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

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- Results presented concisely.
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A COMPARISON OF FIELD OUTBREAK OF CAMELPOX AND CAMEL CONTAGIOUS ECTHYMA IN CAMELS (CAMELUS DROMEDARIUS) IN KENYA

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University of Nairobi, Department of Veterinary Pathology and Microbiology
P.O. Box 29053, Nairobi, Kenya

UNE COMPARAISON DES EPIDEMIES DE VARIOLE CAMELINE ET D'ECTHYMA CONTAGIEUX CAMELIN (CAMELUS DROMEDARIS) AU KENYA

Résumé
La variole cameline et l'ecthyma contagieux camelin sont deux maladies différentes mais cliniquement similaires, qui affectent les dromadaires, en particulier les jeunes. Dans une enquête conduite à Turkana et à Samburu sur les deux maladies, on a observé la variole cameline chez deux troupeaux de jeunes dromadaires à Turkana. La variole cameline était également présente chez deux troupeaux de jeunes dromadaires à Samburu et chez deux troupeaux d'adultes dans la même région. Toutefois, l'ecthyma contagieux camelin ne s'était que dans le district de Turkana où de graves épidémies frappaient quatre troupeaux. Les principales lésions observées pour les deux maladies étaient les pustules autour du museau, mais chez les dromadaires adultes, il y avait en plus la tumeur de la tête et du cou à cause de l'infection de la variole cameline.

Il y avait 100% de morbidité dans chaque troupeau affecté. Alors que la variole cameline était associée au sevrage chez les jeunes dromadaires et à un déplacement sur une longue distance chez les adultes, l'ecthyma contagieux camelin était associé en même temps à l'infection de la variole caprine lors des quatre épidémies. On pouvait faire la distinction entre ces deux dernières maladies à l'aide d'un microscope électronique.

Summary
Camelpox and camel contagious ecthyma are two different but clinically similar diseases that affect camels especially when they are young. In an investigation of the two conditions in Turkana and Samburu, camelpox was found in two young herds in Turkana. Camelpox was also found in two herds of young camels in Samburu as well as in two adult herds in the same area. However, camel contagious ecthyma was only found in Turkana District where four herds had serious outbreaks. The main lesions in both conditions were localised on the mouth area as pustules but in addition, there was swelling of the head and neck in adults with camelpox infection.

In each affected herd, there was 100% morbidity. While camelpox was associated with weaning in the young camels and long distance travel in the adults, camel contagious ecthyma was associated with concurrent caprine parapox infection in the four outbreaks. The two latter conditions could be differentiated by electron microscopy.

Introduction
Camel calf mortality is reported to be the most serious problem facing camel husbandry and can at times get to fifty percent\(^1\). Although competition with siblings for the dam's milk is known to be a major factor for such deaths, the role of disease is little understood.

In Kenya, camelpox and camel contagious ecthyma present as cutaneous eruptions around the nose and mouth but while camelpox is caused by an orthopoxvirus, camel contagious ecthyma is caused by a parapox virus\(^2\), similar to a strain which Roslyakov refers to as "Auzduk"\(^3\). The two conditions have however been reported to have very closely resembling and sometimes indistinguishable clinical manifestation\(^4,5,6,7\).

Outbreaks of the two conditions were therefore investigated in Turkana and Samburu, two main camel-rearing areas in Kenya. The prevalence and clinical manifestation were then compared.

Materials and Methods
Epidemiology
The two districts were chosen as they represent two different agro-ecological zones that camels are reared in, that is arid and semi-arid. Turkana
District is an arid district receiving less than 500 mm of poorly scattered rainfall. About 100,000 camels are kept by Turkana pastoralists in herds ranging from 2 to 70 camels per herd. Several distant areas in the district were visited in the dry month of September and 600 camels in 25 herds examined.

Samburu District is a semi-arid area receiving above 500 mm of rainfall. About 66,000 camels are reared by Samburu pastoralists in herds ranging from 2 to 60 camels per herd. The district was visited in the dry month of October and 500 camels in 20 herds examined. The clinical manifestation of both conditions was examined and skin scabs obtained from infected camels and goat kids, while sera were obtained from infected and normal camels.

Electron microscopy
Skin scabs from infected camels and goat kids were ground and re-suspended in a minimum volume of phosphate buffered saline (pH 7.2). A formvar electron microscope grid was floated on a drop of virus suspension for two minutes, removed and blotted with the edge of blotting paper, and placed on a drop of 2% sodium phosphotungstate (pH 6.6). After 90 s, the grid was blotted, air-dried and examined in a Zeiss EM 10 C/R transmission electron microscope operating at 60,000 V.

Cell cultures
Lamb kidney cell cultures were prepared by trypsin dispersion of kidney cortex tissue from healthy foetal lambs. Cell cultures were grown on 5 mm diameter wells (Costar) and 500 ml medical flat bottles in Eagles MEM non-essential amino acids plus 10% foetal calf serum (FCS) and were maintained with medium 199 plus 5% FCS during virus growth.

Virus
Dried scabs were homogenised in cell culture medium using a frozen mortar and the suspension filtered using a milipore filter (22u). The suspension was then inoculated into lamb kidney cells which were then examined for 10 days.

Serology
Neutralising antibody was determined using 96-well microtitre plates (Flow labs). Serial doubling dilutions of test and control sera (50 ul) were prepared in microtitre wells and an equal volume of virus (sheep kidney grown 100 TCID50/ml) added to each well.

After incubation for 1 hour, the reaction mixture was transferred to confluent cell sheets of sheep kidney cells in microtitre plates. After seven days' incubation, cultures were examined microscopically for cytopathic effects. Serum neutralising antibody titres were determined as the reciprocal of the highest dilution showing 50% inhibition of the virus growth. The titres of sick and normal camels were then compared by analysis of variance.

Results
Clinical camelpox was found in two adult herds in Samburu and in four herds of calves, two in Turkana and two in Samburu (Table 1), with a prevalence of 27% in Samburu and 6% in Turkana. Camel contagious ecthyma was only found in calves in four herds in Turkana District, (Table 2) with a prevalence of 33.5% of the examined camels.

<table>
<thead>
<tr>
<th>Table 1: Outbreaks of clinical camelpox</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of camels</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Area</td>
</tr>
<tr>
<td>No. affected</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### Table 2: Positive cases of camel contagious ecthyma in Turkana District

<table>
<thead>
<tr>
<th>Locality</th>
<th>Animals affected</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Camels No. affected</td>
<td>Goats No. affected</td>
<td></td>
</tr>
<tr>
<td>Kakuma</td>
<td>Age (m) 8-12 12/40</td>
<td>EM+ 10/12</td>
<td>18/20</td>
</tr>
<tr>
<td>Kaikoo</td>
<td>8-18 20/60</td>
<td>7/20 5/20</td>
<td>5/5</td>
</tr>
<tr>
<td>Lokori</td>
<td>8-12 30/80</td>
<td>20/30 10/50</td>
<td>7/10</td>
</tr>
<tr>
<td>Lokitaung</td>
<td>6 5-20</td>
<td>5/5 20/80</td>
<td>16/20</td>
</tr>
<tr>
<td>Total</td>
<td>67/200</td>
<td>52/67 55/250</td>
<td>46/55</td>
</tr>
</tbody>
</table>

Note: EM positive—positive by electron microscopy.

Clinically, camelpox-infected camels were found to have discrete pox lesions on the mouth, nose and lips of the calves (Figure 1) but in the affected adults, severe oedema of the head and neck was found in almost all the affected camels (Figure 2). Unlike camelpox as reported in Iran, no generalised rashes were seen. There was mandibular lymph node enlargement in almost all the camels. In all cases, there was 100% morbidity. While the young camels involved in the camelpox outbreaks had recently been weaned, the two adult camel herds had recently been moved; one herd from the Somalia/Kenya border and the other herd from Galana ranch to Samburu, a distance of approximately 1000 km and 700 km respectively by walking on road. The serological response is shown in Table 3. Actively sick camels had significantly higher titres against camelpox virus (p<.05). Electron micrographs revealed brick-shaped virions of approximately 280 x 180 nm (Figure 3).
Table 3: Camelpox neutralising antibody titres.

<table>
<thead>
<tr>
<th></th>
<th>Normal camels</th>
<th>Camelpox-infected camels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Samburu</td>
<td>Turkana</td>
</tr>
<tr>
<td>No. of samples</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Titres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>40</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>80</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>160</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>320</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>640</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>1280</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>2560</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5120</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Infections (Figure 4). The electron micrographs revealed ovoid parapox virus particles approximately 160 x 360 with their surface wrapped by uniformly arranged outer tubules (Figure 5). The lesions were mainly confined to the skin with occasional involvement of the mucocutaneous junction. There was enlargement of the cervical and mandibular lymph nodes in almost all the affected camels.

Figure 3: Electron micrograph of a camelpox virus (x60 000).

Camel contagious ecthyma on the other hand was only found in camel calves less than one year old. The main clinical lesions were brownish pock lesions on the lips, nose and mouth and the lesions were sometimes coalesced and with severe secondary infections (Figure 4). Camel calves from Turkana with pox lesions on the muzzle, lips and nose infected by camel contagious ecthyma virus.

Figure 4: Camel calves from Turkana with pox lesions on the muzzle, lips and nose infected by camel contagious ecthyma virus.
Camel contagious ecthyma was, however, found only in Turkana. It is likely that this is associated with a low moisture index as other parapox infections in sheep and goats are known to be more prevalent during the dry season\textsuperscript{10}. Other camel contagious ecthyma outbreaks have also been reported in the dry season\textsuperscript{6}. Only camel calves had clinical camel contagious infections in Turkana. It is likely that most camels are exposed when young and adult clinical infections may not be common just as in sheep\textsuperscript{10}.

Camelpox and camel contagious ecthyma are reported as having similar clinical signs especially when both are generalised\textsuperscript{2,5}. In this study, only cases of localised camelpox and camel contagious ecthyma were found. Generalised camel contagious ecthyma has been reported in Kenya and involved the legs, thighs and other parts of the bodies\textsuperscript{5}.

Although there were pustules on the lips and muzzle in both camelpox and camel contagious ecthyma cases, those of camelpox were more discrete while those of camel contagious ecthyma tended to coalesce. Camel contagious ecthyma outbreaks also had much more severe secondary infections than camelpox virus outbreaks.

Camelpox was associated with oedema and swelling of the neck in adult camels which were affected. Swelling of the head in camelpox has been reported by other workers\textsuperscript{11}. However, it has also been reported in cases of contagious ecthyma outbreaks\textsuperscript{5}.

It appears that while camelpox is mostly caused by stress, for example weaning or long distance travel, camel contagious ecthyma outbreaks are associated with outbreaks of the parapox virus in either sheep or goats. In the previously reported outbreak of camel contagious ecthyma in Kenya, there was a concurrent outbreak of ovine parapox infection\textsuperscript{5}. Some workers feel that outbreaks of parapox infection in Alpacas and many other animals are of ovine or caprine origin\textsuperscript{10}.

While camelpox has been regularly propagated on many types of cells\textsuperscript{12,13,14}, successful propagation of camel contagious ecthyma has not been reported except in Mongolia where the virus was grown on the...
chorio-allantoic membrane of embryonated chicken eggs. Some reports have also indicated that the virus can be propagated on sheep kidney and produces cytopathic effects and cell death in 48 hours (D. Black, pes. comm.). In this study, propagation of camel contagious ecthyma was not possible. The serological evidence from camelpox virus outbreaks was in agreement with other workers, that camelpox is enzootic in Kenya.

References


Received for publication on 2nd September 1995
A SERO-EPIDEMILOGICAL SURVEY OF INFECTIOUS BOVINE RHINOTRACHEITIS/INFECTIOUS PUSTULO-VULVOVAGINITIS (IBR/IPV) VIRUS AND BRUCELLA ABORTUS IN DAIRY CATTLE HERDS IN TANZANIA

J.M.K. HYERA, A.M. KAPAGA, H.M. MSAMI AND K. SCHOEPF*
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UNE ENQUETE SEROEPIDEMIOLOGIQUE DU VIRUS DE LA RHINOTRACHEITE INFECTIEUSE BOVINE/PUSTULO-VULVOVAGINITE INFECTIEUSE (RIB/PVI) ET DE BRUCELLA ABORTUS CHEZ DES TROUPEAUX DE BETAIL LAITIER EN TANZANIE

Résumé
Une enquête séroépidémiologique a été menée à l’aide du test ELISA (titrage avec immunoadsorbant lié à une enzyme), en vue de comparer la fréquence relative du virus de la rhinotraceïte infectieuse bovine/pustulo-vulvo-vaginite infectieuse (RIB/PVI) à celle de Brucella abortus chez des troupeaux de bétail laitier dans trois régions de la Tanzanie. Le taux de prévalence de RIB/PVI était de 69,1% (832/1204), tandis que celui de Brucella abortus était de 7,2% (87/1204). La fréquence relative de l'incidence de l'infection était donc d'environ 90,5% et 9,5% respectivement pour le virus RIB/PVI et Brucella abortus.

Summary
A sero-epidemiological survey was carried out using enzyme-linked immunosorbent assay (ELISA) in order to compare the relative frequency of infectious bovine rhinotracheitis/infectious pustulo-vulvo-vaginitis (IBR/IPV) virus and Brucella abortus in dairy cattle herds in three regions of Tanzania. The prevalence rate for IBR/IPV was 69,1% (832/1204) while that for Brucella abortus was 7,2% (87/1204). The relative frequency of occurrence of infection was estimated at about 90,5% and 9,5% accordingly for IBR/IPV virus and Brucella abortus.

Introduction
Infectious bovine rhinotracheitis/infectious pustulo-vulvo-vaginitis (IBR/IPV) virus is widespread in cattle and game species of Tanzania1,2 and IBR/IPV virus has been isolated from cattle with clinical manifestation of either respiratory disease or reproductive failures from some areas of Tanzania3,4.

Reproductive failure (abortions/infertility) in dairy cattle herds in Tanzania has been largely attributed to Brucella abortus infections and as such this has to-date been the most extensively investigated cause of reproductive failure in cattle in Tanzania5,6,7,8. Consequently, infection with this pathogen has been reduced substantially in most of the dairy farms by a rigorous policy of serological testing and culling of all seropositive cattle8.

No sero-epidemiological surveys have been conducted in order to compare the relative frequency of infection with IBR/IPV virus and Brucella abortus in dairy cattle herds anywhere in Tanzania. This was one of the aims which stimulated initiation of this survey.

Materials and methods
Sera
Blood samples (n = 1,204) were collected in vacutainer tubes by puncture of the jugular vein of adult dairy cattle in Ruvuma, Coast and Dar es Salaam regions of Tanzania between 1991–1994. After coagulation, sera were harvested, aliquoted in about 1.5 ml amounts in cryotubes and preserved at −20°C until use. Haemolytic sera were clarified by centrifugation at 2,500 rpm for 10 minutes before storage.

Enzyme-linked immunosorbent assay (ELISA)
All sera were tested for specific antibodies to IBR/IPV virus and Brucella abortus by indirect ELISA using the test kits/systems developed by Dr. Bommeli AG (Statonsstrasse 12, CH-3097 Liebefeld – Bern, Switzerland). The substrate

*Federal Institute of Veterinary Investigation, Langer Weg 27, Innsbruck, Australia.
used is both ELISA systems was ABTS (2'-azino-di (3-ethyl benzothiolin sulfone - 6)).

The conjugate was a commercial antiruminant IgG monoclonal antibody labelled with horseradish peroxidase. Results of the assays were read photometrically using a standard ELISA reader (Fa Anthos—labtec, Jakob Heringlestrasse 8, Salzburg, Austria) at an absorbency wavelength of 405 nm.

**Results and discussion**

Tables 1 and 2 give the infection rates of IBR/IPV virus and *Brucella abortus* in three regions of Tanzania surveyed between 1991 and 1994. Overall, antibody prevalence rates of 69.1% and 7.2% have been established in the three regions respectively for IBR/IPV virus and *Brucella abortus*. The prevalence rates varied from one region to another; the percentage of seropositive reactors to IBR/IPV virus in any of the regions surveyed was comparatively higher than that to *Brucella abortus* (Tables 1, 2). The relative frequency of occurrence of infection with either of the two types of pathogens is estimated at about 90.5 and 9.5% for IBR/IPV virus and *Brucella abortus* respectively (Table 3). These findings indicate that infection with IBR/IPV virus are more common and might, perhaps, be occurring more frequently than those with *Brucella abortus*.

**Table 2:** Prevalence of antibodies against *Brucella abortus* virus in dairy cattle sera sampled from some regions of Tanzania between 1991—1994.

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of sera tested (n)</th>
<th>Number of sera positive</th>
<th>Prevalence (%) ± SE²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruvuma</td>
<td>321</td>
<td>45</td>
<td>14.0 ± 1.94</td>
</tr>
<tr>
<td>Coast</td>
<td>562</td>
<td>27</td>
<td>4.8 ± 0.90</td>
</tr>
<tr>
<td>Dar es Salaam</td>
<td>321</td>
<td>15</td>
<td>4.7 ± 1.18</td>
</tr>
</tbody>
</table>

¹Sera tested using indirect ELISA (Brucellosis ELISA-System: Dr. Bommeili AG., Bern, Switzerland)
²Standard error

**Table 3:** Relative frequency of occurrence of infection with IBR/IPV virus and *Brucella abortus* as determined in a simultaneous sero-survey of 1,004 dairy cattle sera sampled from some regions of Tanzania between 1991—1994.

<table>
<thead>
<tr>
<th>Type of infection</th>
<th>Number of sera positive</th>
<th>Relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBR/IPV</td>
<td>832</td>
<td>90.53</td>
</tr>
<tr>
<td><em>Brucella abortus</em></td>
<td>87</td>
<td>9.47</td>
</tr>
</tbody>
</table>

¹Sera tested using indirect ELISA (ELISA test-kits/system: Dr. Bommeili AG., Bern, Switzerland)

Vaccination programmes against *Brucella abortus* in dairy cattle farms are in practice in Tanzania. However, the farms covered in this survey have not been under such programmes for almost ten years now, mainly due to lack of vaccine. Immunisation programmes against IBR/IPV virus are in contrast not in practice in this country. Therefore, the antibodies detected in cattle in this sero-epidemiological survey indicate most probably natural field exposure to either IBR/IPV virus or *Brucella abortus*.

There is, however, only one authentic report of clinical field outbreak of IBR/IPV in cattle in Tanzania. This outbreak occurred in 1972 at an artificial insemination centre, in central Tanzania and from there spread to many other parts of the country via semen consignments. The disease syndrome was manifested as vulvo-vaginitis and balano-prostitis respectively in heifers/cows and bulls. Virological investigations confirmed implication of IBR/IPV virus.
Many syndromes like abortions and other forms of reproductive failures are known to occur in cattle in Tanzania\textsuperscript{2,9}. Laboratory investigations of such syndromes have however, been directed mainly towards \textit{Brucella abortus}\textsuperscript{5,6,7,8}. Therefore, a lot of epidemiological data has since then been collected on this pathogen and this has facilitated, to a large extent, the formulation of appropriate and effective control measures of \textit{Brucella abortus} infection in most dairy farms in Tanzania\textsuperscript{9}; It is, perhaps, on this ground that the infection rates with \textit{Brucella abortus} are now seemingly lower than the infection rates with IBR/IPV virus (Tables 1, 2).

Little or no virological investigations at all have, on the other hand, been conducted in such syndromes. In view of this discrepancy, it is possible that IBR/IPV virus might also have played a role in these syndromes. Further investigations are therefore needed to explore and evaluate the clinical significance of IBR/IPV virus in relation to \textit{Brucella abortus} in dairy cattle herds in Tanzania.

\textbf{Acknowledgements}

Particular acknowledgements go to Mrs. M. Speckbacher, Mr. J. Mlay and Miss C. A. Mrope for their excellent technical assistance. This work was supported by the Government of the Federal Republic of Austria under a bilateral Technical Co-operation Assistance Project No. 1186 which was executed jointly with the Government of the United Republic of Tanzania.

\textbf{References}

INFEKTIOUS BRONCHITIS VIRUS ASSOCIATED WITH DISEASE OUTBREAKS IN KHARTOUM

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LE VIRUS DE LA BRONCHITE INFECTIEUSE ASSOCIEE A UNE RECRUDESCENCE DE MALADIE A KHARTOUM

Résumé
Il y a eu recrudescence d'une grave maladie respiratoire, provoquant des pertes considérables chez des bandes de poulets de gnl dans trois fermes d'Etat à Khartoum. Le virus de la bronchite infectieuse (VBI) a été isolé des suspensions de trachée et de poumon des poulets infectés, des embryons de poulet, des cultures cellulaires de rein de poulet et des cultures de l'organe trachéal. Selon les résultats de la sérologie, de la nécropsie et de l'histopathologie, l'épidémie était due à VBI.

Summary
Outbreaks of a severe respiratory disease causing appreciable losses among broiler flocks occurred on three farms in Khartoum State. Infectious bronchitis virus (IBV) was isolated from tracheal and lung suspensions from infected birds in developing chick embryos, chick kidney cell cultures and tracheal organ cultures. Serological, necropsy and histopathological findings were suggestive of the disease outbreaks being caused by IBV.

Introduction
Infectious bronchitis virus (IBV), a coronavirus is often associated with respiratory disease and production problems in chicken flocks. The disease was first reported in 1931 from U.A.S.1 and has since assumed worldwide distribution and prominence. The significance of the disease and its adverse effect on egg production and quality have been reported. Appreciable losses among broilers, retardation of growth and high mortality of baby chicks have also been recognised. In the Sudan, apart from a virus isolation report4 no record is as yet available of any investigation having been made into the role of IBV in poultry disease. This communication records the isolation of an IBV associated with respiratory disease outbreaks in poultry in Khartoum as part of this investigation.

Materials and methods

Disease outbreaks
During February, 1993 coinciding with winter outbreaks of a severe respiratory disease occurred in broiler flocks on two neighbouring farms at Shambat as well as the Quds farm of Soba West, which is widely separated from the Shambat farms. Some 3000 birds were involved on the Shambat farms. These were introduced as day-old chicks vaccinated against infectious bursal disease but not IB. When the outbreaks occurred the birds were 47 days old. The main clinical manifestations included dyspnoea, coughing, sneezing gasping and tracheal rales. High morbidity and mortality rates with losses averaging 33.3% were recorded, with little or no response to antibiotics treatment among sick birds.

Collection of samples

Pieces of lungs and tracheas were aseptically removed from sick or dying birds for virus isolation. These were made into 10% suspension (W/V) in phosphate buffered saline to which drops of antibiotics and fungizone mixture were added compromising 100 I.U. penicillin, 100 mg. streptomycin and 50 units fungizone/ml. The suspensions were designated Sh.T., Sh.L2, Qu.T and Qu.L where Sh. T, and Sh. L stand for Shambat Farm 1 and Shambat Farm 2 tracheal
and lung suspensions, respectively, while Qu.T and Qu.L refer to tracheal and lung suspensions from Quds Farm, respectively. All suspensions were stored at -20°C until used for virus isolation. A total of 85 serum samples collected from sick birds at Shambat were likewise kept at -20°C until tested.

Positive antigens and antisera
Commercial IBV haemagglutination-inhibition (HI) antigens and IBV antisera were kindly supplied in lyophilised form by Coral Hatcheries and Feed Production Farms, Khartoum.

Virus isolation attempts
(a) In embryonating chicken eggs: Ten to Eleven days old chick embryos were used. These were inoculated with 0.1 ml of Sh.T, Sh.L, and Qu.L suspensions via the allantoic cavity. Five serial passages were conducted before any specimen was scored negative.

(b) In cell culture: Primary chick kidney cell (CKC) cultures prepared according to Purchase were inoculated with tracheal and lung suspensions and examined daily for cytopathic effect (CPE).

(c) In tracheal organ culture: Tracheal organ cultures (TOC) were prepared after Johnson et al. Ten-fold dilutions of tracheal and lung suspensions were made in maintenance medium. Cultures were inoculated with 0.1 ml of the corresponding sample dilution, incubated in roller drums at 37°C and examined daily five days for evidence of ciliostasis.

Serology
The HI test was applied as described by Alexander et al. for the serological identification of isolated virus using positive IBV serum. A positive control system was maintained for comparison. The test was further extended to include testing of 85 serum samples from Shambat outbreaks for antibody. A baseline of 6 log₂ was adopted in all HI assays.

Necropsy
Birds from sick flocks showing typical manifestations were sacrificed and subjected to post-mortem examination. The lesson were recorded.

Histopathology
Infected tracheal rings from TOC were aseptically removed from tube cultures, fixed in 10% formalin, embedded in paraffin wax and made into 6μm sections. Section preparations were stained with Haematoxylin and Eosin (H&E) and examined.

Results

Virus isolation
(a) Embryonating chicken eggs: Inoculated embryos showed sluggish movement. The first passage revealed dwarfed and curled embryos. In subsequent passages embryos manifested stunted growth, curling, dwarfism and death. Uninoculated embryos showed normal growth.

(b) Cell cultures: Forty-eight hours postinoculation of CKC cultures rounding and detachment of cells were observed in wet CPE (Fig. 1b). Stained CPE preparations revealed marked syncytia containing scores of nuclei (Fig. 2b).

Figure 1a: Normal uninoculated chick kidney cell (CKC) culture.
Tracheal organ cultures: Variable degrees of ciliary activity were observed. Controls showed full ciliary activity. Partial ciliary activity was observed 2 days postinoculation, whereas complete ciliostasis was recorded 5 days postinoculation.

Serology
Haemagglutination activity of an antigen prepared from the virus isolate was inhibited by positive IBV serum at a significantly high titre of $12 \log_2$. Of the sera tested, 12 of 15 (80%) from Shambat Farm 1 and 58 of 70 (82.8%) from Shambat Farm 2 were positive at titres ranging between $6 \log_2$ and $11 \log_2$.

Necropsy
The postmortem examination of infected birds revealed caseous exudate in the tracheas and nasal pasages. The air sacs were cloudy and inflammatory areas were seen on the lungs and around the bronchi.

Histopathology
The epithelial cells lining the mucous membranes of the trachea showed marked hyperplasia and vacuolation (Fig. 3).

Discussion
The overall epizootiological picture of the reported disease outbreaks was highly
suggestive of IB. This was confirmed by laboratory methods including virus isolation and identification as well as serological and histopathological findings. Virus was isolated from organ suspensions in embryonated eggs, CKC culture and tracheal organ culture.

Inoculated chick embryos showed sluggish movement, curled embryos, stunted growth and death. This is consistent with other reports. The CPE in CKC culture coincides with reported findings. However, in contrast to reports claiming impracticability of cell culture for primary isolation of IBV, CKC has been found convenient for this purpose. Furthermore, tracheal organ cultures revealed partial ciliary movement, followed by complete ciliostasis, thus demonstrating the ciliostatic property of IBV. Based on these findings, it was concluded that the respiratory disease outbreaks were caused by IBV.

Acknowledgements

We are grateful to the Coral Poultry and Feed Production Farms, Khartoum for provision of fertile eggs and standard antigens and antisera. Special thanks are extended to our colleague Dr. Zakiza Abbas for assistance with histopathology. Thanks are also due to the Director of Veterinary Research Laboratories for encouragement and the Under-Secretary, Animal Resources for permission to publish.

References


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SEROEPIDEMIOLOGICAL SURVEY OF INTESTIOUS BRONCHITIS VIRUS
IN THE SUDAN

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ENQUETE SEROEPIDEMIOLOGIQUE DU VIRUS DE LA BRONCHITE INFECTIEUSE
AU SOUDAN

Résumé
Dans une tentative d'évaluer l'incidence et la virulence du virus de la bronchite infectieuse (VBI) au Soudan, on a examiné des sérums préllevés des bandes de poulets de différentes parties du pays, en vue de détecker les anticorps antivirus. Sur les 1,063 sérums examinés à l'aide du test de précipitation du gel d'agar (test PGA), 414 (38,9%) étaient positifs, ce qui montre qu'il y a eu infection auparavant et qu'il existe une large répartition du virus. Dans une étude comparative limitée, 346 prélèvements de sérum étaient en même temps examinés à l'aide du test d'inhibition de l'hémagglutination (test HI) et du test PGA. On a obtenu des taux positifs plus élevés avec HI (65,3%) que avec PGA (46,5%), ce qui prouve que le test HI est plus efficace que le test PGA pour le sérodiagnostic de la bronchite infectieuse.

Summary
In an attempt to assess the incidence and magnitude of infectious bronchitis virus (IBV) in the Sudan, serum samples representing chicken flocks from various parts of the country were examined for virus antibodies. Of 1063 sera tested in the agar gel precipitation (AGP) test, 414 (38.9%) were positive suggesting previous exposure and wide distribution of the virus. In a limited comparative study 346 serum samples were tested simultaneously in the hemagglutination-inhibition (HI) and AGP tests. Much higher positive rates (65.3%) were obtained with HI than AGP test (46.5%), suggesting that the HI test is superior to the AGP test for IB serodiagnosis.

Introduction
Avian infectious bronchitis virus (IBV), the type species of the family Coronaviridae, is one of the principal causes of respiratory disease and egg production problems in chicken flocks around the world. Infectious bronchitis (IB) is of particular significance economically to the poultry industry. The disease was first reported in 1931 from North Dakota, U.S.A. and has since gained worldwide distribution and prominence. In the Sudan an isolated report of virus isolation exists, but no study has as yet been undertaken to fully assess the role of IBV in poultry disease despite the growing expansion of poultry farming. This paper attempts to assess the status and significance of IB in the Sudan.

Materials and methods

Antigens
Commercial IBV antigens for the AGP and HI tests were kindly supplied in lyophilised form by Coral Hatcheries and Feed Production Farms in Khartoum. The HI antigens consisted of M41 HI/HAR±1.50 antigen PHI-Doorn-GVP and IBV D1466Ag ±1.50, BA 668-672. Limited quantities of the HI and AGP antigens were also prepared locally in the Central Veterinary Research Laboratories. The HI antigen was prepared according to Alexander and Chettle, while the AGP antigen was prepared as charioallantoic membrane suspension.

Antisera
Positive standard sera of known titres were kindly supplied in lyophilised form by Coral Hatcheries and Feed Production Farms, Khartoum, consisting of HIB M41 serum, HI

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titres ± 7/8 and PHI-Doorn-GVP antiserum D14 HI, B:0892-692009.

Test sera
Random blood samples were collected in sterile bottles from the wing or jugular veins of 1063 apparently healthy chickens from different localities of the Sudan including foreign and local fowls. Of these 231 sera came from local fowls. Sera were separated, decanted and stored at −20°C until tested.

Serum testing
A total of 1063 serum samples were screened for IBV antibodies in the AGP test according to Woerrel. The HI test was applied after Alexander et al. in Titerlab microtitre plates (Flow Laboratories, U.S.A.) with U-shaped wells using 0.025 ml microdiluters and micropipettes. Of the 1063 samples, 346 sera were screened simultaneously in both the AGP and HI tests.

Results
The results of testing poultry sera in the AGP test are presented in Table 1. Of 1063 sera tested, 414 (38.9%) were positive. The highest positive rate (60%) was recorded at Coral Farms and Shambat Private Farm 1, followed by Omdurman Abattoir (56%) and Shambat Private Farm 2 (54.3%). The lowest positive rate (17%) came from Halfaya. All 18 sera from Tambool were negative.

Table 2 shows the results of testing local fowls' sera. Of sera examined, 103 were positive with an overall positive rate of 44.5%. The highest positive rate (68%) was recorded in El Obeid, followed by Omdurman Abattoir (67%), then Atbara (38.6%) and Khartoum North (38.5%). The lowest positive rate (10%) was recorded at Halfaya. Again, none of the 18 sera from Tambool was positive.

For the HI test, a baseline of 6 log₆ was adopted throughout. The comparative results of the HI and AGP tests are presented in Table 3. The 346 sera tested showed an overall positive rate of 65.3% in the HI test compared to 46.5% in the AGP test. The highest positive rate (82.8%) was recorded in the HI test compared to 71% in the AGP test.

### Table 1: Results of testing poultry sera from various parts of the Sudan for IBV precipitating antibodies.

<table>
<thead>
<tr>
<th>Serum origin</th>
<th>No. tested</th>
<th>No. positive</th>
<th>Positive %</th>
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</thead>
<tbody>
<tr>
<td>Coral farms</td>
<td>55</td>
<td>33</td>
<td>60</td>
</tr>
<tr>
<td>African poultry company</td>
<td>70</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>Shambat Private Farm 1</td>
<td>15</td>
<td>09</td>
<td>60</td>
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<tr>
<td>Shambat Private Farm 2</td>
<td>70</td>
<td>38</td>
<td>54.3</td>
</tr>
<tr>
<td>Khartoum North Abattoir</td>
<td>235</td>
<td>84</td>
<td>35.7</td>
</tr>
<tr>
<td>Halfaya Private Farm</td>
<td>109</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>Omdurman Abattoir</td>
<td>182</td>
<td>102</td>
<td>56</td>
</tr>
<tr>
<td>Tambool</td>
<td>36</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>El Obeid Lab. Farm</td>
<td>70</td>
<td>32</td>
<td>45.7</td>
</tr>
<tr>
<td>Atbara</td>
<td>187</td>
<td>68</td>
<td>36.4</td>
</tr>
<tr>
<td>Kassala Government Farm</td>
<td>34</td>
<td>15</td>
<td>44</td>
</tr>
<tr>
<td>Total</td>
<td>1063</td>
<td>414</td>
<td>38.9</td>
</tr>
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</table>
Table 2: Results of testing local fowls' sera for IBV precipitating antibodies.

<table>
<thead>
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<th>Serum origin</th>
<th>No. tested</th>
<th>No. positive</th>
<th>Positive %</th>
</tr>
</thead>
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<tr>
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<td>13</td>
<td>5</td>
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<td>67</td>
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<tr>
<td>Tambool</td>
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<td>0</td>
</tr>
<tr>
<td>El Obeid</td>
<td>22</td>
<td>15</td>
<td>68</td>
</tr>
<tr>
<td>Atbara</td>
<td>88</td>
<td>34</td>
<td>38.6</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>231</strong></td>
<td><strong>103</strong></td>
<td><strong>44.5</strong></td>
</tr>
</tbody>
</table>

Table 3: Comparative results of testing poultry sera for IBV HI and AGP antibodies.

<table>
<thead>
<tr>
<th>Serum Origin</th>
<th>No. sera tested</th>
<th>HI test</th>
<th>AGP test</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>No. positive</td>
<td>Positive %</td>
<td>No. positive</td>
</tr>
<tr>
<td>Coral farms</td>
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<td>62.9</td>
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<td>African Poultry Company</td>
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<tr>
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<td>El Obeid</td>
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<td>57</td>
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<td>9</td>
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<tr>
<td>Kassala</td>
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<td>22</td>
<td>64.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>346</strong></td>
<td><strong>226</strong></td>
<td><strong>65.3</strong></td>
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</table>

Discussion

The advantage of the AGP test has been shown to be in its group-specificity for different IBV strain. Hence this test was used for screening 1063 chicken sera from various parts of the Sudan for IBV antibodies. Significant numbers of sera were positive indicating previous exposure to IBV. Of the numbers tested, 25 sera came from vaccinated flocks all of which showed significant positive rates suggesting high vaccination efficiency. A total of 414 sera were positive with an overall positive rate of 38.9%. The highest positive rate (60%) was recorded at Coral farms and Shambat Farm 1, the latter having witnessed a disease outbreak that was later diagnosed to be due to IBV and which occurred while the serosurveillance was being conducted. This was followed by positive rates of 56% and 54.3% from Omdurman Abattoir and Shambat Private Farm 2 respectively, the latter having also witnessed the same IBV disease outbreak. The lowest positive rate (17%) was recorded at Halfaya indicating that the screened birds had experienced less frequent exposure to IBV. All sera from Tambool were negative suggesting that IB probably did not exist in that area.

Of 231 sera from local fowls tested in the AGP test 103 were positive (44.5%). The highest positive rate (68%) was recorded in El Obeid,
followed by Omdurman Abattoir (67%) then Atbara (38.6%) and Khartoum North (38.5%). The lowest positive rate (10%) was recorded at Halfaya. Again all sera from Tambool were negative. These results indicated that local fowls had experienced previous infection with IBV though no clinical disease has so far been reported among them. Since no vaccination against IB is generally practised in the Sudan, the overall results are taken to be indicative of widespread infection.

The HI test has been demonstrated to be type-specific for IBV\(^7\). The value of this test for the diagnosis of IBV infection and monitoring the vaccinal status of flocks has also been established\(^8\). However, due to limited quantities of reference antigen and antisera it was impossible to apply this test for all sera. Hence, 346 sera were examined simultaneously for IBV antibodies in both the HI and AGP tests, which allowed comparison of the sensitivity of the two tests for serodiagnosis. The HI test revealed an overall positive rate of 65.3% compared to 46.5% in the AGP test. The highest positive rate (82.8%) was recorded in the HI test compared to 71% in the AGP test. Serum samples from vaccinated birds showed high HI titres indicating high vaccination efficiency. Generally sera from all localities except El Obeid revealed higher HI than AGP positive rates. It may be that in El Obeid this was due to a long-standing infection that the AGP test is more likely to detect. It is concluded that the HI test is more sensitive than the AGP test in detecting IBV antibodies, and also being more rapid, the HI test is superior to the AGP test for serodiagnosis of IBV infection.

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We wish to thank the Coral Poultry and Feed Production Farms formally headed by the late Dr. Hassa El Rasoul Haj Suleiman for provision of standard antigen and antisera. Special thanks are extended to the Director, Veterinary Research Laboratories for encouragement and the Under-Secretary, Animal Resources for permission to publish.

**References**


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STUDIES ON THE LACK OF RINDERPEST VIRUS PERSISTING IN NORTH TANZANIA

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ENQUETES SUR L'ABSENCE DU VIRUS DE LA PESTE BOVINE DANS LE NORD DE LA TANZANIE

Résumé
Des prélèvements d'un échantillon de 2,194 veaux choisis au hasard, âgés de 1½−2 ans et mis bas hors de la période de vaccination, et 1,894 prélèvements de séums de moutons et de chèvres ont été recueillis de 53 villages dans le district de Musoma. Les prélèvements étaient examinés à l'aide du test ELISA en utilisant les anticorps monoclonaux spécifiques antivirus de la peste bovine. Selon les résultats, la prévalence moyenne des anticorps antivirus de la peste bovine chez les veaux-sentinelles était de 1,23 ± 0,025%, ce qui ne paraît pas important du point de vue épidémiologique. Seuls deux prélèvements, dont l’un extrait d’un mouton et l’autre d’une chèvre, étaient positifs pour les anticorps antivirus de la peste bovine. Ces résultats montrent encore une fois qu’aucune souche virulente de virus de la peste bovine n’est présente en Tanzanie. La souche éventuelle de prélèvements positifs et leurs conséquences sur le programme d’éradication de la peste bovine sont discutées et il a été conclu que les possibilités pour les petits ruminants de contracter le virus du vaccin contre la peste bovine sont minimes.

Summary
A random sample of 2,194 young calves 1½−2 years of age born outside the vaccination period, and 1,894 samples from sheep and goats were collected from 53 villages in Musoma District. The samples were assayed by the competitive ELISA using rinderpest virus specific monoclonal antibodies. Results showed that the mean prevalence of rinderpest virus antibodies in the sentinel calves was 1.23 ± 0.025%, which is not considered epidemiologically significant. There were only two samples; one from a sheep and the other from a goat which were positive for rinderpest virus antibodies. These results provide additional proof that no strain of rinderpest virus is actively circulating in Tanzania. The possible source of positive samples and their significance in rinderpest eradication programmes is discussed and it is concluded that chances for small ruminants picking up rinderpest vaccine virus are very rare.

Introduction
Although the last clinical suspect cases of rinderpest in Tanzania occurred almost ten years ago (Anon 1983) the source of the virus has never been determined. Rositer et al., (1983b) originally brought up the contention that strains of mild rinderpest virus which persist in an unrecognised form for months or even years in a cycle which includes wildlife could become a source of atypical rinderpest infection in domestic animals. Investigations carried out by the Pan African Rinderpest Campaign (PARC) research contract group (PARC 1989) found no evidence for maintenance of virus in wildlife and they proposed that cattle act as a reservoir of rinderpest virus and that small ruminants and wildlife get infected from cattle. Inter-species transmission of rinderpest virus between cattle and small ruminants is known to occur (Macadam 1968). In a serological survey of small ruminants (Anderson et al., 1991) rinderpest virus antibodies were detected in many areas of North Tanzania. However, these were generally too low to have any epidemiological significance except in Musoma District where up to 12.5 positive samples were recorded. This paper presents results of a more comprehensive serological survey using unvaccinated cattle and small ruminants as sentinel for detecting any circulating virus in Musoma District.

Materials and Methods
Source of sentinel animals
Musoma District in Mara region carried out last vaccinations in 1990. This study was carried out
in 1993, i.e. more than 2 years after the last vaccination. Animals born within this period were considered suitable for use as sentinel animals for detecting any circulating virus. Sheep and goats which are usually not vaccinated during rinderpest campaigns were also sampled to provide additional information.

Sampling frame
The sample frame was based on a cluster model with a "cattle-keeping village" (Loretu 1990) as an epidemiological unit. Based on the 1984 Tanzania Livestock Census, and supported by data collected directly from field staff, Musoma District had 97 cattle-keeping villages, but some of them lie too close to Serengeti District which had carried out rinderpest vaccinations recently. A prevalence of about 10% was assumed and some 53 villages were randomly selected for the survey based on Canon and Row (1982) manual.

Sampling techniques
From each of the selected villages, the sampling team listed the farmers names and randomly selected 4–6 names by the standard "hat selection method". Each selected farmer was asked to present all calves which were 1.5–2 years of age. The sampling team then confirmed the age by dental examination before collecting blood samples for serum. At least 8 animals were sampled from each farmer or from the neighbouring farm if the latter did not have enough young animals. At the same time, the selected farmers also provided sheep and goats for serum sample collection. Each farmer provided at least 4 sheep and 4 goats for sampling.

Serum assay
The analysis of samples for rinderpest virus antibodies was carried out by the competitive enzyme immunoassay method (C-ELISA). The reagents where purchased from the FAO World Reference Laboratory for Rinderpest, at the Institute of Animal Health, Pirbright, U.K. (FAO/IAEA, 1991). The C-ELISA employs a rinderpest virus specific monoclonal antibody and does not cross-react with Peste des Petits Ruminants (PPR).

Results and Discussion
The present survey takes advantage of the cessation of vaccination in Musoma District for more than two consecutive years. This permitted the use of animals 1.5–2 years of age as sentinels for the detection of any circulating rinderpest virus. The expectations were that no positive samples would be detected. Figure 1 shows the map location of the sampled villages and Table 1 shows the results of the positive bovine samples when assayed for rinderpest virus antibodies. A total of 2,195 samples were collected from 53 villages and results showed that 27 samples or 1.230 ± 0.003% were positive for rinderpest virus antibodies. The positive samples were detected in 18 villages (Table 1), but the prevalence appears to be very low.

Figure 1: A sketch map of Musoma District showing sampled villages
Table 1: Village source and frequency of positive bovine samples.

<table>
<thead>
<tr>
<th>Ser. no.</th>
<th>Map 10 ref</th>
<th>Village name</th>
<th>No. tested</th>
<th>No. positive</th>
<th>% positive</th>
</tr>
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<td>13</td>
<td>Buhemba DM</td>
<td>27</td>
<td>2</td>
<td>7.4</td>
</tr>
<tr>
<td>2</td>
<td>37</td>
<td>Kamgesi</td>
<td>32</td>
<td>2</td>
<td>6.2</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>Nyakiswa</td>
<td>50</td>
<td>2</td>
<td>4.0</td>
</tr>
<tr>
<td>4</td>
<td>48</td>
<td>Bisumbwa</td>
<td>54</td>
<td>1</td>
<td>1.8</td>
</tr>
<tr>
<td>5</td>
<td>51</td>
<td>Nyamkanga</td>
<td>20</td>
<td>1</td>
<td>5.0</td>
</tr>
<tr>
<td>6</td>
<td>66</td>
<td>Bwai/Kamsoma</td>
<td>47</td>
<td>2</td>
<td>4.2</td>
</tr>
<tr>
<td>7</td>
<td>90</td>
<td>Katano</td>
<td>50</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>8</td>
<td>88</td>
<td>Sugutu</td>
<td>39</td>
<td>2</td>
<td>5.1</td>
</tr>
<tr>
<td>9</td>
<td>77</td>
<td>Bugoji</td>
<td>43</td>
<td>2</td>
<td>4.6</td>
</tr>
<tr>
<td>10</td>
<td>85</td>
<td>Kasoma</td>
<td>44</td>
<td>3</td>
<td>6.8</td>
</tr>
<tr>
<td>11</td>
<td>86</td>
<td>Mikuyu</td>
<td>58</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>12</td>
<td>84</td>
<td>Chiruwe</td>
<td>48</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>13</td>
<td>89</td>
<td>Wanyere</td>
<td>51</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>14</td>
<td>65</td>
<td>Kome</td>
<td>47</td>
<td>1</td>
<td>2.1</td>
</tr>
<tr>
<td>15</td>
<td>60</td>
<td>Makojo</td>
<td>36</td>
<td>2</td>
<td>5.5</td>
</tr>
<tr>
<td>16</td>
<td>63</td>
<td>Masungu</td>
<td>40</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>17</td>
<td>61</td>
<td>Bugunda</td>
<td>45</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>18</td>
<td>58</td>
<td>Chimali</td>
<td>49</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>780</td>
<td>27</td>
<td>3.4</td>
</tr>
</tbody>
</table>

The positive samples can arise from various sources. One possible source is in the error associated with age estimation. Although all efforts were made to ensure that only animals in the age group 1.5–2 years were sampled, some error of age estimation by dental formula cannot be excluded especially when dealing with mixed breeds. It is also possible that some of the positive animals might have moved from districts where vaccinations had been carried out recently.

Sheep and goats are usually not included in the vaccination campaigns thus making the use of these animals as sentinels more appropriate. A total of 1894 samples were collected from the same 53 villages where bovine samples were collected. Results of rinderpest virus antibody assay showed that only two samples (0.001%) were positive. This rate of prevalence is very low and provides further support for the conclusion made using bovine samples. In their survey using small ruminants, Anderson et al. (1991) also detected low (less than 5%) positive samples in most of the areas surveyed in North Tanzania except in Musoma District where up to 12.5% prevalence was recorded. In the present more comprehensive survey of Musoma District only one sheep sample from Wanyere Village (Figure 189), and one goat sample from Bukumi Village (Figure 156) were positive. In our previous survey in central Tanzania (Loretu and Majuva 1992) using the same model and unvaccinated animals as sentinels, a prevalence of 2.2% positive was detected. Out of 180 serum samples collected early this year from 6 villages in Loliondo area bordering Kenya from young (1.5–2 years) unvaccinated cattle, only 12 or 6% were found positive for rinderpest virus antibodies. This low frequency again provides no evidence for a smouldering rinderpest infection. The net conclusion from these results is that it is very unlikely that a mild rinderpest virus is circulating in Tanzania.

Although the very low frequency of rinderpest antibodies detected in absence of clinical disease may not have epidemiological
significance, the source of such antibodies warrants some speculation. This is particularly important in rinderpest eradication programmes. Apart from errors which cannot completely be excluded from the detection system employed, the use of live virus usually makes recognition of the disease and eradication more difficult. The Kabete "O" vaccine strain used in North Tanzania for many years is genetically stable and has lost its pathogenicity by contact. We have attempted to induce serological response in small ruminants (n = 12) by feeding them with vaccine virus contaminated feed without success. Sheep and goats which were once kept with cattle which were vaccinated with live rinderpest virus all remained negative for rinderpest virus antibodies. It appears therefore that seroconversion in small ruminants originating from virus vaccine occurs very rarely, if at all.

Acknowledgement

I greatly acknowledge the efforts by the Mara Regional Veterinary staff, especially Dr. S.C.M. Wamaheri in sample collection, and Mr. G. Joshua for assisting in testing the samples. This work was financed by the Ministry of Agriculture, Tanzania under the Pan-African Rinderpest Campaign Project, and I thank the Project Coordinator Dr. P. Majuva and his Technical Assistant Dr. R. Vand-Den Ende for their moral and financial support.

References

TICKS COLLECTED FROM INDIGENOUS GOATS IN GABORONE, BOTSWANA

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TIQUES RECUEILLIES DES CHEVRES LOCALES A GABORONE AU BOTSWANA

Résumé
Au total, 2.592 tiques ixodes ont été recueillies de 396/802 chèvres locales dans des villages situés aux alentours de Gaborone en été pendant la période des pluies de décembre 1993 à février 1994. Ceci a entraîné un taux d’infestation de 49,4% et une charge parasitaire moyenne de 6,5 tiques/chèvre. On a trouvé cinq espèces de tique, parmi lesquelles Rhipicephalus evertsi evertsi était la plus abondante, soit 68,6%, suivi de Boophilus decoloratus (16,42%) et de Amblyomma hebraeum (11,69%).

Summary
A total of 2,582 ixodid ticks were picked from 396 out of 802 indigenous goats in villages around Gaborone in the summer rainfal months of December 1993 to February 1994. This gave an infestation rate of 49.4% and a mean of 6.5 ticks per goat. Five tick species were found and Rhipicephalus evertsi evertsi was the most abundant and accounted for 68.66% followed by Boophilus decoloratus (16.42%) and Amblyomma hebraeum (11.69%).

Introduction
Ticks are small blood-sucking ecto-parasites of animals and are deleterious to livestock production for they suck blood, causing anaemia and can act as vectors for infectious diseases such as heartwater and anaplasmosis. In Botswana, most households keep goats as a source of milk and meat and also cash when sold. The national goat flock currently numbers 2,092,000 goats despite the severe drought of 1983 to 1988 and 1992. Most of these goats are kept under a communal system of management but there is need to develop commercial goat production.

The purpose of this study was to find the type of ticks that occur on indigenous goats in some villages around Gaborone, Botswana, as well as to determine the infestation rate of ticks on goats in these villages.

Materials and Methods
The survey was conducted on five villages within a radius of 20 km from Gaborone. The goats were of the local Tswana breed and were of various ages. The goats spent the day grazing and browsing on pastures of mixed Acacia and Combretum shrubs and savanna grasslands.

All visible ticks were collected from the ear pinnae, axillae, belly, fetlock joints, interdigital space, groin, peri-anal region, tail tip and preserved in 70% alcohol. The ticks were identified as to stage of development, genus and species as previously suggested.

During the time of study, the temperature ranged from 28 to 34°C and the relative humidity was very high.

Results
During the summer months of December 1993 to February 1994 a total of 2582 ixodid ticks were collected from goats from 5 villages around Gaborone. Out of the 802 goats sampled, only 396 were infested with ticks to give an infestation rate of 49.38% and a mean of 6.52 ticks per goat (Table 1).

<table>
<thead>
<tr>
<th>Village</th>
<th>No. of goats</th>
<th>No. infested goats</th>
<th>Total ticks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oodi</td>
<td>205</td>
<td>123</td>
<td>1195</td>
</tr>
<tr>
<td>Gabane</td>
<td>192</td>
<td>50</td>
<td>157</td>
</tr>
<tr>
<td>Koping</td>
<td>132</td>
<td>93</td>
<td>550</td>
</tr>
<tr>
<td>Bokaa</td>
<td>117</td>
<td>79</td>
<td>555</td>
</tr>
<tr>
<td>Sebele</td>
<td>156</td>
<td>51</td>
<td>145</td>
</tr>
<tr>
<td>Total</td>
<td>802</td>
<td>396</td>
<td>2582</td>
</tr>
<tr>
<td>Percent</td>
<td></td>
<td>49.38</td>
<td>6.52</td>
</tr>
</tbody>
</table>

Table 1: Abundance of ticks in each village.
Table 2: Genera of collected ticks.

<table>
<thead>
<tr>
<th></th>
<th>Oodi</th>
<th>Bokaa</th>
<th>Kopong</th>
<th>Sebele</th>
<th>Gabane</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhip. evertsi evertsi</td>
<td>932</td>
<td>337</td>
<td>294</td>
<td>145</td>
<td>1773</td>
<td>68.66</td>
<td></td>
</tr>
<tr>
<td>B. decoloratus</td>
<td>140</td>
<td>64</td>
<td>178</td>
<td>-</td>
<td>42</td>
<td>424</td>
<td>16.42</td>
</tr>
<tr>
<td>A. hebraeum</td>
<td>123</td>
<td>154</td>
<td>26</td>
<td>-</td>
<td>-</td>
<td>302</td>
<td>11.69</td>
</tr>
<tr>
<td>H. truncatum</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>40</td>
<td>44</td>
<td>1.70</td>
</tr>
<tr>
<td>Rhip. appendic.</td>
<td>-</td>
<td>-</td>
<td>29</td>
<td>-</td>
<td>-</td>
<td>39</td>
<td>1.51</td>
</tr>
<tr>
<td>Total</td>
<td>1195</td>
<td>555</td>
<td>530</td>
<td>145</td>
<td>157</td>
<td>2582</td>
<td>100</td>
</tr>
<tr>
<td>percent</td>
<td>46.2</td>
<td>21.49</td>
<td>20.52</td>
<td>5.61</td>
<td>6.08</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Five tick species were found and 
*Rhipicephalus evertsi evertsi* was the most abundant for 68.66% of the ticks collected (Table 2). Other ticks included *Boophilus decoloratus* (16.42%) and *Amblyomma hebraeum* (11.69%). Table 2. The majority of the ticks picked were adults (87.09%) and there were more males than females (Table 3).

Table 3: Instar of tick stages per village.

<table>
<thead>
<tr>
<th></th>
<th>Larvae</th>
<th>Nymph</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>Oodi</td>
<td>35</td>
<td>239</td>
<td>520</td>
</tr>
<tr>
<td>Bokaa</td>
<td>17</td>
<td>35</td>
<td>320</td>
</tr>
<tr>
<td>Kopong</td>
<td>6</td>
<td>277</td>
<td>47</td>
</tr>
<tr>
<td>Sebele</td>
<td>-</td>
<td>87</td>
<td>81</td>
</tr>
<tr>
<td>Gabane</td>
<td>-</td>
<td>-</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td>52</td>
<td>280</td>
<td>1285</td>
</tr>
<tr>
<td>Percentage</td>
<td>2.01</td>
<td>10.84</td>
<td>49.76</td>
</tr>
</tbody>
</table>

Discussion

Ixodid ticks were picked from about 50% of the local goats and on average 6.5 ticks were collected from each goat. These findings are similar to those of other workers in the region and it was concluded that ticks were a problem in goat production for one tick may imbibe 1 to 3 ml of blood to complete its life cycle on an animal leading to blood loss anaemia.

*Rhipicephalus evertsi evertsi* was the commonest tick collected and this is in agreement with previous findings which stated that this was the commonest tick in Botswana.

Its high prevalence was due to its perennial breeding nature and its ability to survive in open lands. The role of *Rhip. evertsi evertsi*, the commonest tick in southern African3 in disease transmission to goats remains unclear although it is implicated in the transmission of anaplasmosis and *Borrelia theileri* — the cause of spirochaetosis.

Although only a few *Amblyomma hebraeum* were picked, this is the most significant tick for it is a vector for *Cowdria rumminantum*, the causative agent of heartwater which is regarded as the main killer of goats in Botswana.

The majority of the ticks picked were adults and this is probably because the immature stages prefer to feed on birds and small mammals found on the ground. The preponderance of more males than females could be explained by the fact that female ticks drop off after engorgement whilst male ticks remain attached.

References

LAMENESS IN SHEEP AND GOATS IN RELATION TO HOOF CONDITIONS IN SAHEL ZONE OF NIGERIA

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1Department of Veterinary Surgery and Reproduction, University of Maiduguri, Maiduguri, Nigeria
2Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria

LA BOITERIE DUE A L’AFFECTION DES SABOTS CHEZ LES OVINS ET LES CAPRINS DANS LA ZONE SAHÉLIENNE DU NIGERIA

Résumé
Au total, 2,420 moutons et chèvres ont été examinés pour confirmer la boiterie due à l’affection des sabots. La plupart des animaux boiteux étaient âgés de 3 à 5 ans (n = 467). Le nombre total d’animaux boiteux était de 467. Le nombre d’animaux qui boitaient au mouvement était de 394, le nombre de ceux qui avaient des problèmes lors d’un mouvement et au repos était de 256. Les lésions communes observées étaient la taille excessive des sabots (n = 391), les fissures (n = 232), la desquamation (n = 251), l’usure de la plante des pattes (n = 282), les blessures/plaies (n = 214) et le sabot cassé (n = 197).

Il faudrait conduire d’autres enquêtes pour évaluer les conséquences économiques de la boiterie par le biais des services de vulgarisation. Les éleveurs devraient informer rapidement les vétérinaires chaque fois qu’ils trouvent un animal boiteux dans leurs troupeaux.

Summary
A total of 2,420 sheep and goats were examined for evidence of lameness in relation to hoof conditions. Most of the lame animals were between 3 and 5 years old (n = 467). The total number of lame animals was (n = 467). The number of animals lame on movement was (n = 394) and those during both movement and rest was (n = 256). The common lesions found were overgrown hoof (n = 391), fissures (n = 232), peeling off (n = 251), sole wear (n = 282), wound/injuries (n = 214) and broken hoof (n = 197).

More enlightenment is required for the economic significance of lameness through extension services. Farmers should draw the attention of veterinarians promptly whenever they notice a lame animal in their flocks.

Introduction
Sheep and goats constitute the small ruminants population in Nigeria, the majority of which are located in the northern part of the country. The breeds commonly found are Yankassa, Uda, Balami, and Koroji for sheep and Red Sokoto and Borno White for goats. Sheep and goats are primarily kept for meat production as well as for the improvement of socio-economic status of communities1,2. The northern part of Nigeria is characterised by short rainfall and a prolonged dry season. There is large land mass with low forage especially during the prolonged dry season. As such, grazing animals need to cover a long distance in search of food3,4.

Locomotory soundness is usually mandatory for effective grazing and reproductive performance in all classes of livestock. Although various causes of lameness have been described in different domestic animals, lameness in sheep and goats have not been fully documented as compared with cattle and horses5,6. The predisposing factors of lameness in sheep and goats may range from hard environmental terrain, wetness, untrimmed hoofs, penetrating injuries, trauma fracture, to inflammation of anatomical structures and glands7,8. Diseases causing lameness are among the major constraints in small ruminants9,10 and 11,12,13 production systems.

There is paucity of information on causes of lameness in small ruminants in the Sahel zone of Nigeria. There is therefore the need to investigate diseases and conditions causing lameness in domestic animals, especially sheep and goats in the Sahel zone of Nigeria, because of its economic importance to the livestock
industry. This work reports the causes of lameness in sheep and goats in relation to hoof condition in the Sahel zone of Nigeria.

**Materials and Methods**

Material in this work were obtained from sheep and goats herds in Borno state, in the Sahel zone of Nigeria. The investigation was based on trail animals and those managed under extensive system.

The focus of the survey was on nomadic animals, animals residing at home but still trade a long distance in search of feeds, and also those brought to markets for disposal.

The investigation involved interaction with livestock owners, history talking and physical examination for signs and possible causes of lameness. The lame animals were observed while standing as well as during locomotion to ascertain the degree of lameness. The lameness was then assessed and symbolised based on whether seen during movement (M), during resting and movement (B).

**Results**

A total of 2,420 sheep and goats were examined. The details of the findings are given in Tables 1 to 5 below.

**Table 1:** Number and percentage of lame animals out of the total observation.

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>Total observation</th>
<th>Number lame</th>
<th>Percentage lame</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Ovine</td>
<td>Male</td>
<td>740</td>
<td>146</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>1450</td>
<td>264</td>
<td>18</td>
</tr>
<tr>
<td>Caprine</td>
<td>Male</td>
<td>529</td>
<td>108</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>701</td>
<td>132</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3,420</td>
<td>650</td>
<td>19</td>
</tr>
</tbody>
</table>

**Table 2:** Age distribution of lame animals.

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>Age in years</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Ovine</td>
<td>Male</td>
<td>21/2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>25</td>
<td>45</td>
<td>44</td>
</tr>
<tr>
<td>Caprine</td>
<td>Male</td>
<td>11</td>
<td>12</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>5</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>57</td>
<td>42</td>
<td>167</td>
</tr>
</tbody>
</table>

**Table 3:** Distribution of lesions in the limb with respect to hind/forelimbs.

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>Hind limb</th>
<th>Fore limb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>Ovine</td>
<td>Male</td>
<td>86</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>106</td>
<td>98</td>
</tr>
<tr>
<td>Caprine</td>
<td>Male</td>
<td>73</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>60</td>
<td>85</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>357</td>
<td>370</td>
</tr>
</tbody>
</table>

**Table 4:** Hoof lesions causing lameness.

<table>
<thead>
<tr>
<th>Hoof lesion</th>
<th>Ovine Male</th>
<th>Female</th>
<th>Caprine Male</th>
<th>Female</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over growth</td>
<td>100</td>
<td>123</td>
<td>79</td>
<td>89</td>
<td>391</td>
<td>249</td>
</tr>
<tr>
<td>Fissures</td>
<td>70</td>
<td>105</td>
<td>29</td>
<td>28</td>
<td>232</td>
<td>14.8</td>
</tr>
<tr>
<td>Peeling off</td>
<td>62</td>
<td>74</td>
<td>62</td>
<td>53</td>
<td>251</td>
<td>16.0%</td>
</tr>
<tr>
<td>Sole wear</td>
<td>60</td>
<td>105</td>
<td>55</td>
<td>62</td>
<td>202</td>
<td>10.0%</td>
</tr>
<tr>
<td>Wound/Injuries</td>
<td>55</td>
<td>70</td>
<td>46</td>
<td>43</td>
<td>214</td>
<td>13.7%</td>
</tr>
<tr>
<td>Broken hoof</td>
<td>50</td>
<td>73</td>
<td>38</td>
<td>36</td>
<td>197</td>
<td>12.6%</td>
</tr>
<tr>
<td>Total limbs</td>
<td>397</td>
<td>550</td>
<td>309</td>
<td>311</td>
<td>1,567</td>
<td>100%</td>
</tr>
</tbody>
</table>
Table 5: Distribution of lameness during movement (M) and during both movement and resting (B).

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>M</th>
<th>B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>99</td>
<td>72</td>
<td>171</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>141</td>
<td>79</td>
<td>220</td>
</tr>
<tr>
<td>Caprine</td>
<td>Male</td>
<td>78</td>
<td>59</td>
<td>137</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>76</td>
<td>46</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>394</td>
<td>256</td>
<td>650</td>
</tr>
</tbody>
</table>

Discussion

According to this study, the predisposing causes of hoof lameness in small ruminants in the Sahel zone of Nigeria — where the soil texture is soft, are overgrown hoofs and foreign bodies — fissures, wounds/abrasions, broken hoofs, sole wear, unkept hoofs, penetrating injuries, fractures and inflammation of anatomical structures and glands lead to lameness in small ruminants\(^{14}\). The frequency of wound injuries and foreign body lameness was higher in bucks than rams. This was ascribed to be due to their sexual behaviour\(^{2}\). Small ruminants, especially goats, because of their feeding habit of browsing, use their forelimbs for climbing shrubs while they stand on the hind limb. Such postures expose the forelimbs to more mechanical injury.

In sheep\(^{16}\) inter digital growth has been found, while line diseases, foot rot, foot scald, overgrown hoofs were major causes of lameness. In this study, overgrown hoofs was found to be the predominant cause of lameness when sheep are grazed or kept on a continuous wet environment it may lead to softening of the horny tissues of the claws. This condition stimulates growth which consequently leads to destruction of the hoofs, especially at the white line. This also leads to breakage and fissures of the horny tissues of the sole exposing the sensitive laminae\(^{3}\).

Most of the hoof conditions discussed can be controlled by improved management system, such as hoof trimming hoof paring, hoof bathing. When such a routine is developed, several digital diseases can be detected, attended to early and therefore improve the health status of the animals\(^{17}\). The economic losses due to lameness in small animals may be high. The value of animals, especially rams, becomes very low because lame animals are not used for sacrifice. The major economic losses incriminated due to lameness in cattle include reduced milk yield, weight loss, infertility, veterinary expenses, drugs and additional stockman’s time\(^{18}\). In small ruminants, the above economic losses are equally applicable. The demand made on time, labour and facilities in addition to the economic losses incurred, make it imperative that attempts should be made whenever possible to minimise the incidence of digital lameness by removing some of the predisposing factors of lameness\(^{19}\).

In this study lameness was found to have a high frequency of about 20% in small ruminants. The economic implication of this situation is very tremendous in terms of reduced market value, infertility and overall reduced production. There is therefore the need to study the cost implication of lameness in small ruminants in the Sahel so that both policy makers and farmers will know the significance of lameness as far as small ruminants’ production systems are concerned. Lameness has been found to constitute one of the devastating conditions affecting small ruminants which did not receive adequate attention by veterinarians and farmers in this part of the country which is one of the large-scale producers of small ruminants. There is therefore, a need for public enlightenment through extension services for farmers to know the economic losses associated with lameness, so that proper preventive measures can be taken and farmers can seek prompt veterinary attention whenever they detect lameness in their flocks.

References


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GROSS LESIONS ENCOUNTERED IN SLAUGHTERED WILD ANIMALS IN A GAME RANCHING FARM IN KENYA


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LESIONS MACROSCOPIQUES CONSTATEES CHEZ LES ANIMAUX SAUVAGES ABATTUS DANS UNE FERME D’ELEVAGE DE GIBIER AU KENYA

Résumé


Summary

A total of 110 wild animals belonging to 10 different species slaughtered in a game ranching farm in Kenya were examined for gross abnormalities. Conditions encountered in the Grant’s gazelles were verminous pneumonia, sarcosporidiosis and meases (cysticercoids). In the Thomson’s gazelles, the following conditions were encountered: verminous pneumonia, hydatid cysts, cholangitis (due to *Stilesia spp*) and bladder cysts (similar to *Cysticercus tenuicollis*). In the hartebeest, verminous pneumonia, nodular enteritis (due to *Oesophagostomum ssp*), paramphistomes, meases, hepatitis and renal neoplasms were encountered. In the wildebeests, seven conditions were encountered viz: verminous pneumonia, Oesophagostomum nodules paramphistomes, bladder cysts, hepatitis, meases and neoplasms (lip and skin). The impala showed verminous pneumonia, hydatid cysts, hepatitis and kidney infarcts. In the zebra, the following conditions were observed: gastritis (due to *Gasterophilus spp*), strongylus enteritis, verminous arteritis, peritoneal nematodes (*Setaria spp*) focal hepatitis and renal infarcts. The eland showed focal greyish lesions in the liver and heart. The giraffe, orx and ostrich did not show any abnormalities.

Introduction

Diseases of wildlife are important in that they can either cause ill health to the affected animal, spread disease to the domestic animal (and vice versa), or spread disease to human beings. Generally there is a dearth of knowledge concerning wildlife disease. For conservation purposes, and the fact that some wild animals are used for human food, there is a need to understand what type of diseases that can affect them. This study was undertaken in an attempt to find out the type of diseases that affect some wild animals in Kenya.

Materials and methods

A wildlife slaughter facility in a game ranching farm, Wildlife ranching and Research (WRR) Ltd. near Athi River Town, Kenya, was used for
this study. The farm was visited once a week for a period six months (September 1993 to February 1994). All cropped and slaughtered animals were thoroughly examined and any abnormalities noted. Where necessary, samples from the diseased parts or organs were taken to the laboratory for further examination and diagnosis.

Results
A total of 110 animals belonging to 10 different species were examined (Table 1). These were: Grant's gazelle (Gazella granti), Thomson's gazelle (G. Thomsoni), Impala (Aepyceros melampus); Kongoni Coke's Hartebeest – (Alcelaphus buselaphis cokei), Wildebeests (Connochaetes taurinus), Zebra (Equus burchelli), Eland (Taurotragus oryx); Onyx (Oryx gazella); Giraffa camelopardalis and Ostrich (Struthio camelus). The types of conditions encountered are described below:

Diseases of the respiratory tract
The main abnormality of this system was verminous pneumonia (Table 1). This was encountered in Grant's gazelle (16 of 17 or 94.1%). Thomson’s gazelle (8 of 11 or 72.7%), Hartebeest (21 of 29 or 72.4%), Impala (7 of 12 or 58.3%), and Wildebeests (2 of 22 or 9.1%). The pneumonic lesions were morphologically similar in all animal species, and were associated with the same type of nematode belonging to the Pneumostrongylus (Protostrongylus) spp. The pneumonia was characterised by the presence of greenish grey nodules, which

<table>
<thead>
<tr>
<th>Type of lesion/parasite</th>
<th>Grant’s gazelle (17)</th>
<th>Thomson’s gazelle (11)</th>
<th>Hartebeest (29)</th>
<th>Wildebeest (22)</th>
<th>Impala (12)</th>
<th>Zebra (12)</th>
<th>Other spp*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verminous pneumonia</td>
<td>16 (94.1%)</td>
<td>8 (72.7%)</td>
<td>21 (72.4%)</td>
<td>2 (9.1%)</td>
<td>7 (58.3%)</td>
<td></td>
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</tr>
<tr>
<td>Oesophagostomum nodules</td>
<td></td>
<td>13 (44.8%)</td>
<td></td>
<td>2 (9.1%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paramphistomes</td>
<td></td>
<td>3 (10.3%)</td>
<td></td>
<td>7 (31.8%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastritis (Gastrophilus spp)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Strongyloids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 (100%)</td>
<td></td>
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<tr>
<td>Cholangitis (Stilesia spp)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 (100%)</td>
<td></td>
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<tr>
<td>Hydatid cysts (liver)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Scares, spots</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Penhhepatitis (Liver)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscle cysts (Cysticerus spp)</td>
<td></td>
<td></td>
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<tr>
<td>Peritoneal cysts (Cysticerus spp)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peritoneal parasites (Setaria spp)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sarcocysts/muscles</td>
<td>11 (64.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verminous arteitis</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Other animal species included: Eland (3), Onyx (2), Giraffe (1) and Ostrich (1)
**This lesion was only seen in Eland
---No observations made.
affected mainly the posterior margins of the diaphragmatic lobes. The lesions varied both in size and number, and were in different stages of development.

All the other animal species, i.e. Eland, Oryx, Zebra, Giraffe and ostrich free from this type of lesion. However, one zebra had calcified nodules in both lungs.

Diseases of the alimentary tract
Paramphistomes in the rumen were encountered in Hartebeest (3 of 29 or 10.3%) and wildebeest (7 of 22 or 31.8%). Intestinal nodules attributed to Oesophagostomum spp were encountered in the Hartebeest (13 of 29 or 44.8%) and wildebeest (2 of 22 or 9.1%). These nodules affected mainly the large intestines of these animals. In the zebra, gastritis due to Gasterophilus spp and enteritis due to strongyle worms were observed in all animals (12 of 12 or 100%). The other remaining animal species were free from gastrointestinal lesions (Table 1).

Diseases of the liver
Cholangitis due to Stilesia spp was encountered in the Thomson’s gazelles (5 of 11 or 45.4%) and Impala (6 of 12 or 50%). The bile ducts were thickened with a tendency to form cysts which contained the tapeworms. Calcified cysts similar to hydatid cysts were found in the liver of Thomson’s gazelle (1 of 11 or 9.1%) and Impala (3 of 12 or 25%). (Table 1)

Other liver lesions were either scars, greyish or whitish spots or thickening of the capsule. These were encountered in the following frequencies: Impala (3 of 12 or 25%), wildebeest (8 of 22 or 36.4%), Hartebeest (1 of 29 or 3.4%), and Eland (2 of 3 or 66.7%).

Diseases of muscles
Macroscopic sacrocysts (locally called “rice”) were seen mainly in the subcutaneous muscles of the Grant’s gazelles (11 of 17 or 64.7%). Measles or cysticercoid stages similar to Cysticercus bovis were found in the skeletal muscles of Hartebeest (4 of 29 or 13.8%), Grants gazelle (3 of 17 or 17.6%) and wildebeest (1 of 22 or 4.5%) (Table 1). Besides their location in the skeletal muscles, these cysts were also found in the heart, liver and lungs of these animals. Other animal species were not affected.

Diseases affecting the skin
The only abnormalities seen in the skin were a lip papilla and an unidentified tumour affecting the brisket of two wildebeest. The tumour of the brisket measured about 6 cm in diameter. On cut surface the tumour appeared hollow with gelatinous growths in the lumen, this was with the fatty layer of the subcutaneous tissue.

Peritoneum
A type of cysticercoid similar to Cysticercus tenuicolis (bladder cysts) was found attached either to theomentum or the liver capsule in the wildebeest (3 of 22, or 13.6%) and Hartebeest (2 of 29 or 6.9%). Free round worms identified as Setaria spp were found in the peritoneal cavity of zebras (3 of 12 or 25%) (Table 1).

Cardiovascular system
Verminous arteritis affecting the mesenteric arteries was diagnosed in 2 of 12 (16.7%) of zebras. (Table 1). Other lesions affecting this system were heart measles, which were seen in the Hartebeest (3 of 29 or 10.3%). Grant’s gazelle (3 of 17 or 17.6) and wildebeest (1 of 22 or 4.5%), and greyish spots which were seen in wildebeest (1 of 22 or 4.5%) and eland (2 of 3 or 66.7%).

Urinary system
Renal tumours were seen in the Hartebeests (2 of 29 or 6.9%), while renal infarcts were seen in Hartebeest (1 of 29 or 6.9%), Impala (1 of 12 or 8.3%) and zebra (1 of 12 or 8.3%).

Discussion
The results of this study showed that the most commonly encountered lesions in the wild animals surveyed were those associated with or caused by parasites, especially helminth parasites. In terms of host range, verminous pneumonia was the most frequently encountered lesion having been observed in
five of the ten animal species examined (Table 1). Except in the wildebeest, where the infection rate was low (9.1%), in the other infected animal species, i.e. Grant’s gazelle, Thomson’s gazelle, Impala and Hartebeest, the infestation rates were rather high and exceeded 50% in each species (Table 1). It would appear from the results of this study and those of others that verminous pneumonia is a frequent and important disease among wild ruminants especially antelopes. In this study the lung lesions in all affected animals were caused by the same type of parasite which was identified as *Pneumostongylus spp.* This is not unusual, as Dining and Sashes also found a species of the genus *Pneumostongylus to be non-host* specific, as it affected a wide range of the wild ruminants in the Serengeti National Park.

Depending on the extent of involvement, such lesions may interfere with the normal functions of the lungs and cause stunted growth rates.

Conditions of the alimentary tract were oesophagostomum nodules in the intestines and *parasitochondromes* in the rumens of Hartebeest and wildebeests. In the zebra there was gastritis caused by *Gasterophilus spp* and enteritis caused by the *strongyle* worms. The significance of these lesions in these animals would appear to parallel that in their domestic counterparts as described by various authors. In the liver, the main specific lesions were calcified cysts resembling hydatid cysts which were found in the Thomson’s gazelle and the Impala, and cholangitis due to *Stilesia spp*. These and the other non-specific lesions found in these and other animal species resulted in the condemnation of the organs and hence an economic loss, as most of these animals were cropped and slaughtered for sale.

Macroscopic sarcocystis were only found in the Grant’s gazelle, while intermediate stages (cysticercoids) of some type of tapeworms were found in Grant’s gazelles, Hartebeest and wildebeests. Although no clinical signs have been associated with these parasites in domestic animals, they can lead to economic loses due to condemnation of carcasses.

In zebras, verminous arteritis was encountered in two animals. The prevalence rate of this type of lesion was rather low compared to the frequency of recovering the causative worms from the intestines of these animals. The significance of this type of lesion could be similar to that in horses and donkeys as reported by various authors.

**Acknowledgements**

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**References**


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Estimation of Average Values for Pulse Rate, Respiratory Rate and Rectal Temperature and Development of a Heat Stress Index for Adult Yankasa Sheep

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**Faculty of Veterinary Medicine,
Ahmadu Bello University, Zaria, Nigeria

Estimation des Valeurs Moyennes de la Fréquence des Pulsations, du Rythme Respiratoire, de la Température Rectale et Evolution d’un Indice de Stress du à la Chaleur chez les Moutons Yankasa Adultes

Résumé
Les registres de 384 moutons yankasa adultes ont été examinés à Shika dans la zone subhumide du Nigeria durant trois saisons de l’année, en vue de déterminer les valeurs moyennes de la fréquence des pulsations (P), du rythme respiratoire (R) et de la température rectale (T), et pour évaluer la sensibilité ou la tolérance au stress dû à la chaleur. Les valeurs moyennes obtenues pour P, R et T étaient respectivement de 87 ± 1.96 pulsations/minute; 59 ± 3.53 respirations/minute et 39 ± 0.10°C. Il y avait une corrélation négative entre P et R (r = -0.55) (P < 0.05), qui a été utilisée pour trouver un indice de stress dû à la chaleur H: ((R/59)°(87/P)).

Summary
Records on 384 adult Yankasa sheep were studied at Shika in the sub-humid zone of Nigeria over three seasons of the year to determine the average values of pulse rate (P), respiratory rate (R) and rectal temperature (T) and also to develop a measure of susceptibility or tolerance to heat stress. Average values for P, R and T were 87.0 ± 1.96 beats/min, 59.0 ± 3.53 breaths/min, and 39.0 ± 0.10°C respectively. There was a negative correlation between P and R (r = -0.55) (P < 0.05), which was utilised to derive a heat stress index H: ((R/59)°(87/P))

Introduction
Domestic animals are homeotherms which tend to maintain a constant body temperature through a balance of heat gain and loss. The allowable variation in body temperature is small. The environment surrounding an animal at any particular instant influences the amount of heat exchange between it and the environment. Consequently, it influences the physiological adjustments of the animal which are necessary in order to maintain a body heat balance. If the environment is not within the “comfort zone” of the animal, then the animal is said to be under environmental stress which would be reflected in it’s growth, production and health1.

Many studies on the tolerance of various farm animals to environmental stress have been based on a comparison of T, P and R2,3. The body temperature of the animal does not vary much, but any deviation from normal indicates that the animal cannot maintain homeokinesis despite maximal physiological efforts to do so4. Reactions of sheep to cold stress are mild in comparison to their reaction to heat stress5. The body temperature of sheep is maintained at a mean day time T of about 39°C with a normal range from about 37.5°C to 40.5°C6. P ranges between 60 – 150 beats/min7 and R ranges from 20 – 35 breaths/min8.

Several attempts have been made to develop physiological indices for heat adaptability of domestic animals. The physiological indices so far developed are based on rectal temperature, respiratory rate and moisture vaporisation rate. The reason for the difficulty of developing an index for heat adaptability related to productive performances is the fact that heat adaptability is a complex character that depends on the integrity
of various systems such as the respiratory, circulatory, excretory, nervous, endocrine and enzymatic systems. The coordination of all these systems under thermal stress is different, not only between species, but also between breeds and even between individuals within breeds. Some animals may combat heat most efficiently through depressing their energy metabolism to a greater extent than other animals. Others may attain the same goal by an efficient evaporative or non-evaporative cooling system. Other animals may have an enzymatic system that is capable of reacting normally at a relatively high body temperature. Heat adaptability may also be achieved in animals by low sensitivity of their warm receptors to heat. Such variation among animals in the methods used to combat heat stress makes unsatisfactory the attempts to attribute heat adaptability in domestic animals to one particular mechanism. However, for a quick and accurate on-farm detection of heat stress, the physiological index based on the physiological parameters appears to be the most appropriate.

There is lack of data on normal average values of $P$, $R$ and $T$ for adult Yankasa sheep in the sub-humid tropics. Also, there is absence of a suitable measure of heat stress in tropical sheep. There is therefore the need for studies based on the relationship between these physiological parameters to obtain categorical heat stress indices. The present study was conducted to estimate average values of $P$, $R$ and $T$, also to develop a definitive heat stress index for adult Yankasa sheep.

**Materials and methods**

The Yankasa sheep used in this study were located at the National Animal Production Research Institute, Shika, Zaria, Nigeria (Latitude $11^\circ 12'N$, Longitude $7^\circ 33'E$ and $610m$ altitude), situated in the Northern Guinea Savanna Vegetation Zone. The area has a sub-humid climate. Mean annual rainfall and temperature are $1,107mm$ and $24.4^\circ C$ respectively.

The origin and management of the flock used have been described previously. The sheep were managed under a semi-intensive system involving grazing on improved pastures for 6–8 hours daily plus $0.3–0.5\ kg/head/day$ of a $15–20\%$ crude protein concentrate supplement throughout the year. The animals were housed in well-ventilated pens overnight. Data on climatic variables (minimum and maximum daily temperature, sunshine hours, relative humidity, wind velocity and rainfall) were obtained from the Institute for Agricultural Research meteorological station, Samaru, Zaria.

$P$ was determined for each animal by placing the fingertips on the femoral arteries on the medial aspect of the hind limb for one minute. $R$ was determined for each animal by counting the number of flank movements per minute. $T$ was taken using a clinical thermometer, which was allowed to stay in the rectum of each animal for one minute before the reading was taken. These physiological parameters were taken on each animal at $1000$ and $1300$ hours in the pen and in the run, respectively, on each day and for 3 consecutive days within each season (cold-dry, hot-dry and late-wet seasons).

The data was analysed by least-squares method using the Harvey Computer Package. The summary statistics for climatic variables were calculated within each season.

**Results and discussion**

The normal average values for adult Yankasa sheep were $87$ beats/min, $59$ breaths/min and $39^\circ C$ for $P$, $R$ and $T$ respectively. There was a negative correlation between pulse rate and respiratory rate ($r = -0.55$). This relationship between them, together with their normal average values were used to derive a heat stress index $H = (R/59)^* (87/P)$, where $H$ = heat stress index, $R$ = normal average respiratory rate and $P$ = normal average pulse rate. This equation was used to measure the adaptive ability of the different groups of animals.

The results of this study confirm the work done by which reported that body temperature of sheep is maintained at a mean day time rectal temperature of about $39^\circ C$ with a normal range from $37.5$ to $40.5^\circ C$. This study also agrees with the reports which showed pulse rate of sheep to be between $60–150$ beats/min. However, average respiratory rate value obtained in this
study does not tally with the result by Yeates\textsuperscript{a}, which showed a range of 20–35 breaths/min. This must be due to environmental variation. The heat stress index deduced in this study seems to have an edge over the coefficient of adaptability given by Benezra\textsuperscript{b}: \((BT/38.33) + (NR/23)\), where \(BT\) is rectal temperature and \(NR\) is respiratory rate. This is because pulse rate and respiratory rate are more responsive to heat stress than rectal temperature, therefore the relationship between the former gives a better measure of heat stress. Also, any marked deviation from the normal average values of \(P\), \(R\) and \(T\) as obtained in this study might indicate presence of thermal stress.

**Table 1**: Average weather conditions during the experimental period

<table>
<thead>
<tr>
<th>Season</th>
<th>Minimum temp. (^{\circ}\text{C})</th>
<th>Maximum temp. (^{\circ}\text{C})</th>
<th>Relative hum.%(10.00 am)</th>
<th>Relative hum.%(4.00 pm)</th>
<th>Sunshine hours (hr)</th>
<th>Wind velocity (m/s)</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold-dry</td>
<td>14.7 ± 0.33</td>
<td>29.0 ± 0.00</td>
<td>10.0 ± 0.59</td>
<td>7.7 ± 0.33</td>
<td>8.8 ± 0.23</td>
<td>246.0 ± 8.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Hot-dry</td>
<td>21.7 ± 0.66</td>
<td>36.0 ± 0.66</td>
<td>34.0 ± 4.17</td>
<td>25.3 ± 3.53</td>
<td>9.1 ± 1.00</td>
<td>149.4 ± 9.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Late-wet</td>
<td>20.0 ± 0.58</td>
<td>28.3 ± 0.34</td>
<td>73.3 ± 9.36</td>
<td>66.7 ± 1.34</td>
<td>5.6 ± 1.18</td>
<td>116.0 ± 6.99</td>
<td>2.5 ± 0.02</td>
</tr>
</tbody>
</table>

**Table 2**: Normal average values for pulse rate, respiratory rate and rectal temperature of adult Yankasa sheep

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of observations</th>
<th>Average values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse rate (beats/min)</td>
<td>384</td>
<td>87.0 ± 1.96</td>
</tr>
<tr>
<td>Respiratory rate (breaths/min)</td>
<td>384</td>
<td>59.0 ± 3.53</td>
</tr>
<tr>
<td>Rectal temperature ((^{\circ}\text{C}))</td>
<td>384</td>
<td>39.0 ± 0.10</td>
</tr>
</tbody>
</table>

**Table 3**: Summary of correlations between pulse rate, respiratory rate and rectal temperature.

<table>
<thead>
<tr>
<th></th>
<th>(P)</th>
<th>(R)</th>
<th>(T)</th>
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</thead>
<tbody>
<tr>
<td>(P)</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(R)</td>
<td>0.55</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>(T)</td>
<td>0.07</td>
<td>0.11</td>
<td>1.000</td>
</tr>
</tbody>
</table>

**Acknowledgements**

The authors are grateful to the Director, National Animal Production Research Institute, Shika, Zaria and to the staff, Small Ruminant Research Unit, NAPRI, Shika for providing assistance and facilities.

**References**


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SHORT COMMUNICATION

A CASE OF CANINE INTESTINAL PARVOVIRUS IN NIGERIA

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Since the characterisation of the canine parvovirus earlier on, there have been many reported cases of canine enteritis caused by the virus.

In Nigeria, a look at the literature showed that there is serological evidence of the disease. Although no confirmed clinical disease has been reported, there are reported cases of suspected parvovirus enteritis in the dog and another in the calf. These reports highlighted the clinico-pathological features of the disease.

In this report, we present details of the clinical disease and pathology of a confirmed case of canine parvovirus enteritis in Nigeria.

The dog had a history of copious haemorrhagic dysentary vomiting, complete anorexia, dehydration and a slightly elevated body temperature (39.5°C) for 3 days. Faecal examination was negative for common gastrointestinal parasites despite repeated sampling. Promazine HCl (phenegetin) was used to control the hyperthermia and emesis. Magnesium trisilicate, sulphasemazine and metronidazole were administered fifteen minutes after the promazine administration. The dog’s condition improved slightly and it died two days later.

At postmortem examination, the carcass was markedly dehydrated, emaciated and very anaemic while the mucosa of the small intestine (jejunum and ileum) showed severe petechial haemorrhages. Tissues obtained were fixed in 10% buffered formalin and processed routinely for histopathology.

On microscopy, various sections of ileum and jejunum revealed marked infiltration by lymphocytes, plasma cells and macrophages. There was also marked degeneration of glandular epithelial cells with syncitial formation (Figure 1) as well as total villous collapse. Many of the glands contained necrotic and degenerate cells with the mucosa severely fibrosed. Few degenerate epithelial cells had large amphophilic intranuclear inclusions. Parvovirus was confirmed, courtesy Dr. I.A.P. McCandlish, Department of Veterinary Pathology, University of Glasgow.

The histopathologic findings and clinical picture here are similar to those observed by other workers for canine parvoviral enteritis, although there were no lesions observed in the heart.

This report confirms the suggested existence of parvovirus infection among our dog population in this country and also emphasises the importance of prompt and regular vaccination of all dogs against parvovirus infection.

Acknowledgements

The authors are grateful to Dr. I.A.P. McCandlish, Department of Veterinary Pathology, University of Glasgow for confirmatory diagnosis and to
Mr. Pius Ikpukpu and Mrs. Veronica Akpokodje for typing the manuscript. We are also grateful to Mr. A.U. Usoro for the prints.

References


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SHORT COMMUNICATION

PREVALENCE AND INFECTION LEVELS OF HELMINTHS IN GOATS AT MACHANGA FIELD STATION OVER A PERIOD OF ONE YEAR

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Helminthiasis in livestock is of considerable significance in a wide range of agroclimatic zones in Africa. It constitutes one of the most important constraints to small ruminant production. The widespread occurrence of infections at sub-clinical levels with internal parasites in grazing animals, the associated loss of production, the cost of anthelmintics and death of infected animals are some of the major concerns.

There is seasonal variation in the rate of infection by endoparasites depending on whether eggs passed in faeces develop into infective stages. Most reports indicate high rates of transmission in the wet seasons. The level of pasture contamination can indicate to what degree animals are exposed to parasitic infections in different seasons. This study was undertaken to assess the prevalence and seasonal variations in infection levels of helminths in a flock of goats over a period of one year.

The study was carried out at the University of Nairobi's Machanga field station adjacent to Kamburu dam, in the arid to semi-arid areas of Kenya. The annual rainfall was 680mm in 1993 and 783mm in 1994 with most of it falling during the short rains period (October to December). The area's vegetation consists of several varieties of browse plants and grasses.

The study involved forty Small East African goats aged between 2 and 3 years which were bought from the surrounding farms and brought to the station in October 1993. They were ear-tagged for identification. They were faecal sampled in January and February (during the dry period), May and June (during the wet season-long rains) and October and November (during the wet season short rains) in 1994.

Individual rectal faecal samples were analysed for nematode eggs per gram (EPG) using the modified MacMaster technique. Magnesium Sulphate (Sp.Gr. 1.14) was used as the flotation fluid.

Pooled faecal cultures were made and infective larva were identified using standard methods already described.

Table 1: Prevalence of nematode eggs among goats at Machanga in 1994.

<table>
<thead>
<tr>
<th>Months</th>
<th>Number sampled</th>
<th>Epg ranges</th>
<th>Proportion of total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January and</td>
<td>22</td>
<td>0-100</td>
<td>55</td>
</tr>
<tr>
<td>February</td>
<td>13</td>
<td>200-400</td>
<td>32.5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>500-1000</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>&gt;1000</td>
<td>0</td>
</tr>
<tr>
<td>April and May</td>
<td>6</td>
<td>0-100</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>200-400</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>500-1000</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>&gt;1000</td>
<td>40</td>
</tr>
<tr>
<td>October and</td>
<td>7</td>
<td>0-100</td>
<td>17.5</td>
</tr>
<tr>
<td>December</td>
<td>20</td>
<td>200-400</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>500-1000</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>&gt;1000</td>
<td>12.5</td>
</tr>
</tbody>
</table>
The goats had low epg’s during the months of January and February. Most had values of less than 100 epg (range 0–800). Only 5 goats had values of over 400 epg. (Table 1). Samples for March and early April did not show any significant differences in epg’s.

Towards the end of April (during the long rains) the goats started showing signs of unthriftiness. Several had diarrhoea and rough hair coats. Faecal samples at the beginning of May showed they had high epg’s. 16 goats (40%) had counts over 1000 with 9 goats having counts of over 1800 epg’s. 10 goats (25%) had counts of between 500 and 1000. 8 (20%) had counts of between 200 and 400 epg’s while 6 goats (15%) had counts of between 0 and 100 epg’s. 6 goats had tapeworm segments.

Larval identification showed that 79% of the nematodes were Haemonchus contortus, 12% Trichostrongylus spp and 9% Ostertagia spp. The tapeworms were identified as Moniezia expansa.

The goats were treated with levamisole and samples taken two weeks post treatment showed that the anthelmintic was effective.

### Table 2: Genus of helminth larva identified among goats at Machanga in 1994 and their proportion during the two rainy seasons.

<table>
<thead>
<tr>
<th>Seasons</th>
<th>Larva identified</th>
<th>Proportion of total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long rains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(May – June)</td>
<td>Haemonchus spp.</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Trichostrongylus spp</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Ostertagia spp</td>
<td>9</td>
</tr>
<tr>
<td>Short rains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(October – December)</td>
<td>Haemonchus spp.</td>
<td>73.1</td>
</tr>
<tr>
<td></td>
<td>Trichostrongylus spp</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Ostertagia spp</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td>Nematodirus spp</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Monthly sampling for July, August and September did not show significant rises in epg counts. In mid-October (during the short rains) the goats started showing signs of helminthiasis. Faecal samples showed that they had moderate infections. 5 goats (12.5%) had epg counts of over 1000 while 7 goats (17.5%) had counts of between 0 and 100 epg (Table 1). Haemonchus contortus composed 73.1% of the recovered larvae while Trichostrongylus spp represented 13%. Ostertagia spp 8.2% and Nematodirus spp 5.7%. Except for Nematodirus which was not found in the earlier cultures, the rest of the species did not vary from those found during the long rains (Table 2).

The goats were treated again with levamisole. Samples for November and December did not show any significant rise in epg counts. These results showed that this flock was harbouring worms and shedding nematode eggs throughout the year. The shedding and pasture contamination was more during the wet seasons.

They seemed to harbour the nematodes even when they were not shedding a lot of eggs, a factor which could be attributed to hypobiosis. The onset of the rains could have triggered the development of the hypobiotic larva to maturity and to start laying eggs. This has also been reported in sheep in the high potential areas of the district.

The infective larvae identified showed the majority to be the economically important nematode Haemonchus contortus, which has been shown to undergo hypobiosis in unfavourable weather and could have been responsible for the sudden unthriftiness observed in this flock. This has been reported by earlier workers to be a cause of high mortalities in sheep and goats.

Further research needs to be done in these marginal areas where helminthiasis is a major constraint to sheep and goat production.

### Acknowledgement

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### References

Goats are considered to be one of the most important food producing animals in Nigeria and most households in Zaria area of northern Nigeria keep and manage small flocks under the semi-intensive and traditional village systems. In addition to providing the populace around the area with meat, milk, hides and skin, goats also play important social roles especially during religious festivals.

Until recently, very little attention was given to the disease problems of goats in the area despite the fact that diseases cause significant losses to the goatrearers in the area. Post-mortem examination of animals to ascertain the actual causes of deaths is one of the most important strategies towards planning disease eradication and control programmes in any locality. Necropsy records kept and maintained at the Faculty of Veterinary Medicine and Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria for over a period of eleven years (January 1977 to December 1987) was used in this study to investigate the pattern of diseases of goats most commonly encountered based on postmortem examinations in Zaria area of Nigeria.

The necropsy records revealed that out of the total number of 4,807 animals presented for postmortem examination during the period of eleven years, 583 (12.1%) were goats. The source of these animals included those that belonged to the members of the public, institutional farms and government farms all around Zaria area. In all cases of carcasses presented for necropsy examination, specimens were taken and sent to the relevant laboratories for culture, isolation and parasite identification where appropriate. The percentage of the number of goats diagnosed to have died of the different conditions are summarised in Table 1.

### Table 1: Percentages of goats that died of different conditions encountered during postmortem examination.

<table>
<thead>
<tr>
<th>Disease condition</th>
<th>Percentages (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory disorders</td>
<td>22.64</td>
</tr>
<tr>
<td>Gastrointestinal parasitism</td>
<td>20.64</td>
</tr>
<tr>
<td>Enteritis</td>
<td>12.86</td>
</tr>
<tr>
<td>Gangrenous mastitis</td>
<td>12.14</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>8.75</td>
</tr>
<tr>
<td>Cowdriosis</td>
<td>4.75</td>
</tr>
<tr>
<td>Unspecified</td>
<td>20.24</td>
</tr>
</tbody>
</table>

Analysis of the records over the eleven-year period revealed that respiratory disorders, gastrointestinal parasitism, enteritis and gangrenous mastitis constituted the major diseases of goats most commonly encountered during necropsy. There is clear evidence of seasonality in the prevalence of these diseases with most cases of respiratory disorders recorded during the months of December, January and February which corresponds to the periods of cold season called harmattan in the area. Most cases of gastrointestinal parasitism, cowdriosis and trypanosomiasis were encountered during the months of July and August which corresponds to the periods of rainfall and high relative humidity and the presence of ticks and flies. This observation reflects the pattern of the diseases of goats in Zaria. The pattern is in close agreement with previous reports from most parts of the country. Caprine pneumonia appears to be one of the leading diseases of goats in the locality and is most prevalent during the harmattan which is the period characterised by wind, dusty and cold weather. This weather condition causes some form of stress in the animals which makes them succumb easily to diseases. This finding is in close agreement with previous reports but at variance with reports by Ojo who established through abattoir records that only few cases of caprine pneumonia were observed during the
harmattan period. The probable explanation for this observation could be that most animals that are brought to abattoir for slaughter are healthy animals or those carrying mild infections which could not be diagnosed during meat inspection. Haemonchus and Trichostrongylus species were most commonly identified in over 90% of the cases of gastrointestinal parasitism and were observed to be more prevalent during the rainy season which is in agreement with earlier reports of Akerejola et al.\textsuperscript{2}. The conditions of heavy rainfall and high relative humidity during this season are most favourable for the development and high infectivity of these two groups of helminths\textsuperscript{7}. This may be a possible explanation for the high number of cases of death due to gastrointestinal parasitism recorded during the rainy season. Trypanosomiasis and cowdriosis occurred in less than 15% each, while about 20% of the cases were diagnosed to have died of unspecified conditions like malnutrition, tumour or remained undiagnosed. For any disease control and eradication programme for goats to be effective in Zaria area of Nigeria, some efforts must be directed towards better housing and management for the goats so as to protect them against adverse climatic and environmental conditions and stress especially during the harmattan and dry seasons.

Acknowledgement

The author wishes to thank the members of staff in the Department of Veterinary Pathology and Microbiology, Ahmadu Bello University Zaria, Nigeria, who assisted in the diagnosis of the cases and Prof. G. S. Pandey of the Department of Disease Control, School of Veterinary Medicine, University of Zambia for helpful comments during the preparation of the paper and for reviewing the final manuscript.

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SHORT COMMUNICATION

PREVALENCE OF CLINICAL MASTITIS AND OF INTRAMAMMARY INFECTIONS IN NIGERIAN SHEEP

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There are nine million sheep in Nigeria with about three-quarters of the population concentrated in the Northern States.

The diet of the rural population in Nigeria is highly deficient in animal protein. This deficiency has been compounded by the Sahel drought of the past decades and the depletion of the cattle population by the past outbreaks of rinderpest. These losses in the cattle population have led to very high cost of beef, making it beyond the reach of average Nigerians. This has led to the growing need for mutton and goat meat as alternatives to beef.

Only very limited work had been done on ovine mastitis in Nigeria. Falade reported 100 cases of ovine mastitis among the ewes examined at Ibadan Abattoir. The literature is scanty on the prevalence of mastitis in sheep in Nigeria.

In Nigeria, losses from this disease in sheep may be enormous. Jensen observed that economic losses result from death of affected ewes, reduced milk production, starvation of lambs and cost of therapeutic programmes.

Ovine mastitis is a non-contagious disease of lactating ewes, characterised by severe, usually unilateral necrotising inflammation of the mammary gland. Behrens considered mastitis as the third most important disease of sheep in West Germany.

This paper reports on the clinical prevalence of mastitis and of intramammary infection in sheep, and the causative bacteria.

The work was carried out in four government established sheep farms in Kaduna and Kano States. The farms were NAPRI sheep project (Shika), University farm, A.B.U., Zaria and College of Agriculture and Animal Husbandry, Kaduna for Kaduna State, while only the livestock investigation and breeding centre, Danbatta in Kano State was visited.

Two breeds of sheep comprising Yankasa and Uda, common in the two states, were sampled. They were managed by a semi-intensive system. Various ages of the ewes at different stages of lactation were sampled. All the ewes in each farm were included in the study.

The udder was subjected to visual observation and manual palpation of each individual half of the udder and the teats. They were observed for asymmetry as evidenced by atrophy and variation in the size of the halves, and variation in teat position. Teat’s ends were observed for alterations such as wounds, scars, patent teat orifices and ease of milking. The milk was expressed from individual halves and examined for abnormalities (“Mastitis”) such as discolouration, clots, flakes, pus, blood staining or consistency.

Milk samples were collected from clinically-affected halves. Milk samples were obtained in sterilised sample bottles taking the usual aseptic precautions. They were brought immediately in ice (coleman flask) to the laboratory at A.B.U., Zaria.

Prior to half sampling, the initial fore milk streams were discarded. A form was designed for collecting clinical information on each animal. A total of 546 ewes were examined.

16 milk samples were collected and examined bacteriologically from the mastitic udders and 106 milk samples from apparently normal sheep were also examined bacteriologically using random numbers of sampling in selecting the control ewes within the various farms.

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* Corresponding author
A wire loop was used for milk inoculation into 5% sheep blood and Mac-Conkey agars. Plates were incubated aerobically at 37°C for 24 to 72 h. Plates were examined every day for bacterial growth. Organisms were examined for their morphological staining, cultural characteristics and their biochemical reactions according to standard keys\(^6,7\). Staphylococci were studied particularly for haemolysis and coagulase production (tube method using oxalated rabbit plasma in 1:10 dilution in a nutrient broth, incubated at 37°C and inspected at 30 min intervals for 5 to 6 h for clots formation). A positive coagulase test was judged by any degree of clotting from a loose clot suspended in plasma to a solid clot\(^8\).

Ewes were judged mastitic by the results of physical examination of the udder, teats and milk secretion and by bacteriological examination of the milk.

Of the ewes with mastitis, 14 (37.50%) had enlarged udders, and five (31.25%) of the affected ewes exhibited signs of pain on palpation. Five (31.25%) of the mastitic ewes had large areas of induration and fibrosis in the glandular tissue as revealed by the firmness of the mammary tissues (Table 1).

**Table 1:** Clinical signs of mastitis in 546 sheep.

<table>
<thead>
<tr>
<th>Clinical signs</th>
<th>No. of sheep</th>
<th>% of all sheep</th>
<th>% of sheep with mastitis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mammary gland:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot</td>
<td>3</td>
<td>0.5</td>
<td>18.8</td>
</tr>
<tr>
<td>Enlargement</td>
<td>14</td>
<td>2.6</td>
<td>87.5</td>
</tr>
<tr>
<td>Pain</td>
<td>5</td>
<td>0.9</td>
<td>31.3</td>
</tr>
<tr>
<td>Pitting</td>
<td>11</td>
<td>2.0</td>
<td>68.8</td>
</tr>
<tr>
<td>Firmness of mammary tissue</td>
<td>3</td>
<td>0.5</td>
<td>18.8</td>
</tr>
<tr>
<td>Induration</td>
<td>2</td>
<td>0.4</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>Mammary secretion:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloody</td>
<td>1</td>
<td>0.2</td>
<td>6.3</td>
</tr>
<tr>
<td>Teat injuries/pathology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old scars</td>
<td>9</td>
<td>1.6</td>
<td>56.3</td>
</tr>
<tr>
<td>Lacerations</td>
<td>2</td>
<td>0.4</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>Milk quality:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watery milk</td>
<td>6</td>
<td>1.1</td>
<td>37.5</td>
</tr>
<tr>
<td>Straw coloured milk</td>
<td>2</td>
<td>0.4</td>
<td>12.5</td>
</tr>
<tr>
<td>Yellowish milk (thick)</td>
<td>0.5</td>
<td>18.5</td>
<td></td>
</tr>
<tr>
<td>Flaky milk</td>
<td>9</td>
<td>1.6</td>
<td>56.3</td>
</tr>
<tr>
<td>Fibrinous clots</td>
<td>2</td>
<td>0.4</td>
<td>12.5</td>
</tr>
</tbody>
</table>

The contents of the lactiferous and teat cisterns of the mastitic ewes varied in consistency. Blood tinged milk 1 (6.25%); watery milk, 6 (37%) and fibrinous clots, 2 (12.5%).

All the cases in ewes were unilateral. 11 (68.75%) involved the right half of the udder, while 5 (31.25%) affected the left half.

Out of the 546 sheep examined, 16 (3%) had mastitis. Bacteriological examination of milk. On cultural examination of 16 milk samples collected from mastitic ewes, 7 (43.8%) grew one type of pathogenic bacteria; and 2 (12.5%) showed mixed infections.

Similarly, on bacteriological culture of 106 milk samples from apparently normal sheep udder, bacteria were detected in 39 (36.8%) samples. 67 (63.0%) samples yielded no growth. Thirty-five (33%) samples had growth of one type of bacterial species and 4 (3.8%) samples showed mixed bacterial infections. Of the 36 glands detected to be infected, 23 (58.47%) were right and 16 (41%) were left halves. Table 2 contains the frequency of isolation to the various bacteria from clinically affected and apparently normal udders.

**Table 2:** Frequency of isolation of bacteria from mastitic and apparently normal sheep.

<table>
<thead>
<tr>
<th>Bacterium</th>
<th>Sheep with mastitis</th>
<th>Sheep without mastitis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staphylococcus aureus</strong></td>
<td>6 (37.5)</td>
<td>3 (2.8)</td>
</tr>
<tr>
<td><strong>Escherichia coli</strong></td>
<td>3 (18.8)</td>
<td>8 (7.5)</td>
</tr>
<tr>
<td><strong>Klebsiella pneumoniae</strong></td>
<td>1 (6.3)</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>Coagulase negative-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>0 (0)</td>
<td>27 (25.5)</td>
</tr>
<tr>
<td>Non-haemolytic-Streptococcus</td>
<td>0 (0)</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>Negative cultures</td>
<td>7 (43.8)</td>
<td>67 (63.0)</td>
</tr>
</tbody>
</table>

The 3% clinical prevalence of ovine mastitis in this study was in general similar to that of who reported 2% prevalence of mastitis in 5,000 sheep.

*S. aureus* (37.5%) was the most common pathogen of ovine mastitis in the present study. The predominance of *S. aureus* in ovine mastitis has been reported by earlier workers\(^2,6,12\). This finding however, does not agree with the reports.
of Marsh\textsuperscript{13} and Tunnicliff,\textsuperscript{14} who considered \textit{P. haemolytica} to be the commonest causes of ovine mastitis.

Coagulase negative \textit{Staphylococcus} (25.5\%) predominated in the clinically-normal ewes. They may be just part of the normal flora of milk which collects in the milk cistern. Though Tunnicliff\textsuperscript{14} reported that normal ewe's milk is bacteriologically sterile and so that presence of coagulase negative \textit{staphylococci} may be of some significance.

In Nigeria, from this study and Falade\textsuperscript{2} ovine mastitis may be an important problem. Economic losses, need to be collated before definite opinion could be expressed on the disease. It was recommended that measures aimed at prevention and control be instituted.

\textbf{Acknowledgement}

Special thanks to the University of Maiduguri for providing financial support for the study.

\textbf{References}

SHORT COMMUNICATION

STUDY OF NEOPLASMS OF CHICKENS IN ZAMBIA
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Surveys on avian neoplasms with special reference to their incidence, histopathology, diagnosis and nomenclature were conducted in various laboratories. Our review of available literature revealed paucity of information on the prevalence and type of tumours of poultry in Central Africa. This is the first published report on tumours of chicken in the Republic of Zambia.

The materials used in this study were obtained from chickens brought for routine diagnosis from 1983 through 1993. An examination of over 4,000 autopsied birds of the age group from one to two years was carried out. Specimens from 44 chicken suspected for various neoplastic conditions on postmortem examination were collected in 10% formal saline. The tissues were processed through routine paraffin embedding technique, the sections were cut at 56 μm in thickness and stained with haematoxylin and eosin as a routine. The cases of Marek's disease and lymphoid leucosis were not included in this study.

Seventy organs from 44 chickens were found positive for one or other type of neoplastic conditions. The details of various neoplasms recorded is given in Table 1.

Table 1: Distribution of Neoplasms in different organs of chicken and their type.

<table>
<thead>
<tr>
<th>Type of Neoplasm</th>
<th>Organ</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenocarcinoma</td>
<td>Ovary</td>
<td>26</td>
</tr>
<tr>
<td>Leiomymoma</td>
<td>Oviduct</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td>Mesosalpinx</td>
<td>04</td>
</tr>
<tr>
<td>Secondary denocarcinoma</td>
<td>Oviduct</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td>Mesentery</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Pancreas</td>
<td>10</td>
</tr>
<tr>
<td>Nephroma</td>
<td>Kidney</td>
<td>01</td>
</tr>
<tr>
<td>Dermal squamous cell carcinoma</td>
<td>Skin</td>
<td>01</td>
</tr>
<tr>
<td>Fibroma</td>
<td>Skin</td>
<td>03</td>
</tr>
<tr>
<td>Histiocytic cell sarcoma</td>
<td>Skin</td>
<td>05</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>70</td>
</tr>
</tbody>
</table>

The ovary had the highest incidence of neoplasm. Out of 26 cases, 22 had multiple growths and were invariably enlarged. The cut surface of the neoplasm was fleshy and greyish in colour. The metastatic growth in mesentery pancreas and oviduct were marked by varying sizes of granular or nodular tumours. Microscopically the ovarian tumours in general were glandular in the form of irregular acini-like structures lined by low cuboidal or columnar cells with granular cytoplasm. In four cases the lumen of acini were filled with epithelial cells giving an appearance of solid carcinoma. Gland like structures lined by immature cuboidal or columnar cells with scantly connective tissue were the microscopic features of the metastatic growth in the mesentery, pancreas and oviduct. Leiomyoma in the oviduct were small, lentil to pea-size, hard and greyish pink in colour. One was situated on the serosal surface of the magnum and in three cases tumours were seen protruding from the mucosal surface of the oviduct. Tumours in the mesosalpinx were from pea-size to 2.5cm, firm and pinkish white in colour. Microscopically, haphazardly arranged bundles of smooth muscles were seen. Nephroma involved both the kidneys. Nine cases recorded in the connective tissue were histiocytic cell sarcoma(5) dermal squamous cell carcinoma(1) and fibroma(3), all from the skin. Tumours were firm, lumpy of various sizes and were attached to the skin. Dermal squamous cells carcinoma grossly appeared crater-like ulcers with raised edges. Microscopically, it contained nests and cords of carcinomatous epithelial cells and formed epithelial pearls.

The female reproductive system showed the highest number of neoplasms which is in agreement with work of many researchers. However Fredrickson and Helmblot believe that since few aged males are screened as compared to females the tumours of female reproductive systems are by far the most
frequently encountered. Since in the past few decades there has been increase in the tumors of the reproductive system of chicken, they attribute this increase to intensive method of breeding birds for the production of eggs.

Swarbrick et al.5 presented experimental evidence that prolonged reproductive activity may bear a direct relation to the development of adenocarcinoma of the target organ such as ovary and oviducts. In the present study majority of birds originated from layer flock kept for production of eggs. Presence of metastatic ovarian adenocarcinoma in the pancreas including duodenal loop of the intestine, mesentery and oviduct is in agreement with previous worker1, 4, 6, 9 who suggested that primary tumors are in the ovary and spread is by trancelomic implantation and direct contact. No metastasis to thoracic organs were observed. Leiomyoma of mesosalpinx and wall of the oviduct were most frequently reported tumors in the laying hens2, 4. Bergmann et al. reported 3.26% leiomyoma while we found 8 cases of this tumor out of 77. Pradhan and Nayak13 in a survey of reproductive tract tumors in chicken reported only one case of leiomyoma of oviduct out of 29 neoplasms encountered, Gross and microscopic morphology of dermal squamous cell carcinoma was similar to the report of Catelli12 who found 0.07% incidence of this tumor in the skin of chicken.

Although the present study is based on a very limited number of specimens screened, nevertheless it give clear idea of the prevalence of different types of neoplastic conditions found in adult and laying chickens in Zambia.

Acknowledgements

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References

SHORT COMMUNICATION

INCIDENCE OF CAPRINE PNEUMONIA OBSERVED AT POSTMORTEM IN SAMARU, ZARIA, NIGERIA.

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Goats with an estimated population of 34.45 million are the most important food producing animals in Nigeria in terms of number. The goat industry alone provides between 30 to 36% of the total meat consumption of the Nigerian populace annually. The incidence of respiratory and parasitic diseases in this species has adversely affected the country’s goat industry in recent times. Many authors have reported caprine pneumonia as one of the major respiratory disorders of goats prevalent in Nigeria and the type known as contagious caprine pleuropneumonia is apparently the leading clinical disease of goats widely reported in the country.

It has for long been established that one way of planning for control and eradication measures against diseases is by carrying out postmortem examination of all dead animals to ascertain the cause(s) of death. This study investigates the incidence of caprine pneumonia in Samaru Zaria, northern Nigeria through necropsy records from January 1977 to December 1987 and relates the information to previously available records of the disease in the area. Ways of control and eradication were suggested through analysis of the information gathered.

The data utilised in this study were obtained from necropsy records kept and maintained at the post mortem room for the Department of Veterinary Pathology and Microbiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria and the data from the Meteorological department of the same University was searched to determine the monthly rainfall and percentage relative humidity for the area during the period under study. The source of the animals in this study included dead animals that were presented for postmortem examination by members of the public around Zaria, institutional and government farms and the Veterinary Teaching Hospital. Total number of caprine species presented for necropsy over a period of eleven years (January 1977 to December 1987) was determined from the records. Monthly and yearly summary of the total number was evaluated and then correlated with the average rainfall and percentage relative humidity for the area.

The necropsy records from January 1977 to December 1987 showed that about 4,807 animals were presented for postmortem examination, out of which about 583 (12.10%) were goats and 132 (22.64%) of the goats died of pneumonia.

The total monthly incidence during the period was highest in August, then February, followed by March and then with equal incidences in January, May and July. These were followed closely by June, April, November and September in that order. Lowest monthly incidences were recorded in October and December with an equal number of cases. The records of the meteorological studies kept and maintained at the meteorological department of the University showed a period of wet season from April to October and dry season from November to March. There was a high percentage of relative humidity during the period of wet season with highest being in August.

Analysis of the records showed that the yearly incidence of the disease decreased drastically from January 1977 to December 1987 except for the sharp rise in 1987. The drastic decrease in incidence could be attributed to the establishment of a Veterinary Teaching Hospital in the area whose activities have undoubtedly led to the improvement of animal health services delivery in the area.

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The monthly incidence of the disease during the period is such that many cases of caprine pneumonia were encountered during the months of January, February and March which correspond to the dry, windy and cold period of “harmattan” and also during the months of July and August which also fall within the rainy season. The observed relative humidity was also high during this period (July and August) peaking in August. The incidence of the disease apparently increases with increase in relative humidity and rainfall. This finding appears to be in close agreement with that of previous studies\(^3\) which reported seasonality as one of the main features of the disease with heavy flock losses occurring during the harmattan and rainy seasons. Although some studies in the early seventies\(^5\) reported the status of the disease in the country as being not significant enough to warrant the production of a vaccine against it, current knowledge on the status of the disease in the country is such that the disease has since reached an alarming proportion and there is now the need to reassess the situation with the aim of controlling the disease through vaccination. The vaccination programme should be such that the animals are vaccinated twice annually. The first dose should be given at about the time that the rainy season is to set in, i.e. April and May while the second dose is to be given around November each year, i.e. period just preceding the Harmattan season. Heavy flock losses due caprine pneumonia could also be minimised through provision of shelter and better management practices that could protect the animals from adverse climatic and environmental hazards particularly during the cold and rainy seasons.

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

Présentation des articles
Deux exemplaires des articles doivent être adressés à Monsieur le Rédacteur en Chef, Bulletin de la Santé et de la Production Animales en Afrique, Organisation de l'Unité Africaine/Bureau interafricain des Ressources animales, P.O. Box 30786, Nairobi, Kenya.
Un article ne peut être soumis pour publication que s'il n'a pas encore été proposé ailleurs ; il fera l'objet de quelques modifications par le Comité de Rédaction.

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