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Review of Dermatophilosis and Its Status in Ethiopia

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ABSTRACT

Dermatophilosis is one of the most economically important diseases in Ethiopia with its primary effect on hide and skin which are the second export items for the country next to coffee. Grossly, the lesions on the skin appeared as raised, thick, yellow-brown discrete or confluent crusts containing matted hair on the surface of skin. If the lesions are extensively involved in the body or for those animals constantly exposed to the predisposing factors there is no completely satisfactory treatment. Parenteral treatment of affected animals with high doses of antibiotics is effective. The disease hampers the development of milk production in dairy farms by its effect on exotic breeds and their crosses which are more susceptible to the disease than local zebu cattle. Its effect can be extending up to culling of most productive animals. In this review, the associated risk factors for the occurrence of the disease like mechanical damage to the skin and prolonged wetting of the skin, possible treatment and control measures of dermatophilosis are included. The prevalence of dermatophilosis in different parts of the country in cattle, sheep and goat are also included in this paper.

Keywords: Dermatophilosis, Bacterial disease, Parenteral treatment, Lesions, Local sheeps and goats

INTRODUCTION

Ethiopia is one of the richest countries in livestock population. Recent information indicated that the country has about 35 million cattle, 24 million sheep, 18 million goats, 7 million equines and 1 million camels. This makes the country the first in Africa in livestock population [1]. However, due to higher prevalence of different diseases such as dermatophilosis and poor management system the country is not properly utilizing this huge potential in livestock resource [2].

Dermatophilosis has a worldwide distribution with severe effect in tropical Africa [3]. The disease has been reported nearly in all countries and islands of Africa. The exceptions are Egypt, Lesotho and Sao-Jome and the disease is suspected but not confirmed in Swaziland [4].

Dermatophilosis is the second most important bacterial disease in Zambia next to CBPP, and annual loss of 3 million USD was reported due to treatment, culling, loss of draft power and reduced milk yield associated with the disease [5].

The disease can reach an epizootic proportion in tropical and sub-tropical areas of the world where it can result in considerable economic loss [5]. The disease is also present in countries with high climatic temperature but does not have epizootic proportion [6].

Like in many parts of Africa, Ethiopia is seriously affected by the disease and this was reported by [7-9]. These authors reported the occurrence of dermatophilosis in different management system and environmental conditions.

The diseases are enzootic to Ethiopia [10] has a major economic importance [11]. The disease is reported for the first time in sheep (8.5%) and goats (3.14%) in the country [8]. Since then the disease has been reported in many parts of Ethiopia.

The effect of the disease is primarily on the quality of hides and skin, Ethiopia's second export item next to coffee. Ethiopia exports only 30% of the processed skin in the tanneries [8] and this is due to the quality degradation caused by diseases such as dermatophilosis on the skin.

Dermatophilosis is a skin disease caused by a bacterium called Dermatophilus congolensis. The disease is characterized by scab formation and exudation [12]. Grossly the lesions appear as raised, thick, yellow-brown discrete or confluent crusts containing matted hair on the surface of the

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skin [13]. The disease in cattle is also called cutaneous streptotrichosis, although other local names exist including 'senkobo skin disease' in central Africa, 'kirchi' in Nigeria and 'saria' in Malawi. The disease in sheep is commonly called mycotic dermatitis and also lumpy wool. This disease becomes more severe and fatal when it combines with demodicosis to produce a disease called "senkobo disease" [12].

Dermatophilosis affects a wide range of species of animals in all age groups. It occurs mostly in cattle, sheep, goats and horse, occasionally in pigs and mules and rarely in dogs, cats and humans [14].

Susceptibility of the animal based on breed, age and sex were reported by different authors. Both zebu and exotic breeds are susceptible but exotic and their crossbreed being the most susceptible [15,16,8]. Age wise, adults are more susceptible than young [15]. According to Berhanu and Woldemeskel [7], the disease prevalence is higher in adults than the young ones because adults are more exposed to various predisposing factors. However, another study [17] indicated that there is no age susceptibility and that adults and young animals are equally affected.

Both male and female sexes have been found to be equally susceptible to the disease [9]. But research [16] indicated that males are more susceptible than females. Although there is no significant difference in prevalence of the disease, there is small tendency towards a higher occurrence in male due to skin damage during traction and work overload in the mixed crop livestock production [9].
There is a wide knowledge gap on the associated factors and epidemiology of the disease, and this was an obstacle to create and apply an effective control measure against the disease [7].

Therefore, the objectives of this paper are:

- To illustrate the prevalence of disease in different parts of Ethiopia.
- To provide information on the influence of sex, age, and breed of animal and type of management system in the occurrence of the disease.
- To show the economic impact of the disease in the country.
- To forward some recommendations based on the review.

OVERVIEW OF DERMATOPHILOSIS

Etiology

The bacterium *Dermatophilus congolensis* is a causative agent found in the family *Dermatophilaceace* and order *Actinomycetales*. It is a Gram positive, non-acid-fast, facultative anaerobic organism [18].

This bacterium requires damage to the skin from other causes to establish infection. The organism is dimorphic and grows as branching filamentous mycelia containing dormant zoospores which are transformed by moisture to infective stage of motile isolated cocci [12].

Transmission and Predisposing Factors

Asymptomatically infected animals by chronic form of the disease are considered to be the major source of infection. The agent has been shown to persist in crusts in the environment for up to 42 months, thus accounting for repeated herd outbreak in contaminated areas [19].

Dermatophilus congolensis is not highly invasive and does not normally breach the barriers of healthy skin. These barriers include the stratum corneum, the superficial waxy layer produced by the sebaceous gland, and hair and wool. For the occurrence of the disease, the predisposing factors that destroy the innate resistance of the skin are important. Prolonged wetting leading to maceration of the skin surface, ticks, flies, biting insects, mange mites, pecker birds and thorny bushes are the most important predisposing factors that cause damage and penetration to the skin [12].

Ticks have a great role in the establishment of the epizootics of the disease either by breaking the skin barriers or transmitting the organism or both [12]. According to Woldemeskel and Berhanu [8], out of the total cases positive for dermatophilosis 76% were found to be infected with ticks.

According to research [16], flies and biting insects such *as Stomoxys calcitran*, *Musca domestica* and *Mosquitoes* are important insects involved in the transmission of the disease by breaking the skin barriers. In addition to ticks and biting flies, thorny bushes, mange mites and pecker birds have also been implicated in causing of trauma of the epidermis through which *Dermatophilus congolensis* could invade the skin of cattle [18,20].

Prolonged wetting due to heavy rainfall especially when it is accompanied by warm and humid weather can also be considered as a predisposing factor. Wetting of the scab causes the release of zoospores from one part of the body to another; it also causes leaching out of the waxy layer, maceration of the stratum corneum and facilitating the anchorage of the zoospores to the skin [18].

The disease has its highest incidence during the heavy rainfall seasons, and this is believed to be associated with a concomitant increase in tick and insect infestation [20]. Minor infection on the face and feet is used as a source of more serious infection when other areas of the skin are predisposed [12].

In sheep, prolonged wetting of the fleece due to a prolonged and heavy rain followed by warm and humid weather that impairs drying of the fleece may predispose to more severe infection. Increased environmental humidity and temperature, as distinct from wetting of the skin, does not appear to promote the lesion. A protracted wetting period of the fleece

can also occur following dipping, jetting or spraying of sheep when these procedures are conducted at periods more than 1-2 months after shearing. The incidence of the disease in sheep has been shown to increase with the time period between shearing and dipping. The infection can also be transmitted physically by direct contact from the fleece of one sheep to the fleece of another if sheep are tightly yarded following dipping. Dipping fluids may be contaminated with *Dermatophilus congolensis* from carrier lesions either on the face and feet or in the fleece and it is prudent to destroy the barriers of the skin and may become infected mechanically by the flies or physically by tight yarding after shearing [12].

Due to the difference in predisposing factors the disease in cattle is sporadic in temperate zones but can be epizootic in tropical zones. Similar to sheep, the disease in cattle requires disruption of natural skin barriers. The disease has its highest incidence during the heavy rainfall season. Trauma to the skin produced by thorny bushes and the oxpecker birds (*Buphagus Africans*) has also been associated with the initiation of lesions [20].

PATHOGENESIS AND CLINICAL FINDINGS

Once the epidermal defenses are breached and zoospores germinate, the organism extends its branching filaments through the tissue laterally and into the sheath of the hair follicles but does not invade the dermis. The hyphal penetration induces an acute inflammatory response, characterized by superficial dermal edema and accumulation of large number of neutrophils. The inflammatory response particularly the cellular component involving neutrophils, inhibits deeper penetration of *Dermatophilus congolensis* [18].

Twenty-four hours post infection, a new layer of epidermis is formed as the older layer above deteriorates. The new epidermis that forms under the exudates is protected by the exudates against infection from above but invaded from the side usually by hyphae from adjacent follicle sheath. The second epidermis is then separated from the dermis by exudates. A third epidermis forms and is infected and the process will continue and eventually results in formation of thick scab [14].

The new layers of epidermis are formed mainly as out growths from the follicle sheaths and are infected by lateral branches of the mycelium penetrating the sheath. The follicle sheaths are thus organisms' sole means of access to fresh epidermal tissue; chronic infection depends on continuous penetration of the sheaths [18].

In cattle, lesions occur on the neck, body or back of the udder and may extend over the sides and down the leg and the ventral surfaces of the body. In adult cattle the characteristic lesions are thick, horny crusts, varying in color from cream to brown. In the early stages the lesions are very tenacious and attempts to lift them causes pain. Beneath the crusts there is granulation tissue and some pus. In the later stages, the lesion heals, and the crusts separate from the skin. In young calves there is extensive hair loss with tufting of the fibers, heavy dandruff and thickening and folding of the skin in later stages. In calves, lesions usually commence on the muzzle and spread over the head and neck [12].

In sheep, the lesions are chiefly distributed over the dorsal parts of the body, spreading laterally and ventrally. The muzzle and face also involve. Heavy mortalities can occur in very young lambs where there can be extensive lesions over the body. In adults the underlying skin is moist and reddened [12].

In goats, lesions appear first on the lips and muzzles and spreading up the face to the eyes, and if sufficiently extensive they may be accompanied by laceration and a profuse, mucopurulent nasal discharge [12].

DIAGNOSIS

Diagnosis depends upon the detection of mycelia like organism in scrapings or biopsy sections, and culture of the suspected tissues, using polymyxin B sulfate to suppress contaminants [12]. *Dermatophilus congolensis* grows on blood and infusion media, but not on sabourd agar [13].

The agent can be isolated from positive cases determined under microscopic examination of Giemsa or Gram stain smears. Scabs will be ground up and placed in 2 ml sterile distilled water in a universal bottle for 3 h and 30 min at room temperature to facilitate the release of the motile zoospores [21]. A loop full of fluid from the surface will be removed and inoculated into a 5% sheep blood agar plate. The inoculated plates then incubated at 37ºc for 48 h anaerobically in a candle jar. A pure colony of the culture will be isolated by subsequent subcultures [22].

In early stages, the disease may be confused with photosensitization because of the dorsal distribution of the lesions but they are not selectively distributed on non-pigmented areas. Fleece root and contagious ecthyma (orf) can be considered as differential diagnosis [12].

TREATMENT AND CONTROL

For cases which show very extensive involvement of the body or those being constantly re-infected or exposed to predisposing factors, there is no completely satisfactory treatment. Generally, better results are obtained during dry and hot weather. In tropical Africa treatments which are assumed to be effective have little or no value. Topical applications are not generally recommended because of the impossibility of introducing them into infected layers of skin. However, if it is applied in acute cases the recovery rate will be attractive [23].

Parenteral treatment with antibiotics can be used in conjunction with acaricides when ticks are present, and this is an effective method for the control of the disease. Tetracycline (5 mg/kg body weight) repeated weekly is

recommended, and single dose of long acting oxy tetracycline (20 mg/kg body weight) has been reported to give excellent results in cattle [22] and streptomycin at very high dose rate and penicillin (streptomycin at 70 mg/kg body weight and procaine penicillin G at 70,000 units/kg body weight) is recommended as being 100% effective in heavily infected animal [12].

In acute cases we can perform topical treatment by using dipping or spraying with 0.2-0.5% zinc sulfate. Quaternary ammonium compound 1 in 200 dilutions has been reported to be even more effective. A dilute solution of alum (potassium aluminum sulfate) found to be highly effective and significant improvement has been observed in sheep. [12].

Control measures for dermatophilosis can be isolation of infected animals and avoidance of contact with infected materials such as grooming tools. Cull affected sheep that do not respond to simple treatment is also practiced. In tropical areas, tick control is thought to be of considerable importance. A satisfactory control measure in sheep is spraying or dipping using solution of zinc sulfate. Prophylactic use of alum (potassium aluminum sulfate) is recommended after shearing [12]. Vaccination is unsuccessful, but severity can be reduced by delaying shearing [22].

Economic Importance and Public Health Significance

Primarily the disease is known to cause rejection and down grading of the quality of hides and skin. The disease in sheep causes heavy losses, up to 30% loss of value of wool and 40% loss of value of skin [12].

There is a reduction in weight gain and milk production, decreased drought power of infected oxen, starving to death of calves from dams with infected udder, culling of most productive animals, cost of treatment and restriction due to the disease on the establishment of high producing exotic cattle and up grading of indigenous local zebu breeds by cross breeding [24]. In cattle it causes reproductive failure from vulval infection or infection on the limbs of males preventing mounting [12].

Human infection is reported, such as on the hand of a veterinarian working with infected sheep, but contagion from livestock is rare in spite of ample opportunity [12].

OCCURANCE OF THE DISEASE IN ETHIOPIA

Cattle

The disease is reported in many parts of the country. A comparable prevalence rates from nil to 4.8% [25,26,7,8] were reported in local zebu cattle in Ethiopia **(Table 1)**. However, significantly higher prevalence rate (15%) was reported in local zebu cattle in the highlands of Ethiopia by [9] which is the highest prevalence of the disease reported from any part of Ethiopia. This difference may be due to difference in bacterial strains and influencing risk factors at different areas in the country [9].

The prevalence of the disease in cattle is significantly higher in wet season (6%) than in dry season (3.6%). There is significantly higher prevalence of the disease in exotic (26.9%) than in local (3.2%) breeds of cattle. The highest occurrence (35%) was recorded in cross breeds kept under poor management during the rainy season indicating the association of the disease in cattle with wet season, breed and poor sanitation [8]. The type of management system, muddy pasture and marshy areas were shown to play an important role in the occurrence of the disease [7].

Another report [8] has shown that the lesions in cattle around the scrotum and under and collection of ticks from the same sites suggest the possible involvement of ticks in the establishment of the disease in cattle. These authors also reported that a calf suckling an infected udder had a lesion on the lips and face suggesting transmission of the disease from the infected dam to young through frequent contact during suckling.

The influences of breed, age, sex and management system on the prevalence of dermatophilosis in Ethiopia were reported by [7,8].

There is statistically significant difference in the prevalence of dermatophilosis between local (4.8%) and exotic (12.8%) breeds (Table 2). There is also higher prevalence in adults exposed to various predisposing factors in extensive grazing than in young animals kept mostly in doors. Disease prevalence is higher in male zebu which is attributed to the skin damage acquired during threshing and traction or the use of the same yoke for different oxen at different time [7].

Management system is one of the predisposing factors that play major role in the establishment of the disease. The occurrence is relatively higher in dairy farms (12.8%) mainly due to poor management and high susceptibility of Holstein Friesian. The infection rate is lowest in feedlots (2.9%) where the animals are kept under shade and properly fed in clean and well-ventilated barns. The occurrence of the diseases is lower (4.2%) in the ranch and this could be attributed to the regular acaricide application, immediate treatment and isolation of infected animals in separate pad docks until complete clinical recovery and culling of carriers. There is a higher occurrence of the disease in traditional farms (7.1%) where ticks, pecker birds, both biting and non-biting flies as well as thorny bushes that traumatize the skin and inflict wounds are abundant particularly following the courses of river where animals concentrate for grazing during the dry season. Moreover, during traction and threshing farmers use whip and sticks to drive animal there by inflicting skin damage. They also use the same yoke to pair different oxen during ploughing. These all cause skin damage and favor penetration and transmission of *Dermatophius congolensis* [8].

The involvement of ticks in the establishment of the disease was assessed by [9]. The authors reported that out of 82 animals infected with dermatophilosis, 76% (64/82) were also

Table 1. Prevalence of dermatophilosis in cattle in Ethiopia.

Site	Year	Cattle	
		Local	**Exotic**
Bahir Dar	1985	0.69% (68/9816)	-
Tigray	1994	5% (27/541)	-
Assella	1994	4.7% (19/408)	15% (48/320)
Eastern Shoa	1999	4.8% (302/6280)	12.8% (32/250)
Debre Zeit	2000	3.1% (62/1994)	14.58% (35/240)
Melka Worer	2000	9% (3/33)	35.2% (127/361)
Kombolcha	2001	3% (107/3497)	14.6% (46/314)
Bale	2001	15.04% (79/525)	20% (3/15)
Total	**-**	**2.88% (667/23,194)**	**19.4% (291/1500)**

Source: [25,27,28,7-9]

Table 2. Prevalence of bovine dermatophilosis in different breeds, sexes and age groups in central Ethiopia.

Age	Local Zebu			Holstein Friesian			Total
	Male	**Female**	**Sub total**	**Male**	**Female**	**Sub total**	
< 3 years	27/122 (2.1%)	15/854 1.7%)	42/2082 (2%)	-	-	-	42/2082 (2%)
> 3 years	164/2476 (6.6%)	96/1722 (5.5%)	260/4198 (6.1%)	-	32/250 (12.8%)	32/250 (12.8%)	292/4448 (6.5%)
Total	**191/3704 (5.1%)**	**111/2576 (4.3%)**	**362/6280 (4.8%)**	**-**	**32/250 (12.8%)**	**32/250 (12.8%)**	**342/6530 (5.1%)**

Source: [7]

infected with different species of ticks. From these infected animals 51.6%, 20.3% and 28.1% were infected with *Amblyomma varigatum*, *Rhipicephalus evertsi* and *Boophilus decoloratus*, respectively.

Sheep and Goats

The disease was described for the first time in sheep and goats from Ethiopia with the prevalence of 8.5% and 3.14%, respectively [8]. The higher prevalence in Horrogudru (20.9%) was reported as an outbreak related to heavy rain and contamination during dipping. The report from [8] also shows that on outbreak of the disease in sheep and goats at Alay Dega was associated with dipping.

Assymptomatic carriers during and after dipping might have been the source of spread to non-infected wet sheep. Research [4] has experimentally shown that 15 s to 1 min is sufficient to transfer the disease from wet infected to wet non infected sheep.

Dermatophilosis in sheep and goats is associated with orf and pox lesions, rainy season, dipping and mange mite infestation in wet season. Susceptibility to infection regardless of age and sex difference is uncommon to occur in sheep and goat. The susceptibility of animals for dermatophilosis increases in the presence of concurrent infections such as orf and pox in shoats [9]. Malnutrition and poor management system are also important factors for the disease occurrence by affecting the resistance of animal [4].

The disease is more prevalent in the fine wool breeds of sheep [16]. The failure of complete recovery from the disease in sheep and goats after antibiotic therapy is attributed to the complication of the disease with other infections like orf, mange mites, etc. **(Table 3)** [8].

Table 3. Prevalence of dermatophilosis in local sheep and goats in Ethiopia.

Site	Year	Sheep	Goats
Debre Zeit	2000	6.33% (45/722)	3.45% (4/177)
Alay Dega	2000	4.27% (163/722)	3.11% (37/1188)
Horro Gudru	2000	20.90% (300/1433)	-
Kombolcha	2001	2.10% (10/478)	3.20% (12/376)
Bati	2001	1.30% (4/300)	3.40% (13/376)
Hait	2001	1.25% ((2/160)	1.90% (3/154)
Cheffa	2001	1.60% (2/22)	0.00% (-/36)
Total	**-**	**7.41% (530/7159)**	**3.04% (74/2435)**

Source: [8,29]

CONCLUSION AND RECOMMENDATIONS

Dermatophilosis is one of the economically important diseases that hamper the development of milk production in dairy farms because of higher susceptibility of exotic breeds and their crosses. It has also a major role in the economy of the country by its effect on hides and skins. However, few studies have been done on dermatophilosis in Ethiopia especially on sheep and goats. Even the epidemiology of the disease is not fully studied in the country.

Infected animals are important source of the disease. Among the risk factors ticks, poor management, and breed are important in bovine dermatophilosis [30]. In sheep and goats, the disease is associated with orf and pox lesions, dipping, rainy season, mange mite infestation and poor management.

Treatment of the disease with high dose of long acting oxy tetracycline, topical use of zinc sulfate solution and very high dose of penicillin and streptomycin are reported to be effective. However, these methods are generally in applicable in large herds and are relatively expensive.

Based on the above conclusion, the following recommendations are forwarded.

- Infected animal should be early detected and isolated from the herd during treatment and there by avoid spread of the disease.
- Rigorous tick control method is important to lower the effect of ticks on the establishment of disease.
- The use of single dipping tank for healthy and carrier animals should be avoided to reduce transmission of disease.
- Veterinary extension program should be established to enhance the level of the awareness of the farmers, concerning the occurrence, economic impacts and prevention of the disease.

REFERENCES

1. Livestock Marketing Authority, (2001) Bret baseline information on Ethiopia livestock resource base and its trade Addis Ababa, Ethiopia, pp: 1-9.
2. Getachew A (1993) Veterinary education in Ethiopia. Ethiopian Veterinary Association Proceedings of the 7th Conference, pp 16.
3. Ibu J, Makinde A, Nawathe DR (1987) Oral dermatophilosis in imported cattle in Nigeria. Vet Rec 120: 42.
4. Oppong ENE (1996) Research on dermatophilosis in Africa. Trop Anim Health Prod 28: 95-175.
5. Samui KL, Jones MEH (1990) The financial and production impacts of bovine dermatophilosis in Zambia. Vet Res Commun 14: 357-365.
6. Jub KVF, Kennedy PC, Palmer N (1985) Pathology of domestic animal. 3rd edition, volume 1, Academic press, New York, San Francisco, London, pp: 593.
7. Berhanu D, Woldemeskel M (1999) Bovine dermatophilosis and its influencing factors in central Ethiopia. J Vet Med 46: 593-597.
8. Woldemeskel M, Berhanu D (2000) Some observation on the prevalence of bovine dermatophilosis in different management systems in Eastern Ethiopia. ESAP Proceeding, pp: 297-403.
9. Wodemeskel M, Taye G (2001) Prevalence of dermatophilosis in a tropical highland region of Ethiopia. Trop Anim Health Pro 33: 1-6.
10. FAO, WHO, OIE (1997) Animal health yearbook. Rome, Italy, pp: 281-285.
11. Gillespie JH, Timoney JF (1981) Hagan and Burner's infectious disease of domestic animal, 7th ed., Cornell University Press, London, pp: 281-285.
12. Radostits OM, Gay CC, Hinchcliff KW, Constable PD (2007) A textbook of the disease of sheep, cattle, horses, pigs and goats. Sotheds printed in Spain, pp: 1048-1055.

13. Thomas CJ, Ronald DH, King NW (2006) Veterinary pathology. 6th edition, Black Well Publishing, pp: 1012-1014.

14. Jub KVF, Kennedy PC, Palmer N (1985) Pathology of domestic animal. 3rd edition, Volume 1, Academic Press, New York, San Francisco, London, pp: 593.

15. Bidda SA, Dennis M (1976) Dermatophilosis in Northern Nigeria. Vet Bull 46: 471-480.

16. Lloyd DH (1993) Dermatophilosis infection in animals and man. Proceeding of a symposium held at the University of Ibadan, Nigeria, Academic Press, London, pp: 274-294.

17. Oppong ENE (1973) Bovine streptotrichosis in Accra plains of Ghana JSC 13: 44-62.

18. Robert DS (1967) Dermatophilosis infection. Vet Bull 37: 513-521.

19. Evans AG (1996) Large animal medicine. 2nd edition, USA, pp: 1411-1412.

20. Oduye OO (1987) Control and eradication of dermatophilosis. OIE. 7th Conference, Cairo, Egypt, pp: 19-22.

21. Quinn PJ, Carter ME, Markey BK, Carter GR (1994) Clinical veterinary microbiology. Wolfe Publisher, pp: 153-155.

22. Ileomobade AA (1984) Clinical experiences in the use of chemotherapy for bovine dermatophilosis in Nigeria. Prev Vet Med 2: 83-92.

23. Macadam J (1964) Strepeotrichosis in Nigeria Houses. Vet Rec 76: 420-422.

24. Oduye OO (1975) Incidence, economic effect and control of bovine streptotrichosis in Nigeria. Bull OIE, pp: 19-23.

25. Desta A (1985) Preliminary survey of dermatophilosis around Bahir Dar and its response to single dose treatment. DVM, thesis. Faculty of Veterinary Medicine, Debre-Zeit, Ethiopia.

26. Kiros S (1987) Epidemiology of bovine dermatophilosis in and around Debre Zeit. DVM thesis. Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

27. Tesfaye A (1994) Prevalence of bovine dermatophilosis in and around Mekelle (Tigray). DVM thesis. Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

28. Mulugeta B (1994) Prevalence of bovine dermatophilosis in and around Assella and response to a single dose treatment. DVM thesis. Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

29. Gashaw M (2001) Study on bovine, ovine and caprine dermatophilosis in and around Kombolcha, North East Ethiopia. DVM thesis. Faculty of Veterinary Medicine, Debre-Zeit, Ethiopia.

30. Dalis JS, Kazeem HM, Makinde AA, Fatihu MY (2010) Bacteria associated with bovine dermatophilosis in Zaria, Nigeria. Afr J Microbiol Res 4: 1475-1479.