

The treatment of bovine dermatophilosis and its effect on some haematological and blood chemical parameters

M.E. Hamid^{(1)*} & M.S. Musa⁽²⁾

(1) Department of Preventive Medicine and Public Health, Faculty of Veterinary Medicine, University of Khartoum, P.O. Box 32, Khartoum North, Sudan

(2) Department of Clinical Studies, Faculty of Veterinary Science, University of Nyala, P.O. Box 155, Sudan

*Corresponding author: College of Medicine, Abha P.O. Box 641, Kingdom of Saudi Arabia.
E-mail: mehamid2@yahoo.com

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Summary

In this study, the authors evaluated parenteral treatment of zebu cattle, with naturally and experimentally induced bovine dermatophilosis, in western Sudan, using four different antibiotic treatments. In terms of recovery rate, weight gain, avoiding relapse and preventing death, gentamycin was found to be the most effective treatment, followed by a combination of penicillin and streptomycin and, finally, long-acting oxytetracycline. However, enrofloxacin was not successful. A significant improvement in the red blood cell count was noticed among cattle treated with penicillin-streptomycin ($p = 0.021$) and gentamycin ($p = 0.029$). All treated cattle, except those treated with enrofloxacin, showed a significant improvement in mean corpuscular haemoglobin concentration ($p = 0.021$); mean corpuscular volume ($p = 0.021$), and white blood cell count ($p < 0.021$). Significant improvements were observed among treated cattle in their total levels of protein, calcium ($p = 0.021$) and cholesterol ($p < 0.05$), when compared to untreated cattle infected with *Dermatophilus congolensis*.

This study recommends gentamycin as a drug of choice for the parenteral treatment of dermatophilosis. Treatment was not only effective in early, mild cases but also useful among moderately and heavily affected cattle. According to the observations of the authors, when no intervention took place, the condition of moderately and heavily affected cattle deteriorated and/or resulted in death.

Keywords

Antibiotics – Bovine dermatophilosis – Cutaneous streptothricosis – *Dermatophilus congolensis* – Haematological and blood chemical parameters – Sudan – Western Sudan – Zebu cattle.

Introduction

Bovine dermatophilosis (cutaneous streptothricosis) is a serious skin disease of cattle, sheep and some other species, which is caused by *Dermatophilus congolensis*. Dermatophilosis is worldwide in distribution, but the disease is most economically important in tropical countries. It causes considerable losses, due to damaged

hides, failure to thrive, lowered production, increased culling and death (14, 20, 21, 23).

Many trials have been published on the treatment of dermatophilosis. Blancou (5) found that a combination of penicillin and streptomycin in high doses was effective in the treatment of this disease. However, due to the short duration of this combination, long-acting oxytetracycline was tried (10, 15). Ogwu *et al.* (17) found no difference in

recovery rate between animals that received two doses of the long-acting oxytetracycline and those that received only one dose. These authors, therefore, recommended a closer evaluation of the therapeutic effects of these drugs.

In Sudan, dermatophilosis is known to cause considerable economic losses. Although the disease has long been recognised by both cattle owners and researchers (1, 15, 16, 22), few trials on treating Sudanese cattle have been attempted. The current investigation aimed to evaluate four different antimicrobial treatments for bovine dermatophilosis by clinically monitoring the results and by measuring various serum constituents as health/disease indicators before and after treatment. Values from healthy cattle in the region were employed as controls.

Materials and methods

Experimental animals

Fifteen naturally infected (Fig. 1) and five experimentally infected zebu cattle (of the Baggara type) were used in the experiment. The animals were purchased from Markondi and Kopom localities in the state of South Darfur, Western Sudan, and walked to the Nyala University farm. The cattle were allowed an acclimatisation period of one month, during which they were subjected to thorough clinical examination and received therapeutic doses of ivermectin against internal and external parasites. The animals were maintained on open pasture, with an adequate food (roughage) and water supply, thus simulating the traditional husbandry management system practised in South Darfur.

Before the animals received treatment, their *D. congolensis* infection was identified morphologically on Giemsa-stained smears (Fig. 2), histopathologically and by culturing the causative agent on 7% sheep blood agar and incubating under a concentration of 5% CO₂, as well as by using selected biochemical properties, as recommended by Quinn *et al.* (19). Experimental infection was carried out through the scarification method described by Abu-Samra (1).

Treatment regimes

The 20 animals were placed in five groups. Each group contained three naturally infected cattle and one experimentally infected calf. Of the three naturally infected cattle, one was mildly affected, one moderately affected and one severely affected by the disease (Fig. 1), so that the authors could evaluate their recovery and observe any self-healing cases, which are common among light infections. The disease grades were assessed using clinical and



Fig. 1
Skin lesions on a cow infected with *Dermatophilus congolensis* (graded 'heavily infected'), in Idd Elfirssan province, South Darfur, Sudan

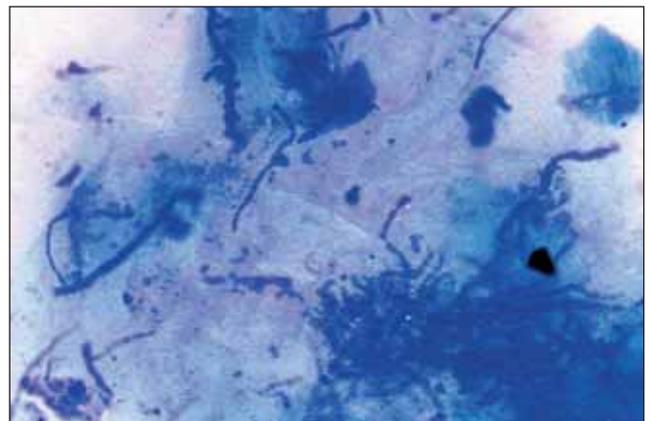


Fig. 2
A branching, filamentous Gram-positive organism, demonstrated in a cow infected with *Dermatophilus congolensis*

bacteriological criteria. Four types of treatment were chosen on the basis of recent *in vitro* testing results (16).

Group 1

This group, which included three naturally infected cattle and one experimentally infected animal, received no treatment and was used as a control.

Group 2

This group received long-acting oxytetracycline (20%) at a dose of 20 mg/kg body weight, delivered intramuscularly. The dose was repeated: in all, 20 mg/kg was given twice, three days apart.

Group 3

This group received multiple doses of procaine penicillin G, in an intramuscular dose of 70,000 IU/kg body weight, in

combination with streptomycin (streptomycin sulphate), at a dose of 70 mg/kg body weight for three consecutive days, given intramuscularly.

Group 4

This group received gentamycin (gentamycin sulphate 10%), in an intramuscular dose of 5 mg/kg body weight. This dose was given twice on the first day and then once a day for a further four days.

Group 5

This group received enrofloxacin (5%) subcutaneously, at a dose of 2.5 mg/kg body weight for three consecutive days. Three more doses were subsequently given, at intervals of seven days.

The weights of the animals in each group were computed before treatment, using the following formula: $W = L G/300$ (18); where W = weight in pounds; L = length from the point of the shoulder to the pin bone in inches; and G = girth in inches.

After treatment, the animals were examined every three days. Their general health was observed and affected areas were inspected for evidence of drying up and/or dropping of the scabs. The beginning of new hair growth was also monitored. Affected animals were considered clinically recovered when the crust dropped off and new hair appeared at the sites of the scabs.

Collection of blood samples

Blood samples were collected from the jugular vein of each animal, using Vacutainer systems. The blood was divided into two aliquots. One aliquot was for the haematological parameters, and contained sodium citrate as an anti-coagulant, and the other aliquot was allowed to clot at room temperature, and centrifuged at 11,000 revolutions per minute for 2 min. The serum was then separated and stored at -20°C until analysed.

Determination of haematological parameters

The haematological parameters were determined by following standard methodology (11). These parameters included the:

- red blood cell (RBC) count
- white blood cell (WBC) count
- haemoglobin concentration
- mean corpuscular haemoglobin
- mean corpuscular haemoglobin concentration (MCHC)
- mean cell volume (MCV)
- packed cell volume.

Determination of blood chemical parameters

The total proteins were determined using the Biuret method, as described by King and Wootton (13). Serum albumin was estimated according to Bartholomew and Delany (4), and serum globulins were calculated as the difference between the total protein and the albumin. Levels of serum inorganic phosphate, calcium and cholesterol were determined with a photocolormeter, using plasmatic laboratory product kits.

Statistical analysis

Numerical data were expressed as means and standard deviations. The Kruskal-Willis test was used to assess whether observations from the samples (pre-treatment and post-treatment) differed significantly (7). The test results were analysed using XLSTAT software (version 2008.7.03).

Results

Treatment

The clinical results of the treatment trials for the five groups are described below.

Group 1 (control)

No change in the clinical picture was noticed in three cows. The condition of one heavily (naturally) infected cow and two moderately infected animals (one infected naturally and one experimentally) got worse. The fourth cow, which was only mildly infected, recovered spontaneously.

Group 2 (long-acting oxytetracycline)

Three out of the four animals (75%) in this group were cured. One of these three treated cows relapsed, four weeks after finishing treatment, and its condition continued to deteriorate until death.

Group 3 (penicillin and streptomycin)

Three out of the four animals (75%) in this group recovered. One of these three cattle relapsed after three weeks. The fourth cow was severely affected and no evidence of improvement has been observed.

Group 4 (gentamycin)

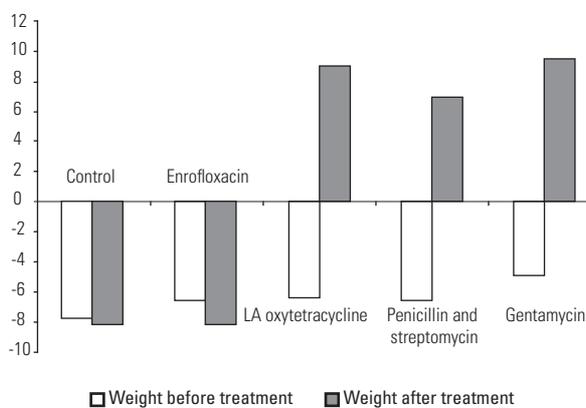
Three of the four animals (75%) in this group were completely cured. The treatment of the fourth cow was considered a failure. This animal was heavily infected (70% of her body was covered in visible scabby lesions) and showed only patches of improvement in areas with dry scabs. However, the moist scab areas, particularly sites of tick attachment, remained, without obvious healing.

Group 5 (enrofloxacin)

No partial healing or complete recovery was observed in this group.

Effects of treatment on body weight

No significant change in body weight was noted in the control group (which received no treatment) or in the cattle treated with enrofloxacin. Significant weight gains were observed among the treated cattle in groups 2, 3 and 4, which received long-acting oxytetracycline, penicillin combined with streptomycin, and gentamycin, respectively (Fig. 3).



LA: long-acting

Fig. 3
Effects of four different antibiotic treatments on body weight in cattle infected with *Dermatophilus congolensis*

The graph shows weight losses (negative numbers) and weight gains (positive numbers)

Effects of treatment on haematological parameters

The effects of the four antibiotic treatments on the haematological values of the cattle infected with *D. congolensis* are shown in Table I. Significant improvements in RBC counts were noticed among the cattle treated with the penicillin-streptomycin combination ($p = 0.021$) and gentamycin ($p = 0.029$). All treated cattle showed significant improvements in their MCHC ($p = 0.021$), MCV ($p = 0.021$) and WBC ($p < 0.021$).

Effects of treatment on serum biochemical values

The effects of the four antibiotic treatments on the serum composition values of the cattle infected with *D. congolensis* are shown in Table II. The untreated cattle demonstrated a drop in their levels of total proteins ($p = 0.021$), calcium ($p = 0.021$) and cholesterol ($p < 0.05$), when compared to

the treated cattle. However, treatment did not affect phosphorus levels, except in those cattle treated with enrofloxacin.

Discussion

Several of the treatments applied in this study resulted in the complete recovery of many of the animals (for instance, 75% of the gentamycin-treated cattle), which will undoubtedly improve their market value. These improvements were reflected in their body-weight gains, clinical pictures and haematological and serum constituent values. The most effective drug was gentamycin, although long-acting oxytetracycline and the combination of penicillin and streptomycin also gave good results.

The required dose of gentamycin for adult cattle was expensive, in comparison with long-acting oxytetracycline and the combination of penicillin and streptomycin. In this way, the study confirms previous findings which recommend long-acting oxytetracycline and the penicillin-streptomycin combination (5, 10, 15, 17, 20). Furthermore, a better treatment – the gentamycin – has emerged. Though it is expensive, this drug achieved remarkable results, including:

- recovery from the disease
- the disappearance of lesions
- weight gain
- the prevention of relapse and/or death.

The cost of these drugs per average adult cow, calculated at the time of the study, was:

- US\$25 for gentamycin
- US\$20 for the combination of penicillin and streptomycin
- US\$15 for enrofloxacin
- only US\$7 for long-acting oxytetracycline.

This should be compared with the value of an adult cow, showing dermatophilosis lesions at, for example, the Nyala livestock market. This value can range from US\$50 to \$150, according to the size and weight of the animal and the degree of damage caused by the disease.

In the present study, the successful antimicrobial treatment of the affected cattle was followed by improvements (towards normal values) in some of their biochemical parameters. A similar elevation of calcium, globulin and cholesterol has been observed following the injection of antibiotics. Serum constituents, notably minerals and proteins, are important parameters to determine the effects of disease on the physiology of an infected animal, and to track their recuperation. Changes in these constituents are

Table I
Mean blood chemical values in cattle infected with *Dermatophilus congolensis*, before and after treatment with antibiotics

Treatment groups ^(a)	RBC/cmm		MCHC (%)		Hb (g/dL)		MCH (pg)		MCV (fl)		PCV (%)		WBC/cmm	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment								
Control	4.6 ± 1.8	4.6 ± 1.4 p = 1.000 NS	26.5 ± 2.7	29.9 ± 2.6 p = 0.248 NS	7.6 ± 2.8	6.2 ± 2.4 p = 0.248 NS	19.1 ± 0.6	13.7 ± 0.24 p = 0.019*	53.4 ± 10	46.1 ± 10.2 p = 0.248 NS	0.3 ± 0.04	0.21 ± 0.02 p = 0.021*	7.8 ± 0.9	8.8 ± 0.9 p = 0.110 NS
Enrofloxacin	5.1 ± 2.7	5.23 ± 1.2 p = 0.309 NS	24.6 ± 3.8	31.7 ± 3 p = 0.021*	6.7 ± 0.73	5.2 ± 1.1 p = 0.059 NS	17.2 ± 0.2	10.1 ± 0.7 p = 0.020*	43.7 ± 1	32.8 ± 0.4 p = 0.021*	0.3 ± 0.02	0.2 ± 0.04 p = 0.309 NS	6.9 ± 0.6	5.3 ± 0.6 p = 0.021*
Long-acting oxytetracycline	6.3 ± 0.6	8.7 ± 1.8 p = 0.059 NS	27.6 ± 2.7	33.6 ± 2.9 p = 0.021*	7.3 ± 0.34	7.8 ± 0.31 p = 0.058 NS	10.7 ± 0.8	15.3 ± 2.5 p = 0.020*	44.4 ± 1.8	31.1 ± 0.1 p = 0.021*	0.3 ± 0.06	0.22 ± 0.01 p = 0.885 NS	8.9 ± 0.13	8 ± 0.2 p = 0.019*
Penicillin & streptomycin	5.34 ± 0.38	7.2 ± 1.4 p = 0.021*	24.4 ± 0.7	28.7 ± 3.4 p = 0.021*	7.9 ± 0.8	8.4 ± 0.6 p = 0.243 NS	9.5 ± 0.1	11.2 ± 3 p = 0.020*	56.5 ± 3	40.1 ± 12.4 p = 0.021*	0.33 ± 0.05	0.3 ± 0.01 p = 0.554 NS	11.3 ± 0.24	7.6 ± 0.1 p = 0.021*
Gentamycin	5.7 ± 0.18	8.3 ± 2.3 p = 0.029*	25.2 ± 1.8	29.5 ± 2.2 p = 0.021*	7.8 ± 0.4	8.6 ± 0.3 p = 0.021*	10.2 ± 1	13.3 ± 3.9 p = 1.000 NS	58.5 ± 0.4	46 ± 0.04 p = 0.021*	0.3 ± 0.05	0.3 ± 0.03 p = 1.000 NS	9.9 ± 0.8	7.5 ± 0.78 p = 0.021*

(a) Each group contained four animals
 RBC/cmm: red blood cells per cubic millimetre
 MCHC: mean corpuscular haemoglobin
 Hb (g/dL): haemoglobin (grams per decilitre)
 MCH (pg): mean corpuscular haemoglobin (picogram)
 NS: no significant difference; computed using the Kruskal-Wallis test at 0.05 alpha level
 * Significant difference
 PCV: packed cell volume
 WBC/cmm: white blood cell per cubic millimetre

Table II
Effects of four antibiotic treatments on the serum biochemical values of cattle infected with *Dermatophilus congolensis*, before and after treatment

Treatment groups ^(a)	Total protein (g/dL)		Albumin (g/dL)		Globulin (g/dL)		Calcium (mg/dL)		Phosphorus (mg/dL)		Cholesterol (mg/dL)	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Control	6.25 ± 1.7	6.9 ± 2.2 p = 0.513 NS	1.3 ± 0.12	1.7 ± 1.32 p = 1.000 NS	3.9 ± 0.8	5.3 ± 1.2 p = 0.149 NS	11.8 ± 1.6	10.6 ± 0.5 p = 0.248 NS	5.7 ± 0.8	5.9 ± 0.12 p = 0.663 NS	194.6 ± 10.6	196.8 ± 14.3 p = 0.885 NS
Enrofloxacin	5.1 ± 0.7	7.4 ± 1.3 p = 0.021*	1.9 ± 0.3	1.6 ± 0.2 p = 0.248 NS	3.3 ± 0.45	5.8 ± 1.4 p = 0.021*	9.5 ± 1.1	14.1 ± 2.1 p = 0.021*	10.9 ± 1.4	6.2 ± 1.4 p = 0.021*	148.2 ± 33.4	196.8 ± 21.4 p = 0.043*
Long-acting oxytetracycline	5.8 ± 0.74	8.8 ± 1.2 p = 0.021*	1.9 ± 0.57	1.5 ± 0.09 p = 0.309 NS	3.7 ± 1.3	6.4 ± 0.3 p = 0.050	10.4 ± 1	13.3 ± 0.19 p = 0.021*	9.4 ± 1.9	7.4 ± 0.18 p = 0.110 NS	195 ± 23.9	311.1 ± 32.6 p = 0.021*
Penicillin & streptomycin	5.6 ± 0.6	8.7 ± 1.1 p = 0.021*	1.9 ± 0.15	1.7 ± 0.27 p = 0.386 NS	4.11 ± 1.1	7.2 ± 1.2 p = 0.021*	10.9 ± 2.9	12.6 ± 0.6 p = 0.021*	11.9 ± 3.1	7.7 ± 1.1 p = 0.080 NS	209.1 ± 37.9	262.2 ± 28.1 p = 0.043*
Gentamycin	5.5 ± 0.3	7.3 ± 1.4 p = 0.021*	1.8 ± 0.02	1.4 ± 0.25 p = 0.021*	3.7 ± 0.13	5.7 ± 1.5 p = 0.021*	11.8 ± 1.7	13.7 ± 0.29 p = 0.021*	12.1 ± 3.6	8.7 ± 0.34 p = 0.191 NS	164 ± 20.9	278.9 ± 37.6 p = 0.021*

(a) Each group contained four animals
 g/dL: grams per decilitre
 mg/dL: milligrams per decilitre
 NS: no significant difference; computed using the Kruskal-Wallis test at 0.05 alpha level
 * significant difference

often associated with disease and might be good laboratory markers for diagnosis and disease surveillance (20). The present study confirmed the potential to treat dermatophilosis effectively, as reported by previous studies (5, 10, 15, 17). Recovery was noted among dermatophilosis cases that were caught early or in cattle that were only mildly affected. The present study emphasises gentamycin as the drug of choice for parenteral treatment. However, the routine administration of gentamycin would be extremely difficult under extensive farming conditions, such as in the nomadic herds in South Darfur State, and the cost of this drug is high. In the limited interviews conducted by the authors, the cost was seen as acceptable by cattle traders, who spend a lot to get sick cattle ready for the market. On the other hand, nomadic cattle-owners might not see this cost as economic.

The drop in total proteins among infected cattle as compared to treated animals, observed in this study ($p = 0.021$), seemed to be due to a decrease in both albumin and globulin fractions. Amakiri (2) observed a reduction in albumin values among *Dermatophilus*-infected cattle in Nigeria. The same author reported an increase in globulin levels in infected white Fulani cattle. In the present experiment, decreased globulin levels among the Baggara cattle might be attributable to a fall in immunoglobulins, due to immunological depression in the terminal stages of the disease, as indicated by Barré *et al.* (3). It is likely that the drop in total proteins could be due to:

- anorexia
- a failure in albumin fraction synthesis by the hepatocytes
- protein urea (3).

On the other hand, a marked rise in serum cholesterol has been detected among *D. congolensis*-infected cattle, compared with the normal established range in healthy cattle. It is known that serum cholesterol concentration increases in several disease states, primarily liver disease (6). This observation is in accordance with that of Gaulier *et al.* (8), who reported toxic hepatitis among *D. congolensis*-infected cattle.

In the present study, the calcium level improved significantly after treatment ($p = 0.021$). This result seems to agree with that of Kapu (12), who observed decreased calcium levels among infected cattle in Nigerian breeds. However, Gbodi (9) found that cattle infected with *D. congolensis* had higher calcium levels than healthy cattle. The influence of bovine dermatophilosis on serum phosphorus has not been investigated before. There was no decrease in the level of phosphorus (or increase in the calcium/phosphorus ratio) after treatment ($p > 0.05$). However, among the cattle treated with enrofloxacin (a treatment which was considered to have failed in this study), phosphorus levels decreased significantly ($p = 0.021$).

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Le traitement de la dermatophilose bovine et ses effets sur certains paramètres hématologiques et hématochimiques

M.E. Hamid & M.S. Musa

Résumé

Les auteurs présentent les résultats d'une étude conduite au Soudan occidental pour évaluer les effets de quatre traitements antibiotiques de la dermatophilose bovine administrés par voie parentérale à des zébus suite à une infection naturelle ou expérimentale. Les meilleurs effets en termes de taux de guérison, d'amélioration du gain pondéral, de prévention des rechutes et de réduction des cas de mortalité étaient obtenus par la gentamicine, suivie par l'association pénicilline-streptomycine et enfin par l'oxytétracycline à longue action. En revanche, l'enrofloxacin s'est avérée inefficace. Les zébus ayant reçu le traitement associant pénicilline et streptomycine ($p = 0,021$) et ceux traités à la gentamicine ($p = 0,029$) ont présenté une augmentation significative du nombre de globules rouges. Chez tous les animaux traités à l'exception de ceux ayant

reçu de l'enrofloxacin, il a été constaté une amélioration significative de la concentration corpusculaire moyenne en hémoglobine ($p = 0,021$), du volume corpusculaire moyen ($p = 0,021$) et du nombre de globules blancs ($p < 0,021$). Une amélioration significative des teneurs totales en protéines, en calcium ($p = 0,021$) et en cholestérol ($p < 0,05$) a été enregistrée chez les zébus traités, comparativement à ceux infectés par *Dermatophilus congolensis* et non traités. Les auteurs concluent de cette étude que la gentamicine est le médicament de choix pour le traitement parentéral de la dermatophilose. Ce traitement s'est avéré efficace pour traiter non seulement les cas de dermatophilose précoce et légère, mais aussi les infections modérées à sévères. En l'absence de traitement, ces infections modérées à sévères entraînent une détérioration rapide de l'état des zébus infectés, allant parfois jusqu'à la mort.

Mots-clés

Antibiotique – Dermatophilose bovine – *Dermatophilus congolensis* – Paramètre hématologique et hématochimique – Soudan – Soudan occidental – Streptothricose cutanée – Zébu.



Tratamiento de la dermatofilia bovine y su efecto sobre determinados parámetros hematológicos y hematoquímicos

M.E. Hamid & M.S. Musa

Resumen

Los autores describen un estudio que se llevó a cabo en el oeste del Sudán para evaluar cuatro antibióticos distintos administrados como tratamiento parenteral a cebúes con dermatofilia bovine, ya fuera ésta de origen natural o inducida. Por lo que respecta al índice de recuperación, el aumento de peso, la ausencia de recaídas y la prevención de muertes, se observó que la gentamicina constituía el tratamiento más eficaz, seguido de la administración combinada de penicilina y estreptomycin y, por último, de la terapia con oxitetraciclina de acción prolongada. La enrofloxacin, en cambio, no deparó buenos resultados. El recuento eritrocitario mejoró considerablemente en los animales tratados con penicilina-estreptomycin ($p = 0,021$) y gentamicina ($p = 0,029$). En todos los animales sometidos a tratamiento, excepto los que recibieron enrofloxacin, se advirtió una notable mejora de parámetros como la concentración mediana de hemoglobina corpuscular ($p = 0,021$), el volumen corpuscular mediano ($p = 0,021$) y el recuento leucocitario ($p < 0,021$). También se observó una importante mejora de los animales tratados por lo que respecta a los niveles totales de proteínas, calcio ($p = 0,021$) y colesterol ($p < 0,05$), en comparación con los animales infectados por *Dermatophilus congolensis* que no recibieron tratamiento alguno. A tenor de los resultados del estudio, los autores recomiendan privilegiar el uso de la gentamicina para el tratamiento parenteral de la dermatofilia. Este fármaco resultó útil no sólo para tratar casos leves e incipientes, sino también infecciones moderadas o graves. Según observaron los autores, a falta de toda intervención los animales con afección moderada o grave evolucionan a peor y/o acaban muriendo.

Palabras clave

Antibióticos – Dermatofilia bovine – *Dermatophilus congolensis* – Estreptotricosis cutánea – Ganado cebú – Parámetros hematológicos y hematoquímicos – Sudán – Sudán Occidental.



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