Dermatophilus Infection in Nigeria: A Mini-Review

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Abstract

Dermatophilosis in Nigeria is reviewed. Dermatophilosis, a chronic dermatitis that damages the skin of cattle, is caused by *Dermatophilus congolensis*. The organism requires existing skin lesions to establish infection. An association between ticks bites and dermatophilosis has been established. 12% prevalence of infection in Nigeria's estimated 10.8 million cattle, and 10% prevalence in draught cattle may account for the loss of nearly 50.81% of annual revenue expected from hides. Infected cattle, which are retarded in growth, are culled early thereby contributing indirectly to the nation's shortfall of about 43.75% in meat expected from domesticated ruminants. 20% drop in milk yield has been observed in lactating cows unwilling to be milked due to painful lesions of dermatophilosis on their udders and teats. Systemic antibiotic chemotherapy is uneconomically feasible, and there is no immunity to re-infection. Control of tick infestation in cattle may help to reduce the incidence of dermatophilosis, but the emergence of resistant strains has rendered most of the available acaricides ineffective for field use in Nigeria. Dermatophilosis has been diagnosed in man in New York, and surveillance is necessary to establish the zoonotic status of the infection in Nigeria. Search for a safe and effective vaccine for immune-prophylaxis should be a priority in current bioresearch in Africa.

Key words: *Dermatophilosis, Nigeria, Cattle, Economy, Control, and Public Health.*

Introduction

Dermatophilosis in Northern Nigeria has been known by its vernacular name *Kirchi*, but was reported for the first time in the country under the title of 'Streptothricosis' (Hudson, 1937). The disease is a chronic dermatitis, which damages the skin of the host and causes rejection of hides for export. The infection also results in toxaemia due to secondary bacterial infection, and difficulties in movement when the limbs are affected. Finally death can result from dehydration when the infection is generalized (Jubb and Kennedy, 1970).

The major aims of this mini-review are to highlight the factors responsible for dermatophilosis, its economic and public health significance in Nigeria, and to stimulate renewed interest in bioresearch in an effort to produce a safe and reliable vaccine for immune-prophylaxis against the infection.

Epidemiology of dermatophilosis

1. Causal agent: *Dermatophilus congolensis*, the causal agent of dermatophilosis, was isolated for the first time from African cattle in the Congo Democratic Republic (Van Saceghem, 1915). It is an aerobic, filamentous microorganism and morphologically bridges the gap between bacteria and fungi: Its size (about 1□ –3□ in diameter) and staining reaction (Gram +ve) distinguishes it as bacterium; however it resembles the moulds morphologically by forming a branched mycelium during early growth (Pier, 1967). The infection was designated as cutaneous streptothricosis in cattle, horse and goats; 'lumpy wool' when the fleece of sheep was affected; and strawberry foot rot when the lower extremity of the feet of sheep were involved. *Dermatophilus congolensis* (Van Saceghem, 1915); *D. dermatonomum* (Austwick, 1958); and *D. pedis* (Austwick, 1958) were proposed as the respective causal agents for streptothricosis, lumpy wool and strawberry foot rot. After a comparative study of the three organisms, Gordon (1964) concluded that all three can be accommodated by the single species *D. congolensis* as was originally proposed by Van Saceghem in 1915. The complicated life cycle of *D. congolensis* has been described (Roberts, 1961). The recognized sketch of the life cycle of *D. congolensis* is shown in figure 1.

2. Susceptible Hosts: Natural infections with *D. congolensis* have been recognized in cattle, sheep, horses and goats which are the definitive hosts, and in deer and monkeys that are reservoir hosts. However, experimental infections have been reproduced in mice and guinea pigs. Human infection was reported for the first time in New York (Dean and Gordon, 1961).

3. Mode of infection: Consensus of expert opinion is that dermatophilosis is transmitted by contact, and that moisture favours transmission. When Macadam (1964) exposed affected cattle to severe rainfall, the

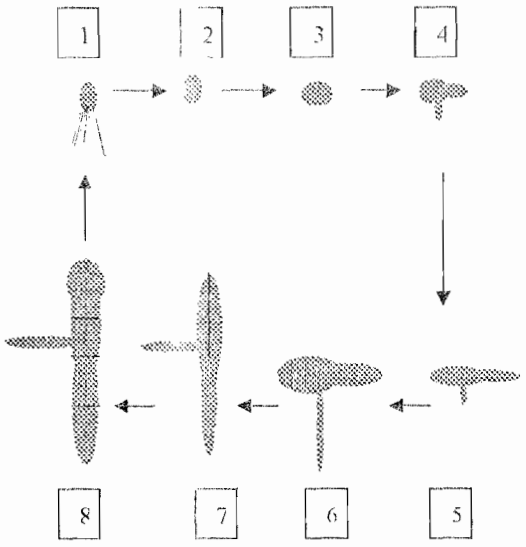

Fig. 1: A sketch of the life cycle of Dermatophilus congolensis

[1]: Motile zoospores (approx. 1□in diameter) formed and released from mature hyphal element. Young zoospores are encapsulated. [2], [3]: Spores enlarge and eventually germinate. [4], [5], [6]: Slender branching filaments (0.5□ to1□are formed from the spores. [7]: These filaments elongate and form transverse septa from the spore-end to the tip of the tapering hyphae. [8]: The hyphae widen (about 3□in diameter), form more septa, mature and release the infective motile zoospores. Mature hyphae are encapsulated.

lesions of dermatophilosis spread rapidly and coalesced over the skin of the animals. But when he kept the animals away from direct rainfall, the lesions regressed. He therefore concluded that moisture is an important factor in the epidemiology of dermatophilosis. Broken skin, however, is the only favoured route of entry of the infective motile zoospores of *D. congolensis*. The infective organism may be introduced through contaminated water, foliage, and mechanically through contaminated mouthparts of ticks and haematophagous diptera (Macadam, 1964; Richard and Pier, 1966; Stachursky, 1988; Koney, 1996; and Walker *et al*, 1999). Oduye (1975) studied the haphazard distribution of dermatophilosis lesions on the backs and sides of affected animals and confirmed that they were consistent with the activities of biting and non-biting flies. He observed that when the flies were disturbed during their blood meals, they quickly or later resettle on the same or another animal to continue with their blood meal. Meanwhile, the bite wound would ooze blood and attract non-biting flies. In this manner infection may be transmitted and spread by the flies after they had fed on moist active dermatophilosis lesions.

4. *Source of infection*: The infective scab, which is rich in the organism, serves as the ultimate source of infection. Isitor *et al* (1985) consistently demonstrated *D. congolensis* from scabs taken from affected animals, regardless of which anatomical site the scabs had been taken from. Dean and Gordon (1961) had isolated *D. congolensis* from scabs taken from lesions that developed on the hands of three men that handled infected deer in New York.

5. *Pathophysiology*: Dermatophilosis infection is limited to the epidermis of the skin in susceptible hosts. Three clinical syndromes of the disease which, may appear on an affected animal at the same time, are described in Table 1. Studies on pathological and serological reactions of the skin in response to dermatophilosis indicate that apart from the skin the vital organs were not significantly affected by the presence of the infecting organism (Roberts, 1967; Amakiri, 1977; Gbodi and Chechet, 1981). Fig.2 illustrates the process of dermatophilus infection leading to severe damage in a cross section of the skin (Hide) of a typical bovine host.

6. *Portal of exit*: The organism is shed from the skin as described in Fig 2 (7a and 7b). Kazeem *et al* (1985) consistently demonstrated the organism of *D. congolensis* in scabs from infected animals regardless of which anatomical site the scab came from.

7. *Seasonality of infection*: Haplin (1975) reported that tropical Dermatophilosis of cattle (*Kirchi*) is a disease of the rainy season. It has been demonstrated that rainfall in the presence of haematophagous arthropod vectors are necessary for the spread of dermatophilosis in Nigeria (Macadam, 1964). Dermatophilosis in cattle (*Kirchi*) increased in severity especially during the rainy season (Kazeem *et. al*, 1985). The dry season in Nigeria is usually a period of extensive bush burning. Wilson (1988) observed that the disappearance of vegetation in the dry season had direct effect on the local abundance of questing adult ticks. He reported that tick abundance was reduced by as much as 88% following removal of vegetation by burning. McCreadie *et al* (1985) pointed out that the seasonal activity of haematophagous diptera attacking cattle was lowest during the dry periods of the year. However, wet season incidence of dermatophilosis in animals has been largely reported in the country (Bida, 1975; Bida and Dennis, 1976).

8. *Vegetation*: It has been speculated that thorns may cause trauma to the skin of cattle thereby predisposing them to *Dermatophilus* infection. It was observed that the incidence of dermatophilosis in Lagos State reduced considerably after thorny bushes were cleared in that State (Macadam, 1964). Wilson (1986) reported a reduced abundance of adult *Ixodes dammini* (Acari: Ixodidae) by as much as 88% following local destruction of vegetation by burning or mowing, though the reduction persisted for only about 12 months.

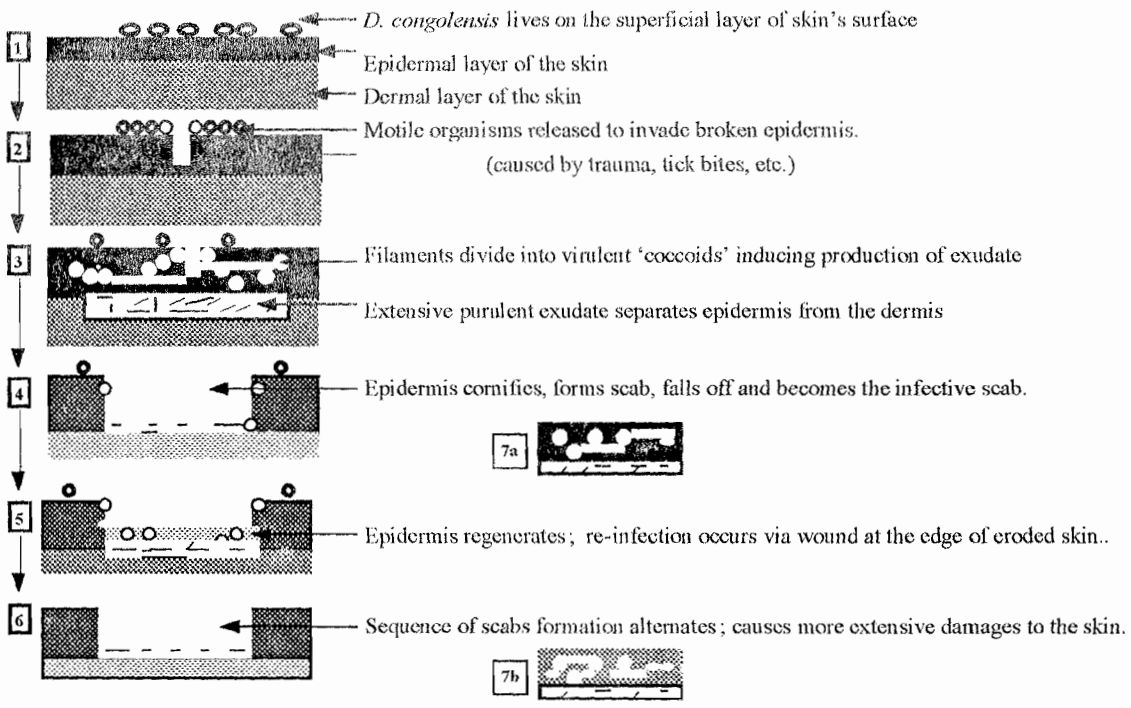

Fig 2: Diagrammatic representation of the infective process. (1) *D. congolensis* lives on the surface of intact skin ; (2) Skin lesion and moisture initiate invasion of the epidermis by motile zoospores of *D. congolensis* ; (3) Proliferation of filaments into virulent coccoid ('Streptothrix') organisms which induces the production of exudate between epidermis and dermis ; (4) Affected epidermis cornifies and separates from the dermis, infective scab falls off to expose the raw dermis ; (5) Secondary infection results at the edges where the scab had fallen off, (6) More extensive damage to the skin result as the process alternates;(7a, 7b) Infective scabs.

Illustrated by Dr O. O. Ikpeze, September 2000

9. *Animal husbandry system*: Animal husbandry in Nigeria is transhumance; a situation in which farmers with permanent place of residence send their herds, tended by herdsmen, for long-periods of time to distant grazing areas. Shittu (1985) observed that people were forced into this system as a result of the aridity and poverty of the land; the system being essential for the survival of the population of both man and his animals. In this system Nigerian cattle are exposed to nearly all the factors responsible for *Dermatophilus* infection.

10. *Prevalence*: Wet season prevalence of dermatophilosis infection in cattle from Northern Nigeria was estimated at 12% (Bida 1975), while in draught cattle the estimated prevalence is 10% (Lloyd, 1976). Cattle population in Nigeria is approximately 10.8 million, 98% of these being located in the north, while the south accounts for only about 2% (FAO, 1966). Onyali *et al* (1989) also reported that about 70% of Nigeria's cattle were derived from Borno State in Northern Nigeria. Going by these reports, it is possible to show that nearly 1.3 million of Nigeria's 10.8 million cattle were to be affected annually by dermatophilosis (Table 2).

11. *Control*: Systemic antibiotic chemotherapy is not economically feasible in Africa and Australia (Lloyd, 1971; Stewart, 1972; Kazeem *et al*, 1985). Nwufoh *et al* (1982) reported the effectiveness of a locally prepared *Pipe guineense* (*'Iyere'*) mixture in clearing the lesions of dermatophilosis after 30 to 50 days of topical application. Direct spraying of acaricides is the usual method of tick control on the host, but the emergence of resistant strains has rendered the use of proprietary products such as Asuntol®, Delnay®, and Gamatox® etc., ineffective for field use in the country (Onyali *et al*, 1989). It has recently been demonstrated by Ikpeze and Mbanugo (2003) that Diazintol® (Diazinon dympylate) with an LD_{50} of 0.079% is the acaricide of choice against *Amblyomma variegatum* (Acarina: Ixodidae), the major tick involved in the initiation and spread of dermatophilosis in Cattle and goats (Stachursky *et. al.*, 1988).

Economic significance of dermatophilosis

1. *Nigerian Hide export market*: The Nigerian export market had recorded huge economic losses

Table 1: Clinical syndromes of Dermatophilosis

Syndromes	Sites	Characteristics	Effects on host
Exudative lesions	Hairy parts of the body. (example: sides, back, face)	Hairs matted with exudate (paint brush-like appearance)	Skin damage, dehydration (blemished hides)
Crust	Less hairy parts of the body subject to friction (axilla, groin, udders, scrotum etc.)	Dried cheese-like, cracked, contain foul-smelling matter which attracts flies.	Painful locomotion, low milk yield, painful milking, painful copulation.
Scab	Any part of the body.	Consist of layers of keratin over corneum, rough, hard outer surface; and wet moist undersurface.	In addition to the above, dehydration, toxaemia due to secondary bacterial infection, and death.

from rejection arising from moderately to severe skin blemishes due to the combined effects of dermatophilosis and Demodicosis (Bida, 1975; Bida and Dennis, 1976). Table 3 shows that about 45% of the expected total proceeds from Nigerian hides are lost due to the effects of dermatophilosis.

Table 2: Dermatophilosis in Nigerian cattle

	Cattle population (approx.)	12% prevalence
Southern Nigeria	216000 (2%)	25920
Borno State	7560000 (70%)	902200
Others (North)	3024000 (28%)	362880
Total	**10800000 (100%)**	**1291000**

Table 3: Economic effects of Dermatophilosis on Nigerian Hides

Expected annual proceeds from Nigerian hides	24.40 M
Annual loss from rejection due to Dermatophilosis	10.00 M (40.98%)
Annual depreciation due to Dermatophilosis	1.00 M (4.10%)
Annual depreciation due to Demodicosis	1.40 M (5.73%)
Annual loss from Dermatophilosis & Demodicosis	**12.40 M (50.81%)**

This situation may be responsible for the exorbitant price of unblemished leather products.

2. *Animals breeding and research*: One of the most catastrophic economic effects of dermatophilosis in the country is on animal breeding and research. There was 100% morbidity and 10% mortality in a herd of 100 Santa Gertrudis cattle imported from Oklahoma, U.S.A. to a farm in the country (Kazeem et al, 1985).

Public health significance of dermatophilosis

1. *Animal protein intake*: Dermatophilosis in bulling/calving heifers lead to rapid retardation in growth. Early culling may indirectly cause a reduction in meat and milk production, thereby complimenting the effects of parasitic-gastroenteritis (Chiejina, 1986) in contributing to the estimated shortfall on the projected national supply of animal protein from domesticated ruminants in Nigeria as shown in Table 4.

Table 4: Animal protein (Meat) from domesticated ruminants in Nigeria

	Meat (Tonnes)		
	1979	**1990**	**2000**
Demand (projected)	339000	553000	800000
Supplied (estimated)	241000 (71.09%)	288000 (52.07%)	450000 (56.25%)
Shortfall in supply	**98000 (28.91%)**	**265000 (47.93%)**	**350000 (43.75 %)**

2. *Zoonosis*: There is a dearth of information on human infection in the country and elsewhere, but a case of dermatophilosis has been reported in man in New York (Dean and Gordon, 1964). The disease is a potential zoonosis in the country, and herdsmen, farmers, veterinarians, and butchers who make direct contact with infected animals are at risk.

Conclusion

Dermatophilosis in Nigeria is a challenge for Nigerian Bio-researchers and Bio-technologists to work towards production of a safe and effective vaccine against the aetiological agents. Success in this area will bring about maximum foreign exchange from our hides, improve animal protein intake among Nigerians, allow for the importation of improved breeds of cattle in the country, and protect the public from this potential zoonosis.

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