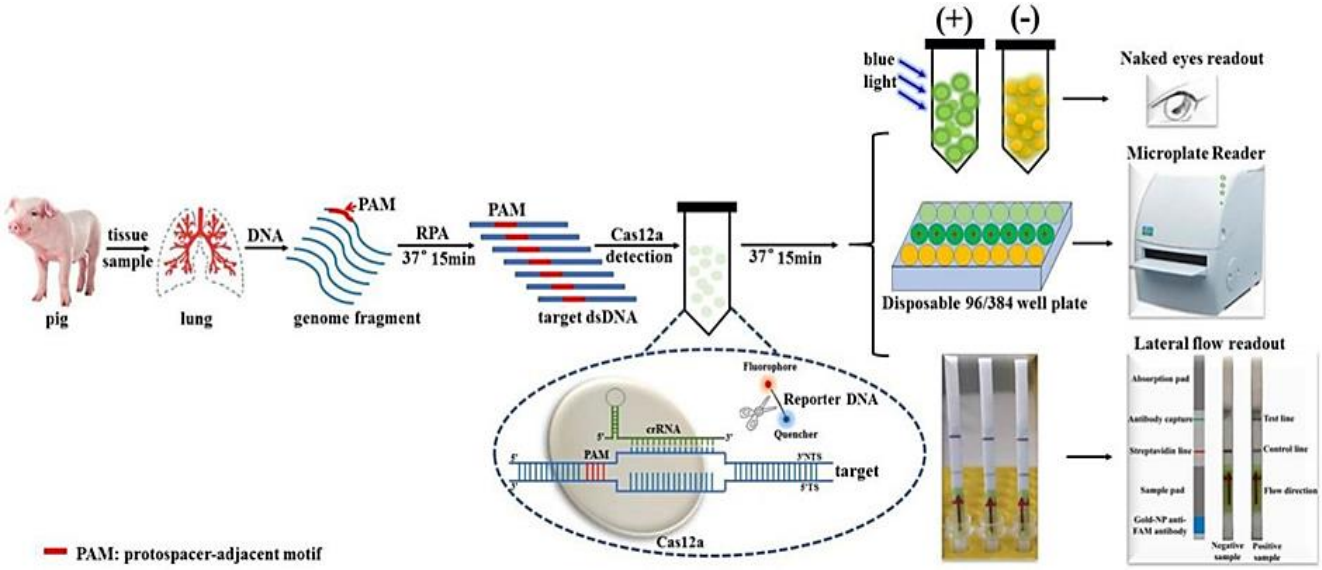

Fig. 2: Cas12a/crRNA-assisted rapid detection (Card) platform schematic design for identifying A. pleuropneumoniae (Luan et al., 2022a).

Histological Examination

A 12-year-old dairy Holstein Friesian cow exhibiting neurological signs such as shocking locomotor ataxia, decreased sensorium, and exophthalmos (unilateral) was suspected for probable bovine spongiform (BSE). The animal was slaughtered and it indicated the existence of an oval neoformation (5 cm) within the mouth cavity as shown in Figure 3. As it was positioned downside in the upper jaw (sulcus palatinus), the lesion was not seen during clinical examination and it was not ulcerative.

Fig. 3: The mouth cavity undergoes neoformation (circle). The sulcus palatinus, deep in the upper jaw bone, the site of the oral lesion (Salvaggio et al., 2023).

Neoformation similar to jaw was present underneath the projecting eyeball also, involving the optical nerve, was identified after dissecting the skull along a Para median transverse axis as shown in figure 4 (Salvaggio et al., 2023).

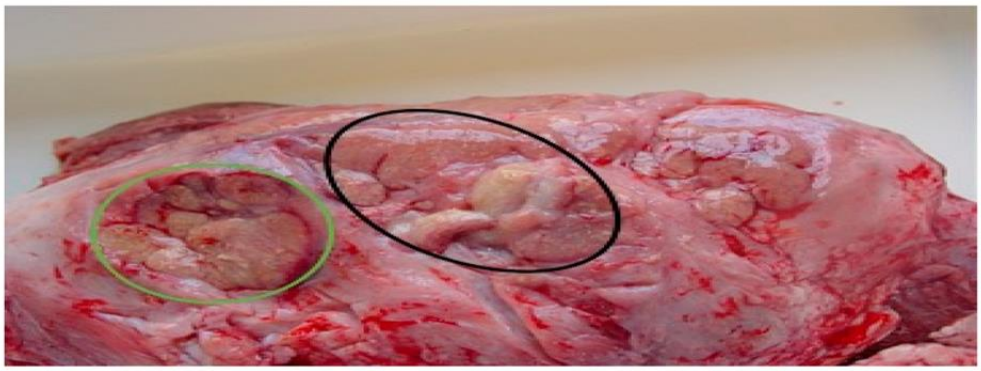

Fig. 4: Granulomatous reaction in the ocular canal (green circle) and the brain (black circle) (Salvaggio et al., 2023).

Cerebral granulomatous tissue sample and neoformations collected were fixed in 10% buffered formalin. The specimens were embedded in paraffin, and processed following standard protocol. Hematoxylin and eosin stain, periodic acid-Schiff (PAS), and Gram stain was used to observe the specimens. Histological tests were conducted utilizing normal laboratory protocols and Tissue Processing Centre TPC 15 Duo encased in paraffin wax. The histological examination showed loose connective tissue having granulomatous foci dispersed throughout. The granuloma is distinguished by a mass of microscopic bacteria aggregates surrounded by numerous neutrophils, macrophages, plasma cells, and some giant cells, as well as a granulation tissue wall that has grown into connective tissue. Gram staining was subsequently performed, showing Gram-negative bacteria (Sellyei et al., 2011; Salvaggio et al., 2023).

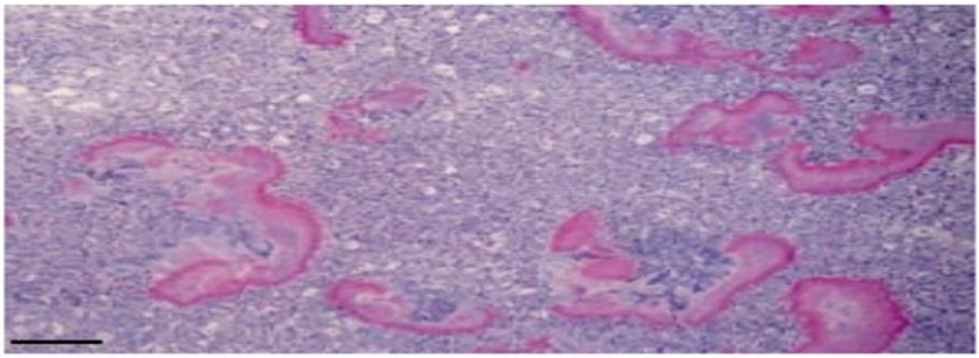

Fig. 5: Typical histological findings of *A. lignieresii*-caused granulomatous disease (Salvaggio et al., 2023).

Post-mortem Examination

The term "post-mortem" refers to "after death." Thus, "post-mortem inspection" refers to the examination of animals after slaughter (Giebels et al., 2020). A developed fibrous tongue (wooden tongue), granular lesion in the lymph nodes, and thickening of the lower esophagus and stomach wall are all post-mortem symptoms. Erosion of the rumen and reticulum mucosa is also reported. Carcasses are condemned in severe cases of actinobacillosis; nevertheless, carcasses are conditionally approved in mild cases (Yar et al., 2023). In chronic cases, granulomatous lesions may be observed, characterized by the presence of firm, grayish-white nodules. These nodules can be found in the affected tissues, such as the tongue, lymph nodes, and lungs as in figure 6 (Caffarena et al., 2018).

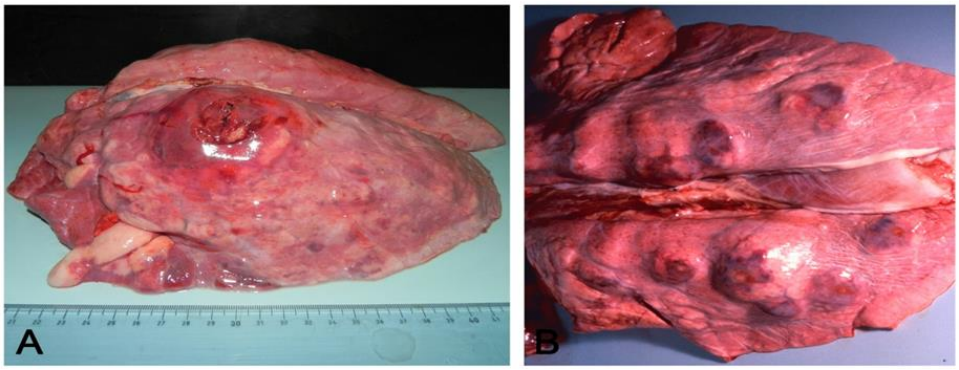

Fig. 6: *Actinobacillus pleuropneumoniae* acute (A) and chronic (B) pleuropneumonia: in (A), an acute, locally widespread, and projecting nodule coexists with concomitant pleuritis localized in the craniodorsal side of the left lung lobe, referring to A. pleuropneumoniae and cranioventral pneumonia. Chronic multifocal nodules are shown in (B) (Sarli et al., 2021).

Treatment and Management

Actinobacillosis is a disease that calls for a combination of medical therapy, supportive care and preventive measures to prevent sick animals from dying, and to minimize spread within herds. The common antibiotics are tetracyclines, penicillin, and streptomycin and the dosage and duration depend on what level of infection you have. Bacterial strains that resist are managed judiciously so that resistant strains do not develop (Ferrulli, 2023). Sodium iodide is highly effective in cases of "wooden tongue," where granulomatous lesions are present. As an alternative to an oral treatment, potassium iodide therapy is typically taken daily at doses prescribed by a veterinarian. Severely affected animals can be given non-steroidal anti-inflammatory drugs (NSAIDs) that reduce swelling and discomfort (Stilz et al., 2024). Supportive care consists of feeding animals with soft, digestible feeds or those with oral or pharyngeal lesions continuous access to clean water, and surgical removal of oral or pharyngeal lesions when necessary and severe (Niehaus & Mora, 2022). Early detection and treatment can help to avoid a need for surgical removal (Turni et al., 2019). Potassium iodide - 6-10 g/day orally for 7-10 days is a common treatment plan for actinobacillosis (Mishra et al., 2015). Early actinobacillosis is usually treated with intravenous sodium iodide, but severe actinobacillosis with osteomyelitis and disseminated abscessation (wounded or unwell) is treated with humane slaughter (Will & Whiting, 2022).

Prevention and Control Measures

A disease caused by bacteria, principally ruminants, such as cattle and sheep that afflicts a condition called 'wooden tongue,' actinobacillosis is primarily. Not only do good animal husbandry measures such as slaughter hygiene, veterinary intervention like the removal of potentially infected animals, and the implementation of biosecurity measures play a central role in effective prevention and control of infection in livestock, but modifications of farm management are also essential (Gottschalk & Broes, 2019). Good husbandry practices include reducing stress on animals, feeding them a balanced diet with enough fiber, monitoring for these early signs of actinobacillosis so that infected animals can be segregated and isolated, quarantining new animals, and disinfect equipment (Fenwick & Rycroft, 2022).

Isolate and quarantine affected animals to prevent the spread of the disease to healthy individuals (Gottschalk & Broes, 2019). Maintain good hygiene by regularly cleaning and disinfecting animal housing, equipment, and facilities. Vaccination programs may be available for certain animal species at high risk of actinobacillosis (Samkange et al., 2019). Farmers and livestock handlers need education and training about early detection, biosecurity, and prevention of injury (Salvaggio et al., 2023). Veterinarians should be prepared to correctly identify and deal with actinobacillosis. Antibiotic stewardship should be avoided, and antibiotics should only be used as directed by a qualified veterinarian. Early outbreaks should be detected by regular monitoring systems and rapid control measures should be implemented (Sweeney et al., 2022).

Economic Impact of Actinobacilosis in Livestock

Actinobacillosis in livestock has an economic impact that is multiple-faceted and can result in substantial financial losses to farmers and the wider livestock industry. Assuming reduced productivity in affected animals, one of the major economic consequences results. Actinobacillosis in livestock, especially in the “wooden tongue” form, causes mouth and tongue lesions that can be painful and thus render animals unable to chew and swallow (Stygar et al., 2016). Data from 6,833,033 slaughters in Federal Inspection Service (SIF) establishments between 2007 and 2015 were analyzed. Losses resulting from decreased productive performance were calculated. Actinobacillosis infected approximately 24.25% of slaughtered animals, leading in an estimated loss of US$ 14.7 million per year for animals slaughtered in establishments with SIF (35.58% of global slaughterers in State). This value would be more than 41.3 million dollars per year if all slaughtering was done with federal, state, or municipal inspection (M Dick *et al.*, 2019). The loss of 11346.2 kg of meat in 2010-2012 and 927.5 kg of meat in 2013 suggests the probable loss of a vital protein source (Jaja et al., 2018). The animals experience reduced feeding intake, weight loss, lower growth rates, and ultimately preparedness and profitability in the meat-producing animals. Also, when dairy animals are diseased, they may have poor nutrition and end up with lowered milk production because of stress from the disease (Caffarena et al., 2018). In addition to production losses, these can be very expensive in terms of the costs of veterinary care and treatment. All of these add yet another cost to operational costs: Farmers must sometimes pay for antibiotics, iodine-based therapies, and sometimes even surgical procedures (Milene Dick, Marcelo Abreu da Silvaa, et al., 2019).

Future Perspectives

In the future, we can expect further refinement of diagnostic methods. With the ongoing development of more sensitive and rapid molecular tools, such as real-time PCR, biosensors, and point-of-care diagnostic devices, veterinarians will be able to diagnose actinobacillosis at earlier stages. This could allow for faster, more accurate identification of the bacteria, even in subclinical or early-stage infections, leading to quicker interventions and better management of outbreaks (Luan et al., 2022a).

Conclusion

Actinobacillosis is a disease mostly caused by *Actinobacillus lignieresii*, a bacterial infection affecting animals and resulting in significant economic losses. The condition known as "wooden tongue" mostly affects cattle, impacting the soft tissues of the mouth and tongue, resulting in granulomatous lesions and other systemic failures. *A. lignieresii*, a crucial and non-pathogenic bacterium in the oral cavity flora of ruminants, may become pathogenic owing to mucosal injury caused by indigestible feed or trauma. Transmission occurs via direct contact with infected animals, contaminated items, the infected environment, and vectors. Histopathological evaluation of clinical samples, together with PCR and other molecular techniques, is used for illness diagnosis. Clinical features include macroglossia, megaesophagus, and nonspecific signs and symptoms in the advanced stages of the illness. Antibiotics prescribed for the condition may include penicillin, streptomycin, and potassium iodide. Applicable control strategies include biosecurity, proper husbandry, and immunization. The economic repercussions include production losses, heightened information condemnation, medical expenses, and several livestock sectors report substantial losses. Recent efforts include molecular diagnostics, information on the pathogenicity factors, and judicious utilization of antibiotics.

References

Abou Fakher, A. (2023). *Comparative genomic analysis of Actinobacillus suis*

Amalina, R. (2023). Perbedaan Jumlah Actinobacillus actinomycetemcomitans pada Periodontitis Agresif Berdasarkan Jenis Kelamin. *Majalah Ilmiah Sultan Agung*, *49*(124), 36-49.

Aper, D., Frömbling, J., Bağcıoğlu, M., Ehling-Schulz, M., & Hennig-Pauka, I. (2020). Comparison of metabolic adaptation and biofilm formation of Actinobacillus pleuropneumoniae field isolates from the upper and lower respiratory tract of swine with respiratory disease. *Veterinary Microbiology*, *240*, 108532.

Apley, M. D., Lubbers, B. V., & Schrag, N. D. (2024). Antimicrobial Therapy in Beef Cattle. *Antimicrobial Therapy in Veterinary Medicine*, 611-633.

Aziz, P., Kamal, K., Gaurav, K., & Saini, M. (2019). Actinobacillosis in a cross-bred heifer: A case report. *Journal of Entomology and Zoology Studies*, *7*(1), 278-279.

Bisgaard, M., Frederiksen, W., Mannheim, W., & Mutters, R. (2019). Zoonoses caused by organisms classified with Pasteurellaceae. In *Handbook of ZOONOSES* (pp. 202-208). CRC Press.

Bossé, J. T., Bujold, A. R., & Li, L. (2022). Actinobacillus. *Pathogenesis of Bacterial Infections in Animals*, 262-289.

Caffarena, R. D., Rabaza, A., Casaux, L., Rioseco, M. M., Schild, C. O., Monesiglio, C., Fraga, M., Giannitti, F., & Riet-Correa, F. (2018). Natural lymphatic ("atypical") actinobacillosis in cattle caused by *Actinobacillus lignieresii*. *Journal of Veterinary Diagnostic Investigation*, *30*(2), 218-225.

Cantas, L., & Suer, K. (2014). The important bacterial zoonoses in "one health" concept. *Frontiers in Public Health*, *2*, 144.

Dick, M., da Silva, M. A., de Souza, J. P., da Silva, R. R. F., Ferreira, O. G. L., & de Souza Maia, M. (2019). Perdas produtivas devido à ocorrência de doenças na bovinocultura Sul-brasileira. *Archivos Latinoamericanos de Producción Animal*, *27*(1-4), 27-31.

Dick, M., da Silvaa, M., Silvab, R., de Souzac, J., Ferreirad, O., & de Souza, M. (2019). Productive losses due to diseases in beef cattle in Southern Brazil. *Archivos Latinoamericanos de Producción Animal*, *27*(1/4), 27-31.

Dick, M., da Silvaa, M. A., da Silvab, R. R. F., de Souzac, J. P., Ferreirad, O. G. L., & de Souza Maia, M. (2019). Productive losses due to diseases in beef cattle in Southern Brazil.

Fenwick, B. W., & Rycroft, A. N. (2022). Pasteurellaceae: Actinobacillus. *Veterinary Microbiology*, 118-128.

Ferraz, M., Ferreira, D., Goes, A., Gregori, F., Miyashiro, S., & Ruiz, V. (2020). Direct detection of actinobacillus pleuropneumoniae in suidae organs in são paulo state, brazil, by polymerase chain reaction (NESTED-PCR). *Arquivos do Instituto Biológico*, *77*, 143-148.

Ferrulli, V. (2023). A multimodal clinical and diagnostic approach to bovine respiratory disease complex (BRDC) in dairy calves.

Giebels, F., Geissbühler, U., Oevermann, A., Grahofer, A., Olias, P., Kuhnert, P., Maiolini, A., & Stein, V. M. (2020). Vertebral fracture due to Actinobacillus pleuropneumoniae osteomyelitis in a weaner. *BMC Veterinary Research*, *16*(1), 438. https://doi.org/10.1186/s12917-020-02656-1

Gottschalk, M., & Broes, A. (2019). Actinobacillosis. *Diseases of Swine*, 749-766.

Ibrahim, M., Ahmad, F., Yaqub, B., Ramzan, A., Imran, A., Afzaal, M., Mirza, S. A., Mazhar, I., Younus, M., & Akram, Q. (2020). Current trends of antimicrobials used in food animals and aquaculture. In *Antibiotics and antimicrobial resistance genes in the environment* (pp. 39-69). Elsevier.

Jaja, I. F., Mushonga, B., Green, E., & Muchenje, V. (2018). Factors responsible for the post-slaughter loss of carcass and offal's in abattoirs in South Africa. *Acta tropica*, *178*, 303-310.

Jung, M., & Won, H. (2019). Development of Actinobacillus pleuropneumoniae ApxI, ApxII, and ApxIII-specific ELISA methods for evaluation of vaccine efficiency. *20*(2), e2. https://doi.org/10.4142/jvs.2019.20.e2

Kempf, I., Jouy, E., & Chauvin, C. (2016). Colistin use and colistin resistance in bacteria from animals. *International journal of antimicrobial agents*, *48*(6), 598-606.

Kulathunga, D. G. R. S., Fakher, A. A., & Costa, M. d. O. (2022). Actinobacillus suis isolated from diseased pigs are phylogenetically related but harbour different number of toxin gene copies in their genomes. *Veterinary Record Open*, *9*(1), e45.

KUMAR, R., Kumar, G., & Pandey, R. (2024). An atypical case of esophageal actinobacillosis in a cow. *Access Microbiology*, 000819. v000811.

Lacouture, S., & Gottschalk, M. (2020). Distribution of Actinobacillus pleuropneumoniae (from 2015 to June 2020) and Glaesserella parasuis (from 2017 to June 2020) serotypes isolated from diseased pigs in Quebec. *The Canadian Veterinary Journal*, *61*(12), 1261.

Liu, Z., Deng, D., Lu, H., Sun, J., Lv, L., Li, S., Peng, G., Ma, X., Li, J., & Li, Z. (2020). Evaluation of machine learning models for predicting antimicrobial resistance of Actinobacillus pleuropneumoniae from whole genome sequences. *Frontiers in microbiology*, *11*, 48.

Luan, T., Wang, L., Zhao, J., Luan, H., Zhang, Y., Wang, C., Langford, P. R., Liu, S., Zhang, W., & Li, G. (2022a). A CRISPR/Cas12a-assisted rapid detection platform by biosensing the apxIVA of Actinobacillus pleuropneumoniae. *Frontiers in Microbiology*, *13*, 928307.

Luan, T., Wang, L., Zhao, J., Luan, H., Zhang, Y., Wang, C., Langford, P. R., Liu, S., Zhang, W., & Li, G. (2022b). A CRISPR/Cas12a-assisted rapid detection platform by biosensing the apxIVA of Actinobacillus pleuropneumoniae [Original Research]. *Frontiers in microbiology*, *13*. https://doi.org/10.3389/fmicb.2022.928307

Layman QD, Rezabek GB, Ramachandran A, Love BC, Confer AW. A retrospective study of equine actinobacillosis cases: 1999–2011. Journal of Veterinary Diagnostic Investigation. 2014;26(3):365-375. doi:10.1177/1040638714531766

Means, K., Townsend, K., & Johnson, P. (2022). Multicavitary septic effusions associated with actinobacillosis in an adult Tennessee Walking Horse with weight loss. *Equine Veterinary Education*, *34*(1), e60-e66. https://doi.org/https://doi.org/10.1111/eve.13549

Mishra, D., Sahu, R., Mishra, N., & Behera, A. (2015). Herbal treatment for common diseases in ruminants: an overview. *J Livest Sci*, *6*, 36-43.

Newcomer, B. W., Cebra, C., Chamorro, M. F., Reppert, E., Cebra, M., & Edmondson, M. A. (2021). Diseases of the hematologic, immunologic, and lymphatic systems (multisystem diseases). *Sheep, Goat, and Cervid Medicine*, 405.

Niehaus, A. J., & Mora, D. P. (2022). Digestive system and abdomen. *Medicine and Surgery of Camelids*, 336-390.

O'Neill, G., Ker, A., Mohammed, A., & Karcher, A. M. (2016). Actinobacillus hominis osteomyelitis: First reported case in the English language medical literature. *JMM Case Rep*, *3*(3), e005030. https://doi.org/10.1099/jmmcr.0.005030

Otake, S., Dee, S. A., Moon, R. D., Rossow, K. D., Trincado, C., Farnham, M., & Pijoan, C. (2003). Survival of porcine reproductive and respiratory syndrome virus in houseflies. *Canadian Journal of Veterinary Research*, *67*(3), 198.

Pacchioni, A., Rius, S., & Pairoba, C. (2022). Jornadas de Ciencias, Tecnologías e Innovación 2022: libro de resúmenes. In: UNR Editora.

Relun, A., Cesbron, N., Bourdeau, P., Dorso, L., Brement, T., Assié, S., Christensen, H., & Guatteo, R. (2019). Atypical actinobacillosis affecting hind limbs and lungs in a single beef cattle herd. *Journal of Veterinary Internal Medicine*, *33*(1), 297-301. https://doi.org/https://doi.org/10.1111/jvim.15387

Roussel, A. J. (2009,). Actinomycosis and Actinobacillosis,. In D. M. R. David E. Anderson (Ed.), *Food Animal Practice (Fifth Edition),* (pp. Pages 6-8).

Salvaggio, A., Giunta, R. P., Percipalle, M., Scalzo, F., & Marino, A. M. F. (2023). Infection Due to *Actinobacillus lignieresii* in Cattle with Brain and Ocular Involvement: Histological and Microbiological Features. *Veterinary Sciences*, *10*(5), 311.

Samkange, A., Mushonga, B., Mudimba, D., Chiwome, B. A., Jago, M., Kandiwa, E., Bishi, A. S., & Molini, U. (2019). African swine fever outbreak at a farm in Central Namibia. *Case Reports in Veterinary Medicine*, *2019*.

Sarkar, R., Roychoudhury, P., Kumar, S., Dutta, S., Konwar, N., Subudhi, P., & Dutta, T. (2022). Rapid detection of Actinobacillus pleuropneumoniae targeting the apxIVA gene for diagnosis of contagious porcine pleuropneumonia in pigs by polymerase spiral reaction. *Letters in Applied Microbiology*, *75*(2), 442-449.

Sarli, G., D'Annunzio, G., Gobbo, F., Benazzi, C., & Ostanello, F. (2021). The role of pathology in the diagnosis of swine respiratory disease. *Vet Sci*, *8*(11), 256.

Sassu, E., Bossé, J., Tobias, T., Gottschalk, M., Langford, P., & Hennig-Pauka, I. (2018). Update on Actinobacillus pleuropneumoniae—knowledge, gaps and challenges. *Transboundary and Emerging Diseases*, *65*, 72-90.

Sen, I., Chandra, A., Sil, A., & Chakraborty, U. (2021). Cutaneous actinobacillosis: Report of a rare infective condition. *BMJ Case Reports*, *14*(8).

Stilz, C. R., Maboni, G., Rissi, D. R., & Mendes, R. E. (2024). Acute drooling and anorexia in a Black Angus steer. *Journal of the American Veterinary Medical Association*, *262*(12), 1695-1697.

Stygar, A. H., Niemi, J. K., Oliviero, C., Laurila, T., & Heinonen, M. (2016). Economic value of mitigating Actinobacillus pleuropneumoniae infections in pig fattening herds. *Agricultural Systems*, *144*, 113-121.

Sweeney, M. T., Gunnett, L. A., Kumar, D. M., Lunt, B. L., Pantoja, L. G., Bade, D., & Machin, C. (2022). Antimicrobial susceptibility of Actinobacillus pleuropneumoniae, Bordetella bronchiseptica, Pasteurella multocida, and Streptococcus suis isolated from diseased pigs in the United States and Canada, 2016 to 2020. *Journal of Swine Health and Production*, *30*(3), 130-144.

Turni, C., Yee, S., Epstein, V., Jackson, B., Li, K., Knowles, G., & Blackall, P. J. (2019). Diverse strains of *Actinobacillus lignieresii* isolated from clinically affected cattle in a geographically restricted area. *Australian Veterinary Journal*, *97*(11), 440-446.

Underwood, W. J., Blauwiekel, R., Delano, M. L., Gillesby, R., Mischler, S. A., & Schoell, A. (2015). Biology and diseases of ruminants (sheep, goats, and cattle). In *Laboratory Animal Medicine* (pp. 623-694). Elsevier.

Watt, A. E., Browning, G. F., Markham, P. F., & Marenda, M. S. (2020). Detection of naturally aerosolized Actinobacillus pleuropneumoniae on pig farms by cyclonic air sampling and qPCR. *Veterinary Microbiology*, *250*, 108856.

Wen, W., Shi, L., & Chen, X. (2020). Simultaneous Detection of Actinobacillus pleuropneumoniae and Haemophilus parasuis in Pig by Duplex Droplet Digital PCR. *eFood*, *1*(5), 369-376. https://doi.org/https://doi.org/10.2991/efood.k.200918.001

Will, D. D., & Whiting, T. L. (2022). Animal protection reporting requirements of Canadian veterinarians: Example case. *Can Veterinary Journal*, *63*(3), 301-306.

Yar, M. K., Mahmood, M., Ijaz, M., Jaspal, M. H., Rafique, Z., Badar, I. H., & Rafique, K. (2023). Effect of Cattle-Specific Diseases on Carcass Inspection and Meat Quality.