

## Bacteria Associated with Pathology of Bovine Dermatophilosis in North Central Nigeria

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**Abstract:** A study was carried out to determine bacteria associated with pathology of bovine dermatophilosis in north central Nigeria. Skin samples obtained from 211 cattle with skin lesions suspected to be dermatophilosis were processed for bacteriology and histopathology. One hundred and sixty seven (79.1%) samples were positive for *Dermatophilus congolensis*, while 44 (20.9%) were negative. Both *D. congolensis* positive and negative samples were processed for isolation of other bacteria and the data was analyzed using  $\chi^2$ -test. *Staphylococcus aureus*, *S. epidermidis*, *Bacillus subtilis*, *Micrococcus* sp., *Corynebacterium* sp., *Escherichia coli*, *Proteus* and *Pseudomonas* sp. were isolated from both *D. congolensis* positive and *D. congolensis* negative scabs. However, the rate of recovery of *S. aureus* from *D. congolensis* positive cattle was significantly ( $p < 0.05$ ) higher than the rate of its recovery from *D. congolensis* negative cattle. There was no significant difference ( $p > 0.05$ ) between the occurrence of the other isolates in *D. congolensis* positive and negative cattle. Histopathology revealed hyperplasia of the epidermis, parakeratosis, necrosis, cellular infiltration of the hair follicles and papillary dermis, diffuse cellular infiltration of the reticular dermis and folliculitis were also observed in some sections. It was concluded that the histopathological lesions observed could be due to *D. congolensis* complicated by secondary bacterial infection. The need to investigate the role of bacteria particularly that of *S. aureus* in the development of bovine dermatophilosis was emphasized.

**Key words:** *Dermatophilus congolensis*, bovine skin, associated bacteria, pathology, North Central Nigeria

### INTRODUCTION

Dermatophilosis is a contagious zoonotic skin disease caused by a Gram-positive actinomycete, *Dermatophilus congolensis*. The disease in cattle is characterized by acute or chronic, local or progressive and sometimes fatal exudative dermatitis, which starts as an erythema, progressing through serous exudation, drying to form characteristic matting of hair (Zaria, 1993; Abdullahi, 2001; Ambrose *et al.*, 1999; Loria *et al.*, 2005).

The skin as an intricate habitat for many bacteria contains different types of bacteria. The type and density of bacteria are determined by anatomic location, local humidity, the amount of sebum and age (Aly, 1991). Bacterial skin flora are commensal, symbiotic or parasitic relative to the host, although alterations in host immune status are known to have significant impact, the type of relationship established is often inherent to the bacteria (Katarina *et al.*, 2001). Persistent colonization is the result of the ability of bacteria to adhere to skin epithelium, grow in a relatively dry acidic environment and rapidly readhere during the normal process of

desquamation (Feingold, 1986). In a study of bacterial flora of the normal bovine skin in Nigeria, Nwufoh and Amakiri (1981) isolated *Staphylococcus epidermidis*, hemolytic *Streptococcus*, *Escherichia coli* and *Bacillus subtilis*.

There is a consensus of opinions that skin samples submitted to the laboratory for isolation of *D. congolensis* were usually contaminated with various species of bacteria. The most common contaminants encountered in the lesion of dermatophilosis include species of: *Staphylococcus*, *Streptococcus*, *Micrococcus*, *Pseudomonas*, *Proteus* and *E. coli* (Abdullahi, 2001; Chodnik, 1956; Okpa *et al.*, 1991; Sutherland *et al.*, 1983).

Resident bacteria on the skin can become pathogenic especially when there is a break in skin continuity (Katarina *et al.*, 2001). Bacteria are capable of producing hypersensitivity reaction just as plant pollens and moulds do. *Staphylococcus aureus* and *Streptococcus pyogenes* produce several toxins that can cause localized destruction or systemic symptoms (Hackett and Stevens, 1993). Bida (1973) in his reports observed that most cattle affected by dermatophilosis did not appear to be clinically

disturbed but continued to graze until the disease was complicated by secondary bacterial infection, which may result in death due to toxemia.

This study was aimed at determining the bacteria that are associated with pathology of bovine dermatophilosis in North central Nigeria.

### MATERIALS AND METHODS

One thousand, nine hundred and twenty cattle from various localities in North central Nigeria were examined for skin lesions. Paired skin samples were obtained from 211 cattle with skin lesions suspected to be dermatophilosis for microbiology and histopathology. Samples for microbiology were collected aseptically in sterile containers and preserved at 40°C, whereas biopsies for histopathology were fixed in 10% buffered formalin and submitted to the Diagnostic Microbiology and histopathology units of the Veterinary Teaching hospital, Ahmadu Bello University, Zaria for examination and confirmation.

#### Laboratory examination

**Cultural isolation of *Dermatophilus congolensis*:** In order to confirm infection, isolation of *D. congolensis* was carried out using the modified Haalstra's technique as described by Vanbreuseghem *et al.* (1976). Briefly, skin scabs were minced with a sterile scalpel blade and placed in Bijou bottles. Five milliliters of sterile water was added to each of the specimen in the Bijou bottles. The bottles were closed loosely and incubated at 37°C in a candle jar for 30 min. One loop full from the surface fluid from each of the bottles was inoculated on to 7% defibrinated sheep blood agar plate. The inoculated plates were incubated at 37°C in a candle jar for 48 h. The plates were examined for colonies of *D. congolensis*. Smears were made from suspected colonies on each of the plates, Gram-stained and examined with the oil emersion objective for morphology typical of *D. congolensis*. *D. congolensis* positive samples were separated from *D. congolensis* negative specimens.

**Isolation and characterization of other bacteria:** Both *D. congolensis* positive and negative samples were inoculated on 7% defibrinated sheep blood agar and MacConkey agar using sterile bacteriological loop. All inoculated plates were incubated aerobically at 37°C for 24 h. Bacterial isolates were identified as described by Cowan and Steel (2004).

**Histopathology:** Skin biopsies fixed in 10% buffered formalin were cut at 5-6 microns after embedding in

paraffin wax and stained with haematoxylin and eosin. Data was analyzed using the  $\chi^2$ -test described by Thrusfield (1997).

### RESULTS AND DISCUSSION

Bacteria were isolated from all the 167 (100%) *D. congolensis* positive scabs, while only 38 (86.4%) of *D. congolensis* negative scabs yielded bacterial growth, the remaining 6 (13.6%) were negative. *Staphylococcus aureus* was isolated from 28.0% of *D. congolensis* positive lesions while *S. epidermidis*, *B. subtilis*, *Micrococcus* sp., *Corynebacterium* sp., *Escherichia coli*, *Proteus* and *Pseudomonas* sp. were recovered from 24.6, 20.4, 10.8, 3.6, 5.0, 0.4 and 2.4% of *D. congolensis* positive lesions, respectively. *S. aureus* was isolated from 6.8% of *D. congolensis* negative lesions, while *S. epidermidis*, *B. subtilis*, *Micrococcus* sp., *Corynebacterium* sp., *Escherichia coli*, *Proteus* sp. and *Pseudomonas* sp. were obtained from 27.3, 25.0, 13.6, 2.3, 6.8, 2.3 and 2.3% of *D. congolensis* negative lesions, respectively (Fig. 1). There was significant association ( $p < 0.05$ ) between *S. aureus* isolation and *D. congolensis* infection. However, no significant association ( $p > 0.05$ ) was found between the occurrence of the other isolates and dermatophilosis.

A variety of lesions of dermatophilosis were observed. Some of the cattle examined had few papules, together with some hard, dry, crusty lesions, which were

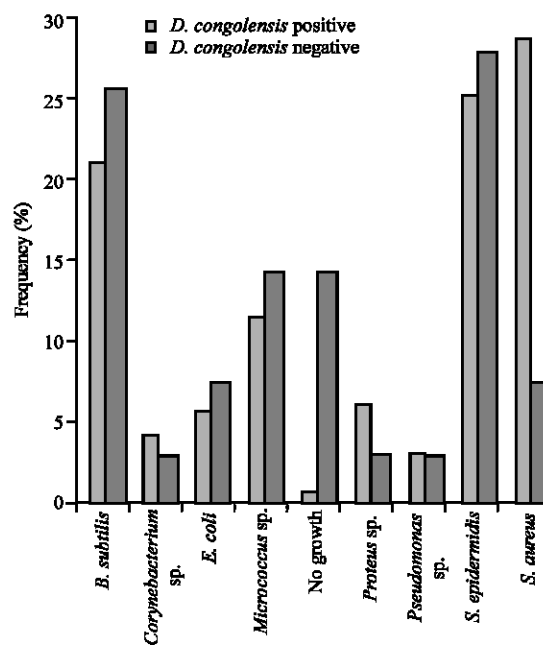


Fig. 1: Bacterial isolates from *D. congolensis* positive and negative cattle



Fig. 2: A group of cattle with dermatophilosis lesions (arrow)

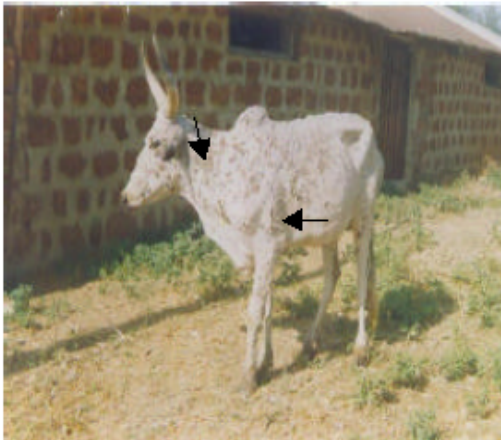


Fig. 3: A cow with generalized dermatophilosis lesions (arrows)

confined to certain areas of the body particularly the back (Fig. 2). In others, the lesions were generalized and covered the whole body especially, the back, neck, the perineal region, lower limbs, tail, mouth and ears of the affected animals (Fig. 3).

Histopathology revealed hyperplasia of the epidermis, parakeratosis, necrosis, cellular infiltration of the hair follicles and papillary dermis (Fig. 4). Diffuse cellular infiltration of the reticular dermis and folliculitis were also observed in some sections (Fig. 5). Hyphae of *D. congolensis* were detected in the superficial hyperplastic and hyperkeratotic epidermis (Fig. 6).

The occurrence of *Staphylococcus aureus*, *S. epidermidis*, *B. subtilis*, *Micrococcus* sp., *Corynebacterium* sp., *Escherichia coli*, *Proteus* sp. and *Pseudomonas* sp. in both *D. congolensis* positive and negative scabs, agree with the reports of Okpa *et al.* (1991) and Abdullahi (2001). Similarly, the rate of recovery

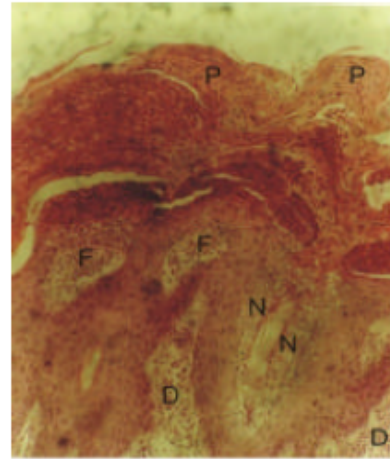


Fig. 4: Photomicrograph of the skin of a cow naturally infected by *Dermatophilus congolensis* showing the epidermis. Note hyperplasia of the epidermis, Parakeratosis hyperkeratosis (P), area of Necrosis (N) with cellular infiltration in the hair Follicles (F) and papillary Dermis (D). H and E x305

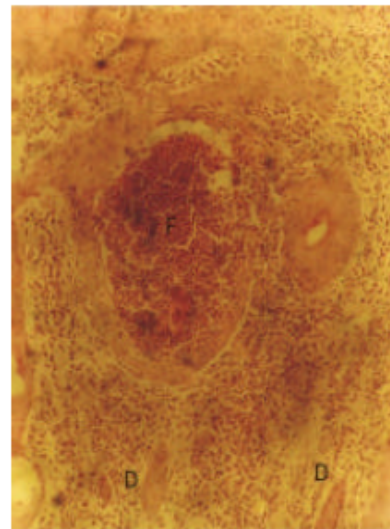


Fig. 5: Photomicrograph of the skin of a bull naturally infected by *Dermatophilus congolensis*. Note bacterial hyphae (arrow) in the superficial hyperplastic and hyperkeratotic epidermis. H and E x305

of *S. aureus* from *D. congolensis* positive scabs, which was significantly ( $p < 0.05$ ) higher than the rate of its recovery from *D. congolensis* negative scabs and the non-significant difference ( $p > 0.05$ ) between the occurrence of the other isolates in *D. congolensis* positive and *D. congolensis* negative samples, were consistent with previous reports (Okpa *et al.*, 1991; Abdullahi, 2001).

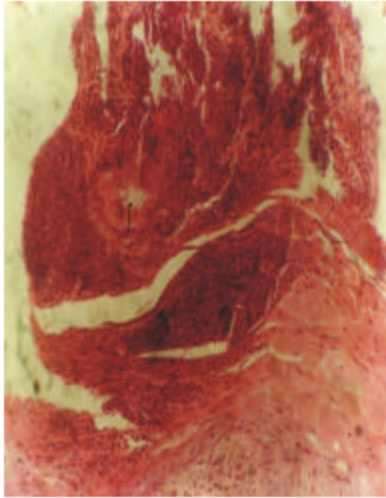


Fig. 6: Photomicrograph of the skin of a bull naturally infected by *Dermatophilus congolensis*. Note bacterial hyphae (arrow) in the superficial hyperplastic and hyperkeratotic epidermis. H and E x305

This could be attributable to the presence of various toxins and enzymes in *S. aureus*, which enables it to invade tissues of humans and animals where it causes a variety of purulent inflammatory diseases (Jones *et al.*, 1997).

Commensal bacteria could protect the host from pathogenic bacteria directly by bacteriocin production, production of toxic metabolites, induction of a low reduction oxidation potential, depletion of essential nutrients, prevention of adherence of competing bacteria, inhibition of translocation and degradation of toxins. Commensal bacteria compete for nutrients, niches and receptors. *Staphylococcus epidermidis* had been reported to bind keratinocyte receptors and inhibit adherence of virulent *S. aureus* (Bibel *et al.*, 1983). They could however, become pathogenic especially, when there is a break in skin continuity (Katarina *et al.*, 2001). It is possible that the large quantities of secretory metabolites from bacteria contribute significantly in maintaining and sustaining hypersensitivity reaction capable of maintaining *D. congolensis* at the lesion site in natural infection (Davis and Philpott, 1980).

Histopathological findings in this report agree with previous reports (Amakiri, 1974; Ambrose *et al.*, 1999). However, the diffuse cellular infiltration of the reticular dermis and folliculitis observed in this report even though not reported by Amakiri (1974) and Ambrose *et al.* (1999) were consistent with the findings of Zaria (1993). This could be due to secondary bacterial infection of the lesions produced by *D. congolensis*. Several bacterial

agents have been isolated from skin lesions of cattle with clinical dermatophilosis (Zaria, 1993; Abdullahi, 2001; Dais *et al.*, 2009).

The observation of *D. congolensis* in the epidermis agrees with the report of Amakiri (1974), who observed *D. congolensis* most frequently in the stratum corneum especially between the disjunctum and conjunctum. This could be due to the presence of the basement membrane (demo-epidermal junction) together with the stratum basale, which might act as barrier to dermal entry of *D. congolensis*.

## CONCLUSION

The histopathological lesions observed could be due to *D. congolensis* complicated by secondary bacterial infection. The role of bacteria particularly that of *S. aureus* in the development of bovine dermatophilosis needs to be investigated.

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## REFERENCES

- Abdullahi, U.S., 2001. Chemotherapeutic and Chemoprophylactic control of Bovine Dermatophilosis. PhD Thesis. Ahmadu Bello University, Zaria, Nigeria, pp: 66-68.
- Aly, R.A., 1991. Cutaneous Microbiology. In: Orkin, M., H.I. Maibach and M.V. Dahl (Eds). Dermatophily. Los: Appleton and Lange, pp: 22-25.
- Amakiri, S.F., 1974. Extent of skin penetration by *Dermatophilus congolensis* in bovine streptothricosis. Trop. Anim. Health Prod., 6 (2): 99-105. DOI: 10.1007/BF02.380546.
- Ambrose, N., D. Lloyd and J.C. Millard, 1999. Immune response to *Dermatophilus congolensis* infections, Parasitol. Today, 15: 295-300. [http://dx.doi.org/10.1016/S0169-4758\(99\)01470-2](http://dx.doi.org/10.1016/S0169-4758(99)01470-2).
- Bibel, D.J., R. Aly, H.R. Shinefield and H.J. Maibach, 1983. The *Staphylococcus aureus* receptor for Fibronectin. J. Invest. Dermatol., 80: 494-496.
- Bida, S.A., 1973. Epizootiological and Pathological studies of Bovine Dermatophilosis (Kirihi) in Northern Nigeria. Ph.D. Thesis Ahmadu Bello University, Zaria, pp: 45-52.

- Chodnik, K.S., 1956. Mycotic Dermatitis of cattle in West Africa. *J. Comp. Pathol.*, 66: 179-186. <http://www.ncbi.nlm.nih.gov/pubmed/13345895>.
- Cowan, S.T. and Steel, 2004. *Manual for the identification of medical bacteria*. Cambridge University Press, Cambridge, pp: 45-122. ISBN: 9780521543286.
- Dalis, J.S., H.M. Kazeem, A.A. Makinde and M.Y. Fatihu, 2009. Distribution of lesions of dermatophilosis in cattle, sheep and goats in Zaria and Jos, Nigeria. *J. Anim. Vet. Adv.*, 8: 385-388. <http://medwelljournals.com/fulltext/java/2009/385-388.pdf>.
- Davis, D. and M. Philpott, 1980. Experimental chronic dermatophilosis. *Proceedings of the Royal Society of Edinburgh*, pp: 47-53.
- Feingold, D.S., 1986. Bacterial adherence, colonization and Pathogenicity. *Arch. Dermatol.*, 122: 161-163. PMID: 1135308. <http://doi.wiley.com/10.1046/j.1439-0450.1999.00246.x>.
- Hackett, S.P. and D.L. Stevens, 1993. Superantigens associated with Staphylococcal and Streptococcal Toxic shock syndrome are potent inducers of Tumor Necrosis factor beta synthesis. *J. Infec. Dis.*, 168: 232-235.
- Jones, T.C., R.D. Hunt and N.N. King, 1997. *Veterinary Pathology*. 6th Edn. Lippincott Williams and Wilkins, Philadelphia, pp: 429-430.
- Katarina, C., B.A. Selkin and G.J. Murakawa, 2001. Skin microflora and bacterial infections of the skin. *J. Invest. Dermatol. Symp. Proc.*, 6: 170-174. DOI: 10.1046/j.0022-202x.2001.00043.x.
- Loria, G.R., E. La Barber, V. Monteverde, O.A. Sparangano and S. Caracappa, 2005. Dermatophilosis in goats in Sicily. *Vet. Rec.*, 156: 120-121.
- Nwufoh, K.J. and S.F. Amakiri, 1981. Normal skin Bacterial Flora of Some Cattle Breeds in Nigeria. *Bull. Anim. Health and Prod. Africa*, 29: 103-105. <http://www.ncbi.nlm.nih.gov/pubmed/7296017>.
- Okpa, B.O., J.O. Ibu, A. Olabode and E.P. Aba-Adulugba, 1991. Bacteria associated with bovine Dermatophilosis in the Jos Plateau. *Trop. Vet.*, 11: 83-88.
- Sutherland, S.S., S.G. Gherardi and M. Monzu, 1983. Body strike in sheep affected with Dermatophilosis with or without fleece rot. *Aust. J.*, 60: 88-89.
- Thrusfield, M.V., 1997. *Veterinary Epidemiology*. 2nd Edn. Blackwell Publishing 108 Cowly Road, Oxford, Great Britain.
- Vanbreuseghem, R., M. Takashio, M.M. Nagh, D. Presler, M. Selly and P. Van Wetter, 1976. Dermatophilus Infection in Animals and Man. *Proceedings of a Symposium held at the University of Ibadan, Nigeria*, pp: 202-211.
- Zaria, L.T., 1993. Dermatophilus congolensis infection (Dermatophilosis) in animals and man. An update. *Comparative immunology and microbial. Infect. Dis.*, 163: 179-222. <http://www.ncbi.nlm.nih.gov/pubmed/8403836>.