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Co-occurrence of scaly leg and bumble foot in backyard poultry and its clinical management

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Abstract
The concurrent occurrence of scaly leg caused by *Knemidocoptes mutans* and bumble foot caused by *Staphylococcus aureus* in Aseel chickens is investigated in this study. Clinical observations and laboratory examinations confirmed the coexistence of parasitic infestation and bacterial infection, highlighting the significance of addressing both conditions for effective poultry management. Scaly leg mites' tunnel beneath epidermal scales, inducing inflammation and crusty formations on the legs, while *S. aureus* causes footpad lesions leading to acute inflammation and tissue necrosis. Treatment involving antimicrobial administration and topical application of deltamethrin resulted in successful recovery without reoccurrence. This study emphasizes the importance of comprehensive strategies for managing concurrent parasitic and bacterial infections in backyard poultry farming to ensure bird health and productivity.

Keywords: Backyard poultry, Bumble foot, *Knemidocoptes mutans*, Scaly leg, *Staphylococcus aureus*

1. Introduction
The Indian livestock industry, notably the poultry sector, has seen rapid growth despite challenges. Commercial poultry production has increased by 4.5% annually, while backyard poultry farming has surged by 45.79% (Singh *et al.*, 2020) [21]. Backyard poultry farming is a traditional practice which provides essential protein and income for rural communities, supported by improved government policies. However, frequent disease outbreaks remain a major obstacle to its success, leading to high mortality rates (Raveloson, 1990; Mandal *et al.*, 2006) [17, 10].

In backyard poultry production, disease control methods differ considerably from commercial practices. Owners often lack awareness regarding the risks posed by infectious diseases in the environment and the significant role of their birds play in spreading these diseases (Cadmus *et al.*, 2019; Abtin *et al.*, 2022) [3, 1]. Backyard poultry farming is often characterized as a system with minimal inputs and outputs, with low productivity primarily due to diseases, suboptimal management practices, and insufficient supplementary feed. Bacterial and parasitic infections are widespread among these birds, with high infection rates leading to clinical illness. Poultry serve as definitive hosts, paratenic hosts, or carriers for various ectoparasites such as mites, lice, ticks, fleas, and flies. Prolonged ectoparasitic infections can predispose the birds to secondary bacterial infections, resulting in clinical disease (McAinsh *et al.*, 2004; Morishita *et al.*, 2005; Edosomwan and Amadasun, 2008) [11, 12, 7]. This article explores the concurrent infection of parasitic and bacterial disease in backyard poultry and discusses strategies for their clinical management.

2. Materials and Methods
A one-year-old, 4 male and 1 female Aseel chickens belonging to the same flock was presented to the Veterinary Clinical Complex, Veterinary College and Research Institute, Orathanadu with the history of reduced feed intake, thickening of legs and presence of scales with bleeding at some places and also showed reluctance to move for the past two months.
Clinical examination of legs revealed severe bilateral hyperkeratosis with whitish film layer with raised, encrusted scales from the tibiotarsal joint to phalanges (Fig.1).

The footpads were appeared to be swollen with dried thick necrotic layer, which might have resulted in lameness and unthriftiness. Based on the history and clinical examination the case was tentatively diagnosed as scaly leg with secondary bacterial infection.

The skin scrapings from the affected region were collected and processed in 10 % KOH solution and examined for the presence of any ectoparasites. At the same time, the dried whitish scales in the swollen foot pads were aseptically dissected with a sterile scalpel blade and a small piece of tissue samples were collected in the nutrient broth and incubated at 37°C for 6 hours for bacteriological examination. A loopful of broth culture was streaked onto 5% Sheep blood agar, Mannitol Salt agar and MacConkey agar plates by quadrant streaking method and incubated at 37°C for 48 hours (Quinn *et al.*, 1994; NCCLS, 1997) [16, 13]. The inoculated plates were examined by gross colony morphology, pigmentation and hemolysis.

Fig 1: Bilateral hyperkeratosis from tibiotarsal joint to phalanges

The affected legs were cleaned with 0.1% potassium permanganate solution. The birds were administered with Inj. Amoxycillin sulbactam @ 10 mg/kg b.wt. IM, Inj. Tribivet 0.3 ml IM and oral vitamin supplementation for five days. The owner was advised to spray the affected area with 10% Deltamethrin for 5 days. The chicken showed uneventful recovery with the treatment given.

3. Results

Microscopic examination of skin scraping with 10 % KOH revealed the existence of *Knemidocoptes mutans* mites. *K. mutans* female mites was identified based on its globular shape, two longitudinal chitinized bars from the base of the pedipals, absence of leg suckers (Fig. 2). *K. mutans* burrow under the scales of legs and induce rough raised nodules with powdery appearance. Bacteriological examination of the skin scrapings revealed the presence of *Staphylococcus aureus.* The isolated presumptive colonies of *S. aureus* were identified based on cultural, morphological, and biochemical characteristics *viz.* Gram staining, morphology, microscopic arrangement, catalase test, coagulase test, haemolysis, pigment production (golden yellow) and mannitol fermentation (Fig. 3 & 4). Thus, the bacteriological and parasitological examination confirmed the co-occurrence of scaly leg and bumble foot in the poultry.

4. Discussion

Ectoparasites significantly impacts the bird's health and productivity by competing for feed, causing irritation, tissue damage, and serving as vectors for diseases. Common ectoparasites such as lice, fleas, mites, and ticks contribute to growth retardation, decreased vitality, and reduced meat and egg production in poultry. They also facilitate the transmission of bacterial and viral infections among bird populations (Nnadi and George, 2010; Kebede-Tsegay, 2017) [14, 9]. Rezaei *et al.* (2016) [18] found the highest prevalence of mites in backyard chickens which includes *Dermanyssus gallinae* (26.33 %), *Ornithonyssus bursa* (8.5 %) and *Knemidocoptes mutans* (7.0 %).

Knemidocoptes mutans, a type of scaly-leg mite found in poultry, which is classified under the Sarcoptidae family. Typically, mites of the *Knemidocoptes* genus are small and round, with short legs, measuring about 0.5 mm in diameter. (Yunker, 1973; Arends, 2003) [24, 2]. In poultry, these mites create sores on the bare areas of the legs and occasionally on the combs and wattles. Typically found on the ground or in damp conditions on the floor of poultry sheds; they tunnel beneath the epidermal scales of the legs and feet, leading to local irritation and inflammation with exudate that hardens on the surface and displace the scales.

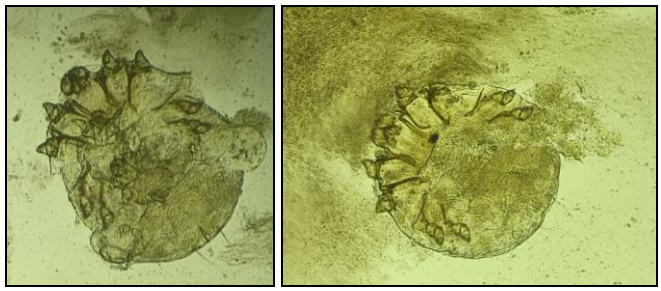

Fig 2: *Knemidocoptes mutans* female mite (x400)-separate epimeres

Fig 3: *Staphylococcus aureus* colonies on Sheep blood agar plate showing double zone of complete and incomplete hemolysis

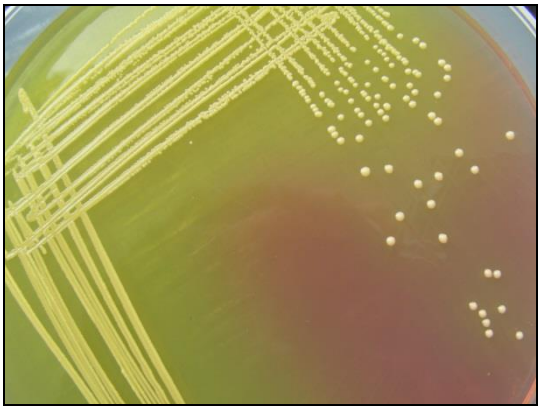

Fig 4: *Staphylococcus aureus* yellow colonies on Mannitol salt agar plate

This condition is often characterized by marked keratinization, leading to the development of elevated scales and crusty formations on the feet and legs of affected poultry (Greiner and Ritchie, 1994; Soulsby, 2012; Digraskar *et al.*, 2017) [8, 22, 6]. Within these lesions, mites create numerous tunnels where they feed on tissue, with adult females

commonly found inhabiting these tunnels. Chickens suffering from this condition typically display rough, yellowish-white crusts covering their limbs extensively, extending up to the toes (Shanta *et al.*, 2006; Digraskar *et al.*, 2017) [20, 6]. In this present case also, the lesions were in accordance with the report of Shanta *et al.* (2006) [20] and Srinivasan *et al.* (2014) [23].

Strategies to control this parasite involve isolating and inspecting recently bought chickens, removing infected birds and maintaining cleanliness in the cages (Morishita *et al.*, 2005) [12]. The most effective and safe drug for treating scaly leg is ivermectin (Srinivasan *et al.*, 2014) [23]. Alternatively, affected legs can be treated effectively by immersing in a 10% sulfur solution or 0.5% sodium fluoride (Soulsby, 2012) [22]. Failure to address scaly-leg mite infestations can lead to leg deformities, difficulty in walking, and even the loss of digits. In the present report, the chickens were treated with deltamethrin which also resulted in complete recovery with no reoccurrence.

Bumblefoot, also called as footpad dermatitis or plantar pododermatitis, characterized by swollen footpads and limping due to the presence of skin lesions on the underside footpad of birds (Poorbaghi *et al.*, 2012) [15]. *Staphylococcus aureus*, *Streptococcus spp*., *Escherichia coli* and *Proteus spp.* are among the microorganisms causes bumblefoot, affecting bones, tendon sheaths, and joints. The common cause of bumblefoot in poultry is *Staphylococcus spp.*, gram-positive cocci, which are frequently present on the skin and various mucous membranes (Devriese *et al.*, 1992) [5]. They typically induce illness when they penetrate tissue and enter the bloodstream due to the breakdown of physical barriers, such as skin or mucous membranes resulting from skin wounds, minor surgical procedures like beak, toe, or comb trimming, and in birds with compromised immunity (Choudhury, 2019) [4].

Diagnosis involves isolating the responsible organisms from lesions cultured on blood agar plates, often identifying Staphylococcus bacteria as secondary pathogens. Treatment usually involves antibiotics like penicillin, erythromycin, lincomycin, and spectinomycin, but it's crucial to conduct antimicrobial susceptibility tests. (Sato and El-Gazzar, 2020) [19].

In the current study, isolated coccoid bacteria, that were well-matched with *Staphylococcus spp*, as this bacteria were most likely secondary invaders from the damaged skin caused by *K. mutans* mite which was confirmed based on maltose fermentation which produced yellow colour colonies on Mannitol salt agar plate and the birds were treated with amoxycillin and sulbactam. In concurrence with the present findings, Morishita *et al*. (2005) [12] also documented the association of severe scaly-leg mite infestation with digit necrosis which might have caused by the bacteria in Bantam Chickens.

5. Conclusion

Thus, the present study reports the co-occurrence of scaly leg caused by *K.mutans* and bumblefoot caused by *S.aureus* in the Aseel birds and its successful clinical management was established. The primary cause for the lameness and unthriftiness in birds could be attributed to the scaly leg caused by mite breached the integrity of the skin epithelial barrier which might have been invaded by the secondary invader, *Staphylococcus spp*. Thus, it is concluded that, the early diagnosis and prompt treatment appeared to be successful, as no new cases of scaly-leg mite were reported in the flock after treatment and the therapeutic regimen appeared to halt progression of the disease.

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