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IN AFRICA

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GUIDANCE FOR AUTHORS

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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.

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(DERMATOPHILUS CONGOLENSIS): A STUDY OF THE CULTURAL CHARACTERISTICS AND ANTIBIOTIC SENSITIVITIES OF TWO CAMEROONIAN STRAINS

NFI A.N.
Institute of Zootechnical and Veterinary Research, P.O. Box 125, Mankon-Bamenda, Cameroon

DERMATOPHILUS CONGOLENSIS (D. CONGOLENSIS): ETUDE DES CARACTERISTIQUES DE CULTURE ET DE LA SENSIBILITE A L'ANTIBIOTIQUE DE DEUX SOUCHES DU CAMEROUN

Résumé
On a isolé Dermatophilus congolensis, organisme provoquant la dermatophilose bovine chez les bovins à Bambui et à Bangangte. L'étude de ses caractéristiques de culture et de sa sensibilité in vitro à une variété d'antibiotiques a été menée. On a observé des organismes à gram positif avec des hyphes ramifiées, alors que les colonies isolées montraient des zones dégagées d'hémolyse-béta.
L'organisme était très sensible à l'auréomycine, au chloramphénicol, à la pénicilline, à la streptomycine et à la tétracycline; en revanche, il était résistant au sulfamide. Il faudrait utiliser des antibiotiques à large spectre d'action pour le traitement de la dermatophilose.

Summary
The organism Dermatophilus congolensis causing bovine dermatophilosis in cattle at Bambui and Bangangte was isolated. The study of its cultural characteristics and in vitro sensitivity to a variety of antibiotics was carried out. The organisms were gram positive with branching hyphae while isolated colonies showed cleared zones of beta-haemolysis.

The organism was most sensitive to aureomycin, chloramphenicol, penicillin, streptomycin and tetracycline while being resistant to the sulphonamides. Broad-spectrum antibiotics should be used as treatment for dermatophilosis.

INTRODUCTION
Dermatophilosis, first described by Van Sacegham in 1915 in Belgian Congo, is an economically important disease of cattle and other ungulates caused by Dermatophilus congolensis. It is characterised by an acute or chronic, local or progressive and, at times, fatal exudative dermatitis. This disease has a high prevalence across West Africa causing serious losses through hide damage, impaired growth, reduced production, increased culling and death due to debility and toxæmia[9]. The prevalence ofdermatophilosis has been documented in Wakwa, Ngaoundere[8] and described as one of the major causes of loss in cattle in the area[3].

Exotic animals are very susceptible to dermatophilosis with the back as the main predilection site, especially on the 'hump' and saddle[6]. Secondary bacterial invaders entering the eczematous lesions may give rise to an extensive cellulitis and death[6].

The organisms can be isolated from the skin of normal cattle as well as from those showing clinical signs. It requires some triggering mechanism to become pathogenic and starts growing in the dermis[9]. Predisposing factors include a scratch or insect bite penetrating to the dermis or repeated wetting which softens the epidermis. The chronic local dermatitis with a serious exudate gives rise to small raised patches on the skin and matted hair in a “paint-brush” fashion[9].

The onset of dermatophilosis in Tropical Africa is closely associated with the rainy season coupled with the higher prevalence and greater activity of biting flies and ticks[5,8,18]. The termination of humid and hot conditions often results in spontaneous recovery; the micro-organisms then remaining quiescent on the skin until the following wet season when the disease progresses once more[8].
Various antibiotics have been claimed to be potent in treatment of this infection\(^{11,13,16,17}\). In this paper, the isolation of the dermatophilosis agent; its cultural characteristics for its pure isolation and antibiotic sensitivity \textit{in vitro} are examined in an attempt to suggest a cheap and effective treatment for the disease.

\section*{Materials and Methods}

Scabs from lesions on infected cattle at the Animal Research Antenna (ARZ) Bangangte and the Animal Research Centre (CRZ) Bambui were collected using a pair of forceps and put in sterile universal bottles. The samples were first examined and shown to be negative for ringworm infection. The scabs were then ground into fine suspensions with 1 ml sterile normal saline. Thin smears from a suspension of each sample were stained by Gram and Giemsa and examined microscopically.

\section*{Cultures}

Materials for inoculation were prepared according to \(^{3}\) and cultured on blood agar (BA) plates (Oxoid blood agar base No. 2 with fresh sheep blood). Cultures were incubated at 37\(^\circ\)C for 24 hours. From the resultant rich growth of mixed colonies, 3 subcultures were carried out on blood agar to obtain a pure culture of \textit{Dermatophilus congolensis}. The latter was confirmed by Gram stain and microscopic examination. A loopful of the colonies were then further subcultured on BA and brain heart infusion broth for appreciation of cultural characteristics.

\section*{Antibiotic sensitivity test}

A uniform suspension of the organisms was made by scraping off pure discrete colonies from the BA plates and mixing with normal saline in a universal bottle. Aliquots of 1 ml of each suspension was spread out uniformly on the surface of sixty three fresh BA plates for each strain of the organism, the excess being aspirated. The plates were inverted and left to dry for 15 minutes. Different concentrations of various antibiotics (Table 1) on Oxoid sensitivity discs, 3 replicates per disc, were placed in the centre of each agar and incubated at 37\(^\circ\)C for 48 hours. The plates were examined later and any zones of growth inhibition measured in millimetres using a pair of callipers.

\section*{Results}

\subsection*{Microscopic Examination}

Stained smears of scabs from both suspensions were gram positive with branching hyphae. The hyphae appeared in rows of 2-4 coccoid cells typical of \textit{D. congolensis} when examined under oil immersion.

\subsection*{Cultural Characteristics:}

\textit{D. congolensis} grows readily and quite rapidly in aerobic culture at 37\(^\circ\)C. The colonic characteristics of the organisms were as described by \(^{6}\) and \(^{3}\). On BA plates, the colonies were either moist and smooth, or white to yellow colour, or rough with prominent ridges which appeared like coral when viewed with a hand lens. The greyish colonies become yellow with age and adherent to the medium. It produces a pellicle on liquid media like brain heart infusion broth. Isolated colonies showed clear zones of beta-haemolysis. Giemsa stained smears of isolated colonies presented the typical micromorphology of \textit{D. congolensis}. Smears reveal the presence of short branching hyphae and clusters of numerous 2-4 coccial forms like staphylococi. The organisms showed motility and characteristic random darting motion in a drop of distilled water under the microscope.

\subsection*{Antibiotic Sensitivity Test}

The various antibiotics either completely inhibited the growth or had no \textit{in vitro} effect on \textit{D. congolensis} as judged by the presence or absence of growth inhibition on solid media. \textit{D. congolensis} was sensitive to most antibiotics except methicillin, furazolidone, thiazamide, novobiocin and nalidixic acid (Table 1). The isolates from Bambui and Bangangte were similar in their cultural characteristics. The Bambui and Bangangte strains were sensitive and resistant to the sulphadiazine and Cyclosporin respectively.
Table 1: Antibiotic Sensitivity of the Bambui and Bangangte Strains of *D. congoensis*

<table>
<thead>
<tr>
<th>Antibiotic Agent</th>
<th>Antibiotic Concentration (µg)</th>
<th>Bambui strain</th>
<th>Bangangte strain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plates</td>
<td>Mean</td>
<td>Plates</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>50</td>
<td>23</td>
<td>26</td>
</tr>
<tr>
<td>Oxytetracycline</td>
<td>50</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>Streptomycin</td>
<td>25</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>10</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Methicillin</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Furazolidone</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spiramycin</td>
<td>25</td>
<td>32</td>
<td>33</td>
</tr>
<tr>
<td>Sulphadiazide</td>
<td>50</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Penicillin</td>
<td>21U</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Lincomycin</td>
<td>10</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>Nettimicine</td>
<td>30</td>
<td>36</td>
<td>34</td>
</tr>
<tr>
<td>Cyclosporin</td>
<td>30</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Cefuroxide</td>
<td>30</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>Aminoside</td>
<td>21U</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>10</td>
<td>28</td>
<td>32</td>
</tr>
<tr>
<td>Thiabendazole</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Omeprazole</td>
<td>15</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>Neomycin</td>
<td>30</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Novobiocin</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nalidixic Acid</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fusidic Acid</td>
<td>10</td>
<td>17</td>
<td>19</td>
</tr>
</tbody>
</table>

Discussion

The beta-haemolytic zones around the colonies have been observed by other workers\(^{(11,13)}\). *D. congoensis* was sensitive to aureomycin, chloramphenicol, penicillin, streptomycin and tetracycline in that order according to earlier observations by \(^{(15)}\). These results agree with \(^{(4)}\) who showed that the penicilins were most active *in vitro* even though their activity *in vivo* was limited. The moderate activity of penicilins and the over sensitivity to chloramphenicol, spiramycin and methicillin of these organisms confirms earlier work by \(^{(11)}\) except for the fact that furazolidone was not active in the present study. The difference could be due to the low concentration (10µg) of furazolidone used in the present study as compared to 100 µg used by Marimi\(^{(11)}\). This variable response of *D. congoensis* to the various antibiotics confirms the studies by \(^{(13)}\).

From these results, it appears that effective cure of dermatophilosis due to *D. congoensis* should be effected by the use of broad spectrum antibiotics.

Acknowledgements

Sincere thanks to MESIRES for the funds. We would like to express our appreciation to the staff, especially Miss Anne F. Nyoh, of the Bamenda School of Laboratory Technology for provision of some of the antibiotic sensitivity discs.

References


Received for publication on 9th March 1994
MICROBIAL FLORA AND INCIDENCE OF SOME FOOD-BORNE PATHOGENS ON FRESH RAW BEEF FROM BUTCHER’S SHOPS IN AWASSA, ETHIOPIA.

MOGESSIE ASHENAFI
Department of Basic Sciences, Awassa College of Agriculture, Addis Ababa University, P.O. Box 5, Awassa, Ethiopia.

FLORE MICROBIENNE ET PRESENCE DE CERTAINS MICROBES PATHOGENES DANS LA VIANDE BOVINE FRAICHE ET CRUE DES BOUCHERIES A AWASSA EN ETIOPIE

Résumé

On a acheté au total 102 échantillons de viande bovine fraîche et crue de différentes boucheries et ils ont été analysés pour déterminer le nombre d’organismes mésophiles aérobies, le nombre d’entérobactéries et l’incidence de Salmonella, de Listeria et de Yersinia spp. Le nombre d’organismes mésophiles aérobies variait en moyenne entre 10<sup>6</sup> CFU/g et 10<sup>8</sup> CFU/g et celui des entéro-bactéries variait entre 10<sup>3</sup> CFU/g et 10<sup>8</sup> CFU/g. S’agissant des échantillons, la variation quant au nombre de bactéries mésophiles aérobies et d’entéro-bactéries était significative dans la plupart des boucheries (CV>10%). Toutefois, le nombre d’organismes mésophiles aérobies n’a pas connu d’énormes variations entre les diverses boucheries (CV<10%). Environ 9% des échantillons contenaient des Salmonella spp., mais on n’a pas trouvé de Listeria ni de Yersinia spp. La microflora aérobie a été dominée par Micrococcus spp. (54%), des bactéries coryneformes (13%) et des staphylocoques (10%).

Summary

A total of 102 fresh raw beef samples were purchased from different butcher’s shops and analyzed for aerobic mesophilic count, counts of Enterobacteriaceae and incidence of Salmonella, Listeria and Yersinia spp. Mean aerobic mesophilic counts ranged between 10<sup>6</sup> CFU/g and 10<sup>8</sup> CFU/g and mean counts for Enterobacteriaceae ranged between 10<sup>3</sup> CFU/g and 10<sup>8</sup> CFU/g. Variation within samples in counts of aerobic mesophilic bacteria and Enterobacteriaceae was significant in most shops (CV>10%). However, aerobic mesophilic counts did not show marked variations among the butcher’s shops (CV<10%). About 9% of the samples yielded Salmonella spp., but no Listeria or Yersinia spp. were encountered. The aerobic microflora was dominated by Micrococcus spp. (54%), coryneform bacteria (13%) and staphylocoecici (10%).

INTRODUCTION

In all parts of the world, meat has long been regarded as a nutritious and highly desirable food. By its nature and origin, however, meat is not only highly susceptible to spoilage but is also frequently implicated in the spread of food-borne diseases.

With the exception of the external surface and the gastrointestinal and respiratory tracts, the tissues of normal healthy animals contain few microorganisms. Meat, however, is contaminated by contact with the hide, skin or feet; stomach and intestine contents; milk from udders; plant and equipment; and even air in the processing and storage areas. Contamination may take place during almost every operation of the slaughtering, cutting, processing, storage and distribution of meat.

Incidence of various groups of bacteria from raw meat is reported by various workers. Isolation of Salmonella, Staphylococcus aureus, Bacillus cereus, pathogenic Escherichia coli and Listeria spp. from raw meat is also documented.

Scientific information on the microbiol-
ogy of raw meat or any other raw food items from Ethiopia is very scanty\textsuperscript{11,12}. The aim of this work was, thus, to evaluate the bacterial load of raw beef as available to the consumer and assess the incidence of some pathogenic bacteria on raw beef.

\textbf{Materials and Methods}

\textbf{Source and Collection of Samples}

This study was carried out in Awassa, which is a small town 275 km south of Addis Ababa and serving as a capital city of one of the administrative regions of Ethiopia. It has a population of about 63,000. Close observations were made initially on the hygienic conditions of the municipality slaughterhouse and the meat vending establishments in the town.

A total of 102 fresh meat samples were collected within two hours of opening of shop. The samples were collected from the butcher's hands into sterile bags and the samples were brought to the laboratory within 15 minutes of collection and the following microbiological analyses were made.

\textbf{Microbiological analysis}

Twenty five grams of a sample were aseptically added to 225 ml of Buffered Peptone Water (BPW) (Oxoid) and blended for two minutes using a Stomacher lab blender (model 400, Seward JAC, London). Appropriate dilutions were plated on Plate Count (PC) agar and Violet Red Bile Glucose (VRBG) agar (both from Oxoid) for aerobic mesophilic count and \textit{Enterobacteriaceae} count, respectively. PC plates were incubated at 30 to 32°C for 48h and VRGB plates at 30-32°C for 24h.

To test for \textit{Salmonella}, BPW was incubated overnight at 37°C. Afterwards, one ml was inoculated in a tube containing nine ml of Selenite broth and into another tube containing an equal amount of Tetraphionate broth (both from Oxoid). In addition 0.1 ml of BPW was also inoculated in a tube containing 10 ml of Rappaport Vasililadis medium and into another containing an equal amount of Rappaport medium (both from Merck). Selenite broth and Rappaport medium were incubated at 37°C and Tetraphionate broth and Rappaport Vasililadis medium at 43°C. After 48h incubation in water baths, a loopful of the various enrichment broth cultures was separately streaked onto XLD medium (Oxoid) and incubated at 37°C for 48h. Suspected colonies (at least two from each plate) were picked, purified and stabbed into and streaked onto Triple Sugar Iron and Lysine Iron agar slants. They were also streaked onto Urea agar slants (all from Oxoid). Tubes showing typical reaction for \textit{Salmonella} were tested for O-agglutination by polyvalent and group antisera.

For the isolation of \textit{Listeria monocytogenes} 10 ml of BPW was added to 90 ml of enrichment broth made to specifications of Lovett et al.\textsuperscript{13} and incubated at 30°C. After 48h of incubation, broths were plated on \textit{Listeria} selective agar, Oxford formula (Oxoid).

For the isolation of \textit{Yersinia enterocolitica}, 10 ml of BPW was added to 90 ml of M/15 phosphate buffered saline and incubated at 30°C for 48h. For plating, \textit{Yersinia Selective Agar Base} was used with \textit{Yersinia Selective Supplement} (both from Oxoid).

After colony counting, 10 colonies were selected at random from countable PC agar plates for assessment of dominant flora. The sub-cultures were further purified by repeated plating. Isolates were differentiated into various bacterial groups by the following characteristics: phase-contrast microscopy was used to examine cell shape and grouping, presence or absence of endospores and motility; Gram reaction was determined using the KOH test of Gregersen\textsuperscript{14}; cytochrome oxidase was tested by the method of Kovacs\textsuperscript{15}; catalase test was made with 3% (v/v) H$_2$O$_2$ solution; and glucose metabolism was investigated by the O/F test of Hugh and Leifson\textsuperscript{16}.

To see if there was variation in counts among samples, coefficient of variation (CV) was calculated by dividing the mean by the variance.
Microbial Flora and Incidence of Some Food Borne Pathogens on Fresh Raw Beef from Butcher’s Shops in Awassa, Ethiopia

Results

A total of 102 fresh raw beef samples were collected from eight meat vending establishments in Awassa town. The establishments did not have any cooling facilities and meat for purchase was held at ambient temperatures (20-22°C at time of sampling). Sampling was done within 2 hours of opening of shop.

The mean aerobic mesophilic counts within the eight establishments ranged between $10^6$ cfu/g and $10^8$ cfu/g and the mean counts for Enterobacteriaceae ranged between $10^3$ cfu/g and $10^5$ cfu/g.

Variations in aerobic mesophilic counts within samples in an establishment were not significant in establishments 1, 2 and 3 (CV<10%). Variations within samples in the other establishments were, however, significantly higher (CV=12-20%). Except two establishments, which had significantly low variations in counts of Enterobacteriaceae within samples (CV<6%), the others had significantly higher variations within samples (CV=11-39%) (Table 1).

No significant variation was observed in mean aerobic mesophilic counts among the eight establishments (CV<10%). However, mean counts of Enterobacteriaceae varied significantly from one establishment to another (CV=18%).

Nine raw beef samples from three different establishments yielded Salmonella spp., Listeria and Yersinia spp. were not isolated from any of the samples.

A total of 873 bacterial strains could be tentatively identified to the genus level with the methods used in this study. Various genera dominated the microbial flora of raw beef. Micrococcus spp., coryneform bacteria and Staphylococcus spp. were the most dominant groups in

Table 1: Mean aerobic mesophilic count (AMC) and count of Enterobacteriaceae of raw beef samples from different butcher’s shops.

<table>
<thead>
<tr>
<th>Butcher’s shop</th>
<th>No. of samples</th>
<th>AMC (log)</th>
<th>Enterobacteriaceae (log)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>x</td>
<td>s</td>
</tr>
<tr>
<td>1</td>
<td>15</td>
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</tr>
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<td>3</td>
<td>13</td>
<td>6.61</td>
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<tr>
<td>4</td>
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<td>7.18</td>
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</tr>
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<td>5</td>
<td>14</td>
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<td>6.51</td>
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<td>7</td>
<td>10</td>
<td>6.01</td>
<td>1.10</td>
</tr>
<tr>
<td>8</td>
<td>12</td>
<td>7.35</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Table 2: Frequency distribution (%) of dominant species isolated from raw beef samples from various establishments.

<table>
<thead>
<tr>
<th>Butcher’s shop</th>
<th>Number of isolates</th>
<th>Micrococcus</th>
<th>Coryneforms</th>
<th>Staphylococci</th>
<th>Acinetobacter</th>
<th>Lactobacillus</th>
<th>Streptococci</th>
<th>Negative rods*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>144</td>
<td>58.3</td>
<td>20.8</td>
<td>14.6</td>
<td>6.3</td>
<td>5.4</td>
<td>18.7</td>
<td>5.4</td>
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<td>2</td>
<td>111</td>
<td>67.6</td>
<td>10.5</td>
<td>2.7</td>
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<td>59.5</td>
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<td>36.3</td>
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<td>6.3</td>
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<td>18.7</td>
<td>5.4</td>
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<td>10.5</td>
<td>37.1</td>
<td>11.7</td>
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<td>11.7</td>
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<td>13.7</td>
<td>10.3</td>
<td>5.5</td>
<td>5.5</td>
<td>2.8</td>
<td>7.9</td>
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*Gram negative rods consisted of Enterobacteriaceae, Pseudomonas, Aeromonas, and Alcaligenes spp.
all or most establishments and constituted 54%, 13% and 10% of the dominant flora (Table 2). Lactobacillus, Acinetobacter spp. and other Gram negative rods (consisting of Enterobacteriaceae, Pseudomonas, Aeromonas, and Alcaligenes) were also part of the dominant flora in raw beef from most establishments.

Discussion

The aerobic mesophilic bacterial load of raw beef in the various vending establishments was found to be quite high. The hygienic conditions of the municipal slaughterhouses and the vending establishments were very unsatisfactory and these sites could be the major sources of contamination. In a study in Tunisia, Fliss et al.,(2) recorded the highest contamination levels from carcasses prepared in a municipal slaughterhouse and from local markets. Although the microbiology of retail cuts of meat is similar to that of carcass in terms of composition of material and intrinsic contamination, differences arise because of greater opportunities for contamination by the extra handling, the greater surface/volume ratio and the exposure to more diverse conditions at retail.(1) Lack of cooling facilities in the vending establishments could contribute to the proliferation of initial contaminants.

The count of Enterobacteriaceae was also high in the meat samples in this study. The presence of Enterobacteriaceae in fresh meat may indicate that the gut is a common source of contamination. However, since most enteric organisms can multiply readily in meat and on materials in slaughterhouses, their numbers in general, do not give a reliable indication of the degree of faecal contamination.(1)

Incidence of Salmonella in this study (about 9%) was slightly higher than reported for two abattoirs in Ethiopia(11) and much higher than reported for raw meat from modern abattoirs in other countries(6,17). Raw beef should thus be considered as an important vehicle of salmonellosis as fresh raw meat is customarily consumed by a considerable proportion of the Ethiopian population. Micrococcus spp. and coryneform bacteria dominated the aerobic mesophilic flora of fresh raw beef in this study and this was similar to the observations in other countries where the two groups of bacteria dominated the microflora of fresh variety meats(18,19).

Although studies in other countries indicated high prevalence of Listeria (95%) and Staphylococcus aureus (20%) in meat and meat products(6,10), no Listeria was isolated in this study. Pociecha et al.,(20) also made no isolation of Listeriae from freshly dressed carcasses or from surfaces with which meat made contact. Only in 10% of the samples in this study were the Staphylococci part of the dominant flora and their number was much lower than that reported from Nigeria(21).

This may be due to the incapacity of these pathogens to compete with the very high number of the non-pathogenic Gram positive contaminants which dominated the flora of the raw beef samples. None of the samples in this study yielded Yersinia spp. Yersinia is reported to be common in fresh pork(22) and important in cold stored vacuum packed meat.(23)

Acinetobacter and Lactobacillus spp. also constituted part of the dominant flora of the raw beef samples. Both groups of bacteria are known to be isolated form meat.(3,4) Acinetobacter, along with Pseudomonas, Aeromonas and Alcaligenes spp. may be important in spoilage at lower temperatures(1) and some Lactobacillus spp are known to produce lipase.(24)

In Ethiopia, meat is usually purchased in small amounts for daily consumptions. Thus microbial spoilage may not be important here. But since consumption of fresh raw beef is widespread in the country, raw beef should be considered as epidemiologically important in the transmission of zoonotic diseases.

Acknowledgements

The technical assistance of Haile
Alemayehu and Tsigereda Bekele is acknowledged.

References


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INFECTION PAR LE VIRUS DE LA DIARRHÉE BOVINE CHEZ DES VEAUX DE FERMES CHOISIES AU MOZAMBIQUE

Résumé

L'infection par le virus de la diarrhée bovine (VDB) a été étudiée chez des veaux de huit fermes laitières et chez trois groupes de bovins à viande dans le Sud et le Centre du Mozambique. La prévalence des anticorps sériques au VDB a été évaluée à l'aide du titrage avec immunoadsorbant lié à une enzyme (la technique ELISA) dans des échantillons provenant de 846 veaux laitiers et 406 veaux de boucherie. Les prévalences relevées dans les différentes fermes et chez différents groupes d'âge variaient entre 7% et 92%. Les prévalences plus fortes: 92%, 87% et 86% ont été observées dans trois des fermes laitières situées dans la province australe de Maputo. Des groupes de veaux de ces trois fermes ont été suivis cliniquement et sérologiquement. Les signes cliniques de l'infection VDB et la séroconversion à VDB ont été notés chez des veaux âgés de trois semaines à quatre mois. VDB a été isolé, à l'autopsie, des prélèvements de veaux affectés par une grave maladie entérique avec des caractéristiques de l'infection VDB dans deux des huit fermes. On en a conclu que l'infection avec VDB est prévalente dans le pays et que VDB provoque la diarrhée et la mortalité chez les veaux de trois des fermes laitières ayant fait l'objet d'enquêtes.

Summary

Bovine virus diarrhoea virus (BVDV) infection was studied in calves from eight dairy farms and three groups of beef herds in the southern and central part of Mozambique. The prevalence of serum antibodies to BVDV was assessed by an enzyme-linked immunosorbent assay in samples from 846 dairy and 406 beef calves. Prevalences found at different farms and in different age groups ranged from 7% to 92%. The higher prevalences, 92%, 87% and 86%, were found in three of the dairy farms, located in the southern province of Maputo. Groups of calves from these three farms were followed clinically and serologically. Clinical signs of BVDV infection and seroconversion to BVDV were observed in calves aged between three weeks and four months. BVDV was isolated from post-mortem specimens of calves affected by a severe enteric disease with characteristics of BVDV infection in two of these farms. It is concluded that infection with BVDV is prevalent in the country and that BVDV was a cause of calf diarrhoea and mortality in three of the dairy farms investigated.

INTRODUCTION

Bovine virus diarrhoea virus (BVDV) is a pestivirus belonging to the family Flaviviridae. The first description of an infection with BVDV was made by Olafson et al. in relation to a disease characterised by fever, diarrhoea and development of erosions in the mucosa of the digestive tract. Two biotypes of BVDV are recognised, i.e. the cytopathogenic (cp) and the non-cytopathogenic (ncp), which are distinguished on susceptible cell cultures. Antigen variants exist, both among cp and ncp biotypes as shown in virus neutralization assays and with monoclonal antibodies. However, the majority of the strains of BVDV isolated from cattle in different parts of the world are neutralized in a similar manner by
antiserum raised against type reference strains.

The infection with BVDV is manifested by different syndromes depending on the circumstances under which infection takes place, i.e. the biological features of the virus strain, the age and the immune status of the animal. Transplacental infection during early pregnancy, before the fetus becomes immunocompetent (up to 125 days of gestation), may result in the birth of persistently infected (PI) calves that are immunotolerant to the homologous BVD virus\(^6,25\). It is usually considered that persistent infection is produced by a ncp-BVDV\(^{13,26,39}\). Calves immunotolerant to BVDV are persistently viraemic and seronegative after maternal antibodies have declined, or they may exhibit a low titre of neutralizing antibodies to BVDV\(^{13,26,39}\). Following exposure to a cp-BVDV strain homologous to the ncp virus responsible for the persistent infection, or by mutation of the ncp virus to cp virus, PI calves may develop acute fatal or chronic mucosal disease (MD)\(^3,5,6,7,8,15,20\). Further, in utero infection may cause fetal resorption, mummification, abortions, stillbirths, birth of calves with congenital defects, birth of weak calves and acute diarrhoea in newborn calves\(^{1,2,10,19,23,36}\).

Post-natal infection in seronegative non-persistently infected animals may result in a variety of manifestations, such as seroconversion without clinical symptoms, mild to severe diarrhoea, reproductive failure or immunosuppression leading to an increased susceptibility to other infectious agents, such as those causing respiratory disease\(^{17,21,28,32,33,34,35}\).

In this study we analysed the situation of BVDV infection in dairy herds and in beef herds as part of a broader investigation concerning calf diarrhoea in Mozambique. Findings are discussed in view of the clinical picture of enteric disease in young calves (from birth to 4 months of age) in problem herds.

Materials and Methods

Calves and samples

The serological survey was carried out in eight dairy farms (D1 to D8) and in three beef herds owned by smallholders (B1 to B3). Six of the dairy farms have calves of the Holstein-Friesian breed while two (D2 and D5) have both Holstein-Friesian and Brown-Swiss breeds. Calves in the smallholder's herds are of the local "Landim" breed. Farms D1, D2, D3, D6 and D7 were selected on the basis of a history of high prevalence of enteric disease and mortality in calves in the age group from birth until the fourth month. The remaining dairy farms, D3, D5 and D8, reported fewer problems with diarrhoea. Enteric disease and mortality among the calves was said to be rare in the three beef herds (B1 to B3).

The calves were examined clinically at the beginning of the study and registered as with diarrhoea or without. Diarrhoea was considered if faeces expelled were semi-liquid to liquid, with or without other abnormal characteristics, such as presence of mucus, blood or necrotic material from the intestine. Blood for sera was collected from a total of 846 animals in the eight dairy farms and from 406 animals in the three beef herds, covering three age groups between birth and 18 months (Table 1).

From farms D1, D2 and D3, groups of 20, 10 and 10 calves respectively were formed for follow-up studies as regards to BVDV infection, during a period of sixteen weeks (Tables 2a, 2b). From these calves sera samples were taken monthly from the first week of age. Clinical signs were recorded and a clinical examination was carried out each time blood samples were collected. Calves developing diarrhoea in these groups were also sampled at 15, 30 and 60 days from onset of diarrhoea.

Fourteen calves that died as a result of diarrhoea in farms D1 and D2 were submitted for post-mortem examination and samples were collected for virological and histopathological examinations. Nine calves were from farm D1, of which six (calves 5, 10, 13, 15, 17 and 18) were from the follow-up group, and five calves were from farm D2, of which three (calves 22, 23 and 29) were from the follow-up
group. For practical reasons, this part of the study was not possible to carry out in the other farms.

**Enzyme-Linked Immunosorbent Assay (ELISA)**

Sera were tested by ELISA for detection of antibodies, using the BVDV-ab Kit from SVANOVA Biotech, Uppsala, Sweden\(^{(18)}\) and the procedure used as recommended by the manufacturer. In short, a single serum dilution was tested in duplicate wells of microtitre plates coated with BVDV antigen and incubated for 1 hour at 37°C. After three washings with phosphate buffered saline containing 0.05% of Tween 20 (PBS-Tween), a horseradish peroxidase conjugated monoclonal antibody against bovine IgG was added, 100μl per well, and the plates were incubated for 1 hour at 37°C. Excess conjugate was removed by washing three times with PBS-Tween. The reaction was developed with Tetramethylbenzidine (TMB) and hydrogen peroxide as substrate, 200μl per well, and stopped after 10 minutes by adding 50μl of 3M H₂SO₄. Absorbance was read at 450nm in an ELISA reader (Titrertek Multiskan MCC, Flow Laboratories).

In the follow-up groups, sera from consecutive samplings were diluted five-fold from 1:10 and tested, in parallel, as above. A rise from a negative to a positive serum titre of at least 1:50 or an increase in antibody titre of at least two steps was considered as seroconversion.

**Virus isolation**

Samples of spleen, tonsils, mesenteric lymph nodes and scrapings of intestinal mucosa from the calves that died showing clinical symptoms of enteric disease were homogenized to prepare ten percent suspensions (w/v) in Hank’s balanced salt solution. Suspensions were frozen and thawed, clarified by centrifugation and penicillin (100 IU/ml) and streptomycin (100 μg/ml) added. The suspensions were inoculated onto monolayers of bovine turbinate (BT) cells grown in Eagle’s Minimum Essential Medium with 10% calf serum. The cells were incubated at 37°C and observed daily for cytopathic effect (CPE) and were checked by immunofluorescence for the presence of viral antigen. Weekly passages of up to five passages were made before the samples were considered negative for virus by absence of CPE or no detection of viral antigen.

**Fluorescent antibody test (FAT)**

BT cells grown on coverslips and inoculated for virus isolation were fixed in acetone, layered with an anti-BVDV monoclonal antibody and incubated for 30 minutes at 37°C. Coverslips were washed three times in PBS and once in distilled water, mounted and the cells were observed for the presence of specific fluorescence in the cytoplasm.

**Neutralization assay**

Identification of the cp strains of virus was done by the neutralization test with a BVDV specific antiserum. Ten-fold dilutions of supernatants from cells with signs of virus growth were mixed with hyperimmune serum against a cp strain of BVDV, incubated for 60 minutes at 37°C and then inoculated on BT cells. The Oregon C24V strain of BVDV, containing 100 TCID50, was included as control. The cells were incubated for five days and observed daily for neutralization of CPE.

**Results**

**Clinical examination**

All the eight dairy farms investigated had calves with enteric disease within the age group from birth to four months. The ratio of affected animals and the characteristics and severity of the cases varied from farm to farm and are summarised as follows. In farms D1, D2, D3, D6 and D7, the majority of the calves observed had diarrhoea with yellow or white, semi-liquid or liquid faeces, sometimes with mucus or blood, later brownish and fetid. A frequent observation in farms D1, D2, and less in D3, was the presence of calves with erosions in the oral mucosa, inside the lips, on the gums and hard palateum. Oral erosions were not seen at the time of
observation in farms D6 and D7, but farm D6 had a history of episodes of diarrhoea when oral erosions were observed. Another consistent observation in farms D1, D2 and D3 was a high frequency of cases of sustained diarrhoea, of both persistent and intermittent types, also present to a lesser extent in farms D6 and D7. Calves affected by prolonged diarrhoea were weak and had low weight.

Respiratory symptoms and lacrimation were also frequent findings in calves from farms D1, D2, D3, D6 and D7.

In farms D4, D5, and D8, cases of diarrhoea were few or mild and of short duration. Farms B1, B2 and B3 had sporadic cases of diarrhoea among the calves.

Prevalence of serum antibodies

Table 1 shows the prevalence of antibodies to BVDV detected by ELISA, in the different age groups of calves from the studied farms. All farms, including the cattle of smallholders, had animals seropositive to BVDV. The prevalence of antibodies to BVDV ranged from 7% to 92%, depending on the age group and farm. Little difference was seen in the number of seropositive animals between age groups within a farm but differences were present among farms. High prevalences of seropositive animals were found in three of the dairy farms, D1, D2 and D3.

Clinical and serological findings in the follow-up calves

In the calves followed clinically and serologically, i.e. in farms D1, D2 and D3, observations made in the four-month period are shown in Tables 2a (farm D1) and 2b (farms D2 and D3). The serological results from calves that seroconverted to BVDV are indicated in Table 3.

In farm D1 (20 calves), 14 calves developed diarrhoea, of which six died. Two of the dead calves (13 and 17) had diarrhoea and erosions in the mucosa of the digestive tract, three (calves 5, 18, 10) died following persistent diarrhoea and one (calf 15) died with acute diarrhoea combined with respiratory symptoms. Four calves (6, 8, 11 and 12) seroconverted to BVDV, one of them, calf 11, without apparent clinical signs.

In farm D2 (10 calves), six calves developed diarrhoea, of which three died. One of the dead calves (22) had diarrhoea and erosions in the mucosa of the digestive tract. Two calves (23, 28) seroconverted to BVDV.

In farm D3 (10 calves), eight calves developed diarrhoea, of which four (calves 32, 34, 37 and 39) died with persistent or recurrent diarrhoea. One calf (35) seroconverted by BVDV.

It was noted that calves that developed diarrhoea accompanied by oral erosions, e.g. calves 13, 17 (farm D1) and 22 (farm D2), had low levels of antibodies or no (detectable) antibodies on initial sampling (Tables 2a and 2b).

Isolation and identification of BVDV

Specimens from fourteen calves from farms D1 and D2 inoculated onto BT cell cultures were assayed for the presence of
Table 2a. Clinical and serological findings in 20 calves followed during a period sixteen weeks in farm D1.

<table>
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<tr>
<th>Calf number</th>
<th>Serum antibody titre¹</th>
<th>Clinical observations</th>
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</thead>
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<tr>
<td>20</td>
<td>250</td>
<td>250</td>
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</tbody>
</table>

¹ Reciprocal of the highest serum dilution giving an absorbance value of 0.2 at 450 nm
² First week of age
§ ncp-BVDV was isolated
†§ cp and ncp-BVDV were isolated from different organs

BVDV antigen by the FAT. Seven of these cases were positive in the FAT. The FAT positive specimens were from calves 10, 13, 17 and 18 (from the follow-up group in farm D1) and one other calf from the same farm, and from calves 22 and 29 (from the follow-up group in farm D2). Five isolates producing CPE were obtained from the spleen and mesenteric lymph nodes of calves 13, 17 and 10 from the follow-up group in farm D1, calf 22 from the follow-up group in farm D2 and from one calf, not included in the follow-up group, in farm D1. The isolate from calf 10 showed positive reaction in the FAT and caused CPE on cells, but CPE was not neutralized by BVDV antiserum. With the other four isolates, CPE was neutralized by BVDV antiserum.

Discussion

Antibodies to BVDV were detected in cattle from all farms tested in this study, showing that infection with the virus is widespread. The prevalence of serum antibodies to BVDV ranged from 7% to 92% in the different farms and age groups. Higher prevalences were found in three dairy farms D1, D2 and D3. The prevalence of BVDV antibodies in cattle has been reported to vary between 50% and 90% (12) in studies performed in Europe and the United States. Studies conducted in African countries mention figures of 50% and 21.5% as being the highest prevalence in native cattle in Kenya and Uganda respectively (37); 41% was reported in cattle from one location
Table 2b. Clinical and serological findings in 20 calves followed during a period of sixteen weeks in farms D2 and D3.

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<th>Serum antibody titre</th>
<th>Clinical observations</th>
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<td>40</td>
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</table>

1) Reciprocal of the highest serum dilution giving an absorbance value of 0.2 at 450 nm.
2) First week of age.
§) ncp-BVDV was isolated.
†‡) cp and ncp-BVDV were isolated from different organs.

Table 3. Serum antibody titres in 7 calves that seroconverted to BVDV after developing diarrhoea* in farms D1, D2 and D3

<table>
<thead>
<tr>
<th>Calf number</th>
<th>First week of age</th>
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<tr>
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<td></td>
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<tr>
<td>23D1</td>
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</tr>
<tr>
<td>28D2</td>
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<td>35D3</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>11D1</td>
<td>10</td>
<td>250**</td>
</tr>
</tbody>
</table>

1) Reciprocal of the highest serum dilution giving an absorbance value of 0.2 at 450 nm.
*Except calf 11D1 that seroconverted without showing clinical symptoms.
**Results from monthly serological follow-up.

in Zaire<sup>11,16</sup>; 76.2% was found in traditionally-managed herds in Zambia<sup>13</sup>; 12% and 34% were reported in zebu cattle from various locations in Tanzania<sup>14,27</sup>.

Antibodies to BVDV were detected in cattle from farms where typical clinical BVDV symptoms have not been reported or observed in the course of the study, e.g. farms D4, D5, D8, B1, B2 and B3. This is consistent with a subclinical course of infection in those farms and in agreement with the concept that post-natal infections with BVDV in immunocompetent cattle often result in mild or no clinical symptoms<sup>11,29</sup>.

The clinical symptoms observed in calves in farms D1, D2 and D3 are compatible with symptoms described for infection with bovine virus diarrhoea.
virus\(^{(1,2,31)}\). Infection with BVDV was indicated in seven cases of seroconversion in farms D1, D2 and D3, as previously mentioned (Table 3). BVDV specific antigen was demonstrated and the virus was isolated from organs of four calves in farm D1 and from one calf in farm D2, which further proves the presence of BVDV infection and is indicative for the clinical symptoms observed. Infection of young calves with BVDV under field conditions has been reported by other authors\(^{(20,38)}\) and was considered to result from late in utero infection of seronegative dams or from neonatal exposure. Experimental infections\(^{(29)}\) have also shown the development of enteritis, sometimes fatal, in newborn calves.

This study did not focus on an effort to trace persistently infected calves. However there was evidence of transplacental transmission in three calves which were seronegative to BVDV and died with diarrhoea accompanied by the development of erosions in the mucosa of the digestive system. Presence of non-cytopathogenic BVDV was revealed by the fluorescent antibody test (FAT) and cytopathogenic BVDV were isolated from organs of these calves, indicating that they were persistently infected.

There was evidence of the involvement of other pathogens causing enteric disease. In one case (calf 10D1), ncp-BVDV was co-isolated with a virus causing CPE which was not neutralized by BVDV specific antibody indicating the presence of another virus besides BVDV. The involvement of rotavirus and coronavirus was investigated in a parallel study. Rotavirus was found to be highly associated with diarrhoea in calves younger than one month and was also isolated from older calves in combination with BVDV. Coronavirus infections were also found to be frequent, as a high percentage of the calves developed active immunity before 8 months of age in all the farms.

The reasons for the severity of enteric disease in the problem farms is most likely multifactorial. It is considered that the involvement of stress factors, particularly enteric agents, may have contributed to the severe disease and high mortality rate observed. An active BVDV infection in three of the farms (D1, D2 and D3) was proved in this investigation. BVDV is an immunosuppressive agent known to impair the host’s defensive mechanisms during infection. Due to its immunosuppressive effect it predisposes to infections by potential pathogens, resulting in clinically more severe diseases\(^{(34)}\).

The study is not conclusive about the significance of BVDV infection in beef cattle since only three cattle-rearing areas (farms B1 to B3), comprising about 150 smallholders, in the southern Maputo province were studied. The relatively low prevalence of antibodies to BVDV indicates that BVDV infection was not of great importance for the calf health in these herds. However, these herds are at high risk if persistently infected animals are introduced.

It is therefore important that cattle imported into the country or moved between farms are checked as regards to persistent infection, since the persistently infected animals are the main transmitters of BVDV. The problem of identifying these animals will be dealt with in future work.

In conclusion, BVDV infections are present in dairy and beef cattle in Mozambique. They play an important role in calf diarrhoea and mortality in some dairy farms, in association with mixed infections and sub-optimal management.

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References


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**HAEMATOLOGICAL AND PATHOLOGICAL STUDIES OF CAMEL BABESIOSIS IN NIGERIA**

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**PREVALENCE, ETUDES HEMATOLOGIQUES ET PATHOLOGIQUES DE LA BABESIOSE CAMELINE AU NIGERIA**

Résumé

La babésiose cameline a été étudiée chez 89 dromadaires et on a noté une prévalence de 7.9%. Il y avait l’anémie hémolytique, l’hémoglobinure, l’hémoglobinémie, l’anisocytose et la polychromasie chez les animaux infectés. La protéine totale était élevée chez les dromadaires infectés et le nombre total et différentiel de globules blancs chez les deux groupes de dromadaires (groupes infecté et non-infecté) était dans les normes. Le foie, la rate et les ganglions lymphatiques étaient visiblement hypertrophiés du point de vue histopathologique et macroscopique; la rate et les ganglions lymphatiques démontraient l’hyperplasie, ce qui était apparentement une réaction à la stimulation antigénique par les organismes des babésioses. Compte tenu de l’incidence actuelle de la maladie, il faudrait faire un diagnostic parasitologique et sérologique qui sera suivi d’un traitement des cas positifs. Ceci permettra d’éviter les pertes économiques qui en découlent souvent à cause de la mort et des infirmités des animaux affectés.

**Summary**

Camel babesiosis was studied in 89 animals and prevalence of 7.9% was observed. There were haemolytic anaemia, haemoglobinuria, haemoglobinemia, and anisocytosis as well as polychromasia in the infected animals. The total protein was elevated in the infected camels and the total and differential WBC counts of both groups (infected and uninfected) of camels were within the normal values. The liver, spleen and lymph nodes were grossly enlarged and histopathologically, the spleen and lymph nodes were hyperplastic. This was apparently a reaction to antigenic stimulation by the babesia organisms. In view of the present incidence there is need for comprehensive parasitological and serological diagnosis which should be followed with treatment when diagnosed positive. This will save some economic losses that usually result due to death and or incapacitation of the affected animals.

**INTRODUCTION**

Camel is an important domestic animal used for transportation in the arid zone where motor vehicles can not penetrate. The animal is known to suffer from a number of protozoan diseases. Camel babesiosis has been reported earlier[14]. Babesia is a virulent, inoculable, non-contagious infectious disease that affects most domestic and wild mammals[11]. The causative agent is a sporozoan of the genus Babesia that is obligatorily transmitted after cyclic development in ticks.

Babesia organism is an intra-erythrocytic parasite whose multiplication within the erythrocyte leads to intravascular haemolysis. The pathology is characterised by a primary parasitic haemolytic anaemia giving rise to haemoglobinuric icterus[5]. Peak parasitaemia coincides with a clinical attack and development in the erythrocyte begins with the trophozoite which is circular or elliptical, small in size and with a nucleus[6]. This study was carried out to determine the prevalence of babesiosis and haematological as well as pathological
changes in camels affected with the disease in Maiduguri, Nigeria. Since there is little or no information concerning camel babesiosis in this area.

**Materials and Methods**

A total of 89 adult camels of both sexes were examined during ante-mortem and post-mortem at the Maiduguri, metropolitan abattoir, Borno State, Nigeria. Five millilitres of blood was taken from each camel in a bottle containing ethylene diamine tetraacetate (EDTA) as an anti coagulant.

During post-mortem (PM) examinations the organs such as lungs, liver, kidney spleen and lymph nodes were thoroughly examined and those that showed lesions were collected for histopathological examination at the veterinary pathology laboratory, University of Maiduguri, Nigeria. The tissues taken were preserved in buffered 10% formal saline, embedded in paraffin-wax, sectioned and stained with haematoxylin and Eosin (H & E).

The blood samples obtained were examined for parasite and used to determine the packed cell volume, (PCV), haemoglobin concentration (Hb), total red blood cell (RBC), total white blood cell counts, (WBC) total protein haemoglobinuria and reticulocytes using the standard methods of schalm et al.\(^5\). The differential WBC counts were determined on blood smears stained with Giemsa and were then converted into absolute counts as described by Coles\(^2\), one way analysis of variance (ANOVA) was used to test the level of significance\(^7\) of the data recorded.

**Results**

**Clinical Findings:**

The following signs were observed in the infected animals; fever, emaciation, dehydration, pale mucous membranes, agitation, aggressiveness, mild bloody diarrhoea, ocular and nasal discharges, rough hair coat, sunken eyes, dyspnoea, and weakness. Some of the uninfected camels exhibited some of these general signs especially emaciation, pale mucous membranes and dehydration.

**Parasitology:**

Only 7 camels (4 males and 3 females) showed parasitaemia (Babesia camelii). The remaining 82 animals were negative for babesia organisms. The prevalence (7.9%) was low when compared with incidences in other animals species.

**Gross pathology:**

There was icterus when the carcasses of the infected animals were opened and the icterus caused many organic lesions. The lungs showed marked areas of congestion and focal areas of haemorrhages. Also observed were splenomegaly, hepatomegaly and hypertrophy of the lymph nodes especially the mediastinal ones.

**Histopathology:**

The alveolar epithelium of the lungs of the infected camels was markedly thickened by oedema fluid, mononuclear cell infiltration and sometimes moderate areas of congestion were observed. There was also bronchiolar oedema and the walls were moderately thickened. Some of the bronchiolar and bronchial walls were disrupted.

**Liver:**

The glisson capsules were mildly thickened and the hepatic parenchyma showed moderate areas of coagulative necrosis with hydropic degenerating patches. There was proliferation of macrophages and some of the macrophages contained RBC. The Kuffer cells contained some haemosiderin and some of the bile ducts were hyperplastic. The ductular walls were also thickened. The hepatic sinusoids were dilated and there was an aggregation of few plasma cells and lymphocytes around the central veins.

**Kidney:**

The renal tubules as well as bowman capsules were oedematous and thickened. The renal tubular epithelium exhi-
bited haemosiderosis. Some of the glomeruli were sclerotic.

**Spleen:**
The splenic capsule and trabeculae were mildly thickened and some nodules were hyperplastic (active), although some showed partial depopulation of the mantle areas. Many macrophages exhibited erythrophagocytosis and haemosiderosis. There was also marked proliferation of lymphocytes, plasma cells as well as macrophages.

**Lymph nodes:**
The trabecular and subcapsular sinus were moderately thickened and oedematous. The lymphoid nodules were hyperplastic and there was marked proliferation of plasma cells, lymphocytes and macrophage. Some of the macrophages showed moderate erythrophagocytosis and mild haemosiderosis.

**Haematology:**
The mean values of the PCV, Hb, Rbc, McV, MCHC, total proteins and total as well as differential Wbc counts are shown in table I. Significant reductions (P<0.05) occurred in PCV, Hb, and RBC values of the 7 infected camels. There were also hyperproteininaemia, macrocytosis, poikilocytosis, anisocytosis polychromasia and haemoglobinuria as well as haemoglobinaemia. The total WBC and differential WBC counts of both groups (infected and uninfected) were within the normal values.

**Discussion**
The prevalence of camel babesiosis was low in Maiduguri when compared with the incidences in other species of animals and in camel in other parts of the world. Some of the clinical symptoms observed from the infected camels were not pathognomonic. However, the agitation and aggressiveness recorded may be consequence of ischamias of the cerebral cortex due to microthrombi resulting from agglutination of the parasitized RBC.

### Table 1: Mean (± standard deviation)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Infected</th>
<th>Uninfected</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV (%)</td>
<td>18.5±4.0</td>
<td>32.5±3.3</td>
</tr>
<tr>
<td>Hb (gm %)</td>
<td>8.3±1.3</td>
<td>13.0±1.3</td>
</tr>
<tr>
<td>RBC (x10^6/mm³)</td>
<td>4.4±1.4</td>
<td>9.9±1.0</td>
</tr>
<tr>
<td>Total WBC (x10^7/mm³)</td>
<td>11.4±2.5</td>
<td>12.8±0.9</td>
</tr>
<tr>
<td>Reticulocytes (%)</td>
<td>0.0±0.0</td>
<td>0.0±0.0</td>
</tr>
<tr>
<td>Total protein (g/l)</td>
<td>84.9±12.9</td>
<td>70.1±6.6</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>42.4±1.7</td>
<td>32.5±1.5</td>
</tr>
<tr>
<td>MCHC (gm/dl)</td>
<td>45.0±0.8</td>
<td>48.7±1.7</td>
</tr>
</tbody>
</table>

**ABSOLUTE DIFFERENTIAL WBC:**

- **Neutrophils:** 6269.7±1.5 7423.8±1.9
- **Lymphocytes:** 3419.0±1.2 3842.1±2.5
- **Eosinophils:** 796.9±3.5 641.5±3.7
- **Monocytes:** 911.0±6.1 896.8±21.2
- **Basophil:** 0.0±0.0 0.0±0.0
- **Poikilocytosis:** + + + +
- **Anisocytosis:** + + + +
- **Haemoglobinuria:** + + + +
- **Haemoglobinaemia:** + + + +
- **Polychromasia:** + + + +

**Key:** + = Present and degree of condition.
- = absent.

The gross and histopathological lesions witnessed in the present study are in consonance with earlier reports and massive release of Hb and metabolic products of porphyrins may be responsible for the lesions and functional disorders in the liver, kidney, lungs and other organs. Kinin acts together with porphyrin degradation to induce liver and kidney lesions.

The hyperplastic nature of the lymphoid organs especially spleen and lymph nodes was apparently a reaction to antigenic stimulation by the babesia organisms. The hypoplasia (depopulation) recorded in some areas may represent an exhaustion phenomenon in the process of continuous antigenic stimulation. The proliferation of lymphocytes and plasma cells probably occurred due to need to produce more antibodies against the parasite antigens. Species such as babesia have protozoal derived antigen on the surface of parasitized eryt-
Erythrocytes and antibody can either directly lyse the erythrocytes or actively promote its phagocytosis and removal. Antibody can also reduce parasitaemia by blocking certain specific sites on a protozoan, preventing it from either attaching to or entering the target cell.

The anaemia recorded was macrocytic hypochromic and haemolytic in nature. Anaemia reduces general metabolic activity and the RBCs are destroyed by babesia development as well as by macrophages which phagocytise the parasitized or non parasitized RBCs particularly in the liver.

The haemolytic mechanism may be attributed to antibody which forms a complex with the parasite antigen, since the increase in antibody level usually coincide with peak parasitaemia.

The RBC may also undergo accelerated aging, because of the presence of parasites and due to changes of plasma composition that cause metabolic disturbances on the surface of the parasitized or non parasitized RBC.

Moreover, these may be exposed to hyperactivity of the macrophages and the entire reticuloendothelial system. Haemoglobinuria and haemoglobinemia observed are common findings in haemolytic type of anaemia especially in babesiosis. The macrocytosis and poikilocytosis recorded in the present study occur probably due to the fact that activity of the haemopoietic organs is disrupted. Also witnessed were anisocytosis and polychromasia and they are evidence of intensified erythropoiesis in response to anaemia.

The hyperproteinaemia observed is presumably due to intensity of immune defences of the host. WBC values of the infected animals are within the normal range of values and this is not in agreement with the findings of Schalm et al., who recorded leucopenia at the initial stage of babesiosis. Although the difference in observations may be attributed to species differences in terms of parasites and animal hosts.

In conclusion, it is pertinent to note that the prevalence of camel babesiosis is low in Maiduguri. Babesiosis induces haemolytic type of anaemia which is usually caused by macrophages, babesia multiplication within the erythrocytes and antibody-antigen complex. The presence of camel babesiosis in Maiduguri calls for a comprehensive parasitological and sero-diagnosis of the disease, which should be followed by treatment when positive. This will prevent some economic losses that usually result due to death and or incapacitation of affected animals.

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References


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THE PREVALENCE OF GASTROINTESTINAL NEMATODES, COCCIDIA AND LUNGWORMS IN OL’MAGOGO DAIRY GOATS

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PREVALENCE DES NEMATODES GASTRO-INTESTINAUX, DES COCCIDIES ET DES VERS PULMONAIRES CHEZ LES CHEVRES LAITIERS A OL’MAGOGO

Résumé
De janvier 1989 à décembre 1991, on a conduit une étude sur la prévalence des parasites du système gastro-intestinal et de l’appareil respiratoire chez les chèvres d’une ferme à Ol’Magogo. Le nombre d’œufs dans les feces, celui d’ovocystes et de larves ont révélé que 75% des chèvres étaient infectées par un type de parasite au moins. 59% des adultes et 67% des chevreaux déversaient des œufs de strongyle. 20% des chevreaux étaient infectés de Trichuris ovis. 77% des adultes et 64% des chevreaux avaient des coccidies. 55% des adultes étaient infectés de vers pulmonaires. 6% des adultes et 12% des chevreaux avaient des vers solitaires, tandis que 3% des adultes et 2% des chevreaux étaient infectés de Strongyloides papillosus. Les infections par des strongyles étaient surtout dûs à Haemonchus spp., Trichostrongylus spp et Oesophagostomum spp, alors que le seul ver pulmonaire identifié étaient Muellerius capillaris. Les espèces coccidiennes identifiées étaient Eimeria arloingi, E. ninakohiyakimovae, E. hirci, E. alijevi, E. christenseni, E. jolchiyevi et E. caprovina. L’âge et la variation saisonnière semblaient avoir des effets sur l’intensité de l’infection coccidienne.

Summary
A survey of the prevalence of gastrointestinal and respiratory tract parasites in goats was conducted at Ol’magogo farm from January, 1989 through to December 1991. Faecal egg, oocyst and larval counts revealed that 75% of the goats were infected with at least one type of parasite. 59% of the adults and 67% of the kids were shedding strongyle eggs. 20% of the kids were infected with Trichuris ovis. 77% of the adult and 64% of the kids had coccidial. 55% of the adult goats were infected with lungworms. 6% of the adults and 12% of the kids had tapeworms whereas 3% of adults and 2% of the kids were infected with Strongyloides papillosus. Strongyle infections were primarily due to Haemonchus spp, Trichostrongylus spp. and Oesophagostomum spp. While the only lungworm identified was Muellerius capillaris. The coccidial species identified were Eimeria arloingi, E. ninakohiyakimovae, E. hirci, E. alijevi, E. christenseni, E. jolchiyevi and E. caprovina. Age and seasonal variation appeared to have influence on the intensity of coccidial infection.

INTRODUCTION
Several surveys on the disease of small ruminants have suggested that two of the most important and frequently encountered diseases are due to the gastrointestinal nematodes and the coccidia1). In the tropical and sub-tropical area, Haemonchus spp. infection of sheep, and to a lesser extent of cattle and goats is one of the most important causes of economic loss in production. Where the disease is unchecked, severe morbidity and high mortality are common; in other areas the cost of control in terms of labour and prophylactic chemotherapy is often a significant factor in production costs2).

The population of goats in Kenya less
than ten years ago stood at 7.7 million, compared to 5.0 million sheep and 9.0 million cattle\(^{(3)}\). Improved breeds of goats for both meat and milk (dual purpose goats or DPG) production would be an important source of animal protein especially to the rural populations\(^{(4)}\). Currently, there is little information on the prevalence of caprine gastrointestinal parasites and their significance on goat production in Kenya. Thus, with the increasing interest in domestic goats as meat and milk producing animals, attention should be directed to the role of parasitism in the economics of production\(^{(1,5)}\).

This study was undertaken to monitor the prevalence of gastrointestinal helminths, coccidia and lungworms under natural challenge in goats at Ol’magogo farm, Naivasha, Kenya. The results may form a basis for studies on the effect of parasitism on goat production in Kenya.

**Materials and Methods**

**Experimental design**

The investigation was carried out on a breeding herd of about 1300 goats at Ol’magogo farm, Naivasha. The animals were housed at night and grazed on open pastures during the day. The survey commenced in January, 1989 and ended in December, 1991. During the study period rainfall data was collected. The goats in the herd were either pure breeds or crosses of East African, Galla, Anglo Nubian and Toggenburg. A mean of 100 faecal samples was collected monthly from 1 or 2 randomly selected groups of goats from the main herd. Each group was divided into kids (less than 1 year old) or adults which included does and bucks. The animals sampled were not necessarily showing signs of clinical disease. However, whenever strongyle egg counts exceeded 1000 eggs per gram of faeces (epg) and coccidial oocysts were extremely high in a particular group of goats examined, they were drug treated with levamisole or albendazole for helminth infections and amprolium for coccidial infection as per standard management practices on the farm.

**Faecal examination**

Faecal samples were obtained directly from the rectum of each animal and the modified McMaster technique used for quantitative analysis of helminth eggs and coccidial oocysts\(^{(6,7)}\). The strongyle ova were not distinguished and were recorded as strongyle eggs, while eggs of the following genera were separately counted: *Strongyloides spp*, *Trichuris spp.* and *Moniezia spp.*

**Isolation of gastrointestinal and lungworm nematode cultured larvae**

Ten grams of randomly selected faecal sample were rinsed with tap water and placed in Petri dishes, which were placed in a humidified chamber of a large plastic container containing moist paper towels and an airtight cover\(^{(8)}\). The chamber was placed in an incubator at 26°C for 1 week. Cultured larvae were collected by the modified Baermann technique\(^{(9)}\). Nematode parasites were identified based on the total length of the larvae and tail structure of the cuticular extension\(^{(8,9)}\). The genera prevalence was based on a differential count of a minimum of 100 larvae obtained from the faecal cultures.

**Sporulation of coccidial oocysts**

Faecal samples with high oocyst counts per gram of faeces (opg) were cultured monthly in 2.5% (w/v) aqueous potassium dichromate solution at room temperature for one week. The coccidian parasites were subsequently examined and identified on the basis of morphological features of the sporulated oocysts\(^{(8,9,10,11)}\).

In the data analysis, the term prevalence was defined as the percentage of the hosts infected\(^{(12)}\).

**Results**

**Strongyles**

Geometric mean epg counts of kids and adult goats and their relationship to rainfall are shown in Fig. 1. In adults, the highest rate of infection was recorded in
March-April, when 67% of the animals examined were infected. This corresponded with the start of the long rains and the mean epg recorded during the period was 1300. In kids, the highest rate of infection was January-February when 94% of the kids examined were shedding strongylo eggs. However, the peak egg output was in May-June, when mean epg was 2000. This corresponded to the time of weaning of kids at Ol’magogo farm. During the study period, kids generally were shedding more eggs than adults.

From the faecal cultures, the following genera were identified: *Haemonchus spp*, 49%, *Trichostrongylus spp* 30%, *Oesophagostomum spp*. 10%, *Ostertagia spp*. 7% and *Cooperia spp*. 4%. Three percent of the adults and 2% of the kids examined were infected with *Strongyloides papillosus*.

**Tapeworm infection**

*Moniezia spp* eggs were observed in both adults and kids. Over the study period, 6% of adults and 12% of kids examined were shedding *Moniezia* eggs. However, adult goats registered relatively higher epg with a mean of 180 compared to a mean of 114 recorded from kids.

**Whipworm infections**

*Trichuris* spp eggs were recorded in kids throughout the study period. The highest epg was recorded in the months of September-October with a mean of 300 and a range of 100 to 600. Based on size and shape at least 20% of the kids shedding eggs were diagnosed as infected with *Trichuris ovis*.

**Lungworm infections**

Lungworms were observed in faecal cultures from 55% of adult goats examined over the study period, with a peak of 69% in May-June. In 10g of faeces cultured, a mean count of 125 larvae was recorded. Identification of the larvae revealed only *Muellerius capillaris* from the cultures.

**Coccidial infections**

Geometric mean opgs of kids and adult goats and their relationship to rainfall are shown in Fig. 2. In both adults and kids, over 60% of the animals were shedding
oocytes throughout the study period. A maximum of 160,000 opg and 540,400 opg were recorded in adults and kids respectively. In adults, infection level peaked in July to October while in kids, peaks were observed in May-June and November-December immediately after the long and short rains. Kids generally had a higher average opg than adults. From faecal cultures, the following species of coccidia were identified: *Eimeria arloingi* (25%), *E. ninakihyakimovae* (23%), *E. hirchi* (21%), *E. alijevi* (13%), *E. christensenii* (10%), *E. jolchijevi* (4%), and *E. caprovina* (4%).

**Discussion**

The results presented in this survey indicate the prevalence of various gastrointestinal and respiratory tract parasite infections in a goat herd over a three year period. Gastrointestinal nematodes have been shown to be prevalent in goats and strongyle egg counts observed in this survey were moderate to high. The high epg in kids may reflect lack of development of resistance to these parasites in animals with no previous exposure to the parasites. Of the strongyle parasites identified, *Haemonchus* spp. was found to predominate (49%), followed by *Trichostongylus* spp. (30%). This agrees with results from earlier surveys conducted on the farm and from other parts of the country. While the means of 900 and 1200 recorded in adults and kids respectively may not cause clinical disease, they, nevertheless, cause subclinical infections which are of greater economic significance in that the parasites reduce growth rate and lead to gradual emaciation and susceptibility to other diseases.

On average, faecal strongyle egg counts were highest during the dry season rather than the wet season. It is, therefore, the time when the rate of pasture contamination is also highest and anthelmintic treatment of the goats should be done at this time just before the rains. This would get rid of worm burdens and so reduce the amount of pasture contamination.

Of the other parasites, *Moniezia* infection showed quite a low prevalence of 6% in adults and 12% in kids. These levels may not cause clinical disease since massive tapeworm infections are necessary
to cause disease[16]. A 20% infection rate of kids with *Trichuris ovis* was recorded during the study period, but again low epg of 300 is not thought to cause clinical disease.

* Muellerius capillaris* was the only lungworm diagnosed in the goats on the farm. This parasite is considered to be non-pathogenic to sheep, although heavy infections are said to predispose animals to secondary bacterial infections[14]. Euzeby[20] reported that faecal larval counts of over 150/g were indicative of a pathogenic infection in sheep. Of the adult goats examined in this study, 17% had larval counts of more than 10 larvae per gram of faeces and were considered as mildly infected.

A very high prevalence of infections with coccidia species was recorded in both adults and kids (Fig. 2). However, higher oocyst counts were observed in the kids compared to the adults. In kids, the ingestion of even a few sporulated oocysts may result in production of millions of oocysts in the first 2-3 weeks[21]. In the more resistant adult goats, fewer ingested oocysts complete their life cycle and so fewer resultant oocysts are passed in the faeces from such animals[21]. Seven species of *Eimeria* were identified in the survey and *E. arloingi* was the predominant species. From a number of studies, this species seems to be the most prevalent in goats. It has been found in 98% of faecal samples in USA[19], 94% in S.E. England[23] and 58% of goats in Nigeria[23]. Post-mortem findings of 32 goats that died of coecidiosis at Kabete, Kenya incriminated *E. arloingi*[24].

It was noted during the survey, especially in kids that there appeared to be a seasonal variation in the level of infection in terms of the number of opg. counts. The level of infection was higher in the rainy season, March-May and October-November, than in the dry months (December-February). Recommended treatment schemes should include drug treatment for coccidia before the rains, even though the goats do not show signs of disease..

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**References**


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THE IMPACT OF BOVINE TRYpanosomiasis ON THE ANTIBODY RESPONSE TO RINDERPEST VACCINATION UNDER FIELD CONDITIONS.

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EFFETS DE LA TRYpanosomiase BOVINE SUR LA REACTION DE L’ANTICORPS A LA VACCINATION CONTRE LA PESTE BOVINE DANS DES CONDITIONS DE TERRAIN

Résumé

L’effet de la trypanosomiase animale sur la réaction de l’anticorps à la vaccination contre la peste bovine dans des conditions de terrain a fait l’objet d’enquête. Trois groupes de bovins choisis au hasard ont été utilisés. Ces animaux ont été offerts de plein gré par les éleveurs et gardés dans leur milieu habituel pendant toute l’expérience. Les enquêtes avant le traitement ont montré qu’aucun de ces groupes n’avait une prévalence d’anticorps contre la peste bovine de plus de 20% et que chacun de ces groupes comprenait des bovins atteints de trypanosomiase d’après l’examen au microscope des frottis sanguins colorés au Giemsa.

Le premier groupe était vacciné avec une dose normale de vaccin antibovipastique en culture de tissus (injection sous-cutanée de 1 ml) et a reçu une dose prophylactique de samorin (M & B). Le groupe II était vacciné trente jours après le traitement au samorin. Le groupe III était vacciné mais n’a reçu de samorin que 63 jours après la vaccination. La réaction de l’anticorps au vaccin, évaluée à l’aide de la technique ELISA 7, 14, 21, 63 et 400 jours après la vaccination, a montré que les animaux du groupe II avaient une prévalence d’anticorps de 90% le 14ème jour, ceux du groupe I le 63ème jour tandis que les animaux du groupe-témoin n’avaient pas du tout atteint le taux de prévalence d’anticorps de 90% et ils ne sont parvenus à 80% que 63 jours après le traitement au samorin. On en a conclu que les trypanosomes pathogènes provoquent, à un certain stade, un retard de la réaction de l’anticorps au vaccin antibovipastique.

Summary

The effect of animal trypanosomiasis on antibody response to rinderpest vaccination under field conditions was investigated. Three groups of cattle randomly selected were used. These animals were volunteered by stock owners and were kept in their usual habitat throughout the trial. The pre-treatment surveys showed that none of these groups had a rinderpest antibody prevalence of more than 20% and that each of these groups included some cattle that had trypanosomiasis as detected by microscopic examination of Giemsa stained blood smears.

The first group was vaccinated with a standard dose of tissue culture rinderpest vaccine (1 ml subcutaneously) and given a prophylactic dose of Samorin (M&B). Group II was vaccinated thirty days following Samorin treatment. Group III was vaccinated but was not given any Samorin until day 63 post vaccination. Antibody response to the vaccine, measured by competitive ELISA technique on days 7, 14, 21, 63 and 400 post-vaccination showed that group II animals had an antibody prevalence of 90% by day 14; group I animals attained a 90% prevalence on day 63; while the untreated group did not attain a 90% antibody prevalence at all and rose above 80% only after Samorin treatment on Day 63. It was concluded that pathogenic trypanosomes to some degree cause a delay in antibody response to the rinderpest vaccine.

INTRODUCTION

The role of pathogenic trypanosomiasis in the suppression of immunity following vaccination with viral and bacterial antigens has been studied and documented by several authors. Most of these studies have been in connection with antibody response following vaccination in animals that were either experimentally infected with trypanosomes or naturally infected but kept in a
controlled environment. The results have indicated that trypanosomiasis causes some degree of immunosuppression, although the extent of the suppression varied in different cases. Scott, Pegram, Holmes, Pay, Knight, Jennings and Urquhart, (1977)\(^2\) found that despite distinct immunosuppression due to *Trypanosoma congoense* in cattle vaccinated against foot and mouth disease and Clostridium the antibody levels obtained to both vaccines were considered sufficient to protect the vaccinated animals against the respective diseases.

Further, Whitelaw, Scott, Reid, Holmes, Jennings and Urquhart (1979)\(^2\), observed that when laboratory mice experimentally infected with *T. vivax*, *T. congoense* or *T. brucei* were vaccinated with loping-ill vaccine, antibody response was completely suppressed; but when the same vaccine was given to cattle infected with similar species of trypanosomes, the antibody response in the animals infected with *T. vivax* and *T. congoense* was reduced by 10% compared to that of the uninfected group and that the response was not affected at all in the animals infected with *T. brucei*.

In cattle infected with either *T. congoense* or *T. vivax*, immune response to intravenous *Leptospira biflexa* and subcutaneous attenuated *Brucella abortus* was suppressed but that the suppression to both vaccines was abrogated by administration of Berenil at the time of antigen administration. The same study showed that *T. congoense* was more suppressive than *T. vivax*. (Rurangirwa, Mushir, Tabel, Losos and Tizard; 1979)\(^3\). Further, Rurangirwa, Tabel, Tizard and Losos; (1980)\(^4\) found that there was no significant immunosuppression when live tissue culture rinderpest vaccine was used in cattle experimentally infected with *T. congoense* and *T. vivax*.

However, Mwangi, Munyua and Nyaga, (1990)\(^5\) also demonstrated that *T. congoense* caused suppression of antibody response to anthrax spore vaccine, although antibody response to *Bacillus anthracis* ensued normally following Diminazine treatment. The above studies were carried out in a controlled environment, and where treatment for trypanosomiasis was carried out using Diminazine aceturate (Berenil, Hoescht) which is purely curative. It is possible that under field conditions this treatment may not keep animals free from trypanosomiasis long enough for sufficient antibody response to take place. Moreover, whereas the forementioned studies serve to highlight the general effect of pathogenic trypanosomes on antibody development, there is still need to find out what would happen in a field situation. In Uganda (as in many other African countries) the Pan-African Rinderpest Campaign is implementing vaccination of cattle in all areas of the country including those regions where tsetse transmitted trypanosomiasis is widespread. The following study was undertaken to determine the effects of trypanosomiasis on the efficacy of vaccination.

**Materials and Methods**

**Area of study**

The trial was carried out in Ngogwe in Mukono District of Central Uganda. This area was chosen because the animals were not yet vaccinated against rinderpest. Despite a high incidence of bovine trypanosomiasis the stock owners in this area do not usually carry out treatment for trypanosomiasis.

**Trial Design**

One hundred and seventy six (176) healthy cattle, aged six months and above were recruited to the study. No attempt was made to segregate animals into breeds, age or any other categories. All were volunteered by local stock owners. Samorin (Isometamidium chloride, May and Baker) was preferred to Diminazine due to its prophylactic effect.

The animals were divided into three groups making sure that those in which trypanosomes were found were more or less equally distributed in the three groups.
Pre-treatment Survey
Before any treatments were administered all the animals were assessed for the following:
- Presence of trypanosomes by microscopic examination of stained blood smears.
- Prevaccination rinderpest antibody prevalence by competitive ELISA.

Laboratory examination of samples

Serology
All serum samples were tested for antibodies to rinderpest using the competitive enzyme linked immunosorbent assay technique, as described by Anderson et al. (1991)\(^6\).

Parasitology
Examination for trypanosomiasis was carried out by microscopic examination of stained blood smears.

Treatments:

GROUP I
The group consisted of 59 animals. All the animals in this group were given 1 ml of rinderpest tissue culture vaccine subcutaneously (vaccine Batch No. 1. PTV 301 Botswana). At the same time each animal received Samorin (Isometamidium chloride) by deep intramuscular injection at a dosage rate of 1 mg/kg of body weight (this is both a curative and prophylactic dose).

GROUP II
Group 2 consisted of 59 animals. These were given Samorin by deep intramuscular injection at the same dosage rate as group 1, on day one. Thirty days later they were given one ml of tissue culture rinderpest vaccine by subcutaneous injection.

GROUP III
This group had 58 animals. These were not given any treatment for trypanosomiasis on Day one, but were given the same standard dose of rinderpest vaccine as the other two groups. On day 63 the animals in this group were given a standard prophylactic dose of Samorin.

Post-treatment survey
Serum samples were collected from all animals for assessment of rinderpest antibody development on days 7, 14, 21, 63 and 400 post-vaccination. Parasitological examinations were carried out weekly to detect the presence of trypanosomes.

Statistical analysis:
The statistical analysis was carried out using Chi square test to assess the significance level between the antibody responses in the different groups.

Results

Pre-treatment survey:
The results of the pre-treatment survey are shown in table 1.

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>T. vivax (No. infected)</th>
<th>T. conglolense (No. infected)</th>
<th>Overall % Trypanosome positive</th>
<th>Rinderpest antibody prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>2</td>
<td>14</td>
<td>27.5%</td>
<td>20%</td>
</tr>
<tr>
<td>II</td>
<td>7</td>
<td>11</td>
<td>28.8%</td>
<td>13.3</td>
</tr>
<tr>
<td>III</td>
<td>6</td>
<td>6</td>
<td>20.3%</td>
<td>20.6</td>
</tr>
</tbody>
</table>

Post treatment survey:

Rinderpest antibody levels:
The antibody response in all three groups is shown in Fig. 1. Group I animals had a slow antibody response reaching 90% prevalence on day 63. Antibody response in Group II animals reached 90% on day 14 and stayed high until day 400. Antibody prevalence in Group III animals did not rise above 80% until after Day 63.

Parasitology:
Table 2 shows the results of the parasitological monitoring for Trypanosomiasis.
Figure 1: Antibody response to rinderpest vaccine: A comparison of the three groups.

Table 2: Trypanosome infections in the 3 groups of cattle monitored weekly using microscopic examination of Giemsa stained blood smears.

<table>
<thead>
<tr>
<th>Week</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>V=2, C=14</td>
<td>V=7, C=11</td>
<td>V=6, C=6</td>
</tr>
<tr>
<td>1</td>
<td>V=10, C=2</td>
<td>V=6, C=8</td>
<td>V=7, C=5</td>
</tr>
<tr>
<td>2</td>
<td>NTD</td>
<td>NTD</td>
<td>V=4, C=3</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>V=3, C=2</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>V=5, C=5</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>V=3, C=5</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>V=4, C=3</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>V=6, C=3</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>V=5, C=2</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>V=4, C=3</td>
</tr>
</tbody>
</table>

Key: V = T. vivax; C = T. congolense; NTD = no trypanosomes detected.

Statistical analysis

The statistical analysis showed that there was a very significant difference in antibody responses between group I and the other two groups on day 14 and 21. Groups I and II also differed very significantly from group 3 on day 63. A summary of statistical values is shown in Table 3. A summary of statistical values is shown in Table 3.

Discussion

This study shows that in cattle naturally infected with tsetse transmitted trypanosomiasis infection there is immunosuppression of the humoral antibody response to rinderpest vaccine manifested as a delay in the time taken for antibody response to attain significant levels.

The Pan African Rinderpest Campaign stipulates that for any cattle population to resist an outbreak, at least 90% of the population should be immune. Hence in this study, the untreated group (Group III) as a population, would not be expected to effectively resist rinderpest infection as the antibody prevalence in the group did not reach this level.

It was evident that treatment of the trypanosome infected animals with Samorin ensured an effective response to vaccination. This was shown by the response of the animals in Group I and II as well as the rise in antibody prevalence in Group III after treatment with Samorin on day 63. These findings tally with the findings of Rurangirwa et al. (1979) who...
showed that both *T. congolense* and *T. vivax* suppress immune\(^b\) response to bacterial immunogens, and that treatment of infected animals abolished the suppression of the immune response. The response of Group I shows that if Samorin is to be used with vaccination campaigns it must be given earlier than the vaccine. Although the animals in this group eventually attained the desired antibody level the delay would be a disadvantage when animals are vaccinated in the face of an outbreak, as often occurs in emergency campaigns. This delay could have been caused by antigenic competition between the vaccine and the parasite antigens released by the trypanocidal treatment. (Nantulya et al. 1982)\(^b\).

In many areas of Africa rinderpest vaccination has been going on for about 5 years now but the most recent sero-survey figures (FAO/IAEA, 1992)\(^b\) indicate that very few countries have achieved the 90% antibody prevalence target. This should perhaps be looked at more closely in relation to the status of trypanosomiasis in the areas where sero-surveillance figures are persistently low.

**Acknowledgements**

The authors are grateful to the following: Mrs. T.N. Galiwango for her technical assistance. Dr. G. Scott (of the CTVM) for checking and confirming the statistical analysis; and the International Atomic Energy Agency for providing facilities for ELISA testing.

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**References**


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AN IN-VITRO STUDY OF THE EFFICACY OF SEVIN (1 napthyl-methyl carbamate) ON ECTOPARASITES OF LIVESTOCK

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UNE ETUDE IN VITRO DE L’EFFICACITE DE LA SEVINE (1 NAPHTHYL-METHYL CARBAMATE) SUR LES ECTOPARASITES DU BETAIL

Résumé
La sévine, un composé de carbamate, permet de tuer à 100% in vitro B. microplus, H. bispinosa et H. a. anatolicum à une concentration de 0,3%. Elle a un effet plus réduit à 0,1 et 0,2%. On peut donc utiliser sur le terrain la sévine à une concentration de 0,3% pour lutter contre l’infestation des tiques chez les bovins et les buffles. L’effet de la sévine in vitro à une concentration de 0,1% sur les poux: H. eurysternus, H. tuberculatus et L. vituli est excellent.

Summary
Sevin, a carbamate compound, produces hundred per cent mortality on B microplus, H. bispinosa and H. a. anatolicum in vitro at 0.3 per cent concentration. At 0.1 and 0.2 per cent it produces a limited effect. Thus, Sevin at 0.3 per cent concentration might be considered for field use in controlling tick infestation on cattle and buffaloes.
The effect of Sevin in vitro at 0.1 per cent concentration on lice, H. eurysternus, H. tuberculatus and L. vituli, is excellent.

INTRODUCTION
Tick and lice are common ectoparasites of cattle and buffaloes. Several species of these ectoparasites not only effect such stock directly through their annoyance and parasitism but also potentially affect them being vectors of pathogenic organisms of animal diseases. Thus a continuous search has been going on for finding more and more effective remedies against insect pests. Kraemer studied the relative efficacy of several materials for the control of poultry ectoparasites and observed that 0.5 per cent emulsion of Sevin gave good control against fowl tick. An in vitro trial to compare the effectiveness of D.D.T. and Sevin on Siphona exigua, a buffalo fly had also been done by other workers and noted that Sevin was more toxic than D.D.T. to flies at the concentration level above 0.2 mg per g. of dry hair. A lower percentage of the Sevin (0.1-1.0 per cent suspension) was also found to be effective in vitro against ticks, ixodes ricinus, Rhipicephalus bursa, Boophilus calcarius and Hyalomma plumbeum, by placing the ticks on paper impregnated with drug. In-vitro experiments were designed to investigate the effect of the carbamate compound, Sevin (Union Carbide India Limited) at different concentrations on the three species of ticks viz., Boophilus microplus, Haemaphysalis bispinosa and Hyalomma anatolicum anatolicum and three species of lice viz., Haematopinus eurysternus, H. tuberculatus and Linognathus vituli the common ectoparasites of livestock in West
Bengal, India and the results are presented in this communication.

**Materials and Methods**

The present investigation was conducted on three species of ticks and three species of lice collected from the skin of cattle and buffaloes at Calcutta Pinjrapole Society, Gosala-4, Kalyani, West Bengal, India.

The experimental procedure adopted by Da Costa et al.\(^7\) was used with some modification. Six petridishes (5 cm dia.) were marked serially. Whatman filter paper (No. 1) of the same diameters as those of the petridishes were impregnated with one of the concentrations of 0.1, 0.2, 0.3, 0.4 and 0.5 per cent of Sevin and placed on separate petridishes No. 1 to 5. The sixth petridish served as the control as its filter paper did not receive any acaricide.

To study the efficacy of Sevin, five male and five female live specimens of the particular species of the tick were placed on the filter paper and a similar filter paper impregnated with the same strength of xodicide was placed on top of the tick and examined every 12 hours for 24 hours. The procedure was followed for each of the other two species of ticks. Ten individuals of each species of lice were similarly treated separately. The entire experiment was repeated thrice and averages calculated.

**Results and Discussions**

The results of the effect of Sevin on the three species of ticks *in-vitro* are presented in Figure 1. At 0.1% Sevin, 22% of males of *B. microplus* and 24% of males of *H. bispinosa* and *H. a. anatolicum* exhibited mortality. The percentage of mortality of females of all the three species of ticks was 60% after 24 hours of the treatment (Fig. 2).

At 0.2% Sevin, 62% of males and 78% of females of *B. microplus* and 64% of males and 80% of females of *H. bispinosa* and *H. a. anatolicum* exhibited mortality.

![Figure 1: Histogram showing per cent mortality of ticks at different concentrations of Sevin.](image)

*Note: Percentage of mortality with Sevin above 0.3 per cent not shown in the figure as hundred per cent mortality is obtained at a concentration of 0.3 per cent.*
Figure 2: Histogram showing per cent mortality in males and females of the three species of ticks at 0.1 and 0.2 per cent Sevin.

(Fig. 2). However, 0.3, 0.4 and 0.5 per cent of Sevin were found to be 100% effective against adult ticks of all the three species irrespective of sex as none of the ticks of such treatment groups survived (Fig. 1). Untreated ticks of the three species in the sixth petridish serving as control exhibited no mortality after 24 hours.

The concentration level of 0.1 per cent and above of Sevin killed all experimental lice after 24 hours of the experiment.

The effect of Sevin at 0.3 per cent concentration level brought about 100% mortality rate of all species of ticks. The present observation was in conformity with that of Dzasakhov et al. at 0.1 to 0.5 per cent suspension of the drug. Females were found to be more susceptible than males. At 0.2% concentration the mortality rate was 80% in females but 60% in males which might be due to the presence of scutum completely covering the whole dorsal surface of the body in the male. Absorption through scutum was probably less than other parts of the body of the ticks.

References

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COMPARISON OF INTRAMUSCULAR AND INTRAVENOUS INJECTION OF XYLAZINE — KETAMINE MIXTURE IN DONKEYS WITH AND WITHOUT ATROPINE PREMEDICATION

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COMPARAISON D’UNE INJECTION INTRAMUSCULAIRE ET INTRAVEINEUSE D’UN MÉLANGE XYLAZINE x KETAMINE CHEZ LES ANES AVEC OU SANS MEDICATION PREOPERATOIRE A L’ATROPINE

Résumé

Un mélange de xylazine Hcl et de kétabmine Hcl dans une seringue a été utilisé pour comparer l’anesthésie après une injection intramusculaire (IM) et intraveineuse (IV). On a également evalué les effets du sulfate d’atropine.

Au total, 20 expériences ont été conduites chez 4 groupes de 5 ânes adultes chacun. Chez deux groupes, le mélange de médicaments a été injecté sans médication préopératoire à l’atropine; en revanche, on a administré l’atropine aux deux autres groupes 20 minutes avant l’injection du mélange de médicaments. Les paramètres anesthésiques et les changements de comportement ont été observés chez les animaux injectés IM et IV.


L’administration par voie intramusculaire du mélange de médicaments s’est avéré plus souhaitable parce qu’elle est plus facile à effectuer et a une durée d’anesthésie plus longue.

Summary

A mixture of xylazine Hcl and ketamine Hcl in a syringe was used to compare anaesthesia after intramuscular (IM) and intravenous (IV) injection. The effects of atropine sulphate were also evaluated.

A total of 20 experiments were carried out in 4 groups of 5 adult donkeys each. In two groups the drug mixture was injected without atropine premedication and atropine was given to the other two groups 20 minutes before injection of the drug mixture. Anaesthetic parameters and behavioural changes were observed for the IM and IV injected animals.

Results showed that both routes of administration of the drug mixture were effective in anaesthetising the donkey. Although IM injection had longer induction time, the anaesthesia lasted longer than I injected animals. Atropine enhanced anaesthesia. Analgesia was present in all parts of the body tested except distal to the fetlock joint. Muscle relaxation was present. Palpebral, pedal and anal reflexes were affected.

Intramuscular administration of the drug mixture was found more desirable because of ease in administration and longer duration of anaesthesia.

INTRODUCTION

Use of xylazine Hcl and ketamine Hcl combination has been reported in different animal species. Recent research using xylazine Hcl and ketamine Hcl injected intramuscularly have shown that a mixture of the two drugs in the same syringe produces better results than when the individual drugs are given separately.

Further investigations to compare
intramuscular and intravenous routes of administration of the mixture of the two drugs were carried out. The present paper reports the results of the comparative study of the two routes of administration with and without atropine premedication.

**Materials and Methods**

20 experiments were carried out in 4 groups of 5 donkeys each. The donkeys weighed between 80 and 200 kg liveweight. These donkeys were examined to ensure that they were healthy before starting the experiments.

Atropine sulphate was administered subcutaneously at a total dose of 25 mg, 20 minutes before the injection of the drug combination in groups II and IV. Xylazine HCl was given at 2.2 mg/kg IM and 1.1 mg/kg IV. Ketamine HCl was given at 4.4 mg/kg IM and 2.2 mg/kg IV. The calculated dosages were mixed in one syringe and injected IM in each of the animals in group I and II and intravenously in each of the animals in group III and IV.

The following parameters were evaluated: Weak time (injection to staggering); recumbency time (injection to recumbency); analgesia (response to pin pricking of neck, flank, scrotum and extremities); reflexes (pedal, palperbral and anal); standing time (injection to standing unaided) and recovery time (when the animal walked and behaved normally).

**Results**

The durations of the different parameters are shown in Table 1.

To get to recumbency, the donkeys went on a dog-sitting position before collapsing into either a sternal or a lateral recumbency. Some animals alternated between these two positions. There was no paddling of the legs when the animals were in lateral recumbency. While recumbent the animals were quiet. Analgesia was good from the fetlock joint dorsally to the dorsal midline but was absent below the fetlock joint. Pain sensation was regained from the fetlock joint dorsally with the dorsal midline being last. Muscle relaxation was present in all cases but was good in IM injected animals and moderate in IV injected animals. Animals showed some degree of unconsciousness as evidenced by lack of movement of ears when hands were clapped during recumbency.

To stand, animals went on a sternal recumbency, rested for a while and often made several attempts to stand. After standing there was staggering, wide base stance and lowering of the head. Animals were quiet during recovery and didn’t react violently to noise around them. There was drooping of the lower lip and sneezing. Males protruded the penis and there was winking of the vulva lips in females. Sixty percent of the animals urinated after standing.

**Table 1: Average Duration (minutes) of various parameters after intramuscular and intravenous injections of the mixture of xylazine HCl and ketamine HCl with or without atropine premedication.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Intramuscular XK</th>
<th>Intramuscular AXK</th>
<th>Intravenous XK</th>
<th>Intravenous AXK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak Time</td>
<td>7.0</td>
<td>5.2</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Recumbency Time</td>
<td>10.0</td>
<td>8.2</td>
<td>0.91</td>
<td>0.83</td>
</tr>
<tr>
<td>Standing Time</td>
<td>40.8</td>
<td>54.8</td>
<td>20.0</td>
<td>22.7</td>
</tr>
<tr>
<td>Recovery Time</td>
<td>177.0</td>
<td>212.0</td>
<td>51.7</td>
<td>56.7</td>
</tr>
</tbody>
</table>

XK — Xylazine-Ketamine.
AXK — Atropine-Xylazine-Ketamine.

The mixing of the two drugs in one syringe is desirable because it minimizes restraint of the animal and this is good as the donkey is usually fractious.

Since the donkeys are usually uncooperative during injection, it appears that the intramuscular injections is preferable. This is enhanced by the fact that the skin of the donkeys is very thick along the jugular groove. The intramuscularly injected drug though with a longer induction time, produces prolonged anaes-
thesia and better muscle relaxation than intravenous injection.

Atropine sulphate reduced induction time and increased anaesthetic time when the drug mixture was administered by both routes. This supports the observations in sheep\(^7\).

The fact that only half of the dosage were used when the drugs were administered intravenously is an economic advantage.

The smooth induction and uneventful recovery observed in the donkeys is similar to what has been reported in horses\(^8\).

Although presence of analgesia has been reported in other species\(^2,5,8,9\) the absence of analgesia below the fetlock joint and gradual loss and regain of analgesia from distal extremities to dorsal midline in the donkey has not been previously reported in other species.

Loss of reflexes in the donkey resembles that of sheep\(^9\) but differs with horses and cats where reflexes were not eliminated\(^9,10\).

Muscle relaxation present in the donkeys has been reported also in horses\(^8\).

Vulva winking and unconsciousness observed in this study have previously been reported\(^9\).

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**References**

KAPOK (CEIBA PENTANDRA) SEED CAKE IN DIETS OF FATTENING PIGS

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LE TOURTEAU DE GRAINES DE KAPOK (CEIBA PENTANDRA)
INCLUS DANS LES REGIMES ALIMENTAIRES DES PORCS A
L’ENGRAIS

Résumé

Vingt-quatre porcs (12 jeunes porcs et 12 jeunes truies) pesant 44.1 ± 5.9 kg étaient
servis de quatre régimes alimentaires. Ils étaient nourris ad libitum d’aliments
contenant 0; 7; 14 et 21% de tourteau de graines de kapok (TKG) pendant trois mois.
Les gains pondéraux étaient de 678g; 588g, 583g et 574g/jour, tandis que les taux de
conversion alimentaire étaient de 3,42; 3,70; 4,12 et 3,58 pour les porcs nourris de
régimes contenant 0; 7; 14 et 21% de tourteau de graines de kapok respectivement.
La digestibilité des aliments était élevée et n’a pas subi l’influence du niveau de
TKG. L’analyse chimique et le taux d’acide aminé ont révélé que TKG était
comparable aux autres tourteaux d’oléagineux tels que le tourteau de graines de
coton, le tourteau de tournesol, le tourteau de sésame, en revanche, il était mois
nourrissant que la farine de soja.

Summary

Twenty four pigs (12 barrows and 12 gilts) weighing 44.1±5.9 kg were allotted to 4
dietary treatments. They were fed ad libitum diets containing 0, 7, 14 and 21% kapok
seed cake (KSC) for up to 3 months. Rates of gain were 678 g, 588 g, 583 g and 574 g/day
whilst feed conversion ratios were 3.42, 3.70, 4.12 and 3.58 for pigs fed diets
containing 0, 7, 14 and 21% kapok seed cake respectively.

Digestibility of the diets was high and was not influenced by the level of KSC.
Chemical analysis and amino acid determination revealed that KSC was comparable
to other oil cakes like cotton seed cake, sunflower cake and sesame oil cake but was
inferior to soyabean meal.

INTRODUCTION

Kapok (Ceiba pentandra) is a tree which grows under a wide range of tropical
climatic conditions. It is grown for its fibre. After oil extraction from its seeds,
kapok seed cake (KSC) is produced as the end product.

Chemical composition of KSC and its feeding value for ruminants has been
reported by1,2,3,4). Protein content ranges from 27 to 33% while crude fibre content
ranges from 20 to 32%. Protein is a major limiting nutrient in diets of pigs and other
monogastric animals in many tropical countries and every available protein
source should be exploited. Kapok seed cake seems to offer some potential as a
source of protein. However, information on its feeding value to pigs is lacking. The
present study was carried out to obtain some information on its nutritive value
for pigs.

Materials and Methods

Growth experiment

Twenty four pigs consisting of 12 gilts and 12 barrows weighing between 35 and
54 were allotted to 4 dietary treatments (6 animals per treatment) on the basis of
sex, litter and initial weight such that treatments were balanced. They were fed
diets containing 0, 7, 14 and 21% kapok seed cake (Table 1) until they weighed 90
kg when they were slaughtered.

Feed and water were provided ad libitum and the pigs were weighed weekly. All left overs were weighed every
morning. As the animals approached 90
kg they were weighed after every two
days so as not to exceed the 90 kg weight
at slaughter. Carcass characteristics were
taken on the hot carcass. The carcass was
hanged and halved. Carcass determina-
tions and weights of organs (which
appear on both sides of the carcass) were
taken on the left hand side of the carcass.
Carcass length was measured from Os
pubis to atlas. Backfat thickness was mea-
sured at three points:

1. at the thickest point over the shoulder
2. at the thinnest point in the region of the
last thoracic vertebra and
3. over the cross-section of the M. gluteus
medius in the rump region (3 measure-
ments)

The area of the M. longissimus dorsi
was taken between the 11th and 12th rib by
tracing on translucent draft paper and
measuring it using a planimeter. The kid-
neys were separated from the kidney fat
and together with the heart, liver, thyroid
and spleen they were weighed on a sensi-
tive scale.

Digestibility experiment
Four castrated pigs were used in a 4 x 4
latin square experiment to determine the
digestibility of the diets used in the
growth study. The preliminary period
lasted for 5 days and collection period for
7 days (5a).
The pigs were placed in individual
digestibility cages. Initial weight of the
pigs ranged from 40.2 to 45.6 kg. The ani-
mals were fed twice per day at 09.00
hours and 15.00 hours. Each pigs was fed
1.4 kg of feed and water at the rate of 2.5
mg/kg feed. Body weight were taken at
the beginning and end of each period.
Daily output of urine was collected in
plastic containers containing copper sul-
phate and sulphuric acid as preserva-
tives. The urine was weighed daily and
10% of the total volume was stored at 4°C
for nitrogen determinations. Faeces col-
collection was done every morning and
weighed, then bulked for each pig in plas-
tic buckets with air tight lids. The faeces
were deep frozen at -10°C and then
thawed for chemical analysis after the
collection period.
The faeces were mixed thoroughly and
samples drawn for chemical analysis.
The rest was discarded. One sample was
analysed fresh for nitrogen content and
the other dried in an oven to constant
weight at 50°C. After cooling the sample
was ground through a 1 mm screen grinder
and stored in air tight bottles.

Chemical and statistical analyses
Proximate analysis of the feedstuffs
and diets was done in accordance with
standard procedures while amino acid
content was determined by the methods,
described by (7). Determination of the anti-
nutritional factors, trypsin, chymotrypsin,
tannins and phytic acid was carried out
in accordance with methods described by (8,9).

Data from the two experiments were
analysed statistically in accordance
with (10). Standard error of difference (SED)
were calculated and t-test at (P<0.05)
were used to compare treatment differ-
ences.

Results
The chemical composition of kapok
seed cake is shown in Table 1. The crude
protein content was 31.3% while the
crude fibre content was 20.4%. Table 2
shows the amino acid composition of
kapok seed cake, soyabean meal, cotton-
seed cake, sunflower seed cake and sim-
sim cake. Kapok seed cake contained
12.56 g lysine/kg dry matter (DM) and 3.88
g methionine/kg DM.
The content of tannins was 0.4% in
kapok seed cake, 0.68% in cottonseed
cake, 2.09% in sunflower cake and 0.81%
in simsim cake. The contents of the other
inhibitors in kapok seed cake were: tryp-
sin, 0.35 μg/g DM, chymotrypsin 1.75 μg/kg
DM and phytic acid, 0.81 mg/g DM.
The effect of level of KSC on growth
and feed efficiency is shown in Table 3.
Dietary levels of KSC had no significant
effect on average daily gain. The level of
lysine and methionine in the diets was
below standard recommendations (11).
Table 1: Composition of experimental diets and kapok seed cake (KSC)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Diets and % composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Kapok seed cake</td>
<td>0.0</td>
</tr>
<tr>
<td>Soyabean meal</td>
<td>12.0</td>
</tr>
<tr>
<td>Wheat feed</td>
<td>55.0</td>
</tr>
<tr>
<td>Cassava root meal</td>
<td>28.4</td>
</tr>
<tr>
<td>Fish meal</td>
<td>3.0</td>
</tr>
<tr>
<td>Salt</td>
<td>0.5</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.0</td>
</tr>
<tr>
<td>Premix</td>
<td>0.1</td>
</tr>
<tr>
<td>Chemical composition</td>
<td></td>
</tr>
<tr>
<td>Dry matter</td>
<td>88.53</td>
</tr>
<tr>
<td>Crude protein</td>
<td>16.45</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>5.93</td>
</tr>
<tr>
<td>Ether extract</td>
<td>6.96</td>
</tr>
<tr>
<td>Ash</td>
<td>7.05</td>
</tr>
<tr>
<td>NFE</td>
<td>49.81</td>
</tr>
<tr>
<td>Calcium</td>
<td>1.00</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.83</td>
</tr>
<tr>
<td>Lysine (calculated)</td>
<td>0.60</td>
</tr>
<tr>
<td>Methionine (calculated)</td>
<td>0.33</td>
</tr>
</tbody>
</table>

*True laboratory values

Table 2: Amino Acid composition of kapok seed cake, soyabean meal, cotton seed cake, sunflower seed cake and simsim cake (g amino acid/kg dry matter).

<table>
<thead>
<tr>
<th>Amino acid</th>
<th>Soyabean meal</th>
<th>Kapok seed cake</th>
<th>Cotton seed cake</th>
<th>Sunflower seed cake</th>
<th>Sisimisim cake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arginine</td>
<td>32.53</td>
<td>35.49</td>
<td>40.49</td>
<td>29.70</td>
<td>44.96</td>
</tr>
<tr>
<td>Aspartic acid</td>
<td>47.65</td>
<td>27.42</td>
<td>32.85</td>
<td>29.84</td>
<td>28.15</td>
</tr>
<tr>
<td>Cystine</td>
<td>6.76</td>
<td>4.06</td>
<td>5.62</td>
<td>5.49</td>
<td>7.99</td>
</tr>
<tr>
<td>Tryptophan</td>
<td>6.10</td>
<td>3.66</td>
<td>4.41</td>
<td>4.54</td>
<td>5.77</td>
</tr>
<tr>
<td>Histidine</td>
<td>11.12</td>
<td>5.68</td>
<td>9.74</td>
<td>7.89</td>
<td>9.09</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>20.05</td>
<td>11.45</td>
<td>12.84</td>
<td>14.74</td>
<td>14.28</td>
</tr>
<tr>
<td>Leucine</td>
<td>31.66</td>
<td>17.77</td>
<td>22.25</td>
<td>20.83</td>
<td>23.69</td>
</tr>
<tr>
<td>Lysine</td>
<td>25.86</td>
<td>12.56</td>
<td>14.18</td>
<td>10.71</td>
<td>9.69</td>
</tr>
<tr>
<td>Methionine</td>
<td>6.17</td>
<td>3.88</td>
<td>5.50</td>
<td>7.46</td>
<td>10.04</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>20.99</td>
<td>16.46</td>
<td>19.97</td>
<td>15.62</td>
<td>16.09</td>
</tr>
<tr>
<td>Tyrosine</td>
<td>16.04</td>
<td>9.21</td>
<td>11.66</td>
<td>9.08</td>
<td>13.86</td>
</tr>
<tr>
<td>Threonine</td>
<td>16.59</td>
<td>8.76</td>
<td>12.20</td>
<td>11.73</td>
<td>12.61</td>
</tr>
<tr>
<td>Valine</td>
<td>21.49</td>
<td>17.23</td>
<td>17.88</td>
<td>17.53</td>
<td>11.53</td>
</tr>
</tbody>
</table>

Table 3: Effect of level of kapok seed cake on feed intake and weight gain.

<table>
<thead>
<tr>
<th>Item</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>SED±</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Kapok seed cake</td>
<td>0</td>
<td>7</td>
<td>14</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Daily feed intake g/day</td>
<td>2318</td>
<td>2178</td>
<td>2403</td>
<td>2055</td>
<td>21</td>
</tr>
<tr>
<td>Initial wt, kg</td>
<td>44.5</td>
<td>44.2</td>
<td>45.3</td>
<td>43.8</td>
<td>1.20</td>
</tr>
<tr>
<td>Final wt, kg</td>
<td>89.8</td>
<td>90.1</td>
<td>88.8</td>
<td>89.8</td>
<td>0.43</td>
</tr>
<tr>
<td>No. of days</td>
<td>66.8</td>
<td>78.0</td>
<td>73.7</td>
<td>80.2</td>
<td>3.66</td>
</tr>
<tr>
<td>Av. daily gain, g/day</td>
<td>678</td>
<td>588</td>
<td>583</td>
<td>574</td>
<td>0.02</td>
</tr>
<tr>
<td>Feed conversion ratio kg</td>
<td>3.30</td>
<td>3.57</td>
<td>3.75</td>
<td>3.54</td>
<td></td>
</tr>
</tbody>
</table>
Table 4: Mean effect of different levels of kapok seed cake on apparent digestibility.

<table>
<thead>
<tr>
<th>Item</th>
<th>Diets</th>
<th>SED</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Kapok seed cake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry matter (%)</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>84</td>
<td>80</td>
<td>82</td>
</tr>
<tr>
<td>Organic matter (%)</td>
<td>91</td>
<td>90</td>
</tr>
<tr>
<td>Ether extract (%)</td>
<td>85</td>
<td>82</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>89*</td>
<td>80*</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
<td>70</td>
<td>73</td>
</tr>
<tr>
<td>NFE (%)</td>
<td>86</td>
<td>79</td>
</tr>
<tr>
<td>ME, MJ/kg DM</td>
<td>13.7</td>
<td>12.8</td>
</tr>
</tbody>
</table>

*ab = means in the same row with different superscripts are significantly different (P<0.05)

Table 5: Effect of different levels of kapok seed cake on carcass composition and organ weights.

<table>
<thead>
<tr>
<th>Item</th>
<th>Diets</th>
<th>SED</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Kapok seed cake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Killing out (%)</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>71.5</td>
<td>72.5</td>
<td>71.7</td>
</tr>
<tr>
<td>Carcass length (cm)</td>
<td>94.8</td>
<td>94.9</td>
</tr>
<tr>
<td>Backfat thickness (cm)</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Loin eye area (cm²)</td>
<td>30.2</td>
<td>28.9</td>
</tr>
<tr>
<td>Kidney weight (g)</td>
<td>200.0</td>
<td>200.0</td>
</tr>
<tr>
<td>Heart weight (g)</td>
<td>250.0</td>
<td>240.0</td>
</tr>
<tr>
<td>Liveweight (g)</td>
<td>1400.0</td>
<td>1300.0</td>
</tr>
<tr>
<td>Thyroid weight (g)</td>
<td>7.2*</td>
<td>7.5*</td>
</tr>
<tr>
<td>Spleen weight (g)</td>
<td>96.8</td>
<td>114.3</td>
</tr>
</tbody>
</table>

*abc = Means in the same raw with different superscripts are significantly different (P<0.05).

Table 4 indicates that the digestibility of the diets was not generally influenced by the level of KSC. The inclusion of 21% KSC had a significant reduction in digestibility of crude protein. Table 6 shows the effect of KSC on carcass characteristics and organ weights. The thyroid gland weight increased significantly (P<0.01) with increasing levels of kapok seed cake. The other organs and carcass measurements were not significantly affected.

**Discussion**

From the chemical composition and amino acid content it is apparent that kapok seed cake is fairly similar to cotton seed cake, sunflower seed cake and simsim cake. However, it had a slightly lower lysine content than cotton seed cake and lower content of methionine and cystine than the other oil cakes. Together with the high crude fibre content (20.4%) it might appear that kapok seed cake may be inferior to the other oil cakes. However, the growth study revealed that the level of KSC in the diet did not significantly influence average daily gain or feed efficiency inspite of KSC substituting the more nutritious soybean meal. The observed growth rates of 574 to 678 g/day in this study are superior to those reported by (5b) using cotton seed cake (0 to 18%) but comparable to those of (12) where the rates of gain ranged from 438 to 705 g/day for pigs fed different levels of copra cake from 0 to 30%. Although there was a gradual reduction of growth rate with increasing KSC in the diet, the reduction was not high enough to indicate any serious toxicological effect of KSC. The reduction in growth rate is probably due to the decreasing level of lysine and increasing level of crude fibre in the diet as the level of KSC was increased (Table 1). The inclusion of 21% KSC also had a

Increasing the level of KSC reduced the cost of feed per kg carcass as the price of KSC was only 1/3 of the price of cotton seed cake and ¼ of sunflower cake. The reduction was 15% for the 21% KSC diet. Thus KSC is cost-effective in pig diets. Generally all the diets were very economical, as the cost of producing one kg carcass was only 25% of the price of pork. Thus, these rations can be adopted by practical pig farmers.

Kapok cake contains cyclopopenopenoid acid whose effect on its utilization is not known. The increased thyroid gland with increase in levels of kapok cake (P<0.01) suggests that the cake could contain goitrogenic substances. Thus further work is required to study possible antinutritional factors present in the cake and their effect on the quality of pork as well as the effect of supplementing with synthetic lysine.

Acknowledgement

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References


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USE OF MEAT INSPECTION RECORDS IN VETERINARY PLANNING

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UTILISATION DES DOSSIERS SUR L'INSPECTION DE LA VIANDE POUR LA PLANIFICATION DES SOINS VETERINAIRES

Résumé

Les données recueillies sur l'inspection de la viande dans un abattoir à Edimbourg (Ecosse) et dans deux abattoirs en Ouganda (à Mukono et à Kampala) ont été analysées. On a examiné les systèmes de contrôle, la condamnation des carcasses et des abats en particulier due à la tuberculose et à la distomiasi, les pertes économiques enregistrées à cause de cette condamnation. Lors de l'examen de l'incidence de ces deux maladies, on a pris en compte l'abattage de bétail, les méthodes de commercialisation, les pertes économiques, l'évaluation des stratégies de lutte contre les maladies ainsi que l'identification de l'importance et de la priorité accordée aux programmes de lutte contre les maladies.

Summary

Meat inspection data from one abattoir in Edinburgh (Scotland) and two in Uganda (Mukono and Kampala), were analyzed. The recording systems, condemnation of carcasses and offals due to especially Tuberculosis and Fascioliasis, and the losses as a result of the condemnations were considered. Frequency of these two diseases, was associated with livestock off-take; marketing practices; economic losses, evaluation of disease control strategies as well as identification of the magnitude and prioritization of disease control programmes.

INTRODUCTION

Meat inspection programmes are predominantly designed for the safety and wholesomeness of meat for human consumption(1). However, the use of data from meat inspection for Veterinary planning has only recently been considered. Yet, for diseases which produce easily recognizable lesions at postmortem, such as Tuberculosis, Fascioliasis, and Contagious Bovine Pleuropneumonia, abattoir records can indicate the prevalence of disease as well as evaluate a disease control programme. Some diseases recorded in abattoirs such as Cysticercosis, Caseous Lymphadenitis, Anthrax and/or FMD, have a significant impact on the international, marketing of meat and animal products.

Abattoirs have been used in countries like Newzealand, Denmark, Australia, for epidemiological surveys(2). In many developing countries however, many livestock not slaughtered in regular abattoirs, are not inspected; and in cases where livestock are slaughtered in organized abattoirs, the records often do not feature significantly as a basis for disease monitoring and control.

This study used and analyzed data with particular reference to Tuberculosis and Fascioliasis, from one abattoir in Scotland and two abattoirs in Uganda.

In Britain in general, although the prevalence of Tuberculosis is low, abattoirs still play a major role in its monitoring in the National Tuberculosis Eradication Programme. Fascioliasis is still economically important in Britain as monitored in
the abattoir in Edinburgh. The prevalence of Fascioliasis and Tuberculosis, and losses associated with the same, in the two Ugandan abattoirs, were studied.

**Materials and Methods**

**Abattoirs:**
An abattoir in Edinburgh, Scotland, which slaughters an average of 1,700 cattle; 9,500 sheep and 3,000 pigs was visited in 1987 and the meat inspection procedures observed in order to associate the inspection records with the meat inspection practice. In Uganda both the Mukono and the Kampala abattoirs, are located in central Uganda. The Mukono abattoir, is in Mukono District (slaughtering on average, 800 cattle, 100 goats and 50 sheep per month) and the other is in Kampala city (slaughtering on average, 1,100 cattle, 120 goats, and 8 sheep per month).

**Inspection Procedures:**
Routine meat inspection procedures were practiced in all these abattoirs, with a synchronized and coordinated location and identification of carcass parts for inspection. Meat inspection is mainly done by Health Inspectors under the supervision of Veterinarians in Edinburgh, while in Uganda, it is done by Meat Inspectors (trained through the Government Veterinary Department) also under the supervision of Veterinarians from the Department of Veterinary Services and Animal Industry. Inspection for Fascioliasis involved, visual examinations with palpation and incision and excising of the liver affected. For Tuberculosis routine incision of pulmonary and regional lymph nodes, the external and internal iliac lymph nodes was done. The lesions used in the records were identified based on only gross pathological changes or abnormalities of the carcass and/or organs. The well equipped laboratory in the Edinburgh abattoir was underutilized for diagnosis, except for hygiene control in the abattoir. No laboratory diagnosis was done within the Ugandan abattoirs.

**General Records:**
Edinburgh abattoir recorded lesions and identifications of carcasses and later this was compiled by hand into a daily register. This formed the basis of the monthly and quarterly records, the latter being submitted to the Ministry of Agriculture, Food and Fisheries for further compilation into an annual report. In Uganda, recorded information included farms or Districts of origin of the slaughtered livestock and lesions identified which were recorded in a notebook, and at the end of the day, recorded into a daily register. A monthly report was forwarded to the Ministry of Animal Industry and Fisheries by the Veterinary Officer in charge.

**Fascioliasis Records**
In Edinburgh, records from 1981-1986, for cows, bulls, oxen, heifers, calves and sheep; and livers condemned, were examined and the percentage prevalence provided in the annual reports, noted. The weights of condemned livers were pooled with other organs as weight of condemned organs. In Uganda, the Mukono abattoir records for 1985-1987, included numbers of livers condemned, cattle carcass weights only, but not for sheep or goats. It was difficult to find a complete annual record. In the Kampala abattoir, records for 1982 only for partially condemned livers, included the weights of their trimmings and the weights of livers of goats (not sheep), so affected.

**Tuberculosis Records**
In Edinburgh abattoir, detailed records of number of carcasses, and organs affected were available but not their weights. The percentage of annual prevalence of tuberculosis was available. In Uganda, the Mukono abattoir had records of carcasses condemned due to tuberculosis, and weights of partially condemned parts (head and quarters) which were recorded as well as the weights for the organs (livers, intestines, spleen). The percentage of animals affected with tuberculosis, percentage
carcase condemned, and total weights and money lost were recorded monthly. In the Kampala abattoir, records were similar to those of the Mukono abattoir, however in addition, the average dressed carcase weight was calculated and recorded monthly.

Results

Scotland (Edinburgh) Abattoir

a) Fascioliasis

Fig. 1, shows cattle slaughtered (15,600 on average per year) against the % infected with Fasciola hepatica (6% on average per year), between 1981-1986. Fig. 2, shows sheep slaughtered (113,000 on average per year) against the % infected with Fasciola hepatica (1.4% on average per year), between 1981-1986.

Fig. 3, compares the % infected (with Fasciola hepatica) cattle, (6% average), and sheep (1.4% average) per year, during the period 1981-1986. Fig. 4, shows cattle slaughtered (13,500 on average) and its relationship to the monthly prevalence of Fasciola hepatica infections (8.6% on average) for the year 1986.

Fig. 5, shows sheep slaughtered (110,000 on average) and its relationships to the monthly prevalence of Fasciola hepatica infections (1.6% on average) for the year 1986.

b) Tuberculosis

Tuberculosis was only diagnosed once in a heifer in 1981, while only six pigs

Figure 1: Slaughters and Fasciola Infected Cattle [Edinburgh Abattoir (1981-1986)].
Figure 2: Slaughters and Fasciola Infected Sheep [Edinburgh Abattoir (1981-1986)].

Figure 3: 3% Cattle and Sheep Infected with Fasciola. Edinburgh Abattoir (1981-1986).
**Figure 4:** Slaughters and % Fasciola Infected Cattle [Edinburgh Abattoir (1986)].

**Figure 5:** Slaughters and % Fasciola Infected Sheep [Edinburgh Abattoir (1986)].
were identified infected during the same period of, 1981-1986.

Ugandan Abattoirs

Fascioliasis and Tuberculosis

Fig. 6, shows frequency of cattle slaughters and corresponding average cases of Fascioliasis (9.1%) and Tuberculosis (0.4%), identified in the Kampala abattoir, in 1982. Fig. 7, shows frequency of cattle slaughters and corresponding average cases of Fascioliasis (21.8%), and Tuberculosis (5.7%), in the Mukono abattoir for the year 1986.

Fig. 8, shows the distribution of Tuberculosis lesions in various organs of cattle slaughtered in Kampala abattoir in 1982. Tuberculosis in cattle in the Kampala abattoir was affecting 19.3% of offals, while only 0.4% of the carcasses were involved.

There were few (7 out of 1000 goats) cases of Fascioliasis in goats reported in the Kampala abattoir and no Tuberculosis cases in the same species.

Ante mortem records

None of the three abattoirs kept records information on antemortem inspection.

Discussion

Use of meat inspection records in Veterinary planning gives insight into the frequency of diseases in slaughtered livestock; the off-take (livestock slaughters); marketing practices and economic factors of the livestock industry relating to

Figure 6: Slaughters; TB & Fasciola Infected Cattle [Kampala Abattoir (1982)].
Figure 7: Slaughters; TB & Fasciola Infected Cattle [Mukono Abattoir (1986)].

Figure 8: TB lesions in various organs of cattle [Kampala Abattoir (1982)].
meat production and other by-products following slaughter. Abattoir records are also useful in the traceback; in case-finding of a disease during a control programme. This latter role, provides records which can be used for animal disease planning and control strategies as well.

Although all the three abattoirs in this study stated that they carried out ante-mortem inspection of slaughtered livestock, it was difficult to prove so without records. Valuable data obtained at ante-mortem inspection which could be made use of in disease monitoring and trace back was not recorded, and where an attempt to record was made, it was difficult to trace back the District/farm of origin. Upon arrival, animals were not well identified. This made trace back of diseased animals difficult. This was even made more difficult due to the complicated system of marketing both in the UK and Uganda in which an animal passed through different ownerships before reaching the abattoir. In Australia, the segregation of slaughter cattle which showed clinical signs of shivering and diarrhoea at ante-mortem inspection limited the transmission of salmonella infection. It is therefore essential that ante-mortem inspection records be kept.

Fascioliasis

**Edinburgh**

In the Edinburgh abattoir, the slaughter of cattle and sheep showed an inverse relationship to the number and (%) of these animals infected with *Fasciola gigantica* (Fig. 1, 2, 4 and 5). This is hypothesised to be related to the slaughter market fluctuations of these livestock. Thus, whenever there were high numbers slaughtered, more healthy cattle (less infected with Fasciola) were taken to the abattoirs, and vice versa; the latter relating to cull animals being sold off during that period especially as seen in the year 1986 (Fig. 4 and 5). It is also probable that, the marketing industry brought to the market every other year, more infected cattle, giving a bi-annual peak of Fasciola infected livestock being slaughtered (Fig. 1 and 2). However, generally cattle were almost 6 times more infected with *Fasciola gigantica* than sheep which were slaughtered during the period 1981-1986 (Fig. 3). This may be related to lower exposure of sheep to infection compared to cattle through better husbandry practices. It was also observed that, generally Fasciola infection prevalence in slaughtered cattle, was higher during and after the month of September, in agreement with the report by Gracey, for Britain as a whole. This was related to increased *Lymnaea trunculata* snails during that period of the year. Yet a bimodal prevalence (June and October), was observed in 1986, attributed to the sheep industry practice in Scotland, of culling (because of infertility) off of ewes prior to the next breeding season. It is also related to the time when adult sheep which are slaughtered, are already infected. The average prevalence of Fascioliasis in sheep of 1.6% per month in 1986, is within the range of 0.3-5%, reported by Cuthbertson.

**Uganda**

In Uganda, the trend of prevalence of Fascioliasis in slaughter cattle in the two abattoirs (Kampala 1982 and Mukono 1986), compared to the number of cattle slaughters, also showed a similar inverse pattern, to that in Edinburgh [1981-1986 and the year 1986 (Fig. 6 and 7)]. Lack of adequate and full record keeping could not permit adequate comparison between the Ugandan and Edinburgh abattoir records. Fig. 7, shows Mukono abattoir records for 1986, which were incomplete for June and July. This clearly illustrates the limitations which exist in developing countries whereby abattoir records are not adequately kept and used. Nevertheless, the pattern seen for the two abattoirs in 1982 (Fig. 6) and 1986 (Fig. 7) may also be associated with the cattle trade and marketing industry, relating to healthier cattle reaching the abattoir during peak slaughter periods, while cull cattle are sold during depressed meat sale periods. The loss in terms of liver condemnations due to fascioliasis in cattle
inspected at Kampala abattoir in 1982 was estimated at 4,030 kg. This figure is lower than that earlier estimated by Bitakaramire and Okao\(^\text{7}\) in an abattoir survey. They estimated a loss of 21,056.2 kg of liver condemned from inspection of a similar number of animals as that slaughtered at the Kampala abattoir in 1982. The amount reported at the Kampala abattoir, included only wholly condemned livers, and this could explain the low estimates. These estimates of liver condemnations may not be accurate, yet they give an insight into the magnitude of the loss incurred. They provide an economic argument for control of the disease in question. The prevalence of fasciolasis in sheep and goats in Uganda was found to be lower than that in cattle. Coyle\(^\text{8}\) had earlier reported that fasciolasis in goats is rarely seen in the abattoir in Uganda. The prevalence value of 0.7% observed in goats in Kampala abattoir in 1982, is much lower than that found by Hammond\(^\text{9}\), in goats in Tanzania (4.1%). Hammond attributed the small numbers of infected goats, to the different feeding habits of goats which gave them less risk of ingesting metacercariae. It was thought that massive invasion of the liver of sheep and goats by young flukes caused sudden death, which explained the lower numbers of these sheep and/or goats with flukes at abattoirs\(^\text{8}\).

Hammond\(^\text{9}\), also thought that, the lesions in sheep and goats require experience to diagnose as the bile ducts are enlarged without much thickening, so that meat inspectors with limited experience of the disease in goats and sheep may as well miss it. It is therefore quite likely that Fasciolasis is an important disease of these animals in Uganda. It is also probable that, the husbandry practices for goats and sheep, in Uganda, do not predispose them to a high infection with Fasciola.

**Tuberculosis**

**Edinburgh/Uganda**

The prevalence of tuberculosis among slaughter cattle in the two Ugandan abattoirs (Fig. 6 and 7) is high in comparison to the Edinburgh slaughters of one case in the 1981-86 period. Nevertheless, the Scotland region may not be fully representative of the situation in the whole of Britain, where in South West England, tuberculosis in badgers may spill over to cattle (10 and 3). Yet generally the low prevalence in slaughter cattle credits the tuberculosis eradication programme in Britain.

In Uganda, the prevalence of tuberculosis lesions in slaughter seems to be constant over the year as in 1982 (Fig. 6) and 1986 (Fig. 7). Peak prevalence periods in the year are related to low slaughter rates probably due to poor quality of slaughter cattle in terms of old age and poor body condition, and thus associating the quality of slaughter cattle to the prevalence of tuberculosis lesions. The Kampala abattoir's 0.4% average prevalence (Fig. 6) and the Mukono abattoir's 5.7% (Fig. 7), are lower than earlier estimates of 27% by Pritchard\(^\text{11}\) and Karamoja Zebu cattle in Uganda. This is associated with the herding together of cattle in kraals and bomas.

This study demonstrated some disease trends from the data obtained. The temporal distributions of Fasciolasis and Tuberculosis in Edinburgh (1986 and 1981-1986), Kampala (1982) and Mukono (1986) abattoirs were illustrated and compared. Losses resulting from condemnations at abattoirs due to fasciolasis and tuberculosis were also assessed including the distribution of the tuberculosis lesions in the various organs.

In countries where most livestock is slaughtered at abattoirs, these records can be an extremely useful source of data on the incidence and prevalence of many animals diseases, which information can form a basis of planning animal disease control programmes.

**Acknowledgements**

The senior author is grateful to the British Council which offered her a scholarship through Uganda Government to
study for an MSc degree in the University of Edinburgh in 1986/87. The assistance rendered by the management of the abatoirs both in Edinburgh and in Uganda is recognized. The Commissioner of Veterinary Services and Animal Industry of the Government of Uganda, is thanked for the permission to use the abattoir annual report records.

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SHORT COMMUNICATION

AN OUTBREAK OF BOVINE LEPTOSPIROSIS DUE TO LEPTOSPIRA HARDJO AND LEPTOSPIRA POMONA IN A ZERO-GRAZING DAIRY HERD IN KENYA.

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INTRODUCTION

Leptospirosis is a febrile disease attributable to any of the serologically distinct members of the Leptospira interrogans and may present itself in a variety of clinical syndromes in animals(1,2,3). It is transmitted mainly through contaminated feed and water by convalescent or reservoir hosts(4). Routes of infection are mainly through the mucosal membranes of the conjunctiva, mouth, oesophagus, intestine, reproductive tract and broken skin(1). This communication reports an outbreak of leptospirosis due to serovars hardjo and pomona in zero-grazing unit.

Twenty four out of 34 adult cattle fed on a fresh batch of hay bought from a different supplier were affected. The affected animals had slightly increased respiratory and pulse rates, decreased ruminal movements and fluctuating fever during which the temperatures were higher in the afternoon than in the morning. Recurrence of fever lasting 2-4 days was observed in some animals 8-12 days after subsiding of the initial fever. Eight milking cows had slack and flabby udder with thick and yellow milk from all the quarters. Nine cows over 5 months pregnant aborted within 2-3 weeks after the onset of the disease, 6 retained fetal membranes and three had stillbirths. Eighteen cows and a bull had photosensitization (bluish-red discoloration) on the posterior surface of the udder, the testicles and around the pastern joint of the hind limbs. There was some lameness in some cows especially of the hind limbs.

The blood samples analysed for haematology and biochemistry showed slight leukocytosis (>12,000 WBC) and slightly elevated aspartate amino transferase (AST) (35-37 IU/L) in some animals. Two thirds (6/9) of the serum samples screened for leptospirosis by the microscopic agglutination test (MAT) were positive for leptospiral antibodies against serovars hardjo and pomona. The main postmortem findings were hepatitis (enlarged, friable anemic and bile stained liver with a marked centrilobular necrosis), nephritis, enlarged spleen and haemorrhages on the serosal membranes. Attempts to isolate the Leptospira organisms were not successful.

The affected animals were in a group of animals which had been fed on a new batch of fresh hay that had been obtained from a different supplier one week before the onset of the disease. It is likely that the hay was contaminated with Leptospira organisms. The febrile relapses observed in most of the animals (14/24) were similar to the relapses reported in animals experimentally infected with serovar hardjo(3,5). Treatment of affected animals with penicillin-dihydro-streptomycin controlled the pyrexia within 4-6 days while treatment with oxytetracycline took longer to contain the pyrexia (6-8 days). This would indicate that penicillin-dihydrostreptomycin treatment was better than oxytetracycline treatment.

The abortions observed in this leptospirosis outbreak occurred within a relatively short period of time of 2-3 weeks after the onset of the clinical signs and most of the cows which aborted (6/9) retained the fetal membranes. This is consistent with other reports of leptospiroa infections(6,7,8). The skin lesions found in the lightly pigmented areas exposed to the sun were probably due to
photosensitization. The photosensitization was most likely of hepatogenous origin as the dead animals had marked liver necrosis and the sick ones had elevated AST levels possibly due to the liver damage. The lameness observed in some animals was probably due to synovitis which occur in some animals suffering from leptospirosis.

This outbreak was rather unique since it occurred in animals which were quite closed whereby the only way of introducing the infection to the animals was either through the feed or infected personnel. Considering that the Leptospira organisms rarely survive in dry feeds and no animal attendant had any clinical disease the source of infection was difficult to establish. Therefore, the occurrence of the disease in such a herd is of epidemiological significance.

References

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SHORT COMMUNICATION

THEILERIA PARVA INFECTIONS IN SLAUGHTER SHORT HORN ZEBU CATTLE IN TANZANIA

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INTRODUCTION

East Coast fever (ECF) is the most common disease of cattle in East and Central African countries. For instance, in Tanzania, ECF is documented to account for the majority of the clinical cases reported in Veterinary investigation centers and for cattle deaths observed in northern parts of Tanzania. Thus, the loss of livestock productivity due to ECF is immense and undermines the potential contribution of the livestock sector to gross national incomes of affected countries.

Dipping of animals still remains the most common method of controlling tick-borne infections. Dipping in Tanzania used to be compulsory, however recently this policy has changed. Dipping operations are currently under the control of livestock keepers or local governments which have introduced a fee per animal immersion. The fee is intended to cover the costs of acaricides and for maintenance of dips. However, most of the dips are no longer operational and this is attributed to soring prices of acaricides and costs of maintenance of dips. The breakdown in dipping operations has resulted in many areas turning into disease enzootic areas.

In ECF endemic areas, mortalities in traditional zebu cattle are confined to calves, whereas adult animals do not succumb to the clinical disease. Infection rates of Theileria parva in adult traditional Zebu cattle from disease endemic areas have never been determined. Therefore, the purpose of this study was to evaluate infection rates in slaughter animals as based on demonstration of Koch’s blue bodies (KBB) in lymph node smears. The study was carried out in Morogoro and Arusha regions.

Slaughter animals originated from within and outside Morogoro and Arusha regions. One prescapular lymph node was dissected from each randomly selected carcass. Approximately 25-30 lymph nodes were collected on each visit from an average of 40 animals slaughtered daily in Morogoro abattoir. Impression smears of cut surfaces were prepared on microscopic slides, dried and stained with Giemsa for evaluation of the presence of schizonts in lymphocytes. Samples were collected in April and May 1992 (representing the rain season) and in June and July (early part of the dry season). Impression smears were also prepared from both parotid and prescapular lymph nodes of animals slaughtered in Arusha during the month of June 1992.

The results show that the percentage infection rates in Morogoro cattle were 51% in April, 48% in May, 33% in June, and 35% in July (Figure 1). There was thus a decreasing trend of percentage of lymph nodes with evidence of KBBs just after the rains. Most of the lymph nodes were grossly enlarged and oedematous. Results of infection rates in slaughter animals in Arusha are shown in Table 1. It was evident that a higher proportion of parotid lymph nodes showed evidence of schizonts than that of prescapular lymph nodes. This difference is likely to be attributed to preferential tick attachment sites. Most Rhipicephalus appendiculatus prefer attaching to the ears, hence infection rates are likely to be higher initially in local lymph nodes (parotid) compared to distant ones such as the prescapular lymph nodes.

A high infection rate of the disease observed during the rain season com-
Figure 1: Infection rates in slaughter animals in Morogoro Abattoir.

Table 1: Infection rates in slaughter animals in Arusha abattoir.

<table>
<thead>
<tr>
<th>Lymph Node Type</th>
<th>No. of lymph node samples</th>
<th>No. of infected lymph nodes</th>
<th>Percent of infected lymph nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parotid lymph nodes</td>
<td>60</td>
<td>23</td>
<td>38</td>
</tr>
<tr>
<td>Prescapular lymph nodes</td>
<td>62</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>122</td>
<td>37</td>
<td>30</td>
</tr>
</tbody>
</table>

Compared to the dry season suggests a seasonal intensity of infection in ticks and/or tick burdens on animals and in pastures. Tick population dynamics are influenced by factors such as vegetation cover, amount of rain, ambient temperatures, relative humidity, and these climatic and environmental factors are likely to be conducive to tick survival and propagation during the rain season. However, a longer period of study (one year) is required to show clearly the seasonal pat-
terns of parasitosis in traditional slaugh-
ter zebu cattle coming from areas where
tick-borne disease control programmes
are not practiced.

In summary, the results show the level
infection of *T. parva* in traditional slaugh-
ter zebu cattle mostly coming from areas
where dipping is no longer in operation.
Infection in adult animals which rarely
show obvious clinical manifestation of
ECF is a major source of infection for ticks
which in turn transmit the parasites to
calves which, in disease endemic areas,
show high mortalities.

**Acknowledgement**

The authors are indebted to cattle own-
ers and meat inspectors for their coopera-
tion.

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INTRODUCTION

Dietary changes have been shown to contribute to the pathogenic processes that cause postweaning diarrhoea in early weaned pigs\(^1\). The antigenicity of the weaning diet plays a role in the development of malabsorption in the early-weaned pig\(^2\). Type III hypersensitivity reaction mediated by glycinin and β conglycinin, the antigenic proteins of soyabean, has been reported in neonatal calves\(^3\) and these cause intestinal damage resulting in the impairment of digestive and absorptive functions in pigs\(^4\). The objectives of this study were to determine the serum anti-soya immunoglobulin (IgG) titres in the commercial herd and assess the effect of age, weaning and postweaning diet on the anti-soya IgG titres.

Female pigs were used in this study and they were categorised by age into three groups viz: suckling (=4 weeks), weaner (5-8 weeks) and gilts (≥6 months). There were 10 animals in each group. Serum samples were collected at regular intervals and kept at -20°C until analysis. Soyabean extract was prepared by steaming at 96°C for 1/2 hour and the toasted beans were ground to a fine powder, mixed with water and stirred with a magnetic stirrer for one hour. The NaCl-soluble soya extract was recovered using Buchner’s filtration apparatus, funnel filtration and antigen filters.

The extract was stored at -20°C until analysis. Antibody was prepared by making a serum dilution of 1:100 with wash buffer which was prepared by mixing PBS with 0.5 M NaCl and 0.05% Tween 80. For the anti-pig IgG, a stock solution of peroxidase conjugated anti-pig IgG was prepared by adding 1 part anti-pig IgG to 999 parts wash buffer (1:1000 dilution) and the substrate was prepared by dissolving one tablet of ortho-phenylene diamine hydrochloride (OPD) per 5 ml diluent.

Analysis of the serum samples for anti-soya IgG was performed using the ELISA technique and the optical density was measured at 495 nm using a multiscan plate reader, Model B 1.45.

Anti-soya IgG was detected in all experimental animals including the communal pigs. None of the animals had clinical signs of hypersensitivity which may suggest that the IgG levels were below the hypersensitivity threshold, though the IgE, which is also involved with hypersensitivity reaction, was not monitored.

In this study, unweaned piglets were housed together with their dams and so had free access to a soya-based diet. Therefore, the high anti-soya IgG titre in suckling piglets can be attributed to both colostral IgG and those produced in response to soya bean in the ration. Thus, even in clinically normal animals the gastrointestinal mucosa does not form a complete barrier to orally administered antigen as shown by Walker and Isselbacher\(^5\).

The anti-soya IgG levels were found highest in the weaners followed by the gilts and least in the suckling piglets.

<table>
<thead>
<tr>
<th>Animal Group</th>
<th>Average Antibody titre</th>
<th>Average Absorbance (nm)</th>
<th>Coefficient of Variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suckling piglets</td>
<td>1.2160</td>
<td>1.247</td>
<td>70.7</td>
</tr>
<tr>
<td>Weaners</td>
<td>1.2480</td>
<td>1.587</td>
<td>51.7</td>
</tr>
<tr>
<td>Adult (Commercial)</td>
<td>1.2360</td>
<td>1.478</td>
<td>33.2</td>
</tr>
<tr>
<td>Adult (Commercial)</td>
<td>1.2240</td>
<td>1.294</td>
<td>35.2</td>
</tr>
</tbody>
</table>

Table: Antibody titre and Optical density values obtained in the experimental pigs.
differences between the groups, however, were not statistically significant (P<0.05). The results obtained in this study also suggest that with adequate pre-weaning oral exposure to dietary antigen, there could be a decrease in the incidence of post-weaning diarrhoea. Miller et al. reported that specific oral tolerance to these antigens before weaning.

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SHORT COMMUNICATION

SEROLOGICAL SURVEY OF LEPTOSPIRAL ANTIBODIES IN CATTLE, SHEEP AND GOATS IN NYANDARUAA DISTRICT OF KENYA

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INTRODUCTION

Leptospirosis is a common zoonotic disease of a world-wide importance\(^1\). It causes economic loss to livestock industry from abortions, stillbirths, deaths, decreased milk production and infertility\(^2\). The *Leptospira* organisms survive best in areas with high rainfall, soil pH of around neutral and temperature range of about 7-34°C\(^3\).

A study was carried out to establish the prevalence of leptospiral antibodies in cattle, sheep and goats in Nyandarua district which has climatic conditions favourable to survival of *Leptospira* organisms. The district has a high relative humidity (65%), high annual average rainfall (839 mm), annual average temperature of about 14.1°C and an average soil pH of 6.4\(^3\).

A total of 683 serum samples were collected from 326 cattle and 357 sheep and goats from randomly selected farms. The samples were screened for leptospiral antibodies by the microscopic agglutination test (MAT)\(^4\) using live antigens representing eleven serovars of *Leptospira interrogans*. The serovars used were: Copenhageni, Mankanro, Autumnalis, Sejroe, Hardjo, Grippotyphosa, Pomona, Canicola, Australis, Patoc, Wollffi. The sera were initially screened at 1:50 dilution against all the eleven serovars. Any positive sera were further titrated using a two-fold serial dilution of 1:50 to 1:3200 for all the antigens. The reading and the interpretation of the titers was done as described by Carter and Moojen\(^5\) where the end point of 1:100 and over was considered positive.

One hundred and sixty one (49.4%) bovine sera and 196 (54.9%) sheep and goats sera were positive to one or more leptospiral antigens. Of the 161 positive bovine sera 51.0% reacted with only one antigen and 49.0% reacted with two or more antigens. Over 66.4% of the positive sheep and goats sera reacted with one antigen while 33.4% reacted with two or more antigens. Most of the cross-reactions were observed at high titers between two or more members of the closely related serovars of the sejroe serogroups\(^6\) (Table 1).

The prevalence of the leptospiral antibodies observed in cattle (49.4%) and sheep and goats (54.9%) was higher than what has been reported in other parts of Kenya\(^7\). The prevalence and incidence of leptospirosis is dependent on various factors such as rainfall patterns, prevailing humidity, annual temperature ranges and soil pH of the area\(^8\). The area under study has climatic conditions and soil characteristics that are associated with optimal survival rate of the leptospiral organisms\(^9\). This could account for the high prevalence of leptospiral antibodies observed in livestock in this area. It should be noted, however, that some of the farmers in this area vaccinate their cattle with a three-way vaccine containing hardjo, pomona and grippotyphosa serovars. Therefore, it is also possible that some of the positive reactions in the cattle sera were due to antibodies raised in response to the vaccine, since MAT does not differentiate infection titers from vaccination titers\(^10\).

The most prevalent serovars in cattle were wollffi and hardjo while serovar hardjo was the most prevalent in sheep and goats (Table 1). Cattle and sheep are the main maintenance hosts of serovar hardjo\(^11\) and transmission of this
Table 1: Prevalence of leptospiral agglutinins and their titers in cattle, sheep and goats from Nyandarua District of Kenya.

<table>
<thead>
<tr>
<th>Serogroup</th>
<th>Serovar</th>
<th>Species</th>
<th>50</th>
<th>100</th>
<th>Reciprocal titre</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>200</td>
<td>400</td>
<td>800</td>
<td>1600</td>
</tr>
<tr>
<td>Icterohaemorrhagie</td>
<td>Copenhageni</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>mankanro</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Autumnalis</td>
<td>autumnalis</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sejroe</td>
<td>sejroe</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>hardjo</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>woffifi</td>
<td>2</td>
<td>10</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>10</td>
<td>1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Grippotyphosa</td>
<td>grippotyphosa</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pomona</td>
<td>pomona</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Canicola</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Australis</td>
<td>australis</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Semaranga</td>
<td>patoc</td>
<td>2</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>19</td>
<td>12</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>

1 = Cattle, 2 = Sheep and goats, parenthesis = percentage of positive sera.

Serovar may occur between the two species\(^{13}\). In the area of study, it is common to find sheep, goats and cattle being raised together in the same farm. Therefore, cross-transmission is likely to occur between sheep and cattle particularly for serovar hardjo which had high prevalence in all the species. The serovars of patoc and autumnalis had high prevalence rates compared to what has been reported in Kenya\(^{8,9}\). These serovars are mainly associated with rodents\(^{15}\) and so their prevalence could assume high percentage in areas where there are large populations of carrier rodents. Although serovar grippotyphosa has been found to be the main serovar in most of the serological surveys and outbreaks of leptospirosis in Kenya\(^{8,9,10,16,17}\), it showed low prevalence in this area. Infection of livestock with any particular serovar of Leptospira differs from one area to another depending on the type of the maintenance hosts in the area and what serovar they maintain\(^2\). Therefore, it is possible that this area does not have a large population of the maintenance hosts for the serovar grippotyphosa.

The results of this study show that there was a widespread leptospirosis in livestock in Nyandarua district and so isolation and serotyping of the Leptospira should be attempted in order to find the real prevalence of the disease. Since sheep may infect cattle and vice versa with the serovar hardjo, their role in the transmission of infections to cattle should be determined.

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of Kenya, survey of Kenya.


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SHORT COMMUNICATION

LAMBING, KIDDING AND MORTALITY PATTERNS IN THE SUB-SAHELIAN REGION OF NIGERIA: A CASE STUDY

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INTRODUCTION

Sheep and goat production is an important economic activity in Africa contributing 10.9% and 8.4%, respectively of total meat output[1]. Productivity in the traditionally managed flocks is low and characterised by long lambing and kidding intervals, low birth weight, low weight gain, high perinatal mortality and slow maturity[2,3,4,5].

Several factors have been reported to affect mortality in small stock: season and type of birth[6]; length of previous parturition interval[7]; parturition number[8]; birth injuries[9]; weight at birth[10,11]; condition score and udder circumference of dam[12] and disease[13]. Although, it has been reported by some workers[14] that birth weight had no significant effect on mortality, others[11,13,15] found that birth weight can be used reliably to predict survival during the neonatal period. In this paper, the records of a semi-intensively managed farm were scrutinised to assess the performance of sheep and goats in this system in terms of lambing/kidding patterns and level of mortality of lambs and kids.

Records of sheep and goats in a semi-intensively managed farm on the outskirts of Maiduguri were examined between 1985-1987. The average number of mature ewes and does in each flock during the period under review was about seventy with slightly fewer does, while the average numbers of rams and bucks was twenty each. There were also lambs and kids in the flock that were born before and during the period reviewed. All sheep and goats were kept together. No new stock was brought onto the farm during the period recorded, but small numbers of ewes and does were culled. The main offtake was rams and bucks. The animals were routinely treated with anthelmintics and sprayed against ectoparasites. They were grazed on communal pastures for about four hours in the morning and given feed supplements (average of 0.5 kg each) on return from grazing. During the rainy season (June to September) they were also grazed in the afternoon for about three hours and the quantity of supplement given was halved. The supplement consisted of wheat offal (83.5%), molasses (15.1%) and cotton seed cake (1.4%). Mineral salt licks were available throughout the year. They were also given water ad libitum. The animals are housed during inclement weather, but otherwise stay in an open, fenced area at night. The data was analyzed using a spreadsheet programme (Quattro, Borland, UK). The study revealed that 81.5% of all lambs were singles compared with 72.5% of kids. Also 17% and 1.5% of the lambings were twins and triplets respectively while 23.5% and 4% of kiddings were twins and triplets respectively. No quadruplets were recorded for either sheep or goats.

Birth occurred throughout the year in both sheep and goats (Table 1). Average lambing and kidding interval was one year which is rather long. Pooled data for the three years revealed that 17% of parturitions in ewes produced twin lambs and 1.5% triplets, while in goats it was 23.5% and 4% respectively. There were no quadruplets amongst sheep and goats, but a higher proportion of multiple birth in goats than in sheep. Deliberate effort must be made to select for prolificacy to increase small ruminant population. The pooled sex ratios of males to
Table 1: Average (± standard deviation) monthly birth and death of lambs and kids recorded for a farm in the sub-sahelian region of Nigeria between 1985-1987

<table>
<thead>
<tr>
<th>Month</th>
<th>Lambs Birth</th>
<th>Lambs Death</th>
<th>Kids Birth</th>
<th>Kids Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>6.6 ± 2.5</td>
<td>2.2 ± 1.0</td>
<td>6.4 ± 2.5</td>
<td>1.7 ± 0.4</td>
</tr>
<tr>
<td>February</td>
<td>8.6 ± 2.9</td>
<td>4.3 ± 0.4</td>
<td>6.1 ± 2.1</td>
<td>4.1 ± 0.5</td>
</tr>
<tr>
<td>March</td>
<td>3.9 ± 1.4</td>
<td>1.2 ± 0.7</td>
<td>5.7 ± 1.7</td>
<td>1.6 ± 0.4</td>
</tr>
<tr>
<td>April</td>
<td>2.7 ± 0.9</td>
<td>0.8 ± 0.3</td>
<td>5.9 ± 1.6</td>
<td>2.9 ± 1.0</td>
</tr>
<tr>
<td>May</td>
<td>10.3 ± 3.2</td>
<td>2.9 ± 0.9</td>
<td>7.6 ± 2.9</td>
<td>1.9 ± 0.6</td>
</tr>
<tr>
<td>June</td>
<td>7.8 ± 3.1</td>
<td>0.9 ± 0.2</td>
<td>3.8 ± 1.4</td>
<td>0.5 ± 0.3</td>
</tr>
<tr>
<td>July</td>
<td>8.8 ± 3.8</td>
<td>2.7 ± 1.0</td>
<td>5.2 ± 1.5</td>
<td>0.6 ± 0.3</td>
</tr>
<tr>
<td>August</td>
<td>7.9 ± 3.0</td>
<td>2.0 ± 1.1</td>
<td>2.5 ± 1.3</td>
<td>0.9 ± 0.3</td>
</tr>
<tr>
<td>September</td>
<td>5.2 ± 2.2</td>
<td>1.6 ± 0.5</td>
<td>5.5 ± 2.0</td>
<td>1.1 ± 0.9</td>
</tr>
<tr>
<td>October</td>
<td>4.1 ± 1.7</td>
<td>0.0 ± 0.0</td>
<td>6.3 ± 2.2</td>
<td>1.2 ± 1.1</td>
</tr>
<tr>
<td>November</td>
<td>7.5 ± 3.3</td>
<td>1.5 ± 0.4</td>
<td>8.1 ± 3.1</td>
<td>1.7 ± 1.3</td>
</tr>
<tr>
<td>December</td>
<td>6.4 ± 2.7</td>
<td>2.2 ± 1.0</td>
<td>3.3 ± 3.0</td>
<td>0.0 ± 0.0</td>
</tr>
</tbody>
</table>

females for the three years was 1:1:10 for lambs and 1:1.06 for kids. Average birth weight of males (3.1 kg for lambs and 2.9 kg for kids) was higher than in the female (2.6 kg for lambs; 2.2 kg for kids) and singles (average weight of 2.9 kg for lambs and 2.5 kg for kids) were heavier than individual twins (average weight 2.1 kg for lambs and 1.9 kg for kids). The average monthly birth weight of lambs and kids was highest in September to November (Table 1). This corresponded to the period of low mortality in lambs and kids supporting Hoffman et al. The average productivity in sheep was 1.2 lambs per birth and 0.76 lambs per year, while in goats productivity was 1.3 kids per birth and 0.82 kids per year. Niare et al., reported similar findings in sheep in a similar environment.

There was a higher mortality (relative to total birth) in sheep than in goats. When mortality in the first four weeks of life was considered, 50% of lambs died in the first week of life compared to 52.6% for kids. Mortality during day 8-14 accounted for 28.6% of lambs mortality and 28.9% of kid mortality, while mortality for day 15-21 and 22-28 accounted for 12.5% and 8.9% of mortality in lambs respectively and 10.5% and 8% of kid mortality respectively. Mortality was lowest in October in lambs (0%) and in December in kids (0%). Overall lamb and kid mortality was unusually high. This needs to be remedied. In a similar environment involving the Balami and desert Sudanese sheep, season, breed, sex and litter size influenced birth weight, age at weaning and the average daily gain from birth to weaning of lambs (P<0.001). Birth weight was lowest during the dry, hot season (March to May) and the heaviest lambs were born during the rainy season (June-August). Alaku also reported that birth, twinning and survival was highest during the dry cold season (December to February). However in our study, mortality was highest in February.

Higher proportion of multiple birth and lower neonatal mortality suggests that goats were better adapted to survival in this environment. Alaku reported that desert Sudanese sheep imported into this region of Nigeria performed poorer than indigenous Balami sheep and performed less well than in their native environment. Other workers also reported that cross-breeding between Djallonke X Sahelian resulted in reduced prolificacy compared to Djallonke sheep. Therefore a more complete assessment of potentials of sheep and goats in the sahel should go pari passu with such cross-breeding programmes.

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References


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