GUIDANCE FOR AUTHORS

Aims and Scope
The Bulletin of Animal Health and Production in Africa publishes articles on original research relevant to animal health and production activities which may lead to the improvement of the livestock industry in Africa and better utilisation of her animal resources. The journal is published quarterly.

Submission of Articles
Two copies of articles should be sent to the Editor, Organisation of African Unity/Inter-african Bureau for Animal Resources, P.O. Box 30786, Nairobi, Kenya.

Manuscripts should be in clear concise English or French, typewritten with double spacing and adequate margins. The spelling should be that of The Short Oxford English Dictionary or Le Petit Robert.

An article submitted for publication implies that its content has not been published elsewhere and that it is subject to editorial revision.

Types of Articles Published in the Bulletin
- Full papers providing accounts of original work
- Short communications
- Review articles invited by the Editor
- Editorials
- Letters to the Editor
- Book Reviews
- News and announcements.

Format for Articles
The manuscripts should contain the following features:

Title, which should be concise, not more than 15 words long, followed by the author(s) name(s) and institutions to which work should be attributed and address for correspondence, if different.

Abstract not exceeding 200 words giving a synopsis of the findings presented and the conclusion(s) reached.

Introduction stating the purpose of the work.

Materials and Methods used.

Results presented concisely.

Discussion of significance.

Acknowledgements.

References numbered consecutively in the order they are first mentioned in the text. Identification of references in the text should be by numbers (in parentheses) and not by authors’ names.

References should take the following form:

1. Journals
Surname and initials of author(s), year of publication (in parentheses). World List abbreviation of title of periodical (underlined), volume number (arabic numerals), first page number. The title of the articles should not be included.

2. Books
Surname and initials of author(s), year of publication (in parentheses), the exact title (underlined), town of publication, publisher, first page number.

3. Annual Reports
Name of country, year of reference, followed by the name of the department or organisation, first page number.

If the same author is cited more than once, his publications should be arranged in chronological order in the list of references, and if more than one publication is included, the letters "a, b, c" should be added in both the list of references and in the text.

Illustrations
Tables should be limited and number of headings restricted. A massive table is difficult to read even if it can be reproduced. Tables and figures should be numbered consecutively. Table 1 etc., or Fig. 1 etc., respectively, and attached at the end of the text. References to tables and figures in the text should be by number and not to "table below" or "figure below". Coloured illustrations are reproduced only at the author(s) expense.

Short Communications
A Short Communication implies the article does not justify publication as a conventional paper. Such communication should be restricted to two printed pages or 1,000 words including a maximum of two illustrations. It should therefore contain similar features as a regular but summary and separate sub-headings are not necessary.

Proofs
One set of proofs will be sent to the author to be checked for printer’s errors and should be returned within three days.

Offprints
25 offprints of each article will be supplied free of charge. Additional offprints may be ordered and paid for at the proof stage. Each extra offprint costs US $1.00.

Subscriptions
The annual subscription price including postage (surface mail) and handling US $15.00 for countries in Africa and US $20.00 for other countries. Air mail charges are available upon request.

Back Volumes
Back issues are also obtainable upon request at similar charges.
IBAR PUBLICATIONS
PUBLICATIONS DE L’IBAR

BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA
BULLETIN DE LA SANTE ET DE LA PRODUCTION ANIMALES EN AFRIQUE

A Quarterly Journal of Original Articles and Abstracts in English and French

Annual subscriptions: OAU Member States US$ 15.00
Other countries US$ 20.00

Revue trimestrielle contenant des articles originaux et des résumés d'études en anglais et en français

Abonnement pour un an: Etats membres de l’OUA 15 $ EU
Autres pays 20 $EU

INFORMATION LEAFLETS
PAGES D'INFORMATION

A weekly information sheet on animal health and production (posted monthly)

Annual subscriptions: U.S. $5.00

Pages d’informations hebdomadaires sur la santé et la production animales (expédiées mensuellement)

Abonnement pour un an: 5,00 $ EU
## CONTENTS

### ORIGINAL ARTICLES

1. Isolation of Streptococcus Uberis from a Mongrel with Pyometra – L.M. TUCHILI & M. BWALYA ................................................................. 99
7. Haematological Effects of Xylazine Hydrochloride, Ketamine Hydrochloride and Their Combination in Donkeys – E.G.M. MOGAO & S.M. MBIUKI ................................................................. 129
8. Resistance of Field Isolates of *Haemonchus Contortus* to Thiabendazole and Fenbendazole in Kenya – R.M. WARUIHU, N. MAINGI & E.J. GICANGA ................................................................. 133
9. Cestrum Poisoning in a Young Horse – A Case Report – J.D. MANDE, P.M.F. MBITHI, J.A. NGUHIU-MWANGI & S.M. MBIUKI ................................................................. 139
11. Mechanical Strength of Plaster Casting Bandages available in Kenya – J.D. MANDE, P.M.F. MBITHI & S.M. MBIUKI ......................................................... 147
12. Resistance to Abrasion of Plaster Casting Bandages available in Kenya – J.D. MANDE, P.M.F. MBITHI & S.M. MBIUKI ......................................................... 151
15. Suspected Cases of Avitaminosis A in Pigs – M.R. SALUM & S.M. NJAVIKE ................................................................. 163

### SHORT COMMUNICATIONS

ISOLATION OF STREPTOCOCCUS UBERIS FROM A MONGREL WITH PYOMETRA

L.M. TUCHILI and M. BWALYA
University of Zambia, School of Veterinary Medicine, Department of Disease Control, P.O. Box 32379, Lusaka, Zambia

ISOLEMENT DE STREPTOCOCCUS UBERIS D’UNE CHIENNE BATARDE SOUFFRANT DE PYOMETRE

Résumé

On a isolé une culture pure de Streptococcus uberis d’une chienne bâtarde ayant des signes cliniques de pyomètre qui comprenaient la fièvre, la dépression et l’anorexie. Les organismes étaient isolés de prélèvements vaginaux extraits de l’intérieur du vagin. La méthode utilisée pour recueillir des prélèvements a été décrite par Olson P.N.S. (1). Un antibiogramme a été effectué et il a permis de trouver des organismes sensibles à l’amoxicilline, à la pénicilline, à l’oxytétracycline, à la tétracycline, au chloramphénicol et à la gentamycine; en revanche, ils étaient résistants à la kanamycine.

Summary

In a female mongrel that presented clinical signs of pyometra which included fever, depression and anorexia was isolated a pure culture of Streptococcus uberis. The organisms were isolated from vaginal swabs taken from the interior vagina. The method used to collect the swabs was that described by (1).

Antibiogram was carried out and the organisms were found to be sensitive to ampicillin, penicillin, oxytetracycline, tetracycline, chloramphenicol and gentamycin but were resistant to kanamycin.

INTRODUCTION

Streptococcus uberis has been known to be associated with bovine mastitis and this was recognised as early as 1990. Apart from causing mastitis, S. uberis has also been associated with other disease conditions in pigs, canine and other animal species. Some Beta-haemolytic streptococci isolated from canine vaginal discharges have been incriminated in infertility, neonatal septicaemia and abortions (2,3). Other isolations of Beta-haemolytic Streptococci have been made from canine vaginal and uterine secretions (2). S. uberis has also been found to be responsible for about 17 percent of cases of bovine mastitis in the U.K. (4) cited by (5), in Zambia the pathogenesis of Streptococcus species has insufficiently been documented as the organisms have often been isolated from sick and health bitches. In this paper we report the isolation, sensitivity and the possible public health significance of S. uberis isolated from a mongrel with pyometra.

CASE HISTORY

A 3-year female mongrel was presented for rabies vaccination and general veterinary medical check-up. Before vaccination was done a thorough clinical check-up was carried out. It was then that purulent discharge from the vulva was noticed. It was revealed by the owner of the dog that the discharge had been present for the past 2 weeks. Further clinical examination showed that the dog had high fever (39.6), was depressed and had anorexia. There was no complaint with fertility. The bitch had actually delivered four healthy puppies in August 1991.

Laboratory Findings

Vaginal swabs collected from anterior vagina were cultured on blood agar (Oxoid) and MacConkey agar (Oxoid) plates for aerobic and anaerobic bacteria isolation. Sheep blood was used. Plates were incubated for 18 hours at 37°C. There was no growth on MacConkey agar plates while a pure culture of small Beta-haemolytic colonies were observed on
blood agar plates. Smears made from these colonies revealed the presence of Gram positive cocci arranged in short chains and were catalase positive. A single colony was subcultured in nutrient broth (Oxoid) with calf foetal serum added to it and incubated for 24 hours at 37°C. Smears made from the broth culture revealed the presence of similar organisms but appearing in longer chains. Some plates incubated under 10 percent carbon dioxide for the same period of time did not improve the growth of these organisms. Pure colonies of these bacteria were further subjected to standard bacteriological methods\(^{(6,7)}\) and were identified as *Streptococcus uberis*.

Before inoculating sugars calf foetal serum was added to enhance growth.

**Sensitivity**

An arbitrary method was used to determine the sensitivity of *S. uberis* to different antibiotics. After an overnight incubation at 37°C, plates were examined and where growth occurred within 2 mm of the edge of the disc was considered as denoting resistance to the drug. *S. uberis* showed resistance to kanamycin but was sensitive to oxytetracycline, tetracycline, chloramphenicol, gentamycin, penicillin and ampicillin. The organisms appeared to be more sensitive to ampicillin and penicillin.

**Discussion**

*Streptococcus uberis* has frequently been isolated from milk and has often been associated with bovine mastitis. The application of biochemical and serological tests to the streptococcus species in the 1920s and 30s led to the first clear description of one of these species as *Streptococcus uberis*\(^{(4)}\). The organisms have also been isolated from the canine vaginal discharges\(^{(3)}\). Other Beta-haemolytic streptococcal isolates from canine vaginal discharges have been incriminated in infertility, abortions and neonatal septicaemia\(^{(3)}\).

The isolation of *S. uberis* in pure culture from a mongrel with pyometra possibly signifies the pathogenicity of this isolate for the canine species. The source of this infection is unknown but it is possible that it was contracted from males during mating or from contaminated beddings.

Control of *S. uberis* in dogs would possibly be difficult due to limited knowledge on its epidemiology. It is therefore suggested that this organism is looked for whenever dogs are presented to Veterinary Clinics for various urogenital ailments. *S. uberis* may be of public health significance since dogs are often in close contact with human beings especially children who tend to be fond of them.

The antibiogram for this isolate has revealed the resistance to kanamycin. This isolate was also sensitive to tetracycline a result which does not conform with that of\(^{(8,9)}\) who found *S. uberis* to be highly resistant to tetracycline.

**References**

2. Olson, P.N.S. Streptococcus canis: An isolate from a canine uterus. Veterinary Medicine, Small Animal Clinician (1975) 70:933-934.

*Received for publication on 17th June 1992*
FUNGAAL INFECTIONS IN KENYA COVERING TEN YEARS (1981 TO 1990)

MACHARIA, M.J.; MWANGI, S.M.; RUNYENJE, N. and BINEPAL, S.Y.
Veterinary Research Laboratories, P.O. Kabete, Kenya

ENQUETES SUR LES INFECTIONS PAR LES FUNGI AU KENYA SUR UNE PERIODE DE DIX ANS (1981-1990)

Résumé

Quatre cent trente quatre échantillons remis à six laboratoires de diagnostic au Kenya pendant une période de dix ans (1981 à 1990) en vue de l’examen des fungi ont été traités et la présente communication fait état des résultats de cette analyse. On a observé la croissance des fungi dans 259 échantillons (69,68%), ce qui n’était pas le cas pour 175 spécimens (40,32%).

La teigne tonsurante était la maladie la plus prévalente chez toutes les espèces d’animaux domestiques. D’après les conclusions de l’enquête, il y avait en moyenne chaque année 7,4 cas de teigne tonsurante chez les bovins. La mastite était la deuxième maladie qui affectait les animaux, Cryptococcus neoformans étant la souche la plus répandue isolée des échantillons de lait bovin. Cette conclusion concorde avec les précédents rapports publiés par Schalm O.W. et al. Aspergillus fumigatus et Candida albicans ont été isolés des tissus des animaux malades, tandis que certains lots de vaccin vérifiés pour s’assurer qu’ils n’étaient pas contaminés ont produit Aspergillus fumigatus ou Penicillium, ou les deux à la fois.

Six des sept échantillons d’aliments analysés en vue de détecter Aspergillus spp. ont été négatifs. Toutefois, trois des spécimens étaient positifs à l’aflatoxine, ce qui est conforme aux observations faites par Pollock G.A. selon lesquelles les aliments du bétail peuvent contenir de la mycotoxine même lorsque la mycotoxine qui produit le fungus ne peut pas être isolée des aliments.

Summary

Four hundred and thirty four specimens submitted to six diagnostic laboratories in Kenya for fungal analysis during a ten-year period (1981 to 1990) were processed and the results form the subject of this paper. Fungal growth was observed in two hundred and fifty nine (59.68%) samples while one hundred and seventy five (40.32%) samples yielded no growth.

The most common fungal disease was found to be ringworm in all domestic animal species. The results showed that an average of 7.4 outbreaks of bovine ringworm occurred every year. Bovine mastitis was the second most common disease in which case Cryptococcus neoformans was the most common isolate from bovine milk samples. This agrees with previous reports by Schalm, O.W. et al. Aspergillus fumigatus and Candida albicans were isolated from pathologic animal tissues while some vaccine batches presented for sterility check yielded Aspergillus fumigatus or Penicillium species or both.

Six out of seven feed samples presented for Aspergillus spp. isolation were negative. Three of these samples were, however, positive for Aflatoxins. This conforms with observations made by Pollock, G.A. that animal feeds may contain mycotoxins even when the mycotoxin producing fungus cannot be isolated from the feeds.

INTRODUCTION

Mycology has been a neglected field in many veterinary diagnostic laboratories. Many fungi such as Aspergillus spp. Rhizopus spp and Geotrichum spp. are widespread in nature (soil, water etc.) some are harmless commensals associated with men and animals (e.g. Histoplasma capsulatum and Blastomyces dermatitidis occur in the soil while Candida albicans lives in the alimentary tract). Sometimes “opportunistic fungi” like Mucor spp., Aspergillus spp., etc. cause disease. The production of disease by these fungi is thought to be related to such factors as “impaired resistance”, prolonged steroid or antibio-
tication therapy or both, and various stresses, including terminal diseases and metabolic disturbances[1]. Fungal diseases manifest themselves in various clinical forms. Sudden deaths (Mycotoxoses), Ringworm, Systemic infections (Aspergillosis), mastitis (Cryptococcus neoformans) and Mycotic abortions are all forms in which fungal disease manifests itself.

There is no previously published data to show the incidence of fungi infections in Kenya and also the domestic animal species involved. Hence the need to highlight this.

**Materials and Methods**

Specimens, submitted for diagnosis, included skin scrapings, hair, feed samples, animal tissues, milk samples and vaccines for sterility check. They were prepared by inoculating them into Saboraud dextrose agar, Saboraud maltose agar and also in the appropriate experimental animals and left for 5-7 weeks. Specimens from animals suspected to have ringworms (skin scraping, hair) were, in addition, subjected to direct microscopic examination after mounting them on a microscope slide containing a drop of 10% KOH. Both the macroscopic and microscopic characteristics of fungal growth were used to identify the fungus the latter of which was done by mounting the fungal growth in a drop of lactophenol cotton blue stain on a slide and observing under microscope.

**Results**

The results of the 434 specimens analysed are shown in Table 1. Of these samples 259 (59.68%) were positive for fungal growth whereas 175 (40.32%) yielded no growth.

Ringworm was found to be the most prevalent fungal infection (48.26% of all positive cases. See Table 1.). It was more prevalent in bovine species (59.20% of ringworm cases in all species) as shown in Table 2. Bovine Ringworm was almost exclusively caused by Trichophyton spp. and Microsporum spp. It was observed that in Kenya there is an average of 7.4 outbreaks of bovine ringworm every year (Table 2). In other species the average number of outbreaks every year is 1.4 in Canine species, 1.2 in Ovine, 0.9 in Equine, 0.7 in Caprine, 0.4 in Camel, 0.3 in Porcine and 0.1 in both Avian and Human species. *Trichophyton verrucosum* was the most common fungus causing ringworm (68.0% of all ringworm cases) followed by *Trichophyton mentagrophytes* (12.8% of all ringworm cases) See Table 2.

*Cryptococcus neoformans* was the most prevalent isolate from bovine milk samples during that period. The only other fungal isolate from bovine milk samples was *Candida albicans*. *Aspergillus fumigatus* was isolated from lung tissues of sheep, goats and poultry. *Penicillium* spp. was isolated from vaccines, bovine skin, ovine skin and canine skin.

*Candida albicans* was also isolated once from bovine semen (Table 1.).

Only one of seven feed samples submitted to the laboratories yielded *Aspergillus* spp. (The requested test) but three of them had significant aflatoxin levels after analysis in the chemistry laboratory.

**Discussion**

An average of 7.4 outbreaks of bovine ringworm, 1.4 of canine ringworm and 1.2 of ovine ringworm occur in Kenya every year (Table 2). This is significant and especially so since ringworm is a herd problem and thus it affects a considerable number of livestock in an outbreak. Ringworm cases were most prevalent in the high potential, high rainfall areas of Kenya although the arid and semi-arid areas quite often received outbreaks during the wet seasons. This is mostly because fungi thrive best in moist conditions.

*Cryptococcus neoformans* was the most common fungus isolated from bovine milk samples (70% of positive bovine fungal mastitis cases) the only other fungal species isolated being *Can-
Table 1: Fungi Isolated per Species from Specimen submitted to Six Investigation Labs, in Ten Years

<table>
<thead>
<tr>
<th>SPECIES/ITEM</th>
<th>SPECIMEN</th>
<th>TOTAL NO. SUBMITTED</th>
<th>FUNGAL SPECIES ISOLATED</th>
<th>TOTAL ISOLATES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ringworm C. neoformans</td>
<td>C. albicans A. Fumigatus T. verrucosum Penicillium spp</td>
<td></td>
</tr>
<tr>
<td>BOVINE</td>
<td>SKIN</td>
<td>103</td>
<td>74</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MILK</td>
<td>82</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>SEMEN</td>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>19</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>OVINE</td>
<td>LUNGS</td>
<td>8</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAPRINE</td>
<td>LUNGS</td>
<td>10</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>7</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>25</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>7</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>AVIAN</td>
<td>LUNGS</td>
<td>41</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SKIN</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VACCINES</td>
<td>57Vials</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ANIMAL FEEDS</td>
<td>7</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>TOTAL ISOLATE</td>
<td>434</td>
<td>125</td>
<td>35</td>
<td>48</td>
</tr>
<tr>
<td>% OF TOTAL POSITIVE CASE</td>
<td>48.26</td>
<td>13.52</td>
<td>12.74</td>
<td>18.53</td>
</tr>
</tbody>
</table>

Table 2: Ringworm Cases Isolated in the Ten Year Period (1981-1990)

<table>
<thead>
<tr>
<th>FUNGAL SPECIES ISOLATED</th>
<th>ANIMAL SPECIES</th>
<th>TOTAL % TOTAL ISOLATES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bovine</td>
<td>Caprine</td>
</tr>
<tr>
<td>Microsporum gypseum</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Microsporum nanum</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Microsporum canis</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Microsporum distortum</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Microsporum vanbreuseghenii</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Trichophyton mentagrophytes</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Trichophyton verrucosum</td>
<td>68</td>
<td>10</td>
</tr>
<tr>
<td>Trichophyton rubrum</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Trichophyton schoenii</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Trichophyton equi</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Trichophyton gallinae</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Keratinomyces ajelloi</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Total No. of cases</td>
<td>74</td>
<td>12</td>
</tr>
<tr>
<td>% of Total Ringworm isolated</td>
<td>59.20</td>
<td>9.60</td>
</tr>
<tr>
<td>Average No. of Ringworm outbreaks per year</td>
<td>7.4</td>
<td>1.2</td>
</tr>
</tbody>
</table>

dida albicans (30% of positive fungal mastitis cases). See Table 2. Odongo, M.O. et al and Schalm, O.W. et al have also made the same observation.\(^{[4,6]}\)

Aspergillus spp. was isolated from 11.04% of all 434 specimens analysed. Carter, G.R.\(^{[3]}\) has reported that widespread saprophytic and "opportunistic" fungi like Aspergillus spp. are frequently found in clinical materials and cause disease only occasionally. Disease production of these fungi is thought to be related to such factors as impaired resistance; prolonged steroid and/or antibiotic therapy; and various stresses, including terminal diseases and metabolic disturbances. For the isolation to be significant then; the fungus must be demonstrated in tissue sections; there should be presence of clinical disease; tissue sections should have pathologic lesions; and there should be repeated isolation of the fungus from pathologic lesions.

The seven feed samples sent for Aspergillus spp isolation were all suspected to have caused aflatoxin poisoning in ani-
mals. Only one of them yielded *Aspergillus fumigatus*. Three other samples were positive for aflatoxins in the chemistry laboratory. This confirms observations made by Pollock, G.A. that fungus does not need to be present for a feed to produce intoxication.

The *Penicillium* spp isolated from the skin scappings was probably a saprophyte (Table 1). The vaccine samples from which fungus was isolated (Table 1) indicated that the whole batches from which the specimen had come were contaminated.

**Acknowledgement**

We wish to thank the entire staff of all the veterinary investigation laboratories and also Mr. Ouko for typing the manuscript.

Our most sincere thanks also go to the Chief Veterinary Investigation Officer, Kenya Dr. W.T. Chong for his worthwhile guidance and help when compiling this paper. This paper is published with the kind permission of the Director of Veterinary Services, Kenya.

**References**


Received for publication on 22nd July 1992
ASSESSING HEPATIC DYSFUNCTION IN SPLENECTOMISED DOGS EXPERIMENTALLY INFECTED WITH T.B. BRUCEI

T.N.C. EGBE-MWIYI1, R.E. ANTIA2 and P.A. ONYEYILI3
1Department of Veterinary Pathology, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria
2Department of Veterinary Pathology, University of Ibadan, Ibadan, Nigeria
3Department of Veterinary Physiology & Pharmacology, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria

EVALUATION DU DYSFONCTIONNEMENT HEPATIQUE CHEZ LES CHIENS SPLENECTOMISES INFECTES EXPERIMENTALEMENT AVEC T.B. BRUCEI

Résumé

Vingt chiens bâtards adultes (mâles et femelles) ont été utilisés en vue d’étudier le dysfonctionnement hépatique. Dix de ces chiens ont subi la splénectomie, tandis que le reste est laissé intact.

Cinq chiens de chaque groupe (groupe splénectomisé et groupe laissé intact) ont été inoculés par voie intraveineuse avec une souche 8/18 de T.b. brucei, les autres chiens non inoculés servaient de sujets témoins. Tous les animaux infectés développaient la trypanosomiasis 4 à 7 jours après l’infection (p.i.).

On a constaté que la splénectomie écourrait la période pré-patente et accentuait la parasitémie. Les niveaux de fibrinogène du plasma et de cholestérol ont augmenté chez les groupes infectés. Les chiens infectés traités avec l’acéturate de diminazène (bérénil®) à raison de 7 mg/kg de poids viennent de 21 jours p.i., même s’ils ont réussi à éliminer l’infection en 24 heures, n’ont pas pu réduire immédiatement les taux élevés de fibrinogène et de cholestérol dus au dysfonctionnement hépatique.

Summary

Twenty adult mongrel dogs of both sexes were used to assess hepatic dysfunction. Ten of the dogs were splenectomised while the rest were not.

Five dogs each from the splenectomised and intact (Non splenectomised) groups were intravenously inoculated with T.b. brucei strain 8/18 while un-inoculated dogs served as controls. All the infected animals developed trypanosomiasis from day 4 to 7 post-infection (P.I.).

Splenectomy was observed to shorten the pre-patent period and enhanced parasitaemia. The plasma fibrinogen and cholesterol levels were increased in the infected groups. The infected dogs treated with diminazene aceturate (Berenil®) at the dose rate at 17.0 mg/kg body weight on day 21 P.I., although effective in eliminating the infection within 24 hours did not immediately reduce the elevated fibrinogen and cholesterol levels which was attributed to hepatic dysfunction.

INTRODUCTION

Canine trypanosomiasis due to T. brucei has earlier been reported[20,21,13,14,23,15]. The disease in dogs is characterised by high parasitaemia and it is very fatal[21]. The spleen usually helps in the control of blood parasites through the production of antibodies and immune development and contains antigen presenting cells (APC)[27]. Splenectomy on the other hand, has been found to increase pathogenicity and parasitaemia[17,8,1,18]. Splenomegaly and hepatomegaly are common features of canine trypanosomiasis especially the acute form[18,20].

Fibrinogen is a plasma protein produced by the liver and helps in clotting mechanism[26]. Hyperfibrinogenaemia is seen mainly in dehydration and inflammatory conditions[15]. Cholesterol present in the body is obtained from the diet and/or synthesised. Increased cholesterol
levels can occur due to hepatocellular damage, over production, hypothyroidism and nephrosis. Esterification primarily occurs in liver and is usually depressed in both acute and chronic hepatocellular disease. Thus producing a higher free cholesterol to ester ratio. Dog are mainly infected by *T. brucei* and *T. congolense* organisms and treatment of these infection is not always successful in spite of chemotherapy.

The aim of this study was to assess the hepatic dysfunction in splenectomised dogs experimentally infected with *T. brucei* brucei since the spleen is involved in the control of the blood parasites. The authors are unaware presently of any such work in splenectomised dogs.

**Materials and Methods**

**Experimental Animals**

Twenty adult mongrel dogs of both sexes purchased from Ibadan, Nigeria and weighing between 10 to 15 kg at the start of the experiment were used for the study. The dogs on arrival were dewormed with febendazole (Panacur, Hoechst AG, Frankfurt main, Germany) at an oral dosage of 100 mg per kg body weight and disophenol (DNp, American Cyanamid Company, Princeton, N.J. USA) subcutaneously at the rate of 0.2 ml per kg body weight. The dogs were kept in a fly-proof house in separate cages and fed twice daily with a combination of soya bean meals, cassava grains, beans, rice and regular supply of meat and bones. Iron supplements were provided for the animals using ferrous sulphate tablets (Fesolate) at a dose of 50 mg per dog per week for 15 weeks. Water was provided *ad libitum*. Before the commencement of experiment, the dogs were screened for the presence of haemoprotezoan parasites using the wet mount and Giemsa stained blood films.

**Trypanosome Organisms**

*T. b. brucei* strain 8/18, obtained from the Nigerian Institute for Trypanosomiasis Research, Vom, was used for the study. It was maintained by serial passages in rodents and is known to produce acute infection in rats with a pre-patent period of 2 to 3 days.

The donor rats were bled after developing parasitaemia and the dogs received 0.5 ml of infected blood in phosphate glucose buffered saline solution containing $1 \times 10^4$ trypanosomes.

The organisms were inoculated intravenously and the dog examined daily for the presence of the parasites. A method previously established was used for the enumeration of the parasites.

**Splenectomy of Experimental dogs**

The details of the splenectomy has been described previously by Brodey.

**Trypanocidal agent**

The agent used for the treatment was diminazene aceturate (Berenil, Hoechst Farbwerk, A.G. Frankfurt, Germany) at the dose of 7.0 mg per kg body weight. The drug was prepared according to the specification of the manufacturer.

**Experimental design**

The dogs were distributed into 4 groups of 5 animals each. Group 1: Consists of splenectomised *T. b. brucei* infected dogs. Group 2: Splenectomised uninfected control dogs. Group 3: Non-splenectomised (intact) infected animals. Group 4: Non-splenectomised (intact) uninfected control dogs.

Groups 2 and 4 were used to monitor the effect of challenge, treatment, splenectomy and possible occurrence of other diseases. Berenil was administered to groups 1 and 3 on day 21 after infection when parasitaemia was well established based on haematocrit buffalo coat technique and examination of blood films.

The parameters used for assessing the degree of hepatic dysfunction and the effect of treatment include the clinical signs, degree of parasitaemia, and the levels of fibrinogen and cholesterol in the blood.

The blood samples for parasitaemia and fibrinogen estimation was obtained
by venipuncture using vacutainer tubes containing ethylene diamine tetracetic acid (EDTA) as an anti-coagulant, while blood samples for cholesterol determination were obtained in EDTA free vacutainer tubes.

The degree of parasitaemia was determined as previously described. Fibrinogen level was determined by heat precipitation method while direct method was used for cholesterol.

Results

Clinical Observations

The splenectomised and non-splenectomised infected dogs exhibited the following clinical signs: anorexia, fever, gradual loss of weight, corneal opacity, orchitis in the males, muscular weakness, oedema of the subcutaneous tissues, pale mucous membranes indicating anaemia, enlargement of peripheral lymph nodes, slow pulse rate and incoordination. These signs were observed to be more intense in the splenectomised infected dogs.

Parasitological Observation

Trypanosomes in blood was first observed on day 4 and 7 post-infection (P.I.) in the splenectomised and non-splenectomised infected dogs respectively. The splenectomised infected group showed higher trypanosome count when compared with the intact (non-splenectomised) infected dogs. The parasites were cleared from blood within 24 hours post-treatment (P.T.) with berenil. The non-infected control groups (groups 2 and 4) showed no trace of other infections or trypanosomiasis throughout the duration of the experiment.

Biochemical (Plasma fibrinogen and cholesterol) findings:

Prior to infection, all the dogs used in the study have low fibrinogen and cholesterol values. The fibrinogen levels were observed to increase in the infected groups (Splenectomised and non-splenectomised) following trypanosome inoculation. There was no marked differences in the fibrinogen levels in the splenectomised and non splenectomised infected dogs (Fig. 1).

Similarly, the cholesterol levels were elevated beyond the pre-infection values with the splenectomised infected dogs having higher cholesterol values more than the intact (non-splenectomised) infected group (Fig. 2).

![Graph showing plasma fibrinogen levels](image)

**Figure 1:** Mean plasma fibrinogen levels of intact and splenectomised *T. brucei* infected dogs.
One of the splenectomised uninfected dogs was observed to have an elevated cholesterol value from 2 to 7 weeks PT. The elevated plasma fibrinogen and serum cholesterol values in the infected animals showed a gradual decrease from the second week PT up to week 12.

**Discussion**

This study has shown that *T. b. brucei* (8/18) can produce parasitaemia associated with anorexia, fever, corneal opacity, muscular weakness, orchitis in the males, oedema of the subcutaneous tissues, anaemia characterised by pale mucous membranes, enlargement of peripheral lymph nodes, gradual loss of weight, slow pulse rate and incoordination. These clinical observations are similar to the findings of previous workers.\(^{26,13,23,20,10}\) The pre-patent period of the *T. b. brucei* infection was observed to be shorter in the splenectomised infected dogs than the non-splenectomised (intact) infected ones. The shorter pre-patent period observed may probably have resulted from the absence of spleen which is involved in the control of blood parasites.\(^{26}\)

This study also showed that splenectomy enhanced parasitaemia and this is in agreement with the observations of other workers.\(^{17,8,19}\) The higher parasitaemia exhibited by the splenectomised infected dogs may probably be due to absence or decreased levels of antibodies and antigen presenting cells (APC) which are known to be produced by the spleen during infection and are involved in phagocytosis and immune development.\(^{27}\)

Similarly the elevated temperature (fever) which was higher in splenectomised infected dogs more than the non-splenectomised infected group, may be due to increased parasitaemia as a result of splenectomy which probably might have induced greater release of inflammatory mediators usually involved in fever production.\(^{5}\)

The present study has further shown that trypanosome infection of animals result in hyperfibrinogenaeina with no observable differences between the splenectomised and non-splenectomised animals. The observed increase in fibrinogen levels is consistent with the reports obtained in *T. gambiense* infection of man,\(^{12}\) *T. rhodesiense* infection of rats,\(^{9}\) and in *T. congolense* infection of cattle,\(^{30}\) although low fibrinogen levels have also been reported in *T. congolense* infection of cattle.\(^{11}\) The hyperfibrinogenaeina recorded in the non-splenectomised and splenectomised infected dogs may be associated with disseminated intravascular coagulation (DIC)\(^{4,24,28,2}\). DIC has been reported in several trypanosomal infections based on alterations of coagulation factors including fibrinogen, thrombocytopenia and increased fibrinogen turnover.\(^{4,24}\) Therefore, the increased fibrinogen levels observed, may have resulted from disorganisation or injury to the liver parenchyma since the liver is involved in the production of fibrinogen.\(^{15,31}\)

The results reported in this study has also shown that hypercholesterolaemia, occurred in dogs infected with *T. b. brucei* with splenectomised infected animals having a higher value compared to intact infected dogs. The elevated cholesterol levels in both the infected groups is in agreement with the findings of previous workers in *T. gambiense* infection of rabbit,\(^{30}\) in rats infected with *T. rhodesiense*\(^{29}\) and in rabbits infected with *T. brucei*.\(^{21}\)

The hypercholesterolaemia seen in the infected dogs might probably be an indication of impairment of liver lipid metabolism.\(^{31}\) The increase in cholesterol value in one of the non-infected dogs could not be explained although it is possible to occur from the diet (meat)\(^{15}\) but we are inclined to disregard with this explanation since all the animals were given the same type of food. The elevated levels of fibrinogen and cholesterol in the infected dogs may probably be an indication that the liver has been compromised\(^{15,13}\) in this *T. brucei* infection. Furthermore, berenil treatment although efficacious in the elimination of the para-
sites within 24 hours of administration did not immediately correct these biochemical lesions which may be an indication that the parenchymal cells are yet to be repaired. The *T. b. brucei* organisms are known to be tissue invasive and the decrease in cholesterol and fibrinogen levels in the infected animals only occurred two weeks post treatment.

References


Received for publication on 16th September 1992
EIMERIA LEUKARTI INFECTION IN KENYAN DONKEYS

KARANJA, D.N.R.; NGATIA, T.A. and WANDERA, J.G.
Department of Veterinary Pathology and Microbiology, University of Nairobi,
P.O. Box 29053, Nairobi, Kenya.

INFECTION DES ANES AU KENYA PAR EIMERIA LEUKARTI

Résumé

Deux ânes sur huit qui ont été examinés avaient des ovocystes en formation d'Eimeria leukarti dans certaines parties de l'intestin. Des macrogamétocytes mesurant 62/44,2 µm et des microgamétocytes mesurant 69,6/55,7 µm ont été observés le plus souvent dans les cellules hypertrophiques de l'hôte dans les lamina propria. On a rarement vu des ovocystes à l'extrémité des villosités. Les bouts infestés de parasites sont devenus claviformes, mais il n'y avait pas de réaction inflammatoire dans les zones infectées.

Summary

Two out of eight donkeys examined had oocyst developmental stages of Eimeria leukarti in intestinal sections. Macrogametocytes measuring 62.0 by 44.2µm and microgametocytes measuring 69.6 by 55.7µm were encountered mostly in hypertrophic host cells in the lamina propria. Oocysts were rarely observed at villi tips. The parasitized tips had acquired club-shaped appearance but no inflammatory reaction could be seen in the infected areas.

INTRODUCTION

Eimeria leukarti Fexch (1883) is an intestinal coccidian parasite of horses, burros and donkeys. It has been found in various parts of the world\[^1\,\,^2\,\,^3\]. Most of the reported cases are in horses but a few have also been seen in burros and donkeys.

The clinical significance of this parasite is not clearly known. In a survey, the infection rate in horse foals was observed to be as high as 94% in farms where fecal samples were collected more frequently\[^4\]. Animals showing intractable diarrhoea occasionally harboured these parasites with no major lesions\[^5\,\,^6\,\,^7\] while others displayed massive intestinal haemorrhage and generalized anaemia with no evidence of other causative agents\[^8\]. Contrary to these reports, no clinical disease was reported with upto 50,000 oocysts in an experimental infection\[^9\] and in a heavily infested donkey\[^10\]. Jubb et al (1985) were of the opinion that the stages developing in the lamina propria could be pathogenic due to the large size of macro- and microgametocytes in hypertrophic host cells.

The prevalence of this parasite is unknown. Oocysts can only be recovered from the sediment of faeces and this could be one of the reasons why it is rarely encountered in floatation techniques\[^2\]. Most of the cases recorded were accidentally encountered and it is therefore imperative to record every case encountered with a hope of establishing a comprehensive but complete account of this parasite. The purpose of this paper is to report the occurrence of E. leukarti sexual stages in Kenya. It is the first of its nature in this region.

Materials and Methods

Intestines were sampled from the duodenum through ileum, jejunum, caecum, colons to the rectum from eight mature donkeys (Equus asinus) that died or were euthanized in the study of Trypanosoma congolense experimental
infection. They were fixed in 10% formalin, embedded in paraffin wax and cut at 6 μm thick. The sections were routinely stained in haematoxylin and eosin (H&E) and periodic acid-schiff (PAS) which distinctively stains for the gametes and their adjoining walls. The sections were later examined under light microscope.

Results

Two out of eight donkeys had oocyst developmental stages in the small intestines mainly in the ileum. This represented about 25% of the samples considered. The developmental stages were mainly located in lamina propria within hypertrophic host cells. These cells had typical signet ring appearance of the nuclei. Macrogametocytes, microgametocytes and rarely oocysts were observed in the sections. Upto 5 stages could be seen in one villus which had assumed a club-shaped appearance (Fig. 1).

Macrogametocytes measured 62.0 by 44.2 μm on average (n=50). They were oval in shape and consisted of a cluster or a ring of dense, circular, eosinophilic, refractile bodies (Fig. 2).

Microgametocytes measured 69.6 by 55.7 μm on average (n=50). They were oval or circular masses found in the lamina propria in hypertrophic cells. They contained many tiny granular basophilic microgametes (Fig. 3). Two microgametocytes could be seen in one hypertrophic host cell and it was speculated that they could have come from one parent (Fig. 2). Degenerating microgametocytes could occasionally be surrounded by lymphocytes.

Oocysts were rarely encountered in the sections. When seen, they were deeply basophilic with a homogenous body. They had a thick wall and were located near the villus tip in the lamina propria.

Discussion

The oocysts developmental stages were identified by elimination and the microscopic appearance. Eimeria sol-
ipedum and *Eimeria uniungulati* have only been reported once in the horse faeces in Russia\(^1\). This leaves *E. leukarti* as the only known coccidian parasite of equines with such a microscopic appearance\(^1,7,10,12,13\).

The life cycle of this parasite is still controversial\(^1\). Asexual and sexual stages have invariably been reported. Schizonts measuring 300 by 170 \(\mu m\) have been reported by Kheysin (1972) while Barker and Remmler (1972) saw no such stages in an experimental infection. The latter workers concluded that schizogony is complete by day 14 post-infection if at all it occurs. In the two Kenyan donkeys sexual stages were positively identified but the source of infection and the duration could not be established. It is difficult with such an obscure picture to rule out or incriminate the possibility of asexual reproduction in this parasite.

Sexual stages namely; macrogametocytes, microgametocytes and oocysts have been observed in hypertrophic host cells in the lamina propria, lymphoid follicles of the ileum and occasionally free in the lumen of the ileum and the jejunum\(^9,12\). The early parasite stages are found in large parasitophorous vacuoles at the base of the villi\(^12,13\) but at later stages they are seen near the villi tips\(^8\). The parasitized host cell have not been properly identified but a few postulations have been advanced. During the early parasite stages, the spindle shaped nucleus gives the impression of a smooth muscle cell from the lamina muscularis\(^12\) while at later stages, the bulky cytoplasm and the large signet ring appearance of the nucleus may point at a macrophage or a displaced epithelial cell from a neighbouring lacteal\(^1,12\).

Macrogametocytes measuring 78-151 \(\mu m\) have been reported\(^8\). They are oval with a ring or cluster of dense, circular, eosinophilic, refractile bodies\(^1,7,12,13\). Microgametocytes could be seen grossly as white foci scattered in the small intestines more intense in the ileum\(^10,12\). Microscopically, they are circular or oval masses containing numerous tiny, granular basophilic gametes\(^1,7,13\). At later stages of development, the latter may measure 148 by 243 \(\mu m\) in diameter and occupy the whole tip of the villus\(^12,13\). The appearance of the sexual stages observed in the Kenyan donkeys with the exception of the sizes concurs with this description.

Oocysts deeply basophilic with a homogenous arrangement are seen in the intestinal sections and in the lumen of the intestines\(^13\). In the fecal samples, they are rarely encountered during routine fecal examination using floatation techniques as they are heavy and sediment to the bottom\(^4,5,6,9\). The short duration of patency being about 12 days and the low oocyst production could have attributed to their infrequent encounters\(^6,9\).

The pathogenicity of the parasite has been a matter of speculations. Most workers agree that this parasite is harmless and is indeed encountered in animals dying from other known causes\(^2\). Little inflammatory reaction has been found accompanying these parasites thus implying that the animals have learnt to live with this parasite. In our report, the parasites were observed in symptomless donkeys and no inflammatory reaction could be attributed to their presence. It can be deduced that the parasite is harmless in these animals.

**Acknowledgement**

The authors wish to thank the technical staff of histopathology section for neat work that enabled proper identification of the parasite.

**References**


Received for publication on 21st August 1992
TUNA FISH INFECTION WITH PROTOZOA, SUBPHYLUM, MYXOSPOREAN: AN AESTHETIC CASE

MBUTHIA, P.G.*, KABURIA, H.F.A.*, NGATIA, T.A.* and KAYIHURA, M.*

1Faculty of Veterinary Medicine, Department of Pathology & Microbiology
2Faculty of Veterinary Medicine, Department of Public Health, Pharmacology and Toxicology, University of Nairobi, P.O. Box 29053, Nairobi, Kenya

INFECTION DES THONS PAR DES PROTOZOAIES ET DES SUBPH. MYXOSPORES: ETUDE D’UN CAS ESTHETIQUE

Résumé

On nous a présenté un morceau de muscle de thon à cause d’une lésion qui a intrigué un consommateur. Du point de vue macroscopique, le morceau de muscle avait de nombreuses taches opaques, gris-branchâtres, des nodules, des pustules et des raies de tailles différentes. Du point de vue histologique, il y avait des kystes sur l’épiderme, le derme et les muscles; ils étaient ronds, ovales ou sphériques. Certains kystes étaient divisés par des septums de tissu cellulaire en deux ou trois parties. Une légère infiltration de cellule mononucléaire par des lymphocytes et des macrophages était la seule réaction visible de l’hôte autour de ces kystes. Les muscles voisins étaient comprimés, ce qui a entraîné l’atrophie et la dégénérescence de la fibre musculaire. Des taches laissées par les kystes ont fait apparaître des spores de 8-10μm de diamètre avec 1 à 6 capsules polaires. La majorité des spores contenait 4 capsules. La culture bactérienne n’a pas donné de résultats significatifs. En tenant compte de la morphologie, de la taille et du nombre de capsules, on a pu déterminer que c’était des myxospores. Il s’agit du premier cas de rejet de viande de poisson pour des raisons esthétiques, qui nous a été présenté. Nous pensons que la présente étude est donc le premier rapport sur l’infection des thons par des myxospores (très probablement Henneguya spp) au Kenya et peut-être à l’Ouest de l’Océan Indien.

Summary

A piece of tuna muscle was brought to us due to lesions that were not appealing to the consumer. Grossly it had numerous opaque greyish white spots, nodules, blotches or streaks of variable sizes. Histologically there were cysts on skin epidermis, dermis and muscles which were either round, oval or spherical. Some cysts were divided by connective tissue septa into two or three compartments. A mild mononuclear cell infiltration by lymphocytes and macrophages was the only visible host reaction in the vicinity of these cysts. Neighbouring muscles were compressed, resulting in muscle fibre atrophy and degeneration. Squash smears of the cysts revealed spores 8-10μm in diameter with polar capsules 1-6 in number. The majority of spores had 4 capsules in them. Bacterial culture yielded no significant findings. On morphology, size and capsule numbers, myxosporian was diagnosed. This is the first case of fish meat rejection on aesthetic reasons presented to us. We believe that it is the first report of myxosporia (most likely Henneguya spp) infection in tuna fish in Kenya and possibly in the West Indian Ocean.

INTRODUCTION

Reports on the occurrence of fish diseases in Kenya are rather scanty. The few available reports dwell on occasional diseases diagnosed from wild fish in the lakes and rivers[1]. Myxosporidia parasites appear to be common in the fish families Cichlidae, Cyprinidae and Mugilidae which are found in brackish waters in Africa[11]. Histozoic myxosporidia identified in these fish belong to the genera Myxobolus, Henneguya, Thelohanellus and Kudoa. Some of these parasites such as Henneguya and Thelohanellus have only been diagnosed in non-cichlid fish (Labeo spp and Barbus spp.). Henneguya spp. was found in the gills of Lates albertianus in lake Albert in

*Author to whom correspondence should be addressed.
Uganda. *Myxobolus* spp have been observed in the visceral organs of cichlids fish in lake Victoria\(^{(1)}\). There is no mention of marine fish infection with myxosporean parasites in Kenya.

Some of the most economic important diseases of fish include microsporidian and myxosporean infestation of muscles. These parasites cause lesions which ruin the aesthetic appearances of fish, examples of these include the myxosporean *Henneguya* spp\(^{(2)}\). The known histozoic myxosporeans that are most destructive to muscles belong to the genera *Kudoa, Henneguya* and *Ceratomyxa*. These parasites have a spore stage within the white muscles of a variety of wild fish and are responsible for softening of muscle texture and considerable economic loss\(^{(3)}\). In this communication we report the occurrence of myxosporean infection in the muscles of a tuna fish.

**Materials and Methods**

A piece of tuna muscle was bought by a consumer from Nairobi city market. On arrival home the consumer found it not appealing due to the presence of large number of grayish spots in virtually every square inch of the muscle. The muscle was then submitted to the Faculty of Veterinary Medicine, Kabete for examination and diagnosis.

Tissues for histopathology were fixed in 10% buffered formalin solution, processed routinely by the paraffin block method, sectioned at 6\(\mu\)m thickness and stained with Haematoxylin and Eosin for microscopic examination. Selected sections with the cysts were also stained with Periodic Acid-Schiff (PAS). The diameter of the cysts was measured using a calibrated ocular micrometer.

Some cysts were separated from the formalin fixed muscles, squashed between two slides and stained with methylene blue.

**Results**

The muscle and its skin were examined morphologically. These had numerous opaque greyish white spots, nodules, blotches or streaks of variable sizes. The

---

*Figure 1: Section of a tuna muscle showing two cysts, a spherical (C) and septate (D) cysts. H/E stain (x 40)*
Figure 2: Septate cysts in Figure 1 showing a mild mononuclear cell infiltration around the cyst capsule (F) and numerous spores (G).

H/E stain (x 400)

Figure 3: A squash preparation of formalin fixed cysts, showing spores with polar capsules (arrow). Methylene blue stain (x 400)
smallest nodule or spot was about 0.85 mm long and the largest was 5 mm in length especially the septate cysts and all were 1.0 mm in diameter. These cyst-like structures were on the skin, under the scales, the dermis, subdermis and in the muscles. Round, oval, individual or multiple cysts or xenomas were seen, giving the appearance of neoplasia or a granulomatous reaction in the muscles.

Histologically, numerous cysts which were round, oval or spherical were seen between muscle fibres, connective tissue, and epidermis. Some were divided by connective tissue septa into two or three joined cysts (Fig. 1). A milk mononuclear cell infiltration composed of lymphocytes and macrophages was prominent on the wall of some cysts (Fig. 2). Otherwise there was no other visible host response.

The cyst wall was fibrous and 10-15μm in thickness. These cysts had exerted pressure on neighbouring muscle fibres resulting in muscle fibre atrophy, degeneration and necrosis in some cases. Inside the cyst wall were numerous spores with refractile wall (Fig. 2).

In squash smear preparations the spores were found to have refractile walls, 8-10μm in diameter with 1-6 polar capsule which were intensively stained by methylene blue. The majority of spores had 4 capsules in them (Fig. 3). It was not possible to demonstrate the spiral filaments. Maybe due to the fact that the muscle had been kept in formalin for a few weeks, before the squash smear was made. The cysts were also PAS positive.

On bacterial culture there was no significant growth both aerobically and anaerobically.

**Discussion and Conclusion**

Various parasites can affect tuna fish. In the yellow fin tuna, the sporozoae Hexacapsula neothunni has been associated with jellification of the muscles\(^\text{4,5}\). The tuna meat become jelly due to a protease secreted by this sporozoae. The bluefin tuna from moroccan water have been found to be parasitized by Kudoa spp. In South Africa tuna fish had a condition known as milkiness due to softening and liquefaction of fresh due to Kudoa thyrisitita\(^\text{6}\).

In temperate countries the effect of myxosporea parasites in fish has been well documented\(^\text{2,3}\). They have been known to cause lesions ruining the aesthetic appearance of the fish\(^\text{2}\), extensive myofibre destruction, softening of the muscle texture and considerable economic loss\(^\text{3}\).

Paperna (1980) has reviewed the fish parasites in Africa. He reported the presence of Henneguya spp, in the gills of the wild fish Lates albertianus in Uganda. Earlier report by Meschkat (1968), had also reported myxosporidiasis in cultured fish in Uganda. Balarin (1985) reported some common fish diseases in Kenya. However, the only myxosporea reported was in the genera Myxobolus as had previously been noted by Paperna (1980). The latter had been diagnosed in Tilapia fish from Lake Victoria. Henneguya spp has not been reported in Kenya.

The tuna fish meat in this communication was rejected by the consumer as the parasitic infection had ruined its aesthetic appearance. Lesions were plenty and the morphological appearance of cysts were like those of the class myxosporea\(^\text{2,3,9,10}\). The cysts, spores and capsules morphology and size are suggestive of the family Myxobolidae, genera Henneguya spp. The cysts had subjected the muscle fibres to severe pressure resulting in muscle fibre atrophy, degeneration and necrosis in some cases. There was no softening of the muscles observed in this case. However, the lesions were similar to those described by others\(^\text{2,3}\). Very little host response to the parasite was observed. This is the first report of fish meat rejection that has been sent to us for diagnosis. Maybe there is a great loss in meat in Kenya, which is not well documented. This is an area that needs more research. This report confirms myxosporea (Most likely Henneguya) infection in tuna fish and maybe the first such report in tuna in Kenya and possibly in West Indian Ocean.
Acknowledgement

The technical help given by the members of department of Veterinary Pathology and Microbiology and department of Veterinary Public Health, Pharmacology and Toxicology — is highly appreciated. Comments and advice given by Prof. Hugh W. Ferguson, University of Guelph on the histopathology is also acknowledged. This paper was typed by Miss. J.N. Mwea.

References


Received for publication on 9th April 1992
A SEROLOGICAL SURVEY OF SOME ABOBITIFACIENT DISEASES OF SHEEP AND GOATS IN THE MAIDUGURI AREA OF NIGERIA

J.D. AMIN and A.J. SILSMORE

Department of Animal Health, The Royal Veterinary College, Hawkshead Road, Boltons Park, Potters Bar, Herts, EN6 1NB, England

ETUDE SEROLOGIQUE DE CERTAINES MALADIES ABORTIVES DES OVINS ET DES CAPRINS DANS LA REGION DE MAIDUGURI AU NIGERIA

Résumé

Des sérums de 211 brebis et 253 chèvres, recueillis dans la région de Maiduguri et des ses environs ont été examinés en vue de détecter des anticorps contre Brucella abortus et B. melitensis à l'aide du test d'agglutination sur lame, contre Toxoplasma gondii avec le test d'agglutination sur latex, contre Chlamydia psittaci par la technique ELISA (titrage avec immunoabsorbant lié à une enzyme) et contre le virus de la fièvre catarrhale ovine à l'aide du test de diffusion en gelose. L'enquête a révélé les taux de prévalence suivants: B. abortus (ovins: 6.6%; caprins: 6.3%), B. melitensis (ovins: 2.2%; caprins: 2.8%), T. gondii (ovins: 11.7%; caprins: 4.8%), C. psittaci (ovins: 3.3%; caprins: 3.6%), fièvre catarrhale ovine (ovins: 74.3%; caprins: 91.2%).

Summary

Sera of 211 sheep and 253 goats, collected from Maiduguri and its environs were tested for antibodies against Brucella abortus and B. melitensis by slide agglutination, Toxoplasma gondii by latex agglutination, Chlamydia psittaci by enzyme linked immunosorbent assay (ELISA) and bluetongue virus by agar gel diffusion. The survey showed the following prevalence rates: B. abortus, sheep 6.6%, goats 6.3%; B melitensis, sheep 2.2%, goats 2.8%; T. gondii, sheep 11.7%, goats 4.8%; C. psittaci, sheep 3.3%, goats 3.6%; bluetongue, sheep 74.3%, goats 91.2%.

INTRODUCTION

Sheep and goats are kept in many parts of Africa because they are cheaper and easier to maintain than cattle. Their management has been largely traditional with little veterinary input. Identification of problems afflicting them and the introduction of improved preventive or remedial measures could therefore greatly enhance production efficiency. Abortion and infertility are usually not reported but diseases causing abortion and infertility have been recorded in sheep and goats in Nigeria.

Chlamydial abortion which was first diagnosed in Scotland is transmitted by oral infection[1,2]. It has been diagnosed in Nigeria[3] but detailed studies on the prevalence of the disease are lacking. The disease has also been diagnosed in the neighbouring Republic of Chad[4] and other parts of Africa[5], affecting both sheep and goats.

Brucellosis is considered to be the single most important reproductive disease of livestock in Nigeria[6], causing abortion and infertility in sheep and goats. However, the prevalence of seropositive animals varies depending on location: 0.8-14.5% in sheep and 0.6-39% in goats[6,7,8]. In Nigeria, the tube agglutination test is commonly used for serological investigation of brucellosis because it allows titration of the antibody level but the slide agglutination test is a rapid screening test and can be used in the field. The latter identifies recently infected animals earlier than the tube agglutination test and has a sensitivity
and specificity of 96.2% and 97.1% respectively.

In other countries the complement fixation test (CFT) is used routinely and enzyme linked immunosorbent assay (ELISA) tests are being introduced for the diagnosis of brucellosis.

Toxoplasmosis is a protozoan infection of man and animals. It causes infertility and abortion in sheep and goats and has been reported from many parts of Nigeria. However, the level of the disease in the north-eastern parts of Nigeria has not been studied. Based on the indirect haemagglutination test (IHAT), a seroprevalence of 4.5% in goats and 9% in sheep has been reported, while using the indirect fluorescent antibody technique it was found that 4% and 9.5% of goats and sheep respectively were seropositive at slaughter. A higher prevalence has been reported when using the very reliable Sabin-Feldman dye test. However, the test requires the use of living Toxoplasma as antigen and an adequate accessory serum factor which makes routine testing difficult. The development of the indirect latex agglutination test (ILAT) eliminated most of the difficulties encountered with the dye test and those of other intermediate tests like the haemagglutination inhibition test. In the ILAT, latex particles, coated with inactivated toxoplasma antigen, agglutinate in the presence of specific antibody in the serum of infected animals. It has a good correlation with the dye test. Recently, workers showed that the latex agglutination test (LAT) and the indirect fluorescent antibody test (IFAT) were able to detect early infection with antibodies first appearing 2-3 weeks after infection, but detection by IHAT was slower and less consistent.

Bluetongue is primarily a disease of sheep caused by an orbivirus and transmitted by insects. The disease is widespread on the African continent and can cause abortion, fetal deformities, or birth of weak lambs. A prevalence of 58% in sheep and 50% in goats has been reported in a serological survey of parts of southern Nigeria.

In this study, a serological survey of these diseases of reproduction was undertaken to define their local significance and to obtain information for further action where necessary.

Materials and Methods

Serum samples were collected from farms, an abattoir and clinics in Maiduwuri and its environs. The samples were from 193 mature ewes and 197 does that had given birth at least once and from 24 mature rams and 66 bucks. For samples taken from clinics, the primary complaint was not abortion or infertility. The serum samples were heat treated at 60°C for 30 minutes after separation from the blood clot. The samples were then stored at -20°C until they were tested.

*Chlamydia ELISA*

The sera were tested at a dilution of 1:400 for antichlamydial antibodies by an indirect ELISA: a chlamydial antigen was prepared in McCoy cell tissue culture and a control antigen was prepared from uninfected cells. These antigens were
diluted 1:100 and 100 ul amounts used to coat each well of the microtitre plate. After adding 100 ul of the diluted serum and subsequent incubation and washing, 100 ul of a suitable dilution of rabbit anti-sheep serum conjugated to horseradish peroxidase (Dako Ltd., CA., USA) was added to the wells. After further incubation, washing and addition of a substrate, the reaction was stopped and the absorbance of the contents of each well was read at 492 nm using a photometer (MR 600, Dynatech, Torrance, CA., USA). The reading of the control well was subtracted from the reading of the test well. The serum samples were considered to be positive if the difference between the test and control readings was greater than 0.1.

Toxoplasma test

A commercial latex agglutination test (LAT) (Eiken Co. Ltd. Japan) was used. 0.025 ml of a buffer solution was added to each of twelve wells across the top of a microtitration plate with “U” shaped wells. Well 12 was used as a control. For wells 1-11, 0.05 ml of a test serum was placed into a small test tube and 0.35 ml of the buffer solution was added to it to make a dilution of 1:8. 0.025 ml of the 1:8 dilution was added to each of these wells to make a 1:16 dilution. Subsequently, serial two-fold dilutions of each sample were made in the wells down the plate and the last 25 ul from the eighth well was discarded. 0.025 ml of the toxoplasma coated latex suspension was added to each well. The procedure was repeated in the twelfth well using the positive control serum provided. The plate was gently shaken and placed on a horizontal surface and covered to avoid evaporation. After 12 hours the resulting agglutination pattern was recorded.

In wells in which agglutination had taken place, latex particles were distributed over the total area of the bottom of the well. In wells in which there was no agglutination, latex particles formed a “button” in the centre of the well.

Brucella stained antigen test

0.02 ml of the undiluted test serum was placed in a 3 cm diameter circle on a white tile. One drop of a stained suspension of Brucella antigen was added to the test serum. The tile was rocked gently for 1 minute to mix the test serum and the stained antigen. If agglutination was obtained within one minute, the test serum was considered to be positive. Each serum sample was tested against a B. abortus and a B. melitensis stained antigen (Wellcome Ltd. UK).

Bluetongue agar gel test

This was carried out at the Institute of Animal Health, Pirbright, England using a standard test\(^{(19)}\).

Results

The results are summarised in Table 1.

Chlamydia ELISA

Sera of seven (3.3%) of 211 sheep and nine (3.6%) of 253 goats were positive for Chlamydia. None of the positive sera were from rams or bucks.

Toxoplasma LAT

Sera of 24 (11.7%) of 206 sheep and 12 (4.8%) of 248 goats were positive for

<table>
<thead>
<tr>
<th>Antigen tested</th>
<th>Males</th>
<th>Females</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. abortus</td>
<td>1/18</td>
<td>11/164</td>
<td>12/182 (6.6%)</td>
</tr>
<tr>
<td>B. melitensis</td>
<td>0/18</td>
<td>4/164</td>
<td>4/182 (2.2%)</td>
</tr>
<tr>
<td>Toxoplasma</td>
<td>3/18</td>
<td>21/188</td>
<td>24/206 (11.7%)</td>
</tr>
<tr>
<td>Chlamydia</td>
<td>0/18</td>
<td>7/193</td>
<td>7/211 (3.3%)</td>
</tr>
<tr>
<td>Bluetongue</td>
<td>15/24</td>
<td>107/140</td>
<td>122/164 (74.4%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Antigen tested</th>
<th>Males</th>
<th>Females</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. abortus</td>
<td>1/18</td>
<td>11/164</td>
<td>12/182 (6.6%)</td>
</tr>
<tr>
<td>B. melitensis</td>
<td>0/18</td>
<td>4/164</td>
<td>4/182 (2.2%)</td>
</tr>
<tr>
<td>Toxoplasma</td>
<td>3/18</td>
<td>21/188</td>
<td>24/206 (11.7%)</td>
</tr>
<tr>
<td>Chlamydia</td>
<td>0/18</td>
<td>7/193</td>
<td>7/211 (3.3%)</td>
</tr>
<tr>
<td>Bluetongue</td>
<td>15/24</td>
<td>107/140</td>
<td>122/164 (74.4%)</td>
</tr>
</tbody>
</table>
Toxoplasma. Of the 24 positive sera from sheep, three were from the 18 rams examined and 21 were from the 188 ewes tested. The twelve positive sera of goats were all from sera of 192 does examined.

**Brucella plate test**
Sera of 12 (6.6%) of 182 sheep and 16 (6.3%) of 252 goats were positive for *B. abortus*. The 12 positive sera of sheep were from one of 18 rams and 11 of 164 ewes, while the 16 positive goat sera were all from the sera of 196 does examined.

Sera of four (2.2%) of 182 sheep and seven (2.8%) of 252 goats were positive for *B. melitensis*. All four positive sheep sera were from the 164 ewes tested and all seven positive goat sera were from the 196 does tested.

**Bluetongue agar gel precipitin test**
Sera of 122 (74.4%) of 164 sheep and 167 (91.2%) of 183 goats were positive by the bluetongue agar gel precipitin test. Of the 122 positive sheep sera, 15 were from the sera of 24 rams tested while 107 were from the sera of 140 ewes tested. Of the 167 positive goat sera, 58 were from the sera of 66 bucks tested while 103 were from the sera of 117 does tested.

**Discussion**
Although feed scarcity constitutes a major constraint to livestock production in Nigeria, the presence of a large variety of diseases, many of them affecting reproduction, also contributes to the low productivity of domestic animals and limits their ability to realise their full productive potential. Recent trends towards intensification of animal production can increase the occurrence of disease. This was demonstrated in a study of an intensively managed farm where 70% of sheep were seropositive for *Brucella ovis*.

Generally, goats are more susceptible to *B. melitensis* than sheep; however, results of this survey show that the infection rate is almost equal, being marginally higher in goats. It is likely, however, that the two brucella antigens used in the plate test cross react and therefore make distinction between the two diseases difficult. For *B. melitensis*, the serum agglutination test is thought to be unsatisfactory and the stained antigen test and agar gel immunodiffusion tests are reasonable substitutes for the CFT if that test is not available. The prevalence of *B. abortus* antibodies in sheep and goats in this study is a reflection of the husbandry system in which cattle are kept together with sheep and goats. It would be interesting to find out if cattle can be infected with *B. melitensis* in this area as this would have serious public health implications.

The prevalence of antichlamydia antibodies found in this survey is low (3.3% of ewes and 3.6% of does), especially when compared with those of other diseases, but the indication that the disease is present implies that the potential for increase is there, especially since it is perpetuated by infection acquired during lambing or abortion. No antibodies were found in the sera of the 18 rams and the 56 bucks examined. The ELISA test used detected group specific antibodies. It is possible, therefore, that positive results could have been due to manifestations other than abortion such as chlamydial pneumonia, arthritis or enteric infection. However, as none of the ram sera were positive it is more likely to be an indication of chlamydial abortion. Since chlamydial abortion was first diagnosed in Nigeria, there has not been an extensive survey of the disease. Random sampling across the country would indicate the level of the disease nationwide and the ELISA would be an appropriate test to use because of its greater sensitivity than CFT and ease of automation.

Toxoplasmosis was the second most prevalent disease among the population examined, especially in sheep (11.7% being seropositive, including 3 of 18 rams). Antibodies were found in 4.8% of goats, none of which were bucks. Cats, the definitive hosts, are widely kept by pastoralists and will influence the level of toxoplasmosis in sheep, in which abor-
tion rates of up to 50% have been recorded\textsuperscript{23}.

Although the sample was small, none of the 56 buck sera examined were positive for chlamydiosis, toxoplasmosis or brucellosis. This may be due to the fact that these diseases are associated more with the female genital tract than with that of the male. The Maiduguri environment, having a semi-sahelian climate, is a harsh one for microorganisms, and could account for the low prevalence of some of these diseases; this may not be the case in wetter parts of the country. Brucellosis and toxoplasmosis have been studied in Nigeria, yet there is no national policy to control these diseases. As a result of a gradual intensification of production and the presence of increased awareness of livestock diseases, chlamydial abortion is more evident. A proper assessment of the threat posed by each of these diseases to the livestock industry must be undertaken before any effective control strategy is adopted. All are zoonoses, especially \textit{B. melitensis} infection and toxoplasmosis. This should give added impetus to their control.

Bluetongue appears to be the most prevalent disease of the four surveyed. The seroprevalence is higher in goats (91\%) than in sheep (74\%). Since antibodies have a role in protection\textsuperscript{24}, it would appear that most sheep and goats are immune to the disease. The presence of bluetongue makes it difficult to import sheep from bluetongue-free areas without taking remedial measures. A study in sheep and goats similar to that conducted in cattle to study the seasonal variation in the disease in Nigeria\textsuperscript{19} could elucidate the epidemiology of the disease in small ruminants.

There is a need to examine a larger sample size to find out the proportion of the population that has been exposed to these diseases. When this is correlated to clinical findings, the data can contribute to a database of information necessary for control programmes for the various diseases.

Acknowledgement

We acknowledge assistance from Mrs. B.C. Wilsmore and Institute for Animal Health, Pirbright Laboratory, with the serological investigations.

References


Received for publication on 31st July 1992
HAEMATOLOGICAL EFFECTS OF XYLAZINE HYDROCHLORIDE, KETAMINE HYDROCHLORIDE AND THEIR COMBINATION IN DONKEYS

E.G.M. MOGOA and S.M. MBIUKI
Clinical Studies Department, University of Nairobi, P.O. Box 29053, Nairobi, Kenya

EFFETS HEMATOLOGIQUES DE L’HYDROCHLORURE DE XYLAZINE, DE L’HYDROCHLORURE DE KETAMINE ET DE L’ASSOCIATION DE CES DEUX PRODUITS CHEZ LES ANES

Résumé
Les effets hématologiques de l’hydrochlorure de xylazine, de l’hydrochlorure de kétamine et de l’association de ces deux produits ont été évalués chez trois groupes de cinq ânes chacun. La xylazine a été injectée à raison de 2 mg/kg et la kétamine à une dose de 4,4 mg/kg. Toutes les injections ont été administrées par voie intramusculaire. Les effets de chaque médicament et de l’association des deux produits sur les éléments constitutifs du sang étaient très variables. L’association xylazine-kétamine a provoqué une baisse significative (P<0,05) des valeurs du PCV et de Hb, tandis que la xylazine et la kétamine n’ont entraîné chacune qu’un léger changement des valeurs des composants du sang.

Summary
Haematological effects of xylazine hydrochloride, ketamine hydrochloride and their combination were evaluated in three groups of five donkeys each. Xylazine was injected at a dosage of 2.0 mg/kg and Ketamine at a dosage of 4.4 mg/kg. All the injections were administered intramuscularly. The effects of the individual drugs and their combination on the blood constituents were quite variable. The drug combination Xylazine-Ketamine caused a significant (P<0.05) decrease in PCV and Hb values whereas xylazine and ketamine on their own caused insignificant changes on blood constituents.

INTRODUCTION
The injection of anaesthetics into animals is accompanied by certain clinical and haematological changes. Changes in haematological components due to xylazine, ketamine or their combination have been reported in sheep\(^1\,^2\,^3\) and cattle\(^4\,^5\). The various reasons for the changes is haematological components due to anaesthetics have also been suggested\(^6\,^7\). The purpose of the study was to evaluate the haematological changes due to xylazine, ketamine and their combination in donkeys.

Materials and Methods
A total of 15 experiments were carried out in three groups of 5 donkeys each. The donkeys were of mixed sex and they were aged between six and eleven years. They weighed between 150 and 200 kg.

Before any experiment was carried out, the donkeys were examined to a certain that they were healthy. Food was withdrawn from the donkeys 18 hours before the experiment was started. However, water was available ad libitum.

Group 1 donkeys were injected with xylazine hydrochloride group 2 with ketamine hydrochloride and group 3 with the ketamine-xylazine combination. All the injections were administered intramuscularly. Xylazine was given at dosage of 2.0 mg/kg and ketamine at 4.4 mg/kg. 5 ml of EDTA blood for haematology was withdrawn from the jugular vein before any drug was injected and this was repeated at one hour and five hours after the injection of the drug(s). These samples were labelled A, B and C respectively. Cell counts and other haematological parameters were carried out within 8 hours of the drawing of the blood samples. Slides for differential white cell
count were prepared, stained with 1:5 giemsa and the counts made.

**Blood Analysis**

The following blood constituents were evaluated for every EDTA blood sample collected. The packed cell volume (PCV) in per cent using the Coulter Counter, total protein (TP) in g/100 ml using the Atago Refractometer, Haemoglobin (Hb) in g/100 ml using the Coulter Counter-Haemoglobinimeter, the Mean Corpuscular Volume (MVC) in Cubic microns ($\mu^3$) using the Coulter Counter, the Red Blood Cell Count (RBC) in million per cubic millimeter (10$^6$/mm$^3$) and White Blood Cell Count (WBC) in thousands per cubic millimeter (10$^3$/mm$^3$) using the Coulter Counter. The Mean Corpuscular Haemoglobin Concentration (MCHC) in grams per 100 ml of cells (g/100 ml cells) was obtained by dividing haemoglobin by PCV and multiplying by 100. The Microhematocrit (MHCT) in per cent was obtained using the microhematocrit method and read off using the Hawksley microhematocrit reader$^{[8]}. The Giemsa stained slides were used to make differential cell counts using a microscope at x 1000 magnification and under oil immersion. 100 white cells were counted and the percentage of each of the various white cells i.e. Neutrophils (TN), lymphocytes (L), Monocytes (M) and Eosinophils (E) recorded. All the results were analysed statistically using variance and covariance with repeated measures.

**Results**

The effects of the drugs on the blood constituents were quite variable. The donkeys injected with Xylazine showed a decrease in the PCV, TP, Hb, RBC, WBC, MCV, TN, eosinophil and micro-hematocrit values in the first one hour following the drug injection while the MCHC and lymphocyte values increased within the same time (table 1(a)). However, these changes were not significant ($p>0.05$).

The donkeys injected with ketamine showed an insignificant ($p>0.05$) increase in the PCV, Hb, RBC, WBC, lymphocyte, eosinophil and micro-hematocrit values with the first hour following the injection of the drug. The TP did not change whereas the MCV and TN values showed an insignificant ($p>0.05$) decline (Table 1(b)).

### Table 1(a) Group 1

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV</td>
<td>36.8±4.0</td>
<td>29.4±5.5</td>
<td>38.4±4.3</td>
</tr>
<tr>
<td>TP</td>
<td>7.6±0.9</td>
<td>7.1±1.0</td>
<td>7.5±1.0</td>
</tr>
<tr>
<td>Hb</td>
<td>11.9±1.5</td>
<td>10.0±2.0</td>
<td>12.5±1.5</td>
</tr>
<tr>
<td>RBC</td>
<td>6.0±1.0</td>
<td>4.9±1.3</td>
<td>6.3±1.0</td>
</tr>
<tr>
<td>WBC</td>
<td>15.8±3.9</td>
<td>13.0±3.3</td>
<td>16.8±3.4</td>
</tr>
<tr>
<td>MCV</td>
<td>61.2±7.7</td>
<td>59.8±6.1</td>
<td>61.4±6.0</td>
</tr>
<tr>
<td>MCHC</td>
<td>32.6±1.8</td>
<td>34.4±2.0</td>
<td>32.6±1.1</td>
</tr>
<tr>
<td>TN</td>
<td>48.2±15.6</td>
<td>45.2±22.3</td>
<td>56.4±14.0</td>
</tr>
<tr>
<td>L</td>
<td>47.6±14.8</td>
<td>53.6±22.3</td>
<td>56.4±14.0</td>
</tr>
<tr>
<td>M</td>
<td>0.8±1.3</td>
<td>0.8±1.6</td>
<td>2.8±1.4</td>
</tr>
<tr>
<td>E</td>
<td>3.4±2.5</td>
<td>1.2±1.6</td>
<td>2.8±1.4</td>
</tr>
<tr>
<td>MHCT</td>
<td>32.2±3.8</td>
<td>31.4±5.4</td>
<td>36.2±5.2</td>
</tr>
</tbody>
</table>

### Table 1(b) Group 2

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV</td>
<td>32.6±6.8</td>
<td>33.0±5.5</td>
<td>34.0±6.5</td>
</tr>
<tr>
<td>TP</td>
<td>6.9±0.3</td>
<td>6.9±0.3</td>
<td>7.1±0.2</td>
</tr>
<tr>
<td>Hb</td>
<td>11.6±2.4</td>
<td>11.8±2.1</td>
<td>11.6±2.0</td>
</tr>
<tr>
<td>RBC</td>
<td>5.8±1.6</td>
<td>5.9±1.3</td>
<td>5.8±1.5</td>
</tr>
<tr>
<td>WBC</td>
<td>11.2±1.5</td>
<td>11.3±1.5</td>
<td>11.8±1.5</td>
</tr>
<tr>
<td>MCV</td>
<td>57.4±11.2</td>
<td>57.2±7.9</td>
<td>60.2±11.3</td>
</tr>
<tr>
<td>MCHC</td>
<td>36.0±5.1</td>
<td>36.0±3.6</td>
<td>34.2±2.9</td>
</tr>
<tr>
<td>TN</td>
<td>49.4±3.7</td>
<td>45.8±4.4</td>
<td>49.2±6.0</td>
</tr>
<tr>
<td>L</td>
<td>46.8±1.9</td>
<td>49.2±7.7</td>
<td>46.0±8.2</td>
</tr>
<tr>
<td>M</td>
<td>0.8±1.3</td>
<td>0.8±0.5</td>
<td>0.8±1.3</td>
</tr>
<tr>
<td>E</td>
<td>3.0±1.7</td>
<td>4.6±3.3</td>
<td>4.0±2.9</td>
</tr>
<tr>
<td>MHCT</td>
<td>33.2±7.2</td>
<td>33.6±8.0</td>
<td>33.6±7.1</td>
</tr>
</tbody>
</table>

### Table 1(c) Group 3

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV</td>
<td>42.4±3.7</td>
<td>35.2±4.2</td>
<td>38.4±3.6</td>
</tr>
<tr>
<td>TP</td>
<td>8.2±0.8</td>
<td>7.3±0.6</td>
<td>7.5±0.3</td>
</tr>
<tr>
<td>Hb</td>
<td>14.1±0.9</td>
<td>11.6±0.9</td>
<td>13.3±0.9</td>
</tr>
<tr>
<td>RBC</td>
<td>6.5±1.1</td>
<td>5.5±0.9</td>
<td>6.0±1.2</td>
</tr>
<tr>
<td>WBC</td>
<td>12.5±3.2</td>
<td>11.8±3.0</td>
<td>13.1±2.7</td>
</tr>
<tr>
<td>MCV</td>
<td>65.8±6.0</td>
<td>65.0±5.0</td>
<td>64.8±6.9</td>
</tr>
<tr>
<td>MCHC</td>
<td>32.2±1.7</td>
<td>33.0±2.1</td>
<td>34.8±1.8</td>
</tr>
<tr>
<td>TN</td>
<td>51.0±16.4</td>
<td>41.8±25.8</td>
<td>51.0±17.3</td>
</tr>
<tr>
<td>L</td>
<td>45.6±15.6</td>
<td>55.8±24.8</td>
<td>47.0±6.5</td>
</tr>
<tr>
<td>M</td>
<td>0.2±0.4</td>
<td>0.2±0.4</td>
<td>0.2±0.4</td>
</tr>
<tr>
<td>E</td>
<td>3.0±1.8</td>
<td>2.2±1.0</td>
<td>2.0±1.0</td>
</tr>
<tr>
<td>MHCT</td>
<td>35.6±2.9</td>
<td>31.2±2.5</td>
<td>31.0±4.1</td>
</tr>
</tbody>
</table>
Within the first hour following the injection of Xylazine-Ketamine combination, the donkeys showed a significant (p<0.05) decrease in the PCV and Hb values. The TP, WBC, MCB, TN eosinophil and Micro-hematocrit values also showed a decrease although not statistically significant (p>0.05). The lymphocyte values showed a rise in level while there was no significant change in the monocyte and basophil counts (table 1(c)).

In all the three groups of donkeys, values for some of the blood constituents as at five hours had returned to initial values whereas others had not.

**Discussion**

The decrease in PCV and Hb values and the slight decrease in most of the other blood constituents in donkeys injected with drug combination is consistent with the findings in sheep\(^2,3\). The fall in some of the blood constituents may be explained by the engorgement of the spleen which occurs when animals are either at ease or under the influence of tranquilizing drugs. This leads to reduced amount of the circulating blood components in the peripheral circulation\(^9\). The fall can also be attributed to hemodilution due to an influx of intestinal fluids due in part to the decreased heart rate and to the low blood pressure\(^9\). Pooling or damming of erythrocytes in the spleen could be the possible reason why RBC, PCV and Hb fall when some anaesthetics are injected\(^9\). The actual effect is a disappearance of lymphocytes from the peripheral blood and the depression of lymphocytic tissue caused by the increased adrenocortical activity\(^6\). Adrenaline release due to stress and anaesthesia produces a profound reduction in the size of the spleen leading to a marked increase in concentration of haemoglobin and the number of red blood cells in peripheral circulation\(^6\). This may explain the reason for the rise in some of the blood components. The significant decrease in PCV and Hb values is important in anaesthesia because anaemic and debilitated animals may be an anaesthetic risk for the Xylazine — Ketamine combination. Therefore, assessment of PCV and Hb values before Xylazine-Ketamine anaesthesia in donkeys is advocated for.

**Acknowledgements**

We are grateful to the technical members of staff of the Clinical Studies Department for their help during the trials and Maureen Mbugua for typing the manuscript.

**References**


Received for publication on 27th May 1992
RESISTANCE OF FIELD ISOLATES OF \textit{HAEMONCHUS CONTORATUS} TO THIABENDAZOLE AND FENBENDAZOLE IN KENYA

R.M. WARIRU, N. MAINGI and E.J. GICHANGA
Department of Veterinary Pathology and Microbiology, University of Nairobi, P.O. Box 29053, Nairobi, Kenya

RESISTANCE DES SOUCHES DE \textit{HAEMONCHUS CONTORATUS} RECUEILLIES SUR LE TERRAIN AU THIABENDAZOLE ET AU FENBENDAZOLE AU KENYA

Résumé
La résistance à deux anthelminthiques: le thiabendazole (TBZ) et le fenbendazole (FBZ) a été déterminée pour deux souches de \textit{Haemonchus contortus} à l’aide de la technique d’éclosion d’œufs (EHA) et avec le test de contrôle de l’efficacité de l’an-
thelminthique (CAE). Les souches M1 provenant de la ferme vétérinaire de Machakos et M2 de la ferme de Machure ont été soumises d’être résistantes aux anthelmin-

thiques, avec une efficacité de moins de 9% pour TBZ et FBZ d’après le test de réduction du nombre d’œufs dans le fèces (FECR) chez les moutons naturellement
infestés.

Dans le test d’éclosion d’œufs, les œufs des deux souches ont été incubées dans diverses concentrations soit de TBZ soit de FBZ. Le niveau de résistance aux anthelminthiques a été considéré comme étant la concentration de médicament
pouvan empêcher l’éclosion de 50% des œufs ou la concentration létale de 50%
(LC50). Les valeurs LC50 pour la souche M1 étaient de 0,45 µg/ml TBZ et 6,500 µg/ml
FBZ; tandis que pour M2, elles étaient de 0,38 µg/ml TBZ et 5,200 µg/ml FBZ.

Lors des abattages qui ont suivi, on a constaté qu’il y avait une baisse de 85% et 43% (par rapport aux sujets-témoins) pour ce qui est des charges parasitaires
moignes chez les groupes de moutons infestés avec la souche M1 et abattus cinq
jours après le traitement au TBZ et au FBZ. TBZ conférait une efficacité de 75% chez
les moutons infectés avec la souches M2, tandis que FBZ a réduit de 70% la charge
parasitaire moyenne de la même souche, ce qui confirme leur résistance à ces
anthelminthiques.

Summary
Resistance to thiabendazole (TBZ) and fenbendazole (FBZ) anthelmintics was
determined in 2 isolates of \textit{Haemonchus contortus} using the standard in-vitro egg
hatch assay (EHA) and a controlled anthelminthic efficacy (CAE) test. The isolates M1
from Machakos Veterinary Farm, and M2 from Machure Farm were suspected to be
resistant to the anthelmintics, based on less than 90% efficacy for TBZ and FBZ in the
faecal egg count reduction (FECR) taest in naturally infected sheep.

In the egg hatch assay, eggs of the two isolates were incubated separately in
various concentrations of either TBZ or FBZ. The level of resistance to the
anthelmintics was recorded as the drug concentration inhibiting 50% of the eggs
from hatching, or Lethal Concentration 50% (LC50). LC50 values for M1 isolate were
0,45µg/ml TBZ and 6,500µg/ml FBZ whereas, those for M2 isolate were 0,38µg/ml TBZ
and 5,200µg/ml FBZ.

In subsequent slaughter trials, there was an 85% and 43% reduction, as compared
with controls, in mean worm burdens of groups of sheep infected with M1 isolate and
killed 5 days after treatment with TBZ and FBZ. TBZ had an efficacy of 75% in sheep
infected with M2 isolate whereas FBZ reduced mean worm burden of the same
isolate by 70%, confirming their resistance to these anthelmintics.
INTRODUCTION

Recent reviews on the development and distribution of anthelmintic resistance show that the problem is increasing\textsuperscript{1,2,3,4,5}. Therefore, the need to determine the anthelmintic sensitivities of gastrointestinal nematode populations is an essential component of any investigation on farms where failure to control helminthiasis is suspected. Rapid and reliable methods are required to: detect resistant nematode populations in livestock; monitor changes in levels of resistance; identify affected animals to restrict the dissemination of resistant parasites; conduct surveys on the prevalence of resistance and to define factors that affect development of resistance\textsuperscript{6}.

Three methods have been considered to be suitable for diagnosing anthelmintic resistance\textsuperscript{7}. These methods are the faecal egg count reduction (FECR) test, the \textit{in-vitro} egg hatch technique\textsuperscript{8,9} and the controlled anthelmintic efficacy test\textsuperscript{10,11}.

The FECR test was used by the authors to investigate the prevalence of anthelmintic resistance in sheep nematode populations in three districts of Kenya. Five commonly used broad-spectrum anthelmintics were tested and an efficacy of less than 90\% using TBZ and FBZ was obtained in two farms. To confirm these findings, a standard \textit{in-vitro} egg hatch assay and a controlled anthelmintic efficacy test were conducted using 2 isolates of \textit{Haemonchus contortus} from these farms.

Materials and Methods

\textit{In-vitro Egg Hatch Assay.}

\textbf{Anthelmintics tested.} The anthelmintics used were commercial formulations of TBZ (Thibenzole\textsuperscript{R}, Merck & Co. Inc.; NJ), FBZ (Panacur\textsuperscript{R}, Hoechst). Formulations of these compounds were diluted with distilled water to give suspensions of active compounds. The suspensions, when mixed with eggs in water gave the following concentrations of active com-
pound in incubating solution: TBZ, 0.01 to 0.60 ug/ml and FBZ, 100 to 8000 ug/ml.

\textbf{Haemonchus contortus isolates.} Two isolates of \textit{H. contortus}, M1, and M2, isolated from 2 separate districts in Kenya were used. M1 was isolated from Machakos Veterinary farm in Machakos district while M2 was isolated from Machure farm in Kiambu district. Benzimidazole (BZ) anthelmintics had been used on the former farm frequently and exclusively for more than 2 years. Death of sheep due to haemonchosis had been reported on the latter farm, although BZ anthelmintics were regularly used. Less than 90\% efficacy in the FECR test in naturally infected sheep was recorded for TBZ and FBZ in M1 and M2 isolates (Table 1). These isolates were therefore suspected to be resistant to the respective anthelmintics.

For isolation of \textit{H. contortus} from the two farms, faecal samples were collected from the naturally infected sheep. These samples were pooled for each farm and cultured at 27\textdegree C for up to 10 days. Infective larvae were then isolated and counted according to standard procedures\textsuperscript{12}.

6 Sheep kept on concrete floor pens and showing negative faecal egg counts were separated into 2 groups. Each sheep was infected orally with 10,000 larvae, sheep in one group receiving M1, while those in group 2 received M2 \textit{H. contortus} isolate. Egg production was monitored from the 21st day post-infection.

\textbf{Collection of eggs and test procedure.} Fresh faeces were collected directly from the rectum of each sheep. Samples from sheep infected with the same isolate were pooled. \textit{H. contortus} eggs were then isolated and cleaned from the faecal samples using a flotation technique\textsuperscript{8,13,14}. All tests were done using 100 to 200 eggs in 3 ml bottles, in triplicate. The eggs were incubated at 27\textdegree C for 48 hrs in concentrations of TBZ ranging from 0.01 to 0.60 ug/ml TBZ/ml and in concentrations of FBZ ranging from 100 to 8000 ug/ml FBZ/ml\textsuperscript{13}. The percentage of eggs failing to hatch at each drug concentration was then calculated and data analysed.
Controlled Anthelmintic Efficacy Test.
Test animals. Twenty four local sheep, aged six to twelve months were used in this study. They were treated with a broad spectrum anthelmintic (ivermectin) on arrival at the faculty of Veterinary Medicine, Kabete, housed and treated again three weeks later. Faecal samples were collected per rectum and examined using a modified McMaster method with a lower limit detection of 100 eggs per gram for the presence of helminth ova after treatment.

Infection of animals. The 24 worm-free lambs were divided into two equal groups. Group 1 lambs were infected with M1 isolate and group 2 with M2 isolate. In all cases, the sheep were infected orally with 10,000 *H. contortus* infective larvae, 30 days before the proposed treatment day.

Anthelmintics. Anthelmintics used were proprietary preparations administered orally at the manufacturer’s recommended dosage.

Thirty days after infection, animals in specific groups were weighed, identified by ear tags and randomly allocated to treatment groups on the basis of their worm egg counts. Lambs in group 1 were treated according to their individual body weight with TBZ (62 mg/kg) and in group 2 with FBZ (5 mg/kg). The lambs in group 3 were the untreated controls.

Post mortem examination. The lambs were slaughtered 5 days after treatment (day 35 post-infection) and total worm counts were conducted using standard parasitological techniques. The abomasal contents of each animal were washed into separate buckets and 10% aliquots were collected and cleaned by washing through a 210 um aperture sieve. The abomasal mucosa was digested at 42°C in 300 mls of a 1% pepsin 2% hydrochloric acid mixture for 4 hrs. Worms were collected on a 40 um sieve and a 10% aliquot retained. Worms in this aliquot were transferred to several petridishes and counted at 10X magnification under a dissecting microscope. Faecal egg counts were also performed on samples taken from lambs 21 days after infection and at 48 hrs intervals thereafter until the lambs were killed.

Estimation of Anthelmintic Efficacy
The results of EHA were subjected to probit analysis. This gave the drug concentration which, on average, would prevent 50% of eggs from hatching or lethal concentration 50% (LC50) and the 95% confidence intervals or fiducial limits. Since BZ susceptible *H. contortus* reference strains were not available in the study, results were compared with those in other available in the study, results were compared with those in other available reports to establish anthelmintic susceptibility status of the isolates.

For the slaughter trials, the efficacy of TBZ and FBZ were calculated from the counts of adult and immature stages of *H. contortus* using the following formula:

\[
\text{Efficacy} = \frac{C - T \times 100}{C}
\]

where C and T are the geometric mean counts from untreated and treated groups respectively.

In the FECR test, faecal egg counts at time of treatment (day zero) and 7 days later had been used to calculate the percent efficacy (PE), based on the percent faecal egg count reduction (FECR%). The equation: \( \text{FECR%} = 100 \left( \frac{1}{(T2/T1)} \times \frac{(C1/C2)} \right) \) was used, where T and C are geometric mean egg counts before and after treatment respectively. Anthelmintics with less than 90% efficacy are considered ineffective.

Results
Table 1 gives the geometric mean faecal egg counts (epg) and percent efficacy for TBZ and FBZ, in the FECR test, in naturally infected sheep. On both farms, there was less than 90% reduction in epg following treatment with either TBZ and FBZ. In Machakos farm, TBZ had an efficacy of 51.3% while that of FBZ was 46.2%. In Machure farm, the percentage reduction of worm eggs were 55.7% for TBZ and 39.9% for FBZ respectively.
Table 1: Geometric mean faecal egg counts (epg) and percent efficacy of TBZ and FBZ in sheep naturally infected with *H. contortus*

<table>
<thead>
<tr>
<th>Farm</th>
<th>Treatment group</th>
<th>Geometric mean epg (range)</th>
<th>% Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Day 0</td>
<td>Day 7</td>
</tr>
<tr>
<td>Machakos</td>
<td>Control</td>
<td>3,000 (200-13,500)</td>
<td>450 (0-850)</td>
</tr>
<tr>
<td></td>
<td>TBZ</td>
<td>2,167 (200-5,800)</td>
<td>144 (0-1,000)</td>
</tr>
<tr>
<td></td>
<td>FBZ</td>
<td>2,725 (300-8,200)</td>
<td>200 (0-1,000)</td>
</tr>
<tr>
<td>Machure</td>
<td>Control</td>
<td>700 (100-1,600)</td>
<td>233 (0-500)</td>
</tr>
<tr>
<td></td>
<td>TBZ</td>
<td>1,183 (100-7,400)</td>
<td>613 (0-2,400)</td>
</tr>
<tr>
<td></td>
<td>FBZ</td>
<td>400 (100-900)</td>
<td>80 (0-300)</td>
</tr>
</tbody>
</table>

Table 2: Lethal Concentration 50% (LC50) and the 95% confidence interval for M1 and M2 isolates obtained in the egg hatch assay using TBZ and FBZ

<table>
<thead>
<tr>
<th>Anthelmintic</th>
<th>LC50 in μg/ml (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M1</td>
</tr>
<tr>
<td>TBZ</td>
<td>0.45 (0.41-0.48)</td>
</tr>
<tr>
<td>FBZ</td>
<td>6,500 (6,350-6,700)</td>
</tr>
</tbody>
</table>

LC50% = Concentration of anthelmintic (micrograms per ml) required to inhibit 50% of incubating eggs from hatching.

Table 2 gives the LC50 values and their 95% confidence intervals for M1, and M2 isolates for TBZ and FBZ. The LC50 values for TBZ were 0.45 and 0.38 μg/ml TBZ for M1 and M2 isolates, while those for FBZ were 6500 and 5200 μg/ml FBZ for M1 and M2 isolates respectively.

The overall percent reduction in group mean worm burdens following TBZ and FBZ treatment is shown in Table 3 for each of the two isolates of *H. contortus*. In lambs infected with M1 and M2 isolates, TBZ and FBZ reduced the group mean worm burden by less than 90%. The two anthelmintics had an efficacy of 85% (TBZ) and 43% (FBZ) for M1 isolate and 75% (TBZ) and 70% (FBZ) for M2 isolate respectively.

Table 3: Results of the slaughter trials carried out on 2 isolates (M1 and M2), suspected as being resistant to TBZ and FBZ anthelmintics

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Treatment group</th>
<th>Worm Burden Geometric mean epg (range)</th>
<th>% efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Control</td>
<td>1767 (400-2700)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>TBZ</td>
<td>267 (0-800)</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>FBZ</td>
<td>1000 (500-1400)</td>
<td>43</td>
</tr>
<tr>
<td>M2</td>
<td>Control</td>
<td>4700 (1200-8200)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>TBZ</td>
<td>1160 (600-1600)</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>FBZ</td>
<td>1400 (600-2400)</td>
<td>70</td>
</tr>
</tbody>
</table>

Discussion

Results of the EHA indicate resistance to TBZ in M1 and M2 isolates, based on the reports of previous workers. These workers observed that TBZ-susceptible *H. contortus* strains' eggs do not hatch in TBZ concentrations above 0.1 μg/ml, and LC50 values for TBZ-susceptible strains are about 0.06 μg/ml TBZ, while those for resistant strains are higher than 0.1 μg/ml TBZ. The data also indicates that M1 and M2 are resistant to FBZ. FBZ-susceptible isolates do not hatch in FBZ concentrations higher than 5000 μg/ml.
FBZ and have LC50 values of about 500 ug/ml FBZ. LC50 values for FBZ-resistant isolates are higher than 500 ug/ml FBZ\(^{(13)}\). The slaughter trials confirmed the presence of TBZ and FBZ resistant populations of *H. contortus* in lambs infected with either M1 or M2 isolate (Table 3). For M1 isolate, TBZ reduced mean worm burdens by 85%, indicating a low level of resistance whereas FBZ reduced mean worm counts by 43%, indicating a high level of resistance. There was a 75% and 70% reduction in worm burdens in the group of lambs infected with M2 isolate and treated with TBZ and FBZ as compared with untreated controls. This indicated that M2 isolate was moderately resistant to TBZ and FBZ respectively.

As resistance has been confirmed to the BZ anthelmintics tested, it is suggested that the use of these anthelmintics in regular drenching programs in the two farms should be discontinued. The use of other anthelmintics with different modes of action such as levamisole is recommended\(^{(2)}\). Reversion to BZ susceptibility may occur after withdrawal, but this might take sometime\(^{(2,22)}\). Investigations for resistance in other parts of the country should also be undertaken and appropriate control and management measures instituted.

**Acknowledgement**

This study was supported by a grant from the Deans’ Committee, University of Nairobi. We thank members of Parasitology Section, Department of Veterinary Pathology & Microbiology, University of Nairobi, for their technical support in the laboratory.

**References**

INTOXICATION D'UN POULAIN PAR CESTRUM: ETUDE D'UN CAS

Résumé

On a signalé un cas d’intoxication aigue d’un poulain par *Cestrum aurantiucum*. Il y avait chez l’animal des changements dus à l’intoxication dans le foie, les reins, les muscles du squelette et le système nerveux central. Il y avait également des changements hématologiques et biochimiques contrairement aux cas d’intoxication par *Cestrum diurnum* observés chez des chevaux. La plante qui est d’habitude utilisée pour faire des clôtures semble provoquer très souvent la mort soudaine des chevaux et des bovins. Il faudrait donc entreprendre d’autres études pour connaître l’agent responsable, les symptômes, les changements hématologiques, biochimiques et pathologiques chez les chevaux nourris de cette plante.

Summary

A case is reported of acute *Cestrum aurantiucum* poisoning in a young horse in which there were signs due to toxic changes in the liver, kidneys, skeletal muscles and the central nervous system. There were also hematological and biochemical alterations unlike those reported for *Cestrum diurnum* poisoning in horses. The plant, which is commonly used for hedges in this area is proposed to be a cause of many sudden deaths in horses and cattle. Consequently, further studies are warranted to determine the active agent, anticipated clinical signs, hematological, biochemical and pathological alterations in horses fed on this plant.

INTRODUCTION

Cestrum plant has previously been reported to grow abundantly in Limuru area and other regions of the former Kenya White Highlands. It was responsible for acute poisoning in cattle leading to sudden death. Other workers have implicated *C. diurnum* as the causative agent of hypercalcaemia and calcinosis in Florida horses and cattle. These had a chronic debilitating disease characterized by progressive weight loss and lameness of increasing severity. The toxic principle is a 1, 25-dihydroxy vitamin D3-glycoside which interferes with calcium and phosphorus metabolism.

This report describes a case of acute Cestrum poisoning in a young horse in which there were signs of intermittent episodes of abdominal pain and lateral recumbency, and central nervous system depression. Liver function was affected with levels of SGOT decreased to 0 for 5 days. There were signs of renal and skeletal muscle disfunction.

History

A two and a half year old colt from Tigoni, Limuru, was admitted to the large animal clinic, Department of Clinical Studies, University of Nairobi, on 13 June 1990. It had a rather protracted history, the owner later admitting that the animal fed on Cestrum plants that had been cut from a hedge.

Physical examination

The colt exhibited intermittent episodes of abdominal pain and lateral recumbency, anorexia, congestion and icterus, hematuria, profuse sweating and edema around the neck and the supraorbital fossae. The hind limbs were weak.
and the animal continuously shifted weight. Very many ticks and tick-bite scars were present all over the body. The rectum was empty and coated with mucin.

Initial hematological examination indicated a neutrophilic leukocytosis and no hemoparasites. A fecal sample contained 200 e.p.g. of strongyle eggs.

An exploratory laparotomy was performed after induction with an intravenous injection of 3 g thiopentone and general anesthesia maintained with Halothane — oxygen mixture in a closed circle system. There were subserosal hemorrhages on a portion of the ileum and a mild twist of intestinal loop which was corrected and the incision closed routinely.

Initial signs of colic, lateral recumbency and CNS depression were still present. Almost predictably, the colt would approximate the limbs contiguously shift weight, tuck up the abdomen and go into sternal recumbency. It would then stiffly stretch its limbs while in lateral recumbency. In this state the patient would profusely sweat, pant show a rapid respiratory and cardiac rates later stabilising to normal. It would take some water and a bit of green grass while in lateral recumbency. After 3-5 hours it would stand on being assisted into sternal position and would otherwise pass for a normal horse. This it was able to do for 15-30 minutes and then go into lateral recumbency. Towards the end of the first week the colt was fully recovered save for some mental depression.

Hematology and Biochemistry

Biochemical findings from clotted blood samples collected daily for the period the colt was hospitalized are shown in Table 1. There was a persistent mature neutrophilic leukocytosis. A voided urine sample collected in the course of convalescence was found to have acidic pH(5) and contained 250 erythrocytes per decilitre thus confirming the cause of the red urine as hematuria.

The patient died of evisceration following suture dehiscence and the pathologi-cal diagnosis was that of acute peritonitis, bronchopneumonia and septisaemia.

Treatment

There is no specific therapy for Cestrum poisoning. To counteract secondary bacterial infection, 30 mls of Combiotic (Pfizer Agricultural Division New York N.Y. 10017-200,000 IU of procaine penicillin G per ml per ml and 250 mg of dihydrostreptomycin) was administered intramuscularly daily for 14 days. A metabolic stimulant — catosol 15 mls intramuscularly and Multivite orally were given to restore electrolyte imbalances. 500 mls of liquid parafin was administered orally for 3 days to aid in gut evacuation. Decubiti-ous wounds were kept clean and an aerosol preparation of oxytetracycline and gentian violet applied.

Discussion

A case is described of acute Cestrum poisoning in a young horse. The eminent signs included intermittent abdominal pain and lateral recumbency, central nervous system depression, hepatic, renal and skeletal muscle dysfunction. Previous reports have described chronic, almost life-long ingestion, leading to a debilitating disease in Florida horses and characterized by progressive weight loss, lameness of increasing severity and deposition of calcium in soft tissues. In this report the calcium levels were within the normal range unlike the previous report, but agrees with the literature on enzootic calcinosis\(^4\). Phosphorus was not assayed due to lack of reagents in our laboratory, but is expected to rise in case of cestrum poisoning.

Available literature reported no change in the levels of alkaline phosphatase, total protein, albumin, cholesterol, uric acid, bilirubin, CPK, LDH, SGOT, BUN, glucose, chloride, erythrocytes, leukocytes hematocrite and hemoglobin\(^4\). In this case alkaline phosphatase was increased possibly due gastrointestinal irritation. CPK was increased following prolonged recumbency, leading to skeletal muscle ischaemia, degeneration and necrosis.
Table 1: Biochemical findings of daily blood samples from the colt since admission

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP (IU/L)</td>
<td>604</td>
<td>577</td>
<td>226</td>
<td>262</td>
<td>513</td>
<td>460</td>
<td>500</td>
<td>657</td>
<td>359</td>
<td>306</td>
<td>312</td>
<td>324</td>
<td>229</td>
</tr>
<tr>
<td>SGOT (IU/L)</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>49</td>
<td>167</td>
<td>188</td>
<td>206</td>
<td>239</td>
</tr>
<tr>
<td>CPK (IU/L)</td>
<td>-</td>
<td>-</td>
<td>3107</td>
<td>2771</td>
<td>0</td>
<td>857</td>
<td>-</td>
<td>36</td>
<td>170</td>
<td>112</td>
<td>71</td>
<td>80</td>
<td>101</td>
</tr>
<tr>
<td>Bilirubin (mg%)</td>
<td>6.8</td>
<td>3.8</td>
<td>3.8</td>
<td>2.8</td>
<td>4.0</td>
<td>3.3</td>
<td>5.5</td>
<td>-</td>
<td>2.9</td>
<td>2.7</td>
<td>-</td>
<td>-</td>
<td>3.2</td>
</tr>
<tr>
<td>BUN (mg%)</td>
<td>29</td>
<td>37</td>
<td>42</td>
<td>38</td>
<td>37</td>
<td>42</td>
<td>23</td>
<td>23</td>
<td>29</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>44</td>
</tr>
<tr>
<td>TPP (mg%)</td>
<td>6.55</td>
<td>5.34</td>
<td>6.72</td>
<td>6.05</td>
<td>6.52</td>
<td>6.39</td>
<td>6.20</td>
<td>7.44</td>
<td>7.10</td>
<td>6.74</td>
<td>7.51</td>
<td>6.51</td>
<td>5.7-7.9</td>
</tr>
<tr>
<td>Albumin (mg%)</td>
<td>2.58</td>
<td>2.58</td>
<td>2.43</td>
<td>2.63</td>
<td>2.63</td>
<td>2.38</td>
<td>2.35</td>
<td>2.95</td>
<td>2.68</td>
<td>2.96</td>
<td>3.48</td>
<td>2.59</td>
<td>2.33-3.85</td>
</tr>
<tr>
<td>A:G ratio</td>
<td>0.77</td>
<td>0.93</td>
<td>0.57</td>
<td>0.77</td>
<td>0.68</td>
<td>0.59</td>
<td>0.61</td>
<td>0.66</td>
<td>0.61</td>
<td>0.78</td>
<td>0.86</td>
<td>0.66</td>
<td>0.62-1.00</td>
</tr>
<tr>
<td>Calcium (mg%)</td>
<td>7.68</td>
<td>8.84</td>
<td>8.46</td>
<td>8.08</td>
<td>10.5</td>
<td>9.08</td>
<td>7.54</td>
<td>11.3</td>
<td>10.4</td>
<td>9.41</td>
<td>11.2-13.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Blood and Radostits. Sixth Ed. Bailliere Tindall, a division of Csell Ltd. l St. Anne’s Road, EAstbourne B N21 3 UN.

AP=Alkaline Phosphatase. SGOT=serum glutamic oxaloacetate. CPK=creatine Phosphokinase.
- indicates that the test was not done on this day.

SGOT was acutely decreased to 0 for 5 days, later being restored to near normal. The cause of this decrease is unclear to us but is somehow related to the cestrum poisoning. Bilirubin was also elevated and this may have been due to starvation or liver insult.

There are differences in the clinical, hematological and biochemical manifestations of poisoning with *Cestrum diurum* and *Cestrum aurantiacum*. Although the toxic principle in *Cestrum diurum* and *Solanum malacoxylon* has been identified as a 1, 25-Dihydroxy vitamin D3 glycoside\(^5\), the toxic substances in *Cestrum aurantiacum* have not been fully characterized and requires further elucidation.

**Acknowledgement**

We wish to thank members of staff at the Department of Clinical Studies for assisting in the surgical operation and post operative management and staff at the Hematology and Biochemistry laboratories for providing the clinical data.

**References**


**Received for publication on 16th July 1992**
THE BREAKING STRENGTH AND RESISTANCE TO ABRASION OF SOME CASTING BANDAGES

JOHN D. MANDE, PETER M.F. MBITHI and STANLEY M. MBIUKI
Large Animal Surgical Clinic, Department of Clinical Studies, Faculty of Veterinary Medicine, University of Nairobi, P.O. Box 29053, Nairobi, Kenya

INTRODUCTION

The ideal cast material should be easy to apply, harden rapidly and achieve maximum strength before the animal tries to stand following general anaesthesia\(^1\). Additionally, it should give consistent results, and be non-irritant, hard wearing, easy to remove, should be radiolucent, reusable and of moderate cost\(^2\). The most important characteristic of a cast material is its ability to withstand the forces that it is subjected to by large animal patients. Plaster casts are an essential part of large animal orthopedic surgery, being used to treat fractures, tendon injuries and soft tissue trauma. However, they take 24 hours to achieve maximum strength, and lack the necessary strength to permit ambulation of adult horses and cattle unless the casts are made very heavy. They soften when in contact with moisture on the outer surface from the environment and on the inner surface when placed over or near exuding wounds\(^3\). Since the most popular resin plaster casting material Zoroc (Johnson and Johnson, 66 Lesmill Road, Don Mills, Ontario) is no longer available, most veterinarians are using synthetic casting tapes made of fiberglass impregnated with polyurethane resin. These products harden very quickly and reach maximum strength in a shorter time period than plaster, are waterproof, porous, lightweight and require fewer tapes than do plaster casts. They are also radiolucent\(^4\).

Summary

Five plaster and one fiberglass casting bandages available on the Kenyan market were evaluated for breaking strength and resistance to abrasion. Under the test conditions, scotchcast was found to be 2.6 times stronger than the strongest plaster of Paris preparation when the load per unit thickness was compared and was significantly different from the plaster casts in terms of maximum load \((p = 0.0001)\). Among the plaster products, there were significant statistical differences \((p = 0.029)\) in maximum strength with Helm and Plasrun-gysp withstanding the greatest load. Scotchcast was the most resistant to abrasion while among the plaster product, Salavaplast and POP-Nairobi Enterprises showed satisfactory resistance. Helm, Plasrun-gysp and Veronesse proved least resistant under the testing conditions.

Résumé

Cinq bandages en plâtre et un bandage en fibre de verre que l’on trouve sur le marché kenyan ont été évalués sur la base du module de résistance et de la résistance au frottement. Dans les conditions de l’expérience, on a trouvé que l’adhésif était 2,6 fois plus solide que le plâtre cuit le plus dur en comparant la capacité de charge par unité d’épaisseur et il était aussi très différent des plâtres en termes de capacité de charge maximum \((p = 0.0001)\). Parmi les produits en plâtre, il y avait des différences statistiques significatives \((p = 0.029)\) pour ce qui est dela solidité, avec Helm et Plasrun-gyps pouvant supporter la plus grosse charge. L’adhésif résistait le plus au frottement, tandis que parmi les plâtres, Salavaplast et POP-Nairobi Enterprises avaient une résistance satisfaisante; Helm, Plasrun-gysp et Veronese étaient les moins résistants dans les conditions de l’expérience.
However, fiberglass casting tapes are more expensive than plaster casts and indeed the cost may be a major constraint to their use in the developing countries compared to plaster. It is therefore important to evaluate the plaster products for strength in order to determine the best plaster material for those cases that will benefit from its use. This follows previous a report on differences in strength of plaster casts.

A number of plaster casting bandages are available on the Kenyan market but no studies have been done to determine the best plaster material for clinical use. The purpose of this study was to evaluate five plaster casts based on breaking strength and resistance to abrasion and to compare them with a fiberglass casting tape.

Materials and Methods

Breaking strength

Five plaster and one fiberglass casting tapes were purchased from Chemists in Nairobi and were used in this study, conducted in the Materials Testing Laboratory, Kenya Bureau of Standards.

2. Salvagyps plaster of Paris bandage; Salvaplast Industries. P O Box 43472, Nairobi, Kenya.
3. Helm plaster of Paris bandage; Helm Pharmaceuticals GMBH, Harburg, West Germany.
5. Veronese plaster of Paris bandage; Adhesia B P 1256-68055, Mulhouse-Cedex.

The materials were prepared according to the manufacturers' instructions. Eight layers of each product were laid on a flat table covered with polythene paper and a cylindrical metal tube used to even them out and were allowed to set for 4 days. Test pieces 10 x 4 cm were cut out using an oscillating saw and the average thickness determined by taking measurements at several points with a micrometer. Test piece was placed between two metal beams, each 8.5 mm thick, 12.25 mm wide and 63 mm apart. A metal rod with a diameter of 12 mm, anchored on an Instron Testing Machine, was used to load the center of the rectangular slab, at a loading speed of 50 mm/sec. The average maximum load of five specimens for each material was calculated from graphs obtained from the chart recorder.

Abrasion Test

Slabs approximately 17 x 10 cm were cut out to fit the flat surface the abrasion tester (Karl Frank GMBH, Weinhein - Birkenua. Type 11665). A circular waterproof abrasive paper with a grain size 240 was fitted on the rotating abrasive part of the machine at a loading height of 7 mm and a load of 10 Newtons. This provided abrasion of a circular area of 63.6 cm². The initial mass was determined by weighing on a Sartorius balance and the difference noted after 300 revolutions. Five samples of each material were tested under the same conditions and the final loss in mass calculated. This was expressed as loss in grams per square meter by dividing the loss in grams by the abraded area, 63.6 cm² and multiplying by 10000. Relative resistance was also expressed as a percentage of the least resistant material.

Statistical Analysis

Data obtained from strengths and abrasion tests of the various materials was subjected to the Analysis of Variance Statistical method. Subsequently, the Fisher Probability of Least Significant Difference (PLSD) test and Scheffe F-test were used to determine the differences.

Results

The results of testing the various cast materials for breaking strength and slab thickness are summarized in Table 1. From the table Scotchcast had the great-
Table 1: The mean maximum load [(Newtons (N)), standard deviation, mean slab thickness in millimeter (mm) and load per unit thickness in Newtons per millimeter (N/mm) of five plaster of Paris and fiberglass casting bandages available in Kenya

<table>
<thead>
<tr>
<th>Plaster of Paris casting material</th>
<th>Mean maximum load (Newtons)</th>
<th>Mean slab thickness (mm)</th>
<th>Load per unit thickness (N/mm)</th>
<th>No. tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nairobi Enterprises</td>
<td>89.1667</td>
<td>±9.57</td>
<td>4.870</td>
<td>18.309</td>
</tr>
<tr>
<td>Salvagyps</td>
<td>92.4000</td>
<td>±18.90</td>
<td>4.662</td>
<td>19.8198</td>
</tr>
<tr>
<td>Helm</td>
<td>110.3333</td>
<td>±8.04</td>
<td>5.575</td>
<td>19.7907</td>
</tr>
<tr>
<td>Plasrun-gyps</td>
<td>99.3333</td>
<td>±15.7</td>
<td>4.588</td>
<td>21.8412</td>
</tr>
<tr>
<td>Veronese</td>
<td>101.3333</td>
<td>±11.325</td>
<td>5.548</td>
<td>18.2648</td>
</tr>
<tr>
<td>Scotchcast</td>
<td>391.1667</td>
<td>±108.047</td>
<td>6.85</td>
<td>57.1046</td>
</tr>
</tbody>
</table>

Table 2: Data on resistance to abrasion of Fiberglass and some plaster of Paris casts available in Kenya

<table>
<thead>
<tr>
<th>Material</th>
<th>Mean initial mass (mg)</th>
<th>Mean final mass (mg)</th>
<th>Loss in mass (mg)</th>
<th>Loss in mass per area (g/m²)</th>
<th>Relative loss in mass (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>POP-Nairobi Enterprises</td>
<td>38.3121</td>
<td>37.4648</td>
<td>0.84732</td>
<td>133.2264</td>
<td>50.2</td>
</tr>
<tr>
<td>Salvaplast</td>
<td>40.8657</td>
<td>40.031688</td>
<td>0.82572</td>
<td>129.8302</td>
<td>48.9</td>
</tr>
<tr>
<td>Helm</td>
<td>33.00632</td>
<td>31.31688</td>
<td>1.69444</td>
<td>265.6352</td>
<td>100</td>
</tr>
<tr>
<td>Plasrun-gyps</td>
<td>37.6974</td>
<td>36.04336</td>
<td>1.65404</td>
<td>260.0692</td>
<td>97.9</td>
</tr>
<tr>
<td>Veronese</td>
<td>39.7511</td>
<td>38.27792</td>
<td>1.47318</td>
<td>231.6321</td>
<td>87.2</td>
</tr>
<tr>
<td>Scotchcast</td>
<td>23.07022</td>
<td>22.77866</td>
<td>0.29156</td>
<td>45.8428</td>
<td>17.3</td>
</tr>
</tbody>
</table>

The breaking strength compared to the plaster products with a statistically significant difference (p = 0.0001). There were significant statistical differences in loading strengths among the plaster products (p = 0.029) with Helm plaster of Paris proving the strongest plaster product. When the maximum load was corrected for thickness, Scotchcast still stood out as the strongest material (57.1046 N/mm) and was about 2.6 times stronger than Plasrun-gyps (21.841095 N/mm) in terms of load per unit thickness.

Data obtained from abrasion testing of the various cast materials is shown in Table 2. Scotchcast has the least amount of loss in mass per square area (45.843 g/m²) and was significantly different from the plaster casts (p = 0.0006). A comparison of data for the plaster of Paris casting materials revealed significant differences in mean loss in mass per unit area (p = 0.0335). The most resistant plaster cast was found to be Salvaplast with the slabs losing only 129.83 g/m² and was statistically similar to Plaster of Paris from Nairobi Enterprises which lost 133.226 g/m². These two products had superior resistance to abrasion among the plaster casts and were significantly different from Veronese (231.632 g/m²), Plasrun-gyps (260.069 g/m²) and Helm plaster of Paris (265.635 g/m²). When the results were expressed as relative loss in mass per square area, Scotchcast still was the most resistant material with only 17.3% of the slab being lost at the end of the test. Salvaplast (48.9%) and POP-Nairobi Enterprises (50.1%) had moderate resistance. Plasrun-gyps (97.0%), and Veronese (87.2%), Helm (100%), plaster casts proved the least resistant under the test conditions.

Discussion

Five plaster of Paris and one fiberglass casting materials were evaluated based on breaking strengths and resistance to abrasion. Under the test conditions, fiberglass proved superior both in terms of breaking strength and resistance to
abrasion compared to the plaster casts in agreement with previous reports\textsuperscript{2,6}.

Among the plaster of Paris preparations there were differences in breaking strengths with Helm plaster of Paris withstanding the greatest maximum load. Plasrun-gyps was the strongest plaster product in terms of load per unit thickness and was 2.6 times weaker than the fiberglass casting tape. However, Helm, Plasrun-gyps and Veronese proved to be least resistant to abrasion. Salvaplast and POP-Nairobi Enterprises were the most resistant to abrasion among the plaster products although these were inferior compared to fiberglass.

Fiberglass was the only cast material showing superiority both in terms of breaking strength and resistance to abrasion. No plaster of Paris cast was found to be the best in both properties. Since the most important characteristic of a cast material is its ability to withstand the forces that it is subjected to by large animal patients\textsuperscript{3}, it is appropriate to infer that Helm and Plasrun-gyps plaster products were superior to the other plaster of Paris casting materials, on the basis of their greater breaking strengths under the test conditions.

The product currently most suitable for cast application in large animals is a rapidly setting fiberglass Vetcast* (Animal Care Products, 3M, St. Paul, MN, 55144)\textsuperscript{11}. In developing countries like Kenya, few clients can afford the expenses of fiberglass cast application to their bovine patients. This product is not easily available to most clinicians in Kenya as is plaster. For those clients who may not afford the fiberglass, plaster casts will continue to be useful for orthopaedic surgery and one would benefit from applying the strongest plaster product, since cast breakage, soaking in moisture and the need to replace broken casts equally elevate the overall expenses.

This study was sponsored by the University of Nairobi Research Fund.

Acknowledgement

We are very grateful to Mr. Mugenda, Principal Laboratory Analyst, Materials Laboratory, Kenya Bureau of Standards, for allowing us to use the facilities at the Institution. We also thank Mr. Edward Kiarie of the large animal surgical clinic, Mr. Musuya and Mr. Ndeki of K.B.S. for their assistance. We are very grateful to the Department of Clinical Studies for the support extended to us.

References


\textit{Received for publication on 16th July 1992}
MECHANICAL STRENGTH OF PLASTER CASTING BANDAGES AVAILABLE IN KENYA

JOHN D. MANDE, PETER M.F. MBITHI and STANLEY M. MBIUKI
Department of Clinical Studies, Faculty of Veterinary Medicine, University of Nairobi, P.O. Box 29053, Nairobi, Kenya

FORCE MECANIQUE DES PLATRES DE MOULAGE DISPONIBLES AU KENYA

Résumé

Cinq plâtres de moulage à savoir: Nairobi Enterprises, Salvagyps, Helm, Plasrun-gyps et Veronese que l'on trouve sur le marché kenyan, ont été évalués sur la base du module de résistance. Le plâtre Helm de Paris avait une charge minimum moyenne beaucoup plus élevée que tous les autres (P<0.05). Plasrun-gyps supportait la plus grande charge maximum moyenne par unité d'épaisseur. À la lumière de la présente étude, Helm et Plasrun-gyps sont considérés comme étant les plâtres de moulage les plus appropriés, compte tenu de la supériorité de leur module de résistance.

Summary

Five plaster of Paris casting bandages including Nairobi Enterprises, Salvagyps, Helm, Plasrun-gyps and Veronese, available on the Kenyan market were evaluated based on breaking strength. Helm plaster of Paris had a significantly higher mean maximum load compared to all the other products (p<0.05). Plasrun-gyps supported the highest mean maximum load per unit thickness. Based on this study, Helm and Plasrun-gyps are recommended as more suitable for cast application on the basis of their superior breaking strength.

INTRODUCTION

Casts are rigid dressings usually made from gauze or crinoline impregnated with plaster of Paris or other material used for immobilizing diseased, deformed or broken parts. Plaster of Paris and resin impregnated materials are the two main types of external support used in man and animals(1). Plaster casts are an essential part of large animal orthopedic surgery, being used to treat fractures, tendon injuries and soft tissue trauma. However, they take 24-48 hours to achieve maximum weight bearing strength and lack the necessary strength to permit ambulation of adult horses and cattle unless the casts are made very heavy. They soften when in contact with moisture on the outer surface from the environment and on the inner surface when placed over or near exuding wounds. In their favour, plaster casts are cheap and conform well(2,3).

The product currently most suitable for cast application in large animals is a rapidly setting fiberglass Vetcast* (Animal Care Products, 3M, St. Paul, MN, 55144)4. However, this product is not available in Kenya and few clients would afford the expense of its application to their bovine patients. Thus in bovine practice in Kenya, plaster casts will continue to be used for orthopedic surgery and it would be beneficial to use the best product. There are different types of plaster products available on the Kenyan market and one is never sure which is the best material inspite of each manufacturers' claims of their products being superior. No reports are available on the experimental and clinical evaluation of the various plaster of Paris casting materials available for orthopedic use in Kenya.

This project was designed to compare mechanical strength of plaster of Paris casting bandages available in Kenya.

Materials and Methods

Mechanical tests involving breaking strength were undertaken at the mate-
rials testing laboratory, Kenya Bureau of Standards, situated off Mombasa Road, Nairobi.

Five different brands of plaster of Paris casting bandages available on the Kenyan Market were purchased from Chemists in Nairobi and used in the study. The products were:

1. Plaster of Paris bandage: Nairobi Enterprises, Ltd. P.O. Box 43472, Nairobi, Kenya.
2. Salvagyps plaster of Paris bandage: Salvaplast Industries, Ltd., P.O. Box 43372, Nairobi, Kenya.
3. Helm plaster of Paris bandage; Helm Pharmaceuticals GMBH, Hamburch, West Germany.
5. Veronese plaster of Paris bandage; Adhesia B.P. 1256-68055, Mulhouse-Cedex, China.

**Experimental procedure**

The materials were prepared according to the manufacturer's instructions. Eight layers of each product were laid on a flat table covered with polythene paper and a cylindrical metal tube used to even them out. The slabs were left to dry at room temperature for four days.

Test pieces measuring 10 x 4 cm in dimension were cut out with the aid of an oscillating saw. The average slab thickness was determined by taking measurements at several points using a micrometer screw gauge and recorded.

The test slab was then placed between two metal beams, each 8.5 mm thick, 12.25 mm wide and 63 mm apart. A metal rod with a diameter of 12 mm, anchored on the test machine was used to load the center of the rectangular slab. All slabs were loaded at a speed of 50 mm per second until the slab fractured. For each plaster of Paris type, six samples were tested, except for salvagyps where only five samples were tested.

Load-versus-displacement curves were obtained from the chart recorder. For each sample tested, the maximum load was determined by reading off the highest value on the curve, where the slab could not bear any more load. The average maximum load of a particular plaster product was considered to represent the breaking strength of the material. The mean maximum load of each cast material was divided by its mean slab thickness in order to express the breaking strength in terms of load per unit thickness.

Data obtained for strengths of plaster of Paris casting bandages was subjected to Analysis of Variance (ANOVA). Subsequently the Fisher Probability of Least Significant Difference (PLSD) and Scheffe-F test were used to determine the differences\(^{(4)}\).

**Results**

The mean maximum load, standard deviation, mean slab thickness and load per unit thickness for the five plaster of Paris casting bandages are presented in Table 1. Helm plaster of Paris had a significantly higher mean maximum load.

---

**Table 1**: The mean maximum load ([(Newtons (N)], standard deviation, mean slab thickness in millimeter (mm) and load per unit thickness in Newtons per millimeter (N/mm) of five plaster of Paris casting bandages available in Kenya.

<table>
<thead>
<tr>
<th>Plaster of Paris casting material</th>
<th>Mean maximum load (Newtons)</th>
<th>Mean slab thickness (mm)</th>
<th>Load per unit thickness (N/mm)</th>
<th>No. tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nairobi Enterprises</td>
<td>89.1667</td>
<td>± 9.57</td>
<td>4.870</td>
<td>18.309</td>
</tr>
<tr>
<td>Salvagyps</td>
<td>92.4000</td>
<td>± 18.90</td>
<td>4.662</td>
<td>19.8198</td>
</tr>
<tr>
<td>Helm</td>
<td>110.3333</td>
<td>± 8.04</td>
<td>5.575</td>
<td>19.7907</td>
</tr>
<tr>
<td>Plasrun-gyps</td>
<td>99.3333</td>
<td>± 15.7</td>
<td>4.588</td>
<td>21.8412</td>
</tr>
<tr>
<td>Veronese</td>
<td>101.3333</td>
<td>± 11.325</td>
<td>5.548</td>
<td>18.2648</td>
</tr>
</tbody>
</table>
(110.33 N) compared to all the other products (p<0.05). The mean maximum loads for Veronese, Plasrun-gyps, Salvagyps and Nairobi Enterprises (101.33 N, 99.33 N, 92.40 N and 89.17 N respectively) appeared different but this was not statistically significant. Plasrun-gyps had a higher mean maximum load per unit thickness. The mean slab thickness for the test pieces used in the strength evaluation of the various products, was significantly different (p<0.05).

Discussion

The breaking strength of five plaster of Paris casting bandages was varied; a finding that contrary to report by another worker\(^{(8)}\) who stated that all plaster is generally good. While investigating the breaking strength of plaster bandage as a function of technique, this worker found it to be a function of soaking time and water temperature, of curing time and of other techniques. Our findings are in agreement with two previous reports whose work, though involving slightly different methods, also demonstrated variations in breaking strength amongst plaster products\(^{(3,6)}\). Variations in data for different products could have been due to either the quantity of plaster on the bandage or the strength of the crinoline gauze. A closer examination of the bandages revealed that the stronger bandages had more (visually) plaster powder as opposed to the other products which were observed to have relatively less plaster powder on the crinoline gauze. It has previously been demonstrated that the ultimate tensile stress of the plaster bandage is determined by the ultimate stress of the crinoline rather than the plaster\(^{(7)}\). This is so because before yield-

ing the load is largely carried by the plaster and as yielding occurs, the plaster structure fails in one or more places, the load is then carried by the crinoline in these places.

Although these results are semiquan-
titative, the mechanical strength of Plas-
run-gyps and Helm was superior. Since these qualities could be reflected clinically, further clinical and experimental studies are warranted to evaluate the superiority, if any, of these two, when used clinically.

Acknowledgement

We thank the Director of Kenya Bureau of Standards (K.B.S.) through Mr. Mugenda, for accepting our request to utilize facilities in the materials Testing Laboratory for part of the study. Special mention goes to Mr. Musuya and Mr. Ndeki for their assistance while at the Kenya Bureau of Standards. The Department of Clinical Studies provided a lot of support without which this study could not have been undertaken.

References


Received for publication on 28th May 1992
RESISTANCE TO ABRASION OF PLASTER CASTING BANDAGES AVAILABLE IN KENYA

JOHN D. MANDE, PETER M.F. MBITHI and STANLEY M. MBIUKI
Department of Clinical Studies, Faculty of Veterinary Medicine, University of Nairobi,
P.O. Box 29053, Nairobi, Kenya

RESISTANCE AU FROTTEMENT DES PLATRES DE MOULAGE DISPONIBLES AU KENYA

Résumé

Cinq plâtres de moulage à savoir: Nairobi Enterprises, Salvagyps, Helm, Plasrun-gyps et Veronese que l'on trouve sur le marché kenyan ont été évaluées sur la base de leur résistance au frottement. La perte moyenne en masse/m² pour Nairobi Enterprises et Salvagyps était beaucoup plus réduite (P<0,05), ce qui montre que ces deux produits étaient plus résistants au frottement. Une nouvelle méthode d'évaluation de la résistance au frottement est aussi décrite.

Summary

Five plaster of Paris casting bandages including Nairobi Enterprises, Salvagyps, Helm, Plasrun-gyps and Veronese, available on the Kenyan market were evaluated based on their resistance to abrasion. The mean loss in mass per square area for Nairobi Enterprises and Salvagyps was significantly lower (p<0.05) indicating that these two products were more resistant to abrasion. A new method of evaluation of resistance to abrasion is also described.

INTRODUCTION

Plaster casts are an essential part of large animal orthopedic surgery, being used to treat fractures, tendon injuries and soft tissue trauma. However, they take 24-48 hours to achieve maximum weight bearing strength and lack the necessary strength to permit amputation of adult horses and cattle unless the casts are made very heavy. They soften when in contact with moisture on the outer surface from the environment and on the inner surface when placed over or near exuding wounds. In their favour, plaster casts are cheap and conform well(1,2).

Although plaster bandages are generally assumed to have similar mechanical properties (wearing), no controlled experimental and or clinical studies have been described. The ease of wearing of casts determines its clinical usefulness. This study was therefore designed to evaluate the resistance to abrasion of plaster casting bandages available in Kenya.

Materials and Methods

Evaluation for resistance to abrasion was undertaken at the materials testing laboratory, Kenya Bureau of Standards, situated off Mombasa Road, Nairobi.

Five different brands of plaster of Paris casting bandages were purchased from Chemists in Nairobi and used in the study. The products were:

1. Plaster of Paris bandage: Nairobi Enterprises, Ltd. P.O. Box 43472, Nairobi, Kenya.
2. Salvagyps plaster of Paris bandage: Salvaplast Industries, Ltd., P.O. Box 43372, Nairobi, Kenya.
3. Helm plaster of Paris bandage; Helm Pharmaceuticals GMBH, Hamburgh, West Germany.
5. Veronese plaster of Paris bandage: Adhesia B.P. 1256-68055, Mulhouse-Cedex, China.
Experimental procedure

Slabs approximately 17.0 x 10.0 cm were cut with the aid of an oscillating saw in order to fit the flat surface of the abrasion tester (Karl Frank GMBH, Weinhein-Birkenau, Type 11665). The initial slab mass was determined by weighing on a Sartorius balance and recorded.

A circular waterproof abrasive paper of grain size 240 was fitted on the rotating abrasive component of the machine and clumped securely at a loading height of 7 mm. This provided abrasion of a constant circular area of 63.6 cm². The counter on the machine was adjusted to zero, a load of 10 N applied on the abrading part and the machine put on. All samples were tested up to 300 revolutions, the direction changing at an interval of five revolutions. The slabs were periodically dusted with a vacuum blower to dislodge the debris from the abraded surface. Each slab was then reweighed and the loss in mass recorded. Five samples were tested for each casting material. For each plaster of Paris brand tested, the mean loss in mass was determined and was later divided by the abraded area, 63.6 cm² and multiplied by 10000 thus expressing the data as loss in mass in grams per square meter.

Data obtained from abrasion tests of the various brands of plaster of Paris casting bandages was subjected to Analysis of Variance (ANOVA). Subsequently the Fisher Probability of Least Significant Difference (PLSD) and Scheffe-F test were used to determine the differences⁹.

Results

The mean loss in mass, standard deviation, standard error, mean loss in mass per square area and percentage loss in mass following abrasion testing of the five plaster of Paris cast material are shown in Table 1. Nairobi Enterprises and Salvagyps lost 0.85 and 0.83 grams respectively (50.1 and 48.9% of the original plaster material respectively), while Veronese, Plasrun-gyps and Helm lost 1.47, 1.65 and 1.69 grams respectively (87.2, 97.9 and 100.0% respectively).

The means of the loss in mass per square meter for Nairobi Enterprises and Salvagyps (133.18 and 129.87 g/m² respectively) were significantly lower than the means of the other three products (p<0.05), indicating that these two plaster products had more resistance to abrasion than the others. Even though the means for Veronese, Plasrun-gyps and Helm (231.60, 260.06 and 265.57 g/m² respectively) appeared to be varied, this observation was not statistically significant.

Discussion

The resistance to abrasion varied among the plaster of Paris products with two of them showing superior performance. This observation is in agreement with the only other previous report⁹, in which marked differences in abrasion resistance between two plaster products (Gypsona and Cellona) were

<p>| Table 1: Data on resistance to abrasion of some plaster of Paris casts available in Kenya |
|----------------------------------|------------|------------|------------|------------|---------------|</p>
<table>
<thead>
<tr>
<th>Material</th>
<th>Mean initial mass (mg)</th>
<th>Mean final mass (mg)</th>
<th>Loss in mass (mg)</th>
<th>Loss in mass per area (g/m²)</th>
<th>Relative loss in mass (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>POP-Nairobi Enterprises</td>
<td>38.31212</td>
<td>37.4648</td>
<td>0.84732</td>
<td>133.2264</td>
<td>50.2</td>
</tr>
<tr>
<td>Salvaplast</td>
<td>40.8657</td>
<td>40.031688</td>
<td>0.82572</td>
<td>129.8302</td>
<td>48.9</td>
</tr>
<tr>
<td>Helm</td>
<td>33.00632</td>
<td>31.31688</td>
<td>1.68944</td>
<td>265.6352</td>
<td>100</td>
</tr>
<tr>
<td>Plasrun-gyps</td>
<td>37.6974</td>
<td>36.04336</td>
<td>1.65404</td>
<td>260.0692</td>
<td>97.9</td>
</tr>
<tr>
<td>Veronese</td>
<td>39.7511</td>
<td>38.27792</td>
<td>1.47318</td>
<td>231.6321</td>
<td>87.2</td>
</tr>
</tbody>
</table>
demonstrated. While the earlier report measured reduction in slab thickness following sanding, the one applied in this investigation was based on loss in mass per square meter, another technique used in mechanical engineering for abrasion testing of materials. It was easy to perform and the accuracy of measuring the mass was assured using the Sartorius balance, an addition to the only existing method available for evaluating the resistance to abrasion of plaster of Paris cast materials.

The method applied in this investigation was a semiquantitative measure of resistance to abrasion; the most resistant material was one with the greatest loss in mass per square area; while least resistant material had the least loss in mass per square area. Veronese, Plasrun-gyps and Helm plaster of Paris slabs lost more mass per square meter (between 1.739 and 2.045 times more than the other two products) indicating that they had lower resistance to abrasion than Nairobi Enterprises and Salvagyps, under the conditions of testing.

Variation in loss in mass per square meter for individual plaster brands may have arisen from the inability to achieve consistently smooth slab surfaces for sanding. The differences in mean loss in mass per square meter among the plaster products were presumed to be a reflection of the quantity of plaster which provides bonding of the matrix hence cohesion of the plaster particles to form a hard structure. However, the fact that some of the products lost substantial mass per square meter further supports observations that the wearing properties of plaster of Paris casting bandages is comparatively poor².

Clinical evaluation of the two products is warranted to elucidate whether these differences are of any clinical advantage.

Acknowledgement

The authors wish to thank the Director of Kenya Bureau of Standards (K.B.S.) through Mr. Mugenda, for accepting our request to utilize facilities in the materials Testing Laboratory for part of the study. Special mention goes to Mr. Musuya and Mr. Ndeki for their assistance while at the K.B.S. The Department of Clinical Studies provided a lot of support without which this study could not have been undertaken.

References


Received for publication on 28th May 1992
CAUSES OF MORTALITY IN RAINBOW TROUTS (*SALMO GAIRDNERI*) FARmed IN EARTH PONDS IN KIAMBU AND NYANDARUa DISTRICTS OF KENYA

PAUL G. MBUTHIA and T.A. NGATIA
Faculty of Veterinary Medicine, Department of Veterinary Pathology and Microbiology, P.O. Box 29053, Nairobi, Kenya

CAUSES DE MORTALITE DES TRUITES ARC-EN-CIEL (*SALMO GAIRDNERI*) ELEVEES DANS DES ETANGS DANS LES DISTRICTS DE KIAMBU ET DE NYANDARUa AU KENYA

Résumé

Des épidémies qui ont sévi dans sept fermes piscicoles de deux districts du Kenya ont fait l’objet d’une enquête approfondie et les résultats de cette enquête sont discutés. Toutes les fermes élevaient des truites dans des étangs; les poissons étaient âgés de 2 à 6 mois et pesaient entre 30 et 100 grammes.

Les principaux symptômes et les observations macroscopiques étaient comme suit: les truites se regroupaient à l’entrée de l’étang, elles suffoquaient et nageaient à la surface, se frottaient aux bords, il y avait une décoloration de la peau foncée et brillante, elles souffraient d’hypérehémie et d’hémorragie sur la peau et au bout des nageoires, elles étaient frappées d’émaciation et d’anorexie, avaient les nageoires effilochées et souffraient d’exophthalmie, d’ascite et de production excessive de mucus. Il y avait dans cinq fermes de fortes infestations de *Trichodina* spp sur les truites et dans six fermes *Aeromonas* spp a été isolé des poissons; la myocardite a sévi dans une ferme. Le traitement de *Trichodina* spp avec 3-4 ppm de permanganate de potassium a permis d’éradiquer ces parasites dans trois fermes.

Summary

Disease outbreaks in seven fish farms in two districts of Kenya were thoroughly investigated and the findings are discussed. All farms were rearing trouts on earth ponds. The fish were aged between 2 to 6 months and weighing between 30 to 100 grams.

The main clinical signs and gross observations were crowding near water inlets, gasping for air and surface swimming, fleshing on sides of the ponds, dark and sheep skin discoloration, hyperemia and haemorrhages on the skin and at the base of the fins, emaciation and anorexia, frayed fins, exophthalmos, ascites and excess mucous production. Heavy *Trichodina* spp infestations on fish were found in five farms, *Aeromonas* spp was isolated from fish in six farms and Myocarditis was observed in one farm. Treatment of *Trichodina* spp with 3-4 ppm potassium permanganate eradicated these parasites in three farms.

INTRODUCTION

Rainbow trouts (*Salmo gairdneri*) were introduced in Kenyan rivers between 1910 and 1921 as a sport fish\(^1\,^2\). Since then trout farming has been established in the cooler areas, mainly around Mount Kenya and along the Aberdare ranges\(^2,^3\). These fish are farmed largely to provide source of income (local and overseas sales), supplement animal proteins, fatty acids, vitamins A and D in human nutrition and to a lesser extent recreation in form of sport fishing in rivers\(^3\).

This intensive fish farming has increased the interaction between the fish and its pathogens unlike in wildfish, resulting in several variable disease conditions in these fish. Extensive literature on diseases affecting trouts and other salmonids has been written in temperate countries\(^4,^5\). However, disease reports or data on the problems of fish in Kenya are very scanty, thus creating a problem to the diagnostician, the farmer and the extension officer in the control of their diseases. There is a need therefore to understand the problems affecting fish in
aquaculture industry in Kenya if assistance has to be provided. In this report we present investigations and observations on seven different farms in two districts where trout farming is being carried out on a small scale. Common diseases diagnosed, their clinical signs, morphological and histological findings, as well as treatments administered and control measures undertaken are described.

Materials and Methods

Seven farms with reported trout mortalities in Kiambu and Nyandarua districts were investigated. The ponds were carefully examined in terms of clarity, bloom and behaviour of fish. To facilitate an assessment of the feeding characteristics and fish behaviour, the feed was thrown into the water, at their usual feeding point. Fish were caught using a net, put in plastic bags filled to one third capacity with some pond water and remaining two thirds with atmospheric air. These fish were carefully examined for any external lesions after being caught. The bags were then tied with a rubber band to stop escape of the air, put in a coolbox with ice. They were then transported to Kabete for diagnosis.

In the laboratory the live fish were immobilised by a blow on the head, the spinal cord severed with a scalpel blade passed behind the base of the operculum. The necropsy procedures followed were as described by Ferguson (1989) and samples taken for various investigations. Blood samples were taken immediately after euthanasia and stained with Giemsa or Methylene blue.

In examining the fish for parasites, wet preparations were prepared on glass slides and examined under the microscope. The samples taken included skin slime and scales, gills, bile contents, and the contents of the stomach, intestines and swim bladder. Squash preparations were also made from the liver, kidney, muscles and brain.

For bacteriological examination, the methods described by Roberts (1989) were followed. The gills, liver portions and swabs from the kidney were used for this purpose.

Tissues for histology were fixed in 10% buffered formalin or Bouin’s solution, processed routinely by the Paraffin wax method, sectioned at a thickness of 6μm and stained with haematoxylin and eosin[^4,5].

Results

The initial stock fish in each farm ranged from 3,000 to 25,000 fish, distributed in different ponds within the farm. The number of earth ponds varied from one to six (Table 1). The majority of ponds were barrage type of earth ponds with very few being of diversion pond type. In two farms there was a rosary arrangement of ponds. Affected fish ponds varied from one to three which means that some farms had unaffected fish in some ponds. Farms had obtained their fish either from Kiganjo or Tamarind trout fish hatcheries. The affected fish were of different ages ranging from 2 to 6 months, and weighing 30 to 100 grams. Both sexes were involved. Estimated fish losses varied from 3.5% to 33.3% per farm. A total of 235 fish were examined from all the farms. Five farms had heavy infestation with *Trichodina spp.* with *T. minuta* being the main species, six farms had infections with *Aeromonas hydrophila* organisms which was isolated in pure culture, and three farms had fungus, *Saprolegnia* spp. Most of the fungal growth was observed on the weak fish (Table 1). In two farms, some fish had deformed backbone, with abnormal movements.

Different clinical signs were observed in all farms (Table 2). The conspicuous sign on the pond side was the dark skin discolouration in the affected fish. Some fish had sheen discolouration of the skin due to excess mucous production. This was seen in all farms. The other signs observed were popped-out eyes in five farms. In all farms, many fish were seen crowding near the water inlets. Gasping for air or swimming sluggishly on the water surface was observed in six farms. Erratic movements expressed by fish try-
Table 1: Farm Characteristics and Fish Mortalities in the seven fish farms

<table>
<thead>
<tr>
<th>FARMS</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fish stock (x 10⁵)</td>
<td>25</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>2. Number of ponds per farm</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>3. Age of fish (months)</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>4. Number of ponds affected per farm</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5. Number of fish examined (dead and live)</td>
<td>30</td>
<td>37</td>
<td>19</td>
<td>56</td>
<td>29</td>
<td>42</td>
<td>22</td>
</tr>
<tr>
<td>6. Estimated fish loss (x 10⁵)</td>
<td>2.07</td>
<td>0.43</td>
<td>2.5</td>
<td>6.0</td>
<td>2.7</td>
<td>1.0</td>
<td>0.21</td>
</tr>
<tr>
<td>7. Estimated mortality rate (%)</td>
<td>8.3</td>
<td>4.3</td>
<td>25</td>
<td>30.0</td>
<td>27</td>
<td>33.3</td>
<td>3.5</td>
</tr>
<tr>
<td>8. Water turbidity</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>9. Organisms isolated</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Trichodina minuta</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Aeromonas hydrophila</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Fungal infection (Saprolegnia spp)</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

KEY:
+ = Positive observation
- = Negative observation

Table 2: The Clinical Signs and Gross Lesions observed in Trout Fish in seven farms

<table>
<thead>
<tr>
<th>CLINICAL SIGNS AND LESIONS</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>FARMS</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Skin discolourations</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2. Loss of scales</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3. Fleshing on sides of the ponds</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4. Crowding near water inlets</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5. Gasp for air/surfacing swimming</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6. Erratic fish movements (jumping out of water)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>7. Sluggish movement</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>8. Frayed fins</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>9. Soiled or clogged gills</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>10. Excess mucous production on skin/gills</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>11. Exophthalmos</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>12. Anorexia or inappetite</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>13. Emaciation</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>14. Deformed vertebral column</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>15. Hyperemia/haemorrhages on skin, base fins or around vent</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>16. Hyperemia/haemorrhages of internal organs</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>17. Ascites</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>18. Myocarditis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

KEY:
+ = Fish had this sign or lesion
- = Fish had no sign or lesion.
ing to jump out of the water and frayed operculum and/or fins were observed in four farms. Feed was repeatedly hand spread on the pond surface, at the usual fish feeding points. In five farms, rubbing (fleshing) on the sides of the ponds and/or anorexia were observed. In these farms, sick fish expressed no interest in the feed, and this was interpreted as anorexia or inappetence (Table 2).

Gross lesions on the fish varied from farm to farm and between individual fish. The lesions seen in fish in different farms were as follows: loss of scales especially on the flanks close to the lateral line, extensively soiled gills and excess mucous production in four farms. Excess mucous production was also seen on the skin giving a sheen discolouration. In some of these fish there was also conspicuous cotty growth of fungus (Saprolegnia spp). In three farms the fish were emaciated. Hyperemia and haemorrhages were seen in four farms. These were seen on the skin on the ventral part of the mouth and abdomen, the base of pelvic and pectoral fins and around the vent. Internally, excess abdominal fluid (ascites) was seen in a few fish in five different farms.

In many of the fish with ascites there were internal haemorrhages on the liver and abdominal fat. In two fish farms, few haemorrhages were observed on the musculature. A state of hyperemia was common in a number of fish.

On microscopic examination, most organs showed hyperemia. On the skin there was oedema in some fish, epidermal necrosis especially associated with fungal lesions. One fish had a moderate hyperplasia of the epidermis. The secondary lamella of the gills were fused, and in club shaped formation in fish from three farms, while others had hyperemia, aneurysms and sloughed off epithelium. Degenerative changes were observed in the liver, kidneys and heart muscles. In one farm focal myocardial degeneration and necrosis was seen. The degenerated or necrotic myofibres were invaded by mononuclear cells, mainly lymphocytes and macrophages. The spongy (trabeculae) myocardial layer was affected. The later fish had sloughed of intestinal epithelium into the lumen.

Parasitological examination revealed numerous Trichodinids identified by their ventrally located ring of internal denticles with cilia and were cup-shaped. Majority had denticles numbering 19 to 20. On the number of denticles and morphological shape, the parasites were similar to T. minuta. Trichodinid spp. counts ranged from 40 to 100 parasites per microscopic field (×10) with a mean of 60 parasites per field. In one farm some coccidial oocysts (Eimeria spp) were seen in the intestinal contents.

Abundant growth of Aeromonas hydrophila was isolated in kidney swabs, gills and liver portions. In most cases it was a primary pure culture, except for two cases where there was overgrowth with Proteus species.

Treatment with potassium permanganate was undertaken in three farms with heavy Trichonid spp infestation. Treatment was done early in the morning and consisted of adding Potassium permanganate solution to the incoming water until a concentration of 3-4 ppm was achieved. This concentration was maintained for one hour, then clean water was allowed to flow through to clear the pond. Most of the potassium permanganate was cleared within four hours. After 3 days fish were sampled and examined for parasites. There were no visible parasites and mortality had stopped in the treated ponds.

Discussion and Conclusion

Trichodina spp are important ectoparasites of fresh water and marine fish worldwide. Earth ponds have been found to favour the development of these parasites on tilapia under intensive culture in Cuba, particularly during the dry period. In our study all the ponds were earth ponds but not all were affected. In Europe Trichodinids spp are known as secondary parasites affecting weakened fish but in Israel they are primary pathogens causing direct fish mortalities.
Low parasite infestation rates have been reported in wildfish (fish fry and fingerlings) of Lake Victoria\(^\text{(10)}\). However, there are no reports on the damage these parasites cause to the trout industry in Kenya.

The *Trichodinid* parasites feed on host tissues and exudates\(^\text{(5,10)}\) leading to scattered dermal haemorrhages, eroded scales and excess mucus production on the skin. Infected fish often respond by "fleshing" (rubbing)\(^\text{(8,10)}\) this gives the fish a greyish sheen and frayed fins\(^\text{(5)}\). These clinical signs were seen in various farms during our study (Table 1 and 2), which means that these parasites were playing a significant role in fish mortalities in the seven farms.

*Trichodina spp* can occur alone\(^\text{(11)}\) or often in conjunction with other parasites such as *Gyrodactyurus* spp\(^\text{(4,12)}\), *Chilodonella* spp\(^\text{(13)}\) and the fungus, *Saprolegnia* spp\(^\text{(14)}\). In our study *Aeromonas hydrophila*, was encountered in six farms; *Saprolegnia* spp in three farms and one case of coccidia parasites were encountered. No other ectoparasites were detected from these farms.

Bacteria are always numerous in the environment of the fish\(^\text{(11)}\). Opportunistic bacteria invade the tissues of a fish host, rendered susceptible to infection by stress factors or other diseases. The most significant micro-organisms in this respect is *A. hydrophila*\(^\text{(15)}\) which was first reported and isolated by Sanarelli (1891, cited by Roberts)\(^\text{(5)}\), which is known to cause severe outbreaks of disease in pond-cultured and wild fishes in many countries\(^\text{(5,16)}\). It has been reported in Lake Kainji in Nigeria\(^\text{(17)}\), Lake Victoria, Masinga dam and other wildfish in Kenya\(^\text{(16,18)}\) and in intensively farmed fish in Mombasa\(^\text{(6)}\). These bacteria cause bacteremia and haemorrhagic septicaemia\(^\text{(4,6)}\). Clinically the disease is expressed by dermal congestion and haemorrhages\(^\text{(5)}\), ulcers and shallow necrotic lesions on the skins. Heavy losses may be experienced in stressed fish, particularly with poor nutrition\(^\text{(6)}\). In our study hyperemia and haemorrhages were observed but no ulcer or necrotic lesions were seen. In three farms fish were found to be too emaciated. *A. hydrophila* may have been a secondary invader accentuating the disease problems on these fish.

Posterior paralysis due to spinal cord infection by *Aeromonas* spp has been reported in sea bream fish\(^\text{(19)}\). The fish with deformed spinal cord in our study had no corresponding bacteria isolates. The deformity was due to trauma.

Fungal infection by *Saprolegnia* spp was observed in three farms. The infection was more prominent in very weak emaciated and anorexic fish. Cottony white growth was the main feature. This fungus has been associated with protozoal infection\(^\text{(17)}\) and is reported to increase tilapia mortalities at low temperatures\(^\text{(14)}\), particularly in fish with concurrent infestation with ectoparasites. We believe that this fungus was a secondary invader on weak fish.

The gross and histological picture seen was due to a heavy primary infestation with *Trichodina* spp coupled with a secondary infection with *A. hydrophila* and *Saprolegnia* spp. The myocarditis seen could be due to *A. Hydrophila* infection but nutritional deficiency in vitamin E/Selenium could not be ruled out, as we did not analyse for them.

Treatment of *Trichodina* parasites are abit difficult\(^\text{(6)}\), but work with Tilapia has shown that the parasite can be treated with formalin\(^\text{(12,20)}\), ammonia\(^\text{(8)}\) especially in juvenile tilapia and potassium permanganate\(^\text{(12,13)}\). Records on treatment of tilapia or trout in Kenya were not available. The authors tried potassium permanganate on three farms. In all farms the treatment was effective and no parasites could be seen on the skin or gills. The treatment also helped to reduce the fish mortality, even though no treatment was undertaken for *A. hydrophila* and *Saprolegnia* spp.

An incident occurred in one farm where the farmer was advised by another farmer to treat the fish with copper sulphate. He overdosed the fish and lost about 1,000 fish within minutes. However, a quick increase in water flow and partial emptying of the pond helped to save the remaining 2,000 fish in the
ponds. We examined his fish after 2 days of this incident and found them free of Trichodinids parasites and Saprolegnia spp of fungi. We believe that the chemical levels were too toxic for the fish and it also helped to control the fungi.

Chemotherapy for Aeromonas spp was not undertaken. However, owners were advised to reduce organic pollutants, remove all dead or dying fish and where possible the volume of water flowing through the ponds should be increased. Market size fish were cropped to ease overcrowding in some farms.

In conclusion, trichodiniasis, A. hydrophil and Saprolegnia spp infection appear to be important problems in rainbow trout farms in Kenya. This is especially so in the small scale farms where fish nutrition is poor, fish are stressed by overcrowding, compared with the amount of water flow into the ponds, temperature fluctuations, especially in marginal trout farming zones where the water temperature can go up to 19°C and more and soil erosions in rainy months. With environmental improvement and controlled treatments, the problems can be minimized to help the farmer produce more fish.

Acknowledgement

The technical help given by the members of department of Veterinary Pathology and Microbiology is highly appreciated. This paper was typed by Miss J.N. Mwea.

References


Received for publication on 17th June 1992
THE PREVALENCE OF UDDER AND TEAT LESIONS IN DAIRY COWS IN KENYA

MAINA, A.K. and MULEI, C.M.
Clinical Studies Department, University of Nairobi, P.O. Box 29053, Nairobi, Kenya

PREVALENCE DES LESIONS DU PIS ET DU TRAYON CHEZ LES VACHES LAITIÈRES AU KENYA

Résumé
Les glandes mammaires de 139 vaches en lactation ont été examinées en vue de dépister les lésions macroscopiques et pour connaître leur aptitude à la traite. Les lésions observées étaient: le dysfonctionnement des quarts de la mamelle (16.5%), les quarts fibrotiques (24.4%), la gêne des trayons (23.3%), les papillomes des trayons (14%), la brûlure des trayons (13.4%), la fistule des trayons (3%), l'obstruction des trayons (2.5%) et l'invagination de l'extrémité des trayons (3%). Selon les résultats obtenus, il y avait un problème de mastite chronique et de mauvaise gestion des troupeaux.

Summary
Mammary glands of 139 lactating cows were examined for gross lesions and milkability. The lesions observed were: non-functional quarters (16.5%), fibrotic quarters (24.4%), teat chaps (23.3%), teat papillomas (14.0%), teat erosions (13.4%), teat fistula (3.0%), blocked teat canals (2.5%) and inverted teat tips (3.0%). The results suggest a problem of chronic mastitis and poor managements in the herds.

INTRODUCTION
Udder and teat lesions occur in all herds. The lesions arise from a variety of causes: viral and bacterial infections, mechanical and chemical damage, trauma and fireburns. They are important in dairy cows because they are painful and make milking difficult and predispose the animal to mastitis. Despite this importance there is no available data about them in Kenya. This study was therefore undertaken to determine the prevalence of udder and teat lesions in small scale dairy farms in Kenya.

Materials and Methods
This investigation was carried out in 16 small scale farms in Kiambu district of Kenya. The data was obtained from 139 lactating cows of different age groups and various breeds.
The cow's mammary glands were examined by visual observation for any lesions, palpation for consistency of the tissues and stripping of the quarters for milkability. The findings were recorded for each cow according to the quarters.

The data was analysed by STATISTIX (statistical programme).

Results
The results are shown in Table 1. Of the 556 quarters examined 164 (29.5%) were affected with lesions and 392 (70.5%) were normal. The distribution of the lesions among the quarters were; right fore quarters 39 (23.8%), right hind quarters 38 (23.2%), left fore quarters 44 (26.8%) and left hind quarters 43 (26.2%). The left quarters had more lesions than the right quarters (p<0.05).
The most common lesions were fibrotic mammary glands (24.4%), teat chaps (23.2%), non-functional quarters (16.5%), teat papillomas (14.0%) and teat erosion (13.4%).

Discussion
The non-functional quarters were those which had dried up completely and fibrotic mammary quarters those which had lost their soft pliable consistency. The high prevalence of these two lesions (16.5% and 24.4% respectively) suggests
Table 1: Udder and teat lesions in 139 dairy cows

<table>
<thead>
<tr>
<th>Lesion</th>
<th>Number of Quarters affected</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RF</td>
<td>RH</td>
</tr>
<tr>
<td>Non-functional quarters</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Fibrotic mammary quarters</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Teat chaps</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Teat papilloma</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Teat erosions</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Teat fistula</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Blocked teat canal</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Inverted teat tip</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total (%)</td>
<td>39(23.8)</td>
<td>38(23.2)</td>
</tr>
</tbody>
</table>

% = percentage of the total affected quarters
RF = Right fore quarter
RH = Right hind quarter
LF = Left fore quarter
LH = Left hind quarter

a major problem of chronic mastitis\(^\text{(3,4)}\). When the inflammatory process persists over a long period, the secretory tissue is damaged and replaced with fibrous tissue. Consequently, the quarter loses its pliable consistency, produces little milk and may dry up completely\(^\text{(3)}\). Teat chaps were the most common teat lesions (23.2%). Others have reported similar observations\(^\text{(2,5,6)}\). Bovine teat is entirely free of sebaceous glands and so it is highly susceptible to dessication and cracking\(^\text{(8)}\). Also because of its location it is highly susceptible to cold and wet conditions and traumatic insults such as walking through long grass\(^\text{(1)}\). The resulting injuries allow bacteria to enter the gland where they may cause mastitis.

The second most prevalent lesions were teat papillomas and erosions (14.0% and 13.4% respectively). These lesions are quite common in cattle and in case of papillomas the incidence may be as high as 25%\(^\text{(3)}\). Ordinarily papillomas cause little harm but often interfere with milking.

Teat fistulas and blocked teat canals had the lowest prevalence (3.0% and 2.5% respectively). This suggests that injuries involving the deep tissues of the teat were uncommon in these herds.

The left quarters had more lesions than the right quarters (p<0.05). This agrees with another observation where perforating and non-perforating teat injuries were considered\(^\text{(9)}\). However, there is no consensus in the few reports available\(^\text{(9,10,11,12)}\). Therefore, more work needs to be done.

In conclusion this study suggests that udder and teat lesions are important and could be a major contributing factor to mastitis and culling of the dairy cows in this area.

References


Received for publication on 26th June 1992
SUSPECTED CASES OF AVITAMINOSIS A IN PIGS

M.R. SALUM* and S.M. NJAVIKE
District Livestock Development Division, P.O. Box 11,
Nachingwea, Lindi Region, Tanzania

CAS SUSPECTS D’AVITAMINOSE “A” CHEZ LES PORCS

Résumé


Summary

Cases of an Avitaminosis A in pigs have been observed in the piggery units of Murumba Mission Centre and Teachers Training College (ITC) in Nachingwea District. In Murumba, two sows farrowed a total of 8 live blind piglets in the sense that 4 had blind eyes, 3 had undeveloped eye-balls and one had unilateral anophthalmia and a blind eye. At TTC unit three adult pigs showed signs of paralysis of the hindquarter and they had staggering movement (incoordination). The authors think that the condition was caused by a vitamin A deficiency because the two units used white maize bran as their feed throughout and it was not supplemented with green material. Clinical signs observed of a typical deficiency of vitamin A included signs such as paralysis of hindquarter and incoordination in movements among adults. Piglets born blind, some with undeveloped eye-balls and anophthalmia.

INTRODUCTION

Vitamins are organic substances present in natural foods which are needed only in minute quantities to maintain the biochemical and structural integrity of body cells and tissues. Several vitamins which are required by animals are synthesized in the animal body, to mention a few; they are vitamin B complex and vitamin D, while some of them need to be presented in the food since the animals cannot synthesize them, like vitamin A, C and E, Tyler (1964). Vitamin A which is one of the principal vitamins known; is a substance called Carotene; it is found in carrots, green vegetables, egg-yolk, fish roe, liver, cod-liver oil and the livers of certain other varieties of fish. Yellow maize is a good source of the provitamin cryptoxanthine; and green foods are rich in carotene; as such the herbivorous animals and pigs usually obtain abundant supplies from grass and other fresh green forage plants, Miller et al (1962).

It is usual to speak of a vitamin deficiency as an avitaminosis. An avitaminosis A in different domestic animals has different signs. According to Miller et al (1962), Tyler (1964), Dunne (1970), Hutyra et al (1973), Boado (1974) and Rodriguez et al (1985), an avitaminosis A in pigs has the following

*Present address: Veterinary Investigation Centre, P.O. Box 186, Mtwara, Tanzania.
signs: failure to grow in piglets and infertility in adult pigs, paralysis of the hindquarters, night blindness, muscular inco-ordination, diarrhea, anorexia, Keratinization of the skin and the cornea; convulsions in advance stage, paralysis of the facial and vestibular nerves, and in the pregnant sows when fed with feeds that are deficient in vitamin A give birth to blind piglets, with undeveloped eye-balls and optic nerves; and, with congenital defects such as anophthalmia, sulcus platus (Depresion), microphthalmia and many other malformations.

The objective of this paper is to demonstrate how feeding of monogastrics (Poultry and pigs) presents a special problem to our farmers and to show or pin-point some of the consequences that can be observed by farmers when they poorly feed their animals.

History:
The piggery of Murumba Mission Centre at Nachingwea had a total number of 64 pigs, out of them 7 were sows. In this Unit all the pigs were fed only with white maize bran as their main feed. The report which was received from the piggery attendant showed that since October 1988, two of the sows conceived and for the whole period of pregnancy they continued receiving the same feed, and no green material were supplemented.

The same system of feeding has also been observed in piggery unit of Teachers Training College (TTC) Nachingwea, which had 18 pigs (weaners and adults).

The district livestock team made an observation of another piggery unit of 10 pigs which were fed with the same kind of maize bran but supplemented with green materials.

Observations:
Late January 1989 the two sows in Murumba Mission Centre furrowed 8 live piglets, that is 4 each. After one week 2 piglets died, and the rest are still alive and doing well. But one prominent feature is that all the 8 piglets furrowed were blind. Four of them had anatomically normal eyes (external observation) but blind, 3 had undeveloped eye-balls, and the remaining one had unilateral anophthalmia, that is, there was no eye on one side, and the other side had a blind eye. In the same unit there was an adult sow with signs of paralysis of the hindquarters.

On the other side, at the TTC unit, there were 3 adult pigs that already showed signs such as paralysis of hindquarters and stagering movement (incoordination). In contrast no such signs were observed in the unit that included green materials in feeding the pigs. An advice was given to those two problematic units to include green materials in their feeding programme and if possible to use a pre-mix (rich in vitamin A) suitable for pigs.

Some improvement was observed in one of the problem units (Murumba Mission Centre), after some few months, which started using greens from pawpaw fruits and leaves.

Discussion

From what has been observed, it shows that white maize bran alone does not suffice for feeding pigs. According to analysis made by Lekule (1987) maize bran is a very good energy supplement which is high in fat (about 12%) and crude protein (10-12%). Kitalyi (1987) showed that maize bran in its natural form is high in fibre content, low protein content and low in minerals and vitamins.

Animals when feeding under natural conditions, with a free choice from a wide range of food-stuffs, consume, as a rule, all the vitamins they require. But under the influence of domestication, and especially of intensive rearing, animals often have no choice in the matter and suffer from vitamins deficiencies either because their artificial diet is too restricted, or because vitamins naturally present have been destroyed in the preparation of the food.

When vitamins are deficient in the diet, typical symptoms appear in the animals, and if not allowed to develop too far, these symptoms can be cured by supplementing with the vitamins.
Thus, the authors believe that the two units had a problem of vitamin A deficiency, based on the feeds given and on the signs observed.

Conclusion and Recommendation

It is concluded that white maize bran alone does not suffice to feed pigs because it is poor in vitamins and minerals although is a good source of energy. As such it is recommended that farmers in this part of the country need to use green materials and/or premix, rich in vitamins (vitamin A included) when preparing their feeds for non-ruminants (Monogastrics), that is poultry and pigs.

Acknowledgement

The authors would like to thank the Nachingwea district Livestock staff for their cooperation shown. They are grateful to Doctors Otaru and Kikopa for their guidance and encouragement. Thanks are also extended to Miss A.L. Mango and Miss J.L. Mlutano for typing the manuscript.

Received for publication on 13th April 1992

References

SHORT COMMUNICATION:

PRELIMINARY OBSERVATIONS ON THE PREVALENCE OF FUNGI IN AFFECTED AND NORMAL UDDERS OF SAHELIAN GOATS IN NIGERIA

J.A. AMEH, G.O. EGWU and MOSES
Faculty of Veterinary Medicine, University of Maiduguri, Maiduguri

INTRODUCTION

Bacteria are known to be the major cause of mastitis in goats\(^1\). However, Fungi, have now also been recognised as primary etiological agents of mastitis\(^2,3\). The importance of fungi as a cause of mycotic mastitis has been highlighted\(^4\) that cryptococcus infections usually cause severe clinical mastitis in bovine characterised by initial swelling of the udder, febrile spikes, inappetence, and severe loss of milk production.

Various species of fungi have been associated with clinical mastitis in goats. Some of these include: Cryptococcus neoformans, Candida albicans, C. krusei; C. tropicalis and Asperillus spp.\(^5\).

In Nigeria, there is no literature on the prevalence of mycotic agents in normal and affected udders of goats. This study is the first caprine mycotic mastitis survey to be done in North East Zone of Nigeria. This study reports on the prevalence of mycotic agents in normal and diseased udders of Nigerian Sahelian goats, so as to highlight their role in the aetiology of Caprine mastitis in Nigeria.

Four breeds of goats comprising Borno-white, Borno Red, Sokoto Red and the long legged Sahels, common in Maiduguri (Sahel Zone) of Nigeria were sampled. These goats were from private (backyard) holding or Government established farms, were managed by semi intensive and extensive systems. Various ages of the does at different stages of lactation were sampled. The affected udders were clinically graded (normal, acute, peracute, subacute and chronic) as described by Blood and Radostits\(^6\).

Milk samples were collected aspectically into sterile sample bottles after milk disinfection by the teat and running off of a few milk streams. Milk samples were obtained from 55 apparently healthy and 29 clinically affected udders. The samples were stored at 4°C and cultured within a week of collection.

A loopfull of thoroughly mixed milk sample was inoculated onto Sabouraud's dextrose agar plates and incubated at 37°C and examined daily for up to two weeks for the growth of fungi. A loopfull of the milk samples were individually inoculated on to 10% sheep blood agar and MacConkey agar, plates were then incubated at 37°C for 24-72 hours and inspected daily for bacterial growth.

Fungal isolates were identified as recommended by Ajello\(^7\). The bacterial isolates were identified according to the methods of Cowan and Steel\(^8\). Table 1 shows the distribution of cases according to the breeds of goats. Borno white with 15(51.7%) and Borno-Red 9(31.03%) had the greatest number of clinically affected udders.

The number of cases of mastitis graded according to clinical severity are shown in Table 2. More acute 13(44.8%) and chronic 9(31.03%) cases were observed out of the 29 affected udders.

More samples 17(58.62%) and 10(19.34%) were collected from goats aged between 4-5 years and greater than 6 years, respectively. The ages between 2 and 3 years had 9(31.03%) cases.

The prevalence of mycotic infections in the udders of goats shows that of the 29 affected udders, 8 were positive for fungi of which 5(62.5%) and 3(37.5%) were C. albicans and Aspergilus spp respectively, whilst, of the 55 clinically normal udders only 2(3.6%) had C. albicans occurred in all the clinical forms of mastitis.
Table 1: Distribution of Cases according to the Breeds of goats examined

<table>
<thead>
<tr>
<th>Breeds</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sahelian</td>
<td>4 (13.79)</td>
</tr>
<tr>
<td>Borno Red</td>
<td>9 (31.03)</td>
</tr>
<tr>
<td>Borno White</td>
<td>15 (51.72)</td>
</tr>
<tr>
<td>Sokoto Red</td>
<td>1 (3.45)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>29 (100)</strong></td>
</tr>
</tbody>
</table>

Table 2: Number of Cases of Caprine Mastitis graded according to Clinical Severity

<table>
<thead>
<tr>
<th>Clinical Stages</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>13 (44.83)</td>
</tr>
<tr>
<td>Peracute</td>
<td>1 (3.45)</td>
</tr>
<tr>
<td>Subacute</td>
<td>6 (20.69)</td>
</tr>
<tr>
<td>Chronic</td>
<td>9 (31.03)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>29 (100)</strong></td>
</tr>
</tbody>
</table>

Of the 8 samples from the 29 affected udders positive for fungi, 7 showed growth of different species of bacteria whilst all the 2 positive samples from the clinically normal udders showed only growth of *Staphylococcus* spp.

This study has shown a prevalence rate of fungi infection of 4.76% on the basis of the total number of animals examined. The value is slightly higher than the 3.3% out of 30 recorded\(^1\) in goats. In their\(^1\) report, it was suggested that fungi played an important primary causal role of mastitis in goats.

In a previous study in Nigeria by Falade\(^2\), consistent with the views of the present authors, the primary role of fungi in Caprine mastitis still remains uncertain. This is because, since no reference is available on mycotic mastitis in Nigeria, no definite opinion can be expressed on the role of fungi in Caprine mastitis, as 7 of the 8 positive samples for fungi yielded concurrent bacteria.

Nevertheless, the clinical significance of these isolates singly or in association with other bacteria or pathogenic agents in inducing various forms of clinical mastitis should not be underestimated.

The reasons for the increased number of cases of mastitis in Borno-white and Red breeds of goats is not very clear. Differences in udder sizes and milk yield may account for the relative susceptibility of the goats in Northern parts of Nigeria\(^3\).

In conclusion, it is to be noted that an experimentally controlled investigation is needed to further elucidate the pathogenic role of these fungi. Moreso, the prevalence of *C. albicans* in normal and affected milk samples emphasise the Zoonotic importance of these pathogens.

References


Received for publication on 16th September 1992
REVIEW:

LABORATORY TRAINING MANUAL ON THE USE OF NUCLEAR TECHNIQUES IN INSECT RESEARCH AND CONTROL


This Laboratory Training Manual is the Third Edition prepared jointly by the Food and Agriculture Organization of the United Nations and the International Atomic Energy Agency. It (Technical Reports Series No. 336) replaces the Laboratory Training Manual on the Use of Isotopes and Radiation in Entomology (Technical Reports Series No. 61) published in 1977. The extensively revised manual by experts in this field is aimed to help entomologists and others responsible for the entomological research and control of insects in developing countries become familiar with the potential use of isotopes and radiation in solving some of their research and insect control problems.

The Laboratory Training Manual consists of six parts, each of which has specific learning objectives. The information contained in each part is clearly and concisely presented. The text is arranged under bold headings, with some information given in simple tables, figures or illustrated with line drawings. Part I. Radiation Safety: provides basic training on safety rules for a radioisotope laboratory, personnel and laboratory radiation monitoring, and procedures to be followed when receiving radioactive shipments. Part II. Radiation and Isotopes: gives education on the types of radiation and on the isotopes used by entomologists. Part III. Radiation Detection and Assay of Radioactivity: gives training on the equipments and methods used to correctly count radioactivity. Part IV. Application to Entomological Problems: describes basic techniques on laboratory and field safety procedures for the prevention of radioactive contamination and, labelling of insects and their practical applications. Part V. Sterile Insect Technique: provides comprehensive account and training on the SIT for the control of insects of economic importance including examples of ongoing and/or successful programmes of control of screwworm, fruit flies, tsetse flies, pink bollworm and cotton bollweevil as well as examples of insect control programmes showing good research development; and, finally it describes eight laboratory exercises on the effects of sterilization of insects using gamma rays or chemosterilants. Part VI. Glossary of Some Basic Terms and Concepts: this last part explains over 150 of the terms and concepts used in the manual from the very basic like 'Curie' to the more complex such as 'First order kinetics'. With simplicity in mind these definitions are, in the main, brief and mostly of great value to the beginner who may well be meeting many of these for the first time. This part also provides useful information on some basic symbols and units used in the manual.

K.M. Katondo
OAU/IBAR

S.K. Moloo
ILRAD
STAFF LIST

Director
W.N. Masiga, B.V.Sc., Dip. Bact., Ph.D.

Chief Animal Health Officer
A.G. Tall, Docteur Vétérinaire

Chief Livestock Projects Officer
K.M. Katondo, B.Sc., M.Sc.

Documents Officer
M.A.S. Machani, B.A., Hons.

Liaison Officer

Translators
M. Ranaivoson
P.E. Dadzie
BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA

Editor
Dr. W.N. Masiga, B.V.Sc., Dip. Bact., Ph.D.

Assistant Editor
Dr. J.T. Musiime, B.V.M., Dip. P.V.M., M.Sc., Ph.D.

Members of Editorial Board

Prof. G.M. Mugera, Dip., Vet., Sci., M.Sc., Ph.D.

Dr. M.M. Rweyemamu, B.V.Sc., Ph.D., M.R.C.V.S.

Dr. S.M. Toure, Docteur Vétérinaire

Dr. M.J. Muttinga, B.Sc., M.Sc., Ph.D.

Dr. A.J. Musoke, B.V.Sc., Ph.D.

Dr. F.R. Rurangirwa, B.V.Sc., M.Sc., Ph.D.

Prof. J.A. Kategile, B.Sc., Ph.D.

Dr. V.M. Nantulya, MD., Ph.D., M.R.C. Path.

Dr. J.M. Ayuya, B.V.M., M.Sc.


Dr. A. Abate, B.Sc., Ph.D.

Prof. A.L. Ndiaye, Docteur Vétérinaire

Prof. A. Sere, Docteur Vétérinaire
RECOMMANDATIONS AUX AUTEURS

Objet
Le Bulletin de la Santé et de la Production animales en Afrique contient des articles de recherches originales traitant d'activités en matière de santé et de production animales visant à assurer le développement de l'industrie animale et une meilleure utilisation des ressources du bétail en Afrique. Le Bulletin est un périodique trimestriel.

Présentation des articles
Deux exemplaires des articles doivent être adressés à Monsieur le Redacteur en Chef, Bulletin de la Santé et de la Production Animales en Afrique, Organisation de l'Unité Africaine/Bureau interafricain des Ressources animales, P.O. Box 30786, Nairobi, Kenya.


Un article ne peut être soumis pour publication que s'il n'a pas encore été proposé ailleurs; il fera l'objet de quelques modifications par le Comité de Rédaction.

Genres d'articles publiés dans le Bulletin
— des communications originales
— des brèves communications
— analyse des articles proposée par le Rédacteur
— des éditoriaux
— le courrier des lecteurs
— analyse d'ouvrages
— informations et annonces

Format des articles
Les manuscrits doivent respecter les conditions suivantes:
Le titre doit être concis et ne pas dépasser plus de 15 mots, il est suivi du (des) nom(s) de l'auteur (ou des auteurs) et des établissements où le travail a été effectué, ainsi que de l'adresse pour les correspondances si elle n'est pas la même.

Le résumé ne doit pas excéder 200 mots. Son texte bref et concis comprendra les principaux résultats et la (les) conclusion(s) de l'étude.

L'introduction expose le but de la recherche.

Le matériel et les méthodes utilisés.

Les résultats présentés brièvement.

Un débat sur l'importance de l'article.

Remerciements éventuels.

Bibliographie: les références bibliographiques doivent être numérotées dans l'ordre, telles qu'elles apparaissent dans le texte. L'identification des références dans le texte se fera à l'aide de nombres (entre parenthèses) et non pas par les noms des auteurs.

La bibliographie doit respecter la présentation suivante:
1. Journal
Le nom de l'auteur (ou des auteurs) suivi des initiales du ou des prénoms, l'année de parution (entre parenthèses), l'abréviation du titre du périodique suivant la World List of Scientific Periodicals (soulignée), le numéro de la première page. Le titre de l'article ne doit pas être inclus.

2. Revue
Le nom de l'auteur (ou des auteurs) suivi des initiales du ou des prénoms, l'année de parution (entre parenthèses), le titre exact (souligné), la ville où elle a été publiée, les éditeurs, le numéro de la première page.

3. Rapport annuel
Le nom du pays, l'année faisant l'objet du rapport, puis le nom du service ou de l'organisation, le numéro de la première page.

Si le même auteur est cité plus d'une fois, ses publications seront indiquées dans l'ordre chronologique dans la liste bibliographique et s'il y a plus d'une publication, les lettres "a, b, c..." seront ajoutées aussi bien dans la liste bibliographique que dans le texte.

Illustrations
Les tableaux et les titres doivent être en nombre aussi réduit que possible. Un tableau d'une trop grande dimension est difficile à lire même s'il peut être reproduit. Les tableaux et les figures doivent être numérotées dans l'ordre, respectivement Tableau 1, etc., ou Fig. 1 etc. et joints à la fin du texte. Les références aux tableaux et aux figures dans le texte doivent être numérotées et non pas indiquées "tableau ci-dessous" ou "figure ci-dessous". Les illustrations en couleurs ne sont reproduites qu'aux frais de l'auteur (ou des auteurs).

Brève communication
Une brève communication signifie que l'article ne peut pas être publié comme une communication normale. Elle ne doit pas dépasser deux pages imprimées ou 1 000 mots en incluant deux illustrations au maximum. Elle doit donc respecter les mêmes normes qu'un article habituel, sauf que le résumé et les sous-titres ne sont pas nécessaires.

Épreuves typographiques
Les épreuves typographiques sont envoyées à l'auteur qui en effectue la correction des coquilles et en assure le retour rapide (dans les 3 jours).

Tirés à part
25 tirés à part de chaque article sont fournis gratuitement. Il est possible de commander des tirés à part supplémentaires et les payer au moment des épreuves typographiques. Le coût d'un tiré à part supplémentaire s'élève à 1 $EU.

Abonnements
Le coût de l'abonnement annuel y compris le tarif d'abonnement (par voie terrestre) et le frais de manutention, est de 15 $EU pour les pays africains et 20 $EU pour les autres pays. L'envoi par avion est possible sur simple demande.

Anciens numéros
Il est également possible de se procurer, sur simple demande, les anciens numéros aux mêmes prix.