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Skin Disease in Livestock and Its Impact on the Tanning Industry: A Comprehensive Review

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Abstract : Skin diseases in livestock are a significant and often overlooked issue, but they greatly affect the quality of leather, the primary raw material for the tanning industry. Skins affected by diseases such as dermatitis, parasitic infestations, or other skin lesions are prone to defects that lower the economic and aesthetic value of the raw material. This decline in quality directly impacts the productivity and profitability of the tanning industry, as defective hides are of lower grade, reducing yields and limiting the ability to meet domestic and export market standards. This problem also affects livestock farmers through lower skin prices and can weaken added value throughout the supply chain. Our scoping study included papers retrieved from SCOPUS, PubMed, and Web of Science databases, as well as reports from various organizations. This review evaluates multiple types of skin diseases in livestock, the defects they cause, and their implications for leather quality and the broader economy. The findings of this review highlight the importance of multidisciplinary interventions in controlling skin diseases in livestock, thereby improving leather quality and enhancing the sustainability of the tanning industry.

Keywords: leather, livestock, skin disease, tanning industry

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INTRODUCTION

Leather is a by-product of livestock with high economic value, as it can be processed into various industrial products, including leather goods, processed foods, and crafts (Said, 2021). Its value depends largely on physical qualities like flexibility, thickness, grain layer integrity, and minimal surface defects (Abdulhusein & Kadim, 2024). The health of the skin greatly affects these qualities while the animal is still alive, so skin disease issues in livestock directly impact the quality of the skin after slaughter (Kappes *et al*., 2023).

Various agents, such as viruses, bacteria, fungi, parasites, and environmental factors, can cause skin diseases in livestock (Mala *et al*., 2021). These conditions cause symptoms such as wounds, nodules, ulcerations, hair loss, crusts, and even permanent scarring (Miro and Sanchez, 2011). These lesions not only lead to decreased livestock performance but also cause structural damage to skin tissue, particularly to the epidermis and dermis (Masson-Meyers *et al*., 2020). This damage results in permanent defects in raw hides/skin that are difficult to repair through further processing.

Some skin diseases currently receiving significant attention include lumpy skin disease in cattle, mange or scabies, ringworm (dermatophytosis), flea and tick infestations, and other bacterial and fungal infections. These diseases are often found in tropical countries, including Indonesia, due to the warm and humid climate that promotes the growth of parasites and disease-causing microorganisms. In addition to reducing animal productivity, skin diseases also have an indirect economic impact on the livestock by-product production chain.

The decline in leather quality due to disease is typically characterized by the appearance of spots, holes, scarring, hardening, thickening, and coarsening of the grain, resulting in a decrease in grade during the leather quality assessment process in the leather industry (Amde, 2017). As a result, many diseased hides are downgraded, rejected, or sold at significantly lower prices by industry players. This loss affects not only livestock farmers but also the leather processing and tanning industries, which rely on high-quality raw materials for optimal production.

This issue is becoming increasingly important to address as demand for quality leather continues to rise, while skin diseases in livestock are still frequently encountered in the field due to inadequate health management, barn sanitation, and parasite control. Therefore, understanding skin diseases in livestock, their causes, their impact on skin structure, and their consequences for the quality of by-products is crucial as a basis for prevention and control efforts.

METHODS

To achieve our goal, we conducted a scoping search of peer-reviewed literature in the Scopus, PubMed, and Google Scholar databases, concentrating on the main terrestrial livestock species (goat, sheep, dairy, and beef cattle). We do not use period exclusion criteria to collect key research on animal illness, but instead focus on current research on the effects of animal skin disease. A search of published reports from relevant organizations, including the World Health Organization and the World Organization for Animal Health (WOAH, formerly known as OIE), is also included. A total of 95 pertinent publications were available for review. Skin disease for 58%, disease prevention and treatment for 20%, and effect on the tanning industry for 22% of the total coverage.

RESULTS AND DISCUSSION

Viral Disease

Pox infection in small ruminants and Lumpy Skin Disease (LSD) in cattle are the two main viral illnesses that affect hides and skins.

a. Lumpy skin disease (LSD)

Lumpy skin disease (LSD) is a disease caused by the Lumpy Skin Disease Virus (LSDV), a member of the poxvirus family, which attacks the integumentary system (Porco *et al*., 2023; Vinothraj *et al*., 2020). LSD is frequently reported in cattle, as they are the primary host, although it can also infect buffalo and bison (Porco *et al*., 2023). Clinical signs include emaciation, weakness, skin nodules, and decreased milk production, which have a significant economic impact (Farah Gumbe, 2018).

The spread of the disease in Indonesia was first reported in early 2022 in Indragiri Hulu, Riau, via transportation, and later on the island of Java, specifically in Kulon Progo, Sleman, Yogyakarta (Kulon Progo Regency Agriculture and Food Security Office, 2023). Survey results indicated that 22.2% of cattle in Lam Urit Village, Simpang Tiga District, Aceh Besar Regency, were infected with LSD (Yustendi *et al*., 2022). The movement of livestock from infected areas contributed to the spread, making this disease a transboundary animal disease (TAD) (Sendow *et al*., 2021). The impact of LSDV not only affects the health of ruminants but also impacts the economic activities of livestock producers, especially cattle (Ratyotha *et al*., 2022). Although LSD is not classified as a zoonotic disease, it can still cause significant economic losses for livestock entrepreneurs (Nurjanah and Dharmayanti, 2022). This disease affects the skin and can cause fever, emaciation, abortion, infertility in bulls, and/or reduced milk production in lactating cows. It is a major agricultural and economic disease that can devastate the livelihoods of livestock farmers (Roche *et al*., 2020).

The LSDV can live for at least three weeks in air-dried hides and one month in skin nodules. In severe cases, the stage lasts seven to twelve days and is characterized by the formation of more than one hundred nodules on the skin over the body (Kumar *et al*., 2021). The hard, somewhat raised nodules are separated from the surrounding skin by a thin hemorrhagic ring. The dermis, epidermis, nearby subcutis, and muscle are all affected by the nodules (Amin *et al*., 2021) (Figure 1).

Figure 1. **A.** The clinical manifestation of lumpy skin disease, the lymph nodes grow markedly, three to five times larger than usual (Ratyotha *et al*., 2022). **B.** Histopathological changes (diffuse hemorrhages and infiltration of mononuclear inflammatory cells in the dermis) in the skin nodules of animals with lumpy skin disease (Kristianingrum *et al*., 2025).

The virus can infect suckling calves and is expelled in the blood, nasal secretions, saliva, ear notches, semen, and milk (Aerts *et al*., 2021; Bedeković *et al*., 2018). In general, vectors increase the mechanical and biological transmission of LSDV. Numerous studies have shown that the virus can spread and be excreted in the salivary glands, head, body, and feces of insects after blood-sucking vectors (mosquitoes, ticks, fleas, and flies) consume blood from infected cattle (viremia stage). As a result, the infected insects can serve as a reservoir for additional transmission (Tuppurainen *et al*., 2013). Studies on the infectivity of LSDV in tick eggs and juveniles (R. decoloratus) have revealed that the disease can spread through transovarial transmission (Lubinga *et al*., 2015). Additionally, flies can spread disease through mechanical touch. In endemic regions, direct contact between cattle in cages has been frequently observed. However, contaminated cars and veterinary equipment, as well as farm shareholders moving to far-off places, also contributed to the viral spread (Roche *et al*., 2023; Kasem *et al*., 2018).

Most LSD infections are identified during the summer when vectors are active; this may suggest the spread of the virus and blood-feeding insects. A warm, humid climate that promotes vector reproduction is linked to increased risk factors. One of the risk factors is the introduction of new animals to a herd. The virus that causes lumpy skin disease can survive up to three months in dry scabs on the skin and is well-tolerated in environments with pH levels between 6.3 and 8.3 (Roche *et al*., 2020).

The direct or indirect economic effects of LSD have been recorded by several important industries and companies. The most noticeable and important result directly linked to LSD is a sharp decline in milk output in South Asia, which is home to 21% of the world's dairy herd (Vinitchaikul *et al*., 2023). Additionally, as is the case with hides from animals exposed to high amounts of LSD, any cracks, lesions, or scars may reduce the value of a raw cowhide (Khattab *et al*., 2022). Bangladesh exports 3.5% of its yearly leather, of which 56% is derived from cows, and its cowhide is renowned for its superior quality (Hasib *et al*., 2021). India ranks ninth globally in exports and earns $8,500 million yearly from the sale of leather and cowhide products (Kumar & Tripathi, 2022).

Vaccination and quick and accurate diagnosis are the most crucial instruments for disease control. Stamping out diseased herds and partial immunisation are the actions that should be taken following confirmation of the disease, according to EU legislation. Additionally, vaccination is only permitted after the disease has been confirmed, under EU legislation (Bedeković *et al*., 2017; Abutarbush *et al*., 2016)

b. ***Foot and mouth disease virus* (FMDV)**

The foot-and-mouth disease virus (FMDV) is the cause of foot-and-mouth disease (FMD), a highly contagious illness. This virus is a member of the Picornaviridae family's genus Aphthovirus (Zell *et al*., 2017). FMD affects animals with cloven hooves, including pigs, sheep, goats, cattle, and buffalo (Jamal & Belsham, 2018). Seven serotypes of FMDV have been identified from various parts of the world, including O, A, C, Asia 1, SAT 1, SAT 2, and SAT 3 (Brito *et al*., 2017). The animals are susceptible to disease because of some factors, including their 1-2 week incubation period (Bouma *et al*., 2003), resilience to severe surroundings, low infectious dose (Stenfeldt *et al*., 2022), and quick viral replication in the host. High viral titers found in nasal secretions are the primary cause of illness transmission to vulnerable animals (Awel *et al*., 2021). Fever and vesiculo-erosive lesions in the mouth and on the feet are the hallmarks of the clinical phase of FMDV infection in naïve cattle (Arzt *et al.*, 2011) (Figure 2).

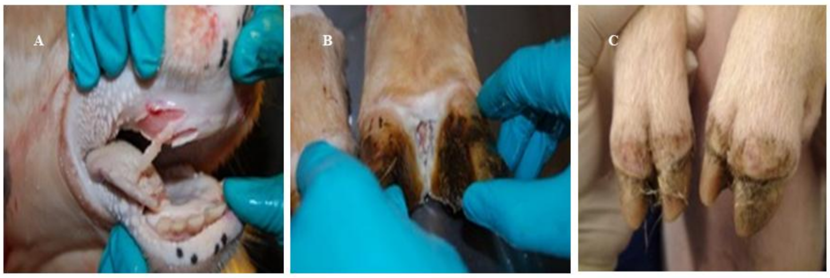


Figure 2**.** Erosive lesions, cattle (A), foot lesion, cow (B), and foot lesion, pig (C) (Belsham *et al*., 2025).

Indonesia has seen another FMD epidemic after being declared clear of the disease for 32 years. The Decree of the Minister of Agriculture Number 652/KPTS/PK.300/M/08/2022, concerning the Determination of Foot and Mouth Disease Outbreak Areas, which covers 24 Indonesian provinces, provides information on the areas affected by the FMD outbreak (Ministry of Agriculture, 2022). According to the Decree of the Minister of Agriculture of the Republic of Indonesia No. 121/KPTS/PK.320/M/03/2023, the Indonesian government redesignated FMD as a strategic infectious animal disease, prioritizing its prevention and treatment (Ministry of Agriculture, 2023). The Indonesian government spent 1.66 billion USD treating FMD over 100 years (1887–1986).

Even though FMD is not a zoonotic illness, it can nevertheless result in large financial losses; hence, prevention and control measures must be taken. Strict biosecurity measures, such as protecting free zones by limiting the movement of livestock or animals, traffic control and surveillance, prohibiting the entry of livestock from infected areas, slaughtering infected animals or those acting as carriers, disinfecting all exposed cage equipment (vehicles, clothes, cage equipment, etc.), destroying carcasses and animal products in infected areas, and isolating and quarantining livestock, are some ways to prevent and control FMD (Dinas Ketahanan Pertanan Provinsi Bali, 2023).

Additionally, vaccination can be used for both prevention and control. However, it is challenging due to the numerous host species, high transmission rates, and multiple viral serotypes that cause FMD (Paton *et al*., 2018). Meanwhile, immunization successfully eliminates FMD in cattle. Only healthy cattle and calves that are at least two weeks old can get the FMD vaccination, which seeks to develop immunity to the disease (Yuliana *et al*., 2023).

c. Sheep Pox

Sheep and goat pox is a very contagious viral disease. Due to its delayed and permanent scar formation, sheep pox is regarded as the most commercially significant infectious illness impacting sheep in the tanning industry (Ozmen *et al*., 2009). Sheep pox outbreaks cause significant financial losses because of increased mortality, miscarriages, and a decline in the infected animals' market value. creatures (OIE, 2008). The animal's breed, immunity to Capri pox viruses, and viral strain all affect morbidity and death. The illness is on the OIE list A. Trade, exports, and the growth of intensive animal production may be restricted by pox infections (OIE, 2008).

In a fully susceptible flock, mortality might reach 50%, and in young animals, it could reach 100% (Bhanuprakash *et al*., 2005). Native breeds frequently have mild infections. However, lambs, animals under stress, animals with co-occurring diseases, and animals from regions where pox is not endemic may experience more severe symptoms (Mangana *et al*., 2008; Rao and Bandyopadhyay, 2000). The Poxviridae family, Chordopaxvirinae subfamily, and Capripox virus genus are the viruses that cause sheep and goat pox (Buller *et al*., 2005). The lips, cheeks, nose, eyelids, ears, head, neck, inner thigh, tail base, perineum, vulval lips, udder, teats, inguinal region, and scrotum were among the body parts where pock lesions were most noticeable (Figure 3).

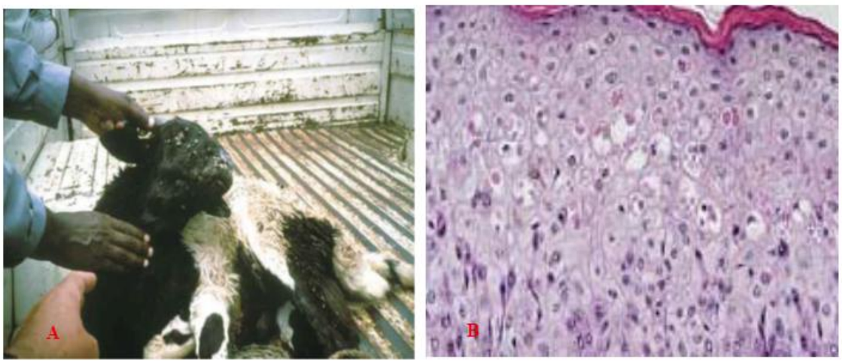


Figure 3**.** Sheeps infected with the sheep pox virus. **(A)**, Skin: Eosinophilic pox inclusions in the cytoplasm of hyperplastic keratinocytes with ballooning degeneration **(B)** (Gitao *et al*., 2017).

Sheep and goats are susceptible to the highly contagious virus known as sheep pox. In native breeds, morbidity can range from 70% to 90%, while in recently introduced breeds, it can approach 100% (ESGPIP, 2007). The leather sector suffers enormous financial losses as a result of the disease. All layers of the epidermis and dermis are usually affected by skin lesions, and the healing process is sluggish and frequently leaves permanent scars that significantly impair skin quality.

Economic losses occur from lower milk output, damage to the quality of skins and wool, and other production losses. The skin lesions heal slowly, and the scars are permanent. The occurrence of the disease affects the trade of animals and products and can inhibit efforts to improve local sheep and goats through the importation of improved breeds. The hides and skins that are processed by salting treatment or drying solely from SP enzootic areas may constitute a risk for reintroduction to SP-free regions or nations like the EU (EFSA, 2014).

To control the disease, early discovery and notification, movement restrictions, culling of infected animals, and vaccination with a ring vaccine are recommended (Kitching, 1986). Routine control methods involve cleaning and disinfecting depopulated areas, as well as establishing protection and surveillance zones within a 3 and 10-km radius of the epidemic, respectively (Mangana *et al*., 2008). As previously mentioned, unchecked animal mobility in SGP-endemic regions presents significant challenges to effective disease control. Therefore, it is vital to vaccinate sheep flocks routinely, on an annual basis, using a safe and efficient vaccine, for the control of this dangerous and economically important illness in endemic regions (OIE, 2010).

Bacterial Disease

Skin illnesses produced by microorganisms, such as anthrax and dermatophilosis, may damage skin quality. One of the most notable effects on leather is the formation of a "pinhole appearance" on the surface, which severely compromises leather quality and commercial value.

a. Dermatophilosis

Dermatophilosis, also known as cutaneous actinomycosis, is a long-term bacterial skin illness caused by ticks that affects a variety of animal species. It is characterized by crustiness and exudates building up at the base of hair or wool fibers. Cattle, sheep, and goats are more badly affected, and the public is just slightly infected. According to Walter *et al*. (2017), this disease is seen in both tropical and temperate regions of the world, with wet weather or rainy season climates being the most common. In addition to its effects on leather quality, it causes financial losses due to decreased body weight gain and milk production, sporadic mortality, decreased productivity in working animals, and expenses related to disease prevention and treatment.

Dermatophilus congolensis, a bacterium from the Dermatophilaceae family, is responsible for this disease. It is a Gram-positive, spore-producing, acid-fast, facultative anaerobic bacterium with branching actinomyces. Exudative dermatitis causes scab formation, crusting, and hair loss, resulting in animal welfare concerns and economic losses due to diminished growth, milk supply, and hide quality (Habte *et al*., 2025). Transmission can happen directly through contact with sick animals or indirectly through fomites and insect vectors (Hordofa *et al*., 2025).

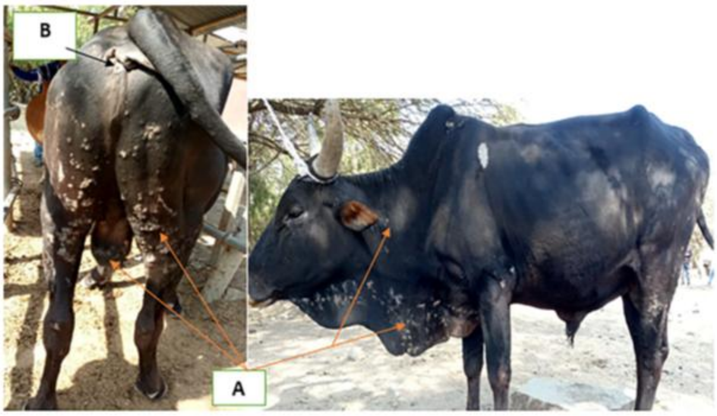


Figure 4. A picture of a probable bull with dermatophilosis (A): lesions in various body regions, and B: tick vector in the rectal area. (Habte *et al*., 2025).

Clinical signs of clinical dermatophilosis include matting of the hair or wool, scab and crust formation, and generalized creation of huge crust in chronic instances, which leads to hair loss and even local loss of the upper skin layers, predisposing to later issues (Figure 4). Ticks or biting flies can cause papular crusted lesions on various parts of the body, including the trunk, head, lower part of the neck, ears, axillae, groin, udder, lower limb, and scrotum. This suggests that ticks may play a role in the disease's spread at these locations (Constable *et al*., 2017; Siva and Vijaya, 2015). The recent case report confirms the presence of ticks and clinical indications of dermatophilosis on the bull's body, including erythema, thick scab formation, and cutaneous keratinized wart-like lesions.

Penicillin and streptomycin, tetracycline, chloramphenicol, and erythromycin, together with topical adjuvant therapy with lime sulphur, antibacterial shampoo, chlorhexidine, and spraying or dipping with copper or zinc sulphate, can all be used to treat dermatophilosis. Acaricide application has also been deemed a sensible strategy for vector management (Constable *et al*. 2017; Hamid and Musa, 2019). In contrast to treating the infected animal, maintaining livestock health from this contagious disease primarily depends on appropriate control and preventive plans with changes in husbandry practices, isolating clinically affected animals, controlling ectoparasites, and avoiding direct contact with grooming materials (Rebhun and DeLahunta, 2019).

b. Bacillus anthrax

Anthrax is an acute bacterial zoonosis that primarily affects domestic and wild herbivores, such as cattle, sheep, goats, donkeys, horses, reindeer, antelopes, and camels; however, it can infect any warm-blooded mammal. It is sometimes spread to people and is caused by Bacillus (B.) anthracis (Malkhazova *et al*., 2014). Hunting, breeding, and occupational or dietary exposure to contaminated animal products can all have an impact on humans. Anthrax nosoareals are created and shaped globally by ecological, social, cultural, political, and economic forces that continue to impact this process (Makarov and Bryco, 2011). Certain nations in Asia, Africa, the Americas, and southern Europe have endemic anthrax. According to estimates from the World Health Organization (WHO) (OIE, 2008), there are fewer than 100,000 cases of anthrax worldwide each year.

The causal agent is a facultatively anaerobic, encapsulated, Gram-positive, non-motile bacterium that forms endospores and measures around 0.8–1.2 mm by 3–5 (10) mm (Bohm, 1985) (Figure 5). B. anthracis produces spores, which are frequently found in soil, just like all other Bacillus species. It is the sole obligatory pathogenic Bacillus of mammals, in contrast to other species in this genus.

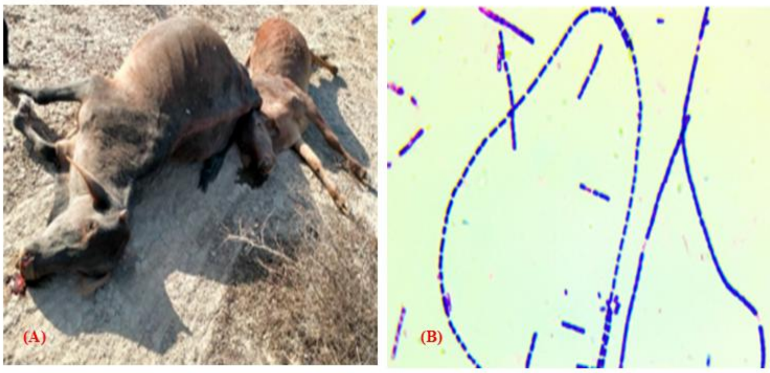


Figure 5. (A) An outbreak of anthrax (Sardar *et al*., 2023); Gram staining reveals extensive chains of Gram-positive rods. (B) This image was captured on May 2, 2019, while the National Animal Health Diagnosis and Investigation Center in Ethiopia was investigating an anthrax outbreak (Olani *et al*., 2020).

Heat, desiccation, and certain disinfectants don't really harm anthrax spores. They can therefore endure for decades in soil, surface waters, mud, skins, hides, fur, wool, hair, bristles, hooves, horns, or bones from sick animals, in wastewater and sludge from tanneries, or on surfaces like wood and metal, depending on the type and nature of contaminated material and the biotic and abiotic features of the external environment (Hudson *et al*., 2008; Lavander *et al*., 2013).

Ninety to ninety-five percent of anthrax cases are cutaneous. Small lesions, such as abrasions, cuts, or fissures on exposed skin, usually serve as the source of infection (OIE, 2008). The organisms can spread indirectly through the processing, storage, or transportation of contaminated animal products and objects contaminated with spores, or directly via contact—such as during killing or slaughtering—with infected or dead animals, their excrement, blood, meat, milk, or internal organs (Aikimbayev, 2016). Blood-feeding bug bites can also cause infections (Aikimbayev, 2016). During epizootic seasons, 1–12% of illnesses might be caused by biting flies (Drankin and Malafeeva, 1972).

The following suggestions are sent because the illness is widespread in Indonesia and is typically underreported: Improving veterinary and public health laboratories' diagnostic capabilities is crucial for prompt illness diagnosis, treatment, prevention, control, and reporting; The regional laboratories ought to have received training in biosafety, sample collecting, diagnosing suspected instances of anthrax, and looking into any unexpected or sudden livestock deaths; To stop the disease, active surveillance, appropriate animal vaccination, and raising awareness are crucial; According to the WHO's recommended case definition, reported cases of anthrax should be categorized as suspected, probable, and confirmed; The area where the dead animal was discovered should be properly cleaned.

Parasitic Disease

Ectoparasites can infect the surface layers of the skin and hair. Lice, keds, ticks, and mange mites are some of the principal pre-slaughter abnormalities that cause downgrading and rejection.

a. Sarcoptes scabiei

The ectoparasite *Sarcoptes scabiei* (S. scabiei) is found all over the world and infects humans as well as more than 148 domestic and wild animal hosts from 39 families and 12 orders (Escobar *et al*., 2022). Additionally, S. scabiei produces skin conditions such as baldness, crusty dermatitis, erythema, and pruritus (Escobar *et al*., 2022). Due to comparable symptoms shared with other dermatological conditions, such as allergic dermatitis and fungal skin infections, S. scabiei infestation is frequently misdiagnosed in clinical practice (Nielsen *et al*., 2022). The observation of clinical cases in people (Elwood *et al*., 2015) and domestic animals (e.g., rabbits, pigs, and sheep) has been the main focus of earlier research on pathological alterations in S. scabiei infestation (El-Ashram *et al*., 2020; Goyena *et al*., 2013; Malik *et al*., 2006; Joshi *et al*., 2021; Darzi *et al*., 2007); Murshed *et al*., 2022).

Sarcoptes scabiei, an obligatory ectoparasite that burrows into the stratum corneum of the host's skin, is the cause of animal scabies, also known as sarcoptic mange. Numerous domestic and wild mammals can be infested by several strains of the species S. scabiei; host selection and transmission patterns are influenced by genetic heterogeneity among mite populations. The stratum corneum of the skin's epidermis must be penetrated by scabies mites before they may infect a host. Observing this activity under a microscope is a laborious procedure.

Nonetheless, all life phases of S. scabiei var. hominis and S. scabiei var. canis have been experimentally examined under a microscope as they pierced the host skin (Arlian & Morgan, 2017). When mites are applied to the skin, a transparent fluid—likely saliva—is secreted, creating a pool surrounding their bodies (Figure 6). The mite appears to dissolve (lyse) the stratum corneum and sink into a skin depression. Legs I and II appear to move in a tortoise-like manner as it sinks (digging, crawling/swimming action). As a tunnel burrow forms in the stratum corneum, the mite is propelled forward by the movement of its legs. As previously said, it takes very little time to fully sink into the stratum corneum.

According to research by Malik *et al*. (2006), systemic avermectin medication is one therapeutic option for scabiosis cases, while topical lime sulphur treatment is another.

Figure 6. The clinical manifestation of the Sarcoptes scabiei skin disease (Doukas *et al*., 2021); Sarcoptes scabiei was seen on the results of native skin scrapings under a microscope with magnification of 100x (Hidayah *et al*., 2021).

b. Rhipicephalus boophilus

As obligatory hematophagous ectoparasites of vertebrate animals, ticks are thought to be significant carriers of some bacterial, viral, protozoal, and rickettsial pathogens that infect both people and animals (Welle and Liner, 2022). These ectoparasites are separated into the families Argasidae (soft ticks) and Ixodidae (hard ticks) and are members of the phylum Arthropoda, class Arachnida, and order Ixodida (Ernieenor *et al*., 2017). The majority of tick species that are harmful to ruminants and of veterinary significance belong to the Ixodidae family. The most significant species for livestock, particularly in subtropical and tropical regions, is Rhipicephalus (Boophilus) microplus, also referred to as the cattle tick, Southern cattle tick, or Asian blue tick (Marufu *et al*., 2014). In addition to spreading infections, a large R. microplus infestation in cattle can cause financial losses because the afflicted animals' weight and output are significantly reduced, their anemia worsens, and their leather is condemned at slaughter (Ernieenor *et al*., 2017).

Ruminants' skin and hide sustain damage or sores from tick bites. As a result, tick-infested ruminants develop skin and hide irritation, which indirectly causes self-harm. Granuloma, collagen degeneration, eosinophilic folliculitis, pustule formation, dermal infiltration, and a crust and scab at the tick bite site are all visible histopathologically in the injured skin and hide of ruminants (Figure 7). The nation's economy is therefore impacted. Even if a significant number of tanneries are involved in the manufacture of completed and semi-finished leather products, the sector and the country are losing revenue due to a deterioration in leather quality. A large part of these pre-slaughter abnormalities is directly related to skin disorders or secondary damage that occurs when the animal scratches itself to relieve the itching associated with some of these diseases (Addise and Achenef, 2013).

In addition to deteriorating the quality of skin and hides, skin illnesses cause significant financial losses since they lower the quality of wool, reduce the yield of meat and milk, result in losses from culling, cause occasional deaths, and increase the cost of treating and preventing the diseases. Certain skin conditions are relatively simple to treat, while others are more challenging, and some, like ringworm, can be extremely contagious to those who come into contact with them. Animal productivity is also affected by skin issues in various ways, ranging from minor irritations to rapid mortality.

Therefore, the following suggestion, such as: more research should be done on pathological findings and the degree of tick-related skin and hide damage; tick infestation control and prevention should be taken into account to prevent skin and hide loss from tick-infested leather and quality degradation; owners of animals should be made aware of the harm that ticks can do to their skin and hide as well as potential preventative and control measures (Mersha & Gashaw, 2013).

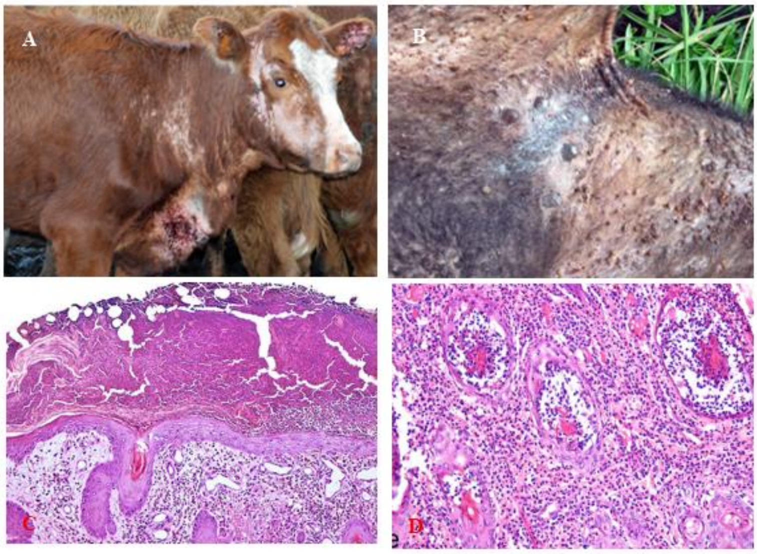


Figure 7. Ticks, ulcers, crusts, baldness, hypotrichosis, and skin on the ears, dewlap, and side of the face (a); Inguinal skin with ticks, crusts, and hypotrichosis (b); Epidermis covered in crusts made of eosinophilic amorphous material and cell detritus. mixed inflammatory infiltrates, fibrin buildup, and blood vessel growth and ectasia in the dermis. HE (c); Hair follicles are affected by neutrophilic inflammatory infiltrates in the superficial dermis (mural folliculitis) (Melo *et al*., 2023)

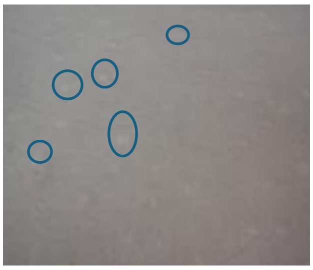
Fungal disease

Ringworm, also known as dermatophytosis, is a contagious fungal infection that primarily affects the superficial layers of skin, hair, nails, and claws in both humans and animals. It is caused by dermatophyte species (Aala *et al*., 2010). There are just three genera that are known to be harmful to humans and animals: Trichophyton, Microsporum, and Epidermophyton. Dermatophytes are categorized as anthropophilic, zoophilic, or geophilic based on their natural reservoir (Weitzman & Richard, 1995). The widespread use of immunosuppressive medications by humans and the unsanitary conditions of the animals around them are the primary causes of the recent high prevalence of fungal infections (Woodfolk, 2005). The primary source and reservoir for infection among susceptible hosts through direct or indirect contact are diseased animals, polluted environments, and infected fomites (Murray *et al*., 2005). The sickness is more common in animals kept in poorly enclosed contact, which facilitates the spread of the illness.

Implications for the tanning industry

The tanning business and the economy are greatly impacted by skin damage or flaws in animal skins (Palumbo and De Clemente, 2020). Defects such as insect bites, skin diseases, and damage from improper handling cause the quality of raw materials to deteriorate in the tanning industry (Alemu and Girma, 2019). Skins with significant damage are not suitable for processing into high-value products, such as shoes, purses, or high-end fashion items, as they have a lower grade (Meyer *et al*., 2021). They are exclusively applied to low-value goods. Additionally, damaged skins must be trimmed or discarded, which reduces production efficiency and yields. Each type of disease causes defects that describe the form of skin damage that results, such as a lump, spots, uneven surface, rough changes in texture, or irregularities in the skin surface, which have the potential to reduce the quality of the skin as a raw material for the tanning industry, as can be seen in Table 1.

Table 1. Types of Livestock skin diseases, resulting defects, and visual representation

No	Disease	Defect	Lession
1	Viral disease	• Severe defects in the form of lumps and depressions • Leather is difficult to use for premium products • Large areas of leather must be removed (trimming loss	 Lumps and depressions
2	Bacterial disease	• Hard and brittle spots • Uneven skin tone • Cracks easily during the finishing process	 Uneven skin tone
3	Parasitic disease	• Rough and uneven surface • Small holes or scars appear • Decreased tensile strength and elasticity	 Rough and uneven surface
4	Fungal disease	• Permanent blemishes • Spotted or pitted skin surface • Decreased visual quality (appearance)	 Spotted or pitted skin surface

Because additional procedures are needed to hide flaws or because of stricter raw material sorting, production costs increase, and the risk of ending up with a failed final product rise. As a result, the tanning industry becomes less competitive, especially in meeting export market quality standards. From livestock farmers to downstream companies, skin damage affects the entire business chain economically. Faulty hides have lower value, so livestock farmers earn less, and the tanning industry loses potential added value because it cannot produce high-quality goods. If skin flaws become widespread, the national leather industry may become less competitive and increasingly depend on imported raw materials. Over time, these issues could slow the growth of the leather industry, limit job opportunities, and decrease the sector's economic contribution. Therefore, preventing and managing leather damage is vital for maintaining the sustainability of the tanning industry and boosting its overall economic value.

CONCLUSIONS

Livestock skin diseases have been shown to significantly impact leather quality. Conditions such as infections, parasitic infestations, and other skin diseases directly reduce the value of raw materials. These impacts are felt not only at the processing stage in the tanning industry through reduced yields, increased production costs, and limited market access, but also affect the upstream sector, particularly livestock farmers. Therefore, controlling livestock skin diseases through improved livestock management, sustainable animal health programs, and better integration between the livestock sector and the tanning industry is a strategic step to improve leather quality, industry efficiency, and overall economic competitiveness.

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