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Microbiological and Hematological Diagnostic Profiles of Strawberry Footrot in Sheep in Karawang, Indonesia

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CASE REPORT ARTICLE
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ABSTRACT

Dermatophilus congolensis (*D. congolensis*) is a gram-positive, coccus-shaped pathogenic bacterium that develops a filamentous structure during the infectious phase. The *D. congolensis* can cause scab lesions on sheep's feet, which may eventually develop into bloody tissue resembling crushed strawberries. The present study aimed to provide diagnostic, microbiological, and hematological profiles of strawberry footrot in sheep in Karawang Regency, Indonesia. Six sheep (*Ovis aries*), with an average age of two years and exhibiting similar signs of strawberry footrot, were sampled from community farms in the region. Blood samples and exudate swabs from scab lesions on the feet and udder were collected in August 2024 for analysis. Hematological testing and bacterial isolation using blood agar, gram staining, fermentation, and biochemical tests were performed. The hematologic results indicated thrombocytosis, macrocytic normochromic anemia, and leukocytosis in the sheep. All samples exhibited beta hemolysis zones on blood agar and were gram-positive, coccus-shaped bacteria with a railroad appearance. Biochemical tests were positive for catalase, negative for indole, negative for Voges-Proskauer (VP), and showed the ability to ferment glucose and maltose. Based on clinical signs, hematological findings, and bacterial isolation, *D. congolensis* was confirmed as the causative agent of strawberry footrot in sheep in Karawang Regency, Indonesia.

Keywords: *Dermatophilus congolensis,* Hematological profile, Microbiology, Strawberry footrot

INTRODUCTION

Strawberry footrot is a disease caused by *Dermatophilus congolensis* (*D. congolensis*) and is often associated with contagious ecthyma caused by *Parapoxvirus* (Blick et al., 2019). Strawberry footrot presents as scabs with defined edges affecting small ruminants, including sheep and goats. These scab lesions can develop into openings on the foot, leading to bleeding tissue that resembles crushed strawberries (Tellam et al., 2021). In cases of secondary infection by pyogenic bacteria, purulent discharge may occur. The occurrence of strawberry footrot is sporadic in tropical regions such as West Africa, East Africa, and the Caribbean and tends to increase during the rainy season or humid conditions (Dirkeswan, 2014). In sheep, morbidity can range from 0.77% to 31%, with mortality reaching 10%, often linked to factors such as poor nutrition and ectoparasites (Faccini et al., 2022). Clinical signs of strawberry footrot include dryness, fistulas, and lesions. Exudative lesions may develop when lesions are exposed to prolonged moisture (Chitra et al., 2017). Lesions can resolve spontaneously within six to eight weeks (Aitken, 2007).

In 1993, an outbreak of skin disease occurred in Ongole crossbred cattle in Kulon Progo Regency, Yogyakarta, Indonesia. An investigation was conducted to assess parasite infestation, and treatment was administered using ivermectin; however, it did not yield a healing response. Microscopic analysis using direct smears and bacterial isolation of the scabs revealed the infection with *D. congolensis*, characterized by long filaments and coccoid bacteria (Dirkeswan, 2014). Until now, comprehensive investigations and reports regarding diagnostics and the prevalence of *D. congolensis* infection in Indonesia remain limited. The present study aimed to provide diagnostic, microbiological, and hematological profiles of strawberry footrot in sheep (*Ovis aries*) in Karawang, Indonesia.

MATERIALS AND METHODS

Ethical approval

The present case report was conducted at Balai Veteriner Subang, a government veterinary diagnostic and research institution operating under the Ministry of Agriculture, Republic of Indonesia. The procedures were performed in accordance with the institution's standardized diagnostic protocols and operational guidelines. Blood samples were obtained by a licensed veterinarian in a calm setting to minimize stress. Farmers and owners received information about the study's purpose and procedures before participation.

Study area

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Six male sheep (*Ovis aries*) were obtained from community farms in Indonesia and were approximately two years old. The sheep showed clinical signs suggestive of *D. congolensis* infection, such as fever, facial swelling, swollen knees, and scab lesions on their lower legs. Blood samples and exudate swabs from the scab lesions on the digits and udder were collected from three farms in the Karawang Regency, West Java, Indonesia, on August 8, 2024. Hematological examination and bacterial isolation were performed at the Subang Veterinary Center, West Java, Indonesia.

Hematological analysis

Blood samples were collected from six sheep (*Ovis aries*) displaying clinical signs of suspected *D. congolensis* infection, including fever, scab lesions, facial swelling, and swollen knees, using a three mL syringe with a 23G needle. A total of three mL of blood was taken via jugular vein and placed into the EDTA tube, then analyzed using a hematology analyzer (Rayto RT 7600, China). Hematological testing was performed in cases of suspected *D. congolensis* infection to assess the systemic physiological response of the host to the bacterial infection, with total leukocyte (10^3 /µL), erythrocyte (10^6 /µL), and platelet count (PLT, 10^3 /µL) as parameters (Simsek et al., 2022).

Isolation and identification of *Dermatophilus congolensis*

Swab samples of exudate from the scab lesions of the digit and dry scab of the udder in the sheep were taken for bacterial isolation and identification. Each swab of scab exudate sample was directly inoculated onto blood agar media (Oxoid, UK) using the streaking method with a sterile loop and incubated 37°C for 24 hours (Khan et al., 2024). Gray and beta hemolytic colonies were analyzed by Gram staining and catalase test, followed by biochemical tests such as indole, Voges-Proskauer (VP), and sugar fermentation tests (Glucose, Maltose, Salicin, Mannitol, and Sorbitol). Gram staining was performed to identify the presence of branching, filamentous Gram-positive bacteria with a tram-track appearance to confirm *D. congolensis* as the etiological agent (Habte et al., 2025). The biochemical characteristics of the gray and beta hemolytic colonies on blood agar were compared with previously published profiles of *D. congolensis* to support species-level identification (Samuel et al., 1998; Amor et al., 2011; Walter et al., 2017).

Statistical analysis

The collected data were compiled, processed, and analyzed using descriptive statistical methods. Hematological parameters were evaluated by calculating the mean and standard deviation values to identify relevant patterns and trends.

RESULTS AND DISCUSSIONS

Clinical findings

Clinical examinations were conducted to evaluate the type, distribution, and severity of skin lesions, including an assessment of lesion structure, consistency, location, and exudate. Infected sheep demonstrated a variety of dermatological abnormalities strongly suggestive of *D. congolensis* infection. Sheep exhibiting signs such as fever, lethargy, and swelling in the face, knees, and lower legs were observed for different changes (Moriello, 2019). Confidence in diagnosing *D. congolensis* infection was based on the key clinical signs in affected sheep, which exhibited fever with body temperatures ranging from 41°C to 42°C. These sheep developed scab lesions on the digit, and dry scabs were observed on the udder (Figure 1). Additionally, some sheep showed signs of alopecia and pustular lesions on the head (Figure 2). The observed sheep aligned with findings by Marsella (2014), which indicated that this bacterial infection caused local alopecia and primary lesions such as papules that developed into pustules, potentially leading to matted hair and thick crust formation in some cases. Purulent exudate was readily visible in active lesions.

Motile zoospores of *D. congolensis* infect the epidermis and hair follicles, leading to scab exudate lesions in dermatophilosis. These zoospores germinate and develop into filamentous hyphae that invade and multiply within the live epidermis and hair follicles, areas where the skin's protective barrier is weak (Moriello, 2019). The acute inflammatory response features infiltration of neutrophils and other immune cells, resulting in serous exudation on the skin surface. Scabs composed of crust exudate and necrotic epithelial debris form due to hyperkeratinization and keratinization of the affected epidermal tissue (Tellam et al., 2021). The infection cycle is extended in the presence of moisture because it encourages zoospore growth and release from the hyphae inside these scabs (Tellam et al., 2021). Dry scab lesions on the sheep udder occur from repeated infections in the epidermis, leading to a thickened cornification layer. Eventually, the lesions continue to grow and thicken until they detach and form scab exudate lesions (Aitken, 2007).

Figure 1. Pathological lesions in a 2-year-old male sheep (*Ovis aries*). **A**: Exudate scab lesion on the digit, **B**: Exudate scab lesion on the fourth digit of the sheep, **C**: Dry scab on the udder of the sheep, arrow indicates the wet scab lesions on the udder. Source: Authors of the present study

Figure 2. Pathological lesions in a 2-year-old male sheep head (*Ovis aries*). **A**: Alopecia of the sheep's head, **B**: Pustular lesion of the nose. Source: Authors of the present study

Clinical examination of the affected sheep in Karawang Regency, Indonesia, showed characteristic lesions on different body parts, including the mouth, udder, forelimbs, hindlimbs, and areas of alopecia on the face and body. These clinical signs were suspected to be manifestations of infection with *D. congolensis,* the causative agent of strawberry footrot (Dermatophilosis), and the *parapoxvirus* that causes contagious pustular dermatitis (CPD). According to Kumar et al. (2015), CPD typically presents as lesions located around the lips, oral mucosa, gingiva, and inner mouth, with possible spread to the udder and inguinal region. Lesions on the udder frequently occur along with lesions on the peri-labial area. In some cases, CPD-associated lesions extend to the limbs, particularly the interdigital space and the coronary band, leading to pedal degeneration. The lesions often display a proliferative or papillomatous morphology resembling cauliflower-like growths. The incubation period of CPD ranges from 2 to 3 weeks, and initial clinical signs include fever, lethargy, hypersalivation, gingival and inguinal swelling, followed by the emergence of pustular or papillomatous lesions (Kumar et al., 2015). In clinical cases observed on sheep in Karawang regency, Indonesia, lesions were present in the digit region but were notably absent in the coronary band area. In the present study, lesions observed in sheep were localized to the digits, with no involvement of the coronary band, which is commonly affected in CPD (Mansoor et al., 2025). The presence of exudative, crusted lesions and localized hair loss pointed more toward dermatophilosis, suggesting *D. congolensis* as the primary pathogen rather than a *parapoxvirus* infection.

Hematological findings

The blood sample results of the six sheep can be seen in Table 1.

Table 1. Hematology test results of sheep (*Ovis aries*) with clinical signs of suspected *D. congolensis*

Parameter	Result (Mean ± SD)	Normal range***
HB (g/dL)	9.18 ± 0.2	9-15
HCT (%)	28.1 ± 1.6	27-45
MCH (pG)	14.6 ± 3.6*	8-12
MCHC (pG)	32.12 ± 0.9	31-34
MCV (fL)	45.35 ± 10.8*	28-40
PDW (%)	13.78 ± 3.24	29-96
PLT (10^3/µL)	2.258 ± 1.376*	800-11.000
RBC (10^6/µL)	6.48 ± 1.6**	9-15
RDW (%)	1.6 ± 1.9	16- 22
WBC (10^3/µL)	13.58 ± 8.5*	4-8

* Indicated above normal value, ** Indicated below normal value, ***Source of control data. Source: (Merck, 2024), HB: Hemoglobin, HCT: Hematocrit, MCH: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentration, MCV: Mean corpuscular volume, PDW: Platelet distribution width, PLT: Platelet count, RBC: Red blood cell count, RDW: Red cell distribution width, and WBC: White blood cell count.

The average red blood cell count (RBC) in the six sheep was below the normal reference range, indicating anemia. According to Nayyef (2020), anemia results from a deficiency of RBC and hemoglobin (HB), leading to inadequate oxygen delivery to meet physiological demands. Similarly, Turner et al. (2023) noted that anemia is defined by reduced erythrocyte counts, HB levels, and hematocrit (HCT) values. This condition compromises physiological efficiency, weakens antioxidant activity, and may progress to hypovolemic shock (Sousa et al., 2022).

Blood analysis of the six sheep revealed macrocytic-normochromic anemia, marked by elevated mean corpuscular volume and mean corpuscular hemoglobin, along with enlarged erythrocytes due to impaired maturation (Killeen and Adil, 2025). Additionally, the hematological analysis revealed leukocytosis, characterized by elevated white blood cell counts, which typically occurs in response to infection, inflammation, malignancy, or genetic disorders (Mank et al., 2024). This finding correlated with the observed clinical signs, as tissue injuries would naturally trigger a leukocytic response to infection. In addition, thrombocytosis (Increased PLT) was detected, a condition often associated with infectious processes, inflammatory states, or hemorrhage, consistent with the open lesions that were inducing both inflammation and bleeding in affected animals (Rokkam et al., 2024). As previously reported by Hamid and Musa (2009) and Simsek et al. (2022), *D. congolensis* infection led to decreased RBC counts, Hb levels, and HCT values, mirroring the current results.

Microbiological findings

Blood agar isolation revealed two colony types, including milky white and grayish, both convex, smooth, and beta hemolytic (Figure 3a). On blood agar, the colonies demonstrated morphological characteristics consistent with *D. congolensis*, appearing as smooth, grayish-white colonies with distinct beta-hemolysis (Burd et al., 2007; Oladunni et al., 2016). A catalase test was performed on bacterial colonies with beta hemolysis. After receiving H_2O_2, bacterial colonies in the catalase test generated foam (Figure 3b). The catalase test yielded a positive result, as evidenced by the immediate formation of oxygen bubbles upon the application of hydrogen peroxide, indicating the presence of catalase enzyme activity. The catalase enzyme is present in *D. congolensis* and can break down H_2O_2 into O_2 and H_2O (Tresamol and Saseendranath, 2015). The bubbles produced from the production of oxygen gas demonstrated positive catalase results. The beta-hemolytic colonies observed in blood agar were subjected to Gram staining, which revealed Gram-positive coccus-shaped bacteria with a characteristic tram track pattern indicated by the blue coloration observed in the staining results (Figure 3c).

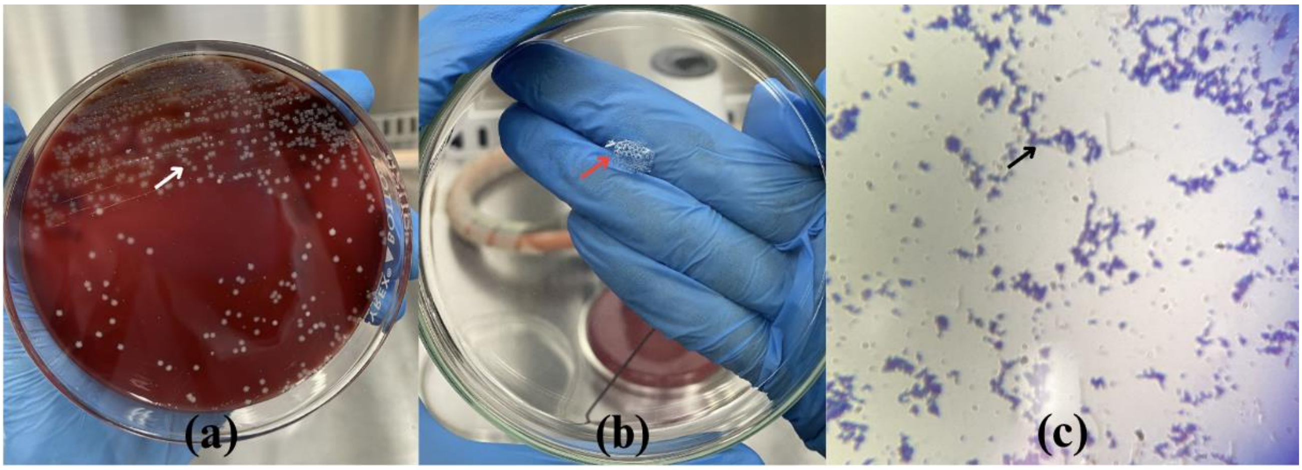

Figure 3. The results of bacterial isolation from the exudate of the scab lesions of the digit and the dry scab of the udder in the sheep (*Ovis aries*) on blood agar media. **A**: White arrow shows grayish bacterial colonies that hemolyze the media, **B**: Red arrow shows catalase positive, and **C**: Black arrow shows gram-positive coccus-shaped and tram track-like appearance. Source: Authors of the present study.

The *D. congolensis* was included in the Gram-positive and has elongated filaments consisting of cocci in rows of two or four cocci and looked like railroad tracks (Tram track-like appearance; Habte et al., 2025). The *D. congolensis* possesses a well-defined life cycle comprising two primary morphological forms, including filamentous hyphae and motile zoospores. The hyphal structures are composed of branching filaments that undergo transverse and longitudinal septation, eventually fragmenting into coccoid cells. These coccoid cells then develop into flagellated zoospores, which constitute the infective stage of the organism. The zoospores are capable of penetrating compromised skin, particularly under conditions of high humidity or mechanical skin damage, initiating infection in a susceptible host (Marsella, 2014).

Fermentation testing was conducted to determine the ability of sugar fermentation in colonies suspected of *D. congolensis*. The ability of *D. congolensis* to ferment sugars was revealed on test agar by a yellow color transition, reflecting acid production and subsequent pH decrease in the culture medium (Mannan, 2009). Based on the fermentation test, the bacteria fermented glucose and maltose (Figure 4; Walter et al., 2017). Isolated crust samples taken from animals with skin lesions indicated that *D. congolensis* can ferment glucose and maltose and cannot ferment mannitol, sorbitol, or salicin. Indole testing performed in the present study yielded negative results, consistent with the findings of Amor et al. (2011) that *D. congolensis* lacks indole-producing enzymes. The negative reaction was confirmed by the absence of a characteristic ring formation upon addition of Kovac's reagent to the culture medium. The VP test is a biochemical test that detects the ability of bacteria to metabolize pyruvate into a neutral intermediate product called acetylmethylcarbinol or acetonin (Shanmugaraj et al., 2021). All isolates of the present study were VP-negative, which was aligned with the findings reported by Samuel et al. (1998) that *D. congolensis* was negative in VP testing. All of the results, including clinical signs, hematological profile, and bacterial isolation, were consistent with *D. congolensis* infection as observed in sheep (*Ovis aries*) from Karawang Regency, Indonesia. The affected sheep exhibited characteristic clinical signs such as crusted skin lesions and alopecia, hematological changes including leukocytosis, thrombocytosis, and macrocytic-normochromic anemia, and the isolation of branching Gram-positive bacteria and a tram track-like appearance.

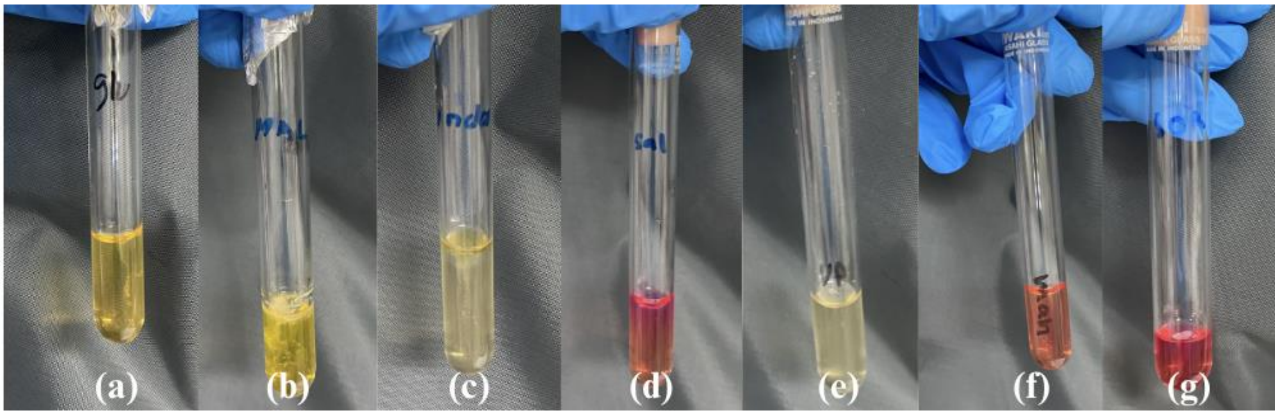

Figure 4. Biochemical and fermentation test results of a colony of beta-hemolytic suspected to *D. congolensis.* **A**: Positive glucose test, **B**: Positive maltose test, **C**: Negative indole test, **D**: Negative salicin test, **E**: Negative Voges-Proskauer test, **F**: Negative mannitol test, **G**: Negative sorbitol test. Source: Authors of the present study

CONCLUSION

The *D. congolensis* causes scab lesions on sheep's digits and udder areas. Hematology examination results illustrated a blood profile of leukocytosis, thrombocytosis, and macrocytic-normochromic anemia. Microbiological analysis performed on swab samples of scab exudate on the digit area indicated that this bacterium is a Gram-positive, coccus-shaped bacterium with a tram track-like appearance, capable of beta hemolysis on blood agar media, and can ferment glucose and mannitol. Further studies should focus on the molecular characterization and genotyping of *D. congolensis* isolates and investigate larger sheep populations to provide epidemiology, risk factors, and distribution patterns of *D. congolensis*.

DECLARATIONS

Availability of data and materials

All data obtained or analyzed in the course of the present study are presented within the manuscript. Additional information or datasets can be provided by the corresponding author upon reasonable request.

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Authors' contributions

Jasmine Yasyfa' Sukmayani was responsible for directly contributing to sample processing, data processing, and drafting the manuscript. Fadeli Bermani was responsible for supervising the draft and revising the draft manuscript. Dwi Nawang Wicaksana conceptualized and designed the idea for the present study. Each author had an important role in the preparation of the manuscript. All authors were responsible for reviewing the manuscript and contributing to the refinement of the final version of the manuscript. All authors read and approved the final edition of the manuscript for publication.

Competing interests

The authors declare no conflict of interest.

Ethical considerations

All authors have been checked the manuscript for plagiarism, dual publication and/or submission, falsification and/or fabrication, and redundancy.

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