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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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Introduction stating the purpose of the work.

Materials and Methods used.

Results presented concisely.

Discussion of significance.

Acknowledgements.

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

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

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CLINICAL, SEROLOGICAL AND PATHOLOGICAL RESPONSE IN GOATS INFECTED WITH CORYNEBACTERIUM PSEUDOTUBERCULOSIS THROUGH CUTANEOUS AND SUBCUTANEOUS ROUTES

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REACTION CLINIQUE, SEROLOGIQUE ET PATHEOLOGIQUE DES CHEVRES INFECTEES AVEC CORYNEBACTERIUM PSEUDOTUBERCULOSIS PAR VOIES OUTANEE ET SOUS-CUTANEE

Résumé

On a injecté des chèvres avec du pus caséiforme contenant 10^6 unités constituant une colonie (cfu) de Corynebacterium pseudotuberculosis par voie sous-cutanée (s/c) ou par voie intradermique (i/d). Les chèvres étaient également enduites avec du pus caséiforme sur la peau scarifiée ou sur la peau laissée intacte. Tous les animaux étaient ensuite examinés régulièrement pour détecter les anomalies cliniques ainsi que la présence des anticorps à C. pseudotuberculosis. Tous les animaux étaient tués 10 semaines après l'infection puis examinés afin de voir les lésions de la lymphadénite caséiforme (CLA). On a observé la boiterie aigue chez les animaux infectés s/c mais pas chez les autres groupes. Les ganglions lymphatiques régionaux sont apparus bien enflés trois jours après l'infection chez les animaux infectés i/d et chez un animal infecté sur la peau scarifiée. La voie d'infection n'avait pas d'effet sur le départ de la réaction sérologique, mais les animaux infectés i/d avaient une réaction plus rapide et plus forte. Lors de l'examen post-mortem, les animaux infectés s/c, i/d ou sur la peau scarifiée avaient des abcès dans les ganglions lymphatiques régionaux, tandis que ceux infectés sur la peau intacte n'en avaient pas. Ces résultats ont montré que CLA peuvent être transmises par voies s/c, i/d ou sur la peau scarifiée, en revanche une infection sur la peau intacte est peu probable. La maladie due à une injection i/d ou à une infection sur la peau scarifiée était une caractéristique plus typique de la maladie naturelle eu égard au fait qu'elle n'avait pas de signes cliniques aigus.

Summary

Goats were injected with caseous pus containing 10^6 colony forming units (cfu), of Corynebacterium pseudotuberculosis either subcutaneously (s/c), or intradermally (i/d) or smeared with caseous pus on either scarified or intact shaved skin. All animals were then examined regularly for clinical abnormalities and also for antibodies to C. pseudotuberculosis. All animals were sacrificed 10 weeks after infection and examined for caseous lymphadenitis (CLA) lesions. Acute lameness was observed in animals infected s/c but not in the other groups. The regional draining lymphnodes were detected palpably swollen by day three post infection in animals infected i/d and in one infected on scarified skin. The route of infection did not influence the onset of serological response but animals infected i/d had a more rapid and higher response. At postmortem, animals infected s/c, i/d or on scarified skin had abscesses in regional draining lymphnodes but those infected on intact skin had none. These results indicated that CLA can be transmitted through either s/c, i/d or through scarified skin but that infection through intact skin was unlikely. The disease induced by i/d injection or on scarified skin was more typical of the natural disease in that it had no acute clinical signs.

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Introduction

Infection in goats by Corynebacterium pseudotuberculosis leading to caseous lymphadenitis (CLA) is believed to occur principally through superficial skin wounds caused by sharp objects such as barbed wire, thorns or by fighting\(^1\). Infections may also occur through buccal mucosae abrasions caused by rough feed\(^2\). The source of infection is pus from discharging ruptured abscesses which contaminate the environment or directly contaminate skin and hair of other animals\(^3,4\). Rubbing the body against contaminated fencing posts could be important in transmission\(^5\) while contaminated dipping fluids can act as a source of infection for recently shorn sheep\(^6\).

Application of purulent material or bacterial culture on intact shorn skin can transmit the disease\(^6,7\). The present study was undertaken to investigate the transmission of CLA in goats through subcutaneous, intradermal and cutaneous routes and the subsequent clinical, pathological and serological responses.

Materials and Methods

Animals

Fourteen four-months-old Small East African male goats were prescreened for CLA by clinical and serological examination. They were then divided into five groups of 3, 3, 3, 3 and 2 animals. Each group was housed separately in a concrete stall with straw bedding. The animals were sprayed twice at two weeks interval with acaricide solution (Amitraz, 12.5% W/V, Kenya Swiss Co. Ltd.), at the concentration recommended by the manufacturer and also dewormed with albendazole, (Verbazine (R), Kenya Swiss Co. Ltd.) at 2mls per animal. The animals were fed with hay and wheat bran and water was provided ad. libitum. They were allowed two weeks of acclimatization before commencement of experiment.

Infectious material

Caseous abscess material was produced in a rabbit by a subcutaneous injection of 0.1ml of a 19-hour brain-heart infusion culture of C. pseudotuberculosis strain (HI 13) emulsified in incomplete Freund’s adjuvant. Two weeks later, the ripe abscess was lanced, the pus expelled into sterile universal bottles and stored at 4°C. A 10% (W/V) homogenate of the pus was prepared in sterile Ringer’s solution. The viable bacterial count of the abscess material was determined by plate count method on 10% ox blood agar using the surface drop technic\(^8\). Freshly prepared homogenate was used for infections.

Infection procedure

Table 1 summarises the experimental infection design. Each animal was infected at two sites, i.e. approximately 5 cm behind the right prescapular and precrural lymphnodes. An area approximately 2.5 x 2.5 cm on each site was shaved and animals in groups 1 and 2 injected s/c and i/d respectively with 0.4 ml of abscess homogenate containing 106 cfu at each site. In group 3, an area approximately 1.5 x 1.5 cm on the shaven site was superficially scarified using sterile scalpels blades and then smeared with undiluted caseous pus using sterile minispatulars. In group 4, a similar area on the sites was smeared with undiluted pus. Group 5 animals served as controls.

<table>
<thead>
<tr>
<th>Group</th>
<th>Goat Nos.</th>
<th>Route of infection</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1, 2, 12</td>
<td>Subcutaneous</td>
<td>1 x 10^6 cfu.</td>
</tr>
<tr>
<td>2</td>
<td>5, 6, 7</td>
<td>Intradermal</td>
<td>1 x 10^6 cfu.</td>
</tr>
<tr>
<td>3</td>
<td>8, 10, 11</td>
<td>Scarified skin</td>
<td>40 mg caseous pus</td>
</tr>
<tr>
<td>4</td>
<td>9, 13, 14</td>
<td>Intact skin</td>
<td>40 mg caseous pus</td>
</tr>
<tr>
<td>5</td>
<td>3, 4</td>
<td>Not infected</td>
<td>None</td>
</tr>
</tbody>
</table>

Clinical examinations

The injection/application sites, the right prescapular and precrural lymphnodes were examined daily for swellings. The contralateral lymphnodes served as controls for swelling in each animal. Blood for serology was collected on weeks 0, 1, 2, 3, 4, 6, 8 & 10 from each animal.
and discharges from infection sites were sampled for bacterial isolation.

**Serological analysis**

The haemolysis inhibition test (HIT), and the bacterial agglutination test (BAT), were performed\(^6,10\). Titres were read as \(\log^{10}\) the reciprocal value of the highest dilution of serum that inhibited haemolysis or agglutinated antigen respectively. HIT titres \(2 \geq 0.6\) and BAT titres \(\geq 2.1\) respectively were considered positive.

**Postmortem examination**

All animals were sacrificed 10 weeks post infection and postmortem carried out. The injection sites, the regional lymphnodes, the internal lymphnodes and organs were examined. Both test and control prescapular and precrural lymphnodes were excised, stripped of all extracapsular tissues, weighed and examined for abscesses. All abscesses were cultured for bacterial isolation.

**Statistical analysis**

Variation in weights of test and control lymphnodes was analysed by a T-test and variation in weights between the groups by analysis of variance. Serological results were analysed by analysis of variance\(^{11}\).

**Results**

**Clinical examination**

**Group 1**

One goat (No.12) died of pneumonia one day after infection. Two days post-infection, the two remaining animals were lame on the right hind leg and the injection sites were tender. On day three, the animals were weak, sickly, inappetent, and injection sites were swollen. Lameness disappeared after one week and the animals were apparently normal again. On the third week, swellings of injection sites were hard and circumscribed and prescapular infection site in goat No.1 was also discharging caseous pus. Test precrural lymphnode of the same animal and both prescapular and precrural nodes in goat No. 2 were also palpably swollen. All injection sites were discharging and test precrural nodes in both animals were visibly swollen by the fourth week.

**Group 2**

Injection sites and test regional lymphnodes were swollen by day three post infection in all animals. By day six, injection sites were discharging pus through fistulae. Two weeks post infection, there was caked pus on injection sites followed by scab formation and healing by week four. One goat (No.5), died of pneumonia on day 25 while another (No.6), developed a subcutaneous abscess close to the test prescapular lymphnode.

**Group 3**

The scarified sites were observed slightly swollen by day one. Test lymphnodes of goat No.8 were palpably swollen by day three. Within a week, there was scab formation on the scarified sites of all animals followed by healing. Test lymphnodes of goat Nos. 10 & 11 were slightly swollen by week three and the precrural lymphnode of goat No. 11 was visibly swollen by week five. Goat No.8 died of pneumonia on day 36.

**Group 4 and 5**

There were no clinically detectable changes in the animals during the course of the experiment. Lymphnode clinical examination results for all groups are summarised in Table 2.

**Serology**

Haemolysis inhibition test and BAT titres are shown in Figures 1a & b respectively. BAT titres were positive by week two for all goats in groups 1, 2 and 3. HIT titres were positive by week two in one animal in group 1 and two animals in group 2, and by week three in the other one animal in groups 1 and 2 and all three animals in group 3. No positive titres were observed in group 4 & 5. The differences in mean titres and the differences in weekly titre changes between groups were significant for both tests \((p = 0.001 < 0.05)\).
### Table 2: Clinical and postmortem (pm) findings in regional lymphnodes of goats infected C. pseudotuberculosis through different routes.

<table>
<thead>
<tr>
<th>Group</th>
<th>Infection Route</th>
<th>Goat No.</th>
<th>Lymphnode</th>
<th>Day</th>
<th>Week</th>
<th>Abscess AT PM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I</td>
<td>S/C</td>
<td>1</td>
<td>A</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>B</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>A &amp; B</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>II</td>
<td>I/D</td>
<td>5</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>III</td>
<td>Scarification</td>
<td>8</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>IV</td>
<td>Intact skin</td>
<td>13</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>V</td>
<td>Control</td>
<td>3</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>A &amp; B</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**KEY:** Route S/C = subcutaneous, I/D= intradermal, Lymphnode A = prescapular, B= precrural, + = positive, ++ = markedly positive, - = negative, 0 = no data

**Figure 1:** Weights of draining lymphnodes (prescapular (A) and precrural (B)) in goats infected with C. pseudotuberculosis through different routes.
Postmortem findings

Test prescapular and precrural lymphnodes of all animals in groups 1, 2 and 3 were abscessed (Table 1) and the abscessation was accompanied by weight increase (Fig. 2a & b). No other lymphnodes, superficial or internal, or internal organ was found abscessed in any animal. Animals in group 1 also had abscesses at the infection sites and goat No.6 of group 2 had a subcutaneous abscess close to test prescapular lymphnode. *C. pseudotuberculosis* was re-isolated in pure culture from all abscesses.

Figure 2: Serological response in goats following infection with *C. pseudotuberculosis* through different routes.

A = Haemolysis inhibition test (HIT);
B = Bacterial agglutination test (BAT)

Figure 2a & b shows the comparative mean weights of test and control lymphnodes. The weight difference was significant by an unpaired T-test, (p = 0.02 < 0.05) while the variation of the difference between groups was significant for precrural lymphnodes, (p = 0.04) but not for prescapular lymphnodes, (p = 0.08).

Discussion

The present results indicate that pseudotuberculosis in goats can be induced through introduction of infectious material either s/c, i/d or by contact with scarified skin. The results indicate that infection through intact skin is unlikely.

The four routes of experimentation were selected with consideration to the natural disease which usually involves superficial lymphnodes. It is generally accepted that infection takes place through skin wounds\(^6\,\,12\,\,13\), although infection of lymphnodes of the head region has been linked to abraded oral mucosae\(^2\). The disease occasionally affects internal lymphnodes and organs especially the lungs by dissemination via lymphatic and haematogenous routes but not through inhalation\(^14\).

Introduction of infectious material s/c produced the most severe clinical reaction. There was inappetence and lameness. Similar reactions including pyrexia and sometimes death, have been reported by others\(^15\,\,16\).

Intradermal infections produced the most rapid swelling of regional lymphnodes (3 days). Results elsewhere (unpublished data) however indicate that abscessation of the lymphnodes was not concurrent with swelling as the latter was mainly due to oedema. There was also abscessation of injection sites which then discharged and healed rapidly. Such discharges would be an important source of infection for other animals in the herd.

Animals infected on scarified skin developed a mild swelling of infection sites followed by scab formation and healing. Both regional lymphnodes were found abscessed at postmortem. In the present investigation, use of
caseous material rather than brolyh cultures probably enhanced transmission. The material remain attached to the sites, favouring retention of moisture, thus ensuring viability of the microorganism.

Animals infected by placing infectious material on intact shorn skin developed no infection contrary to reports by others. Transmission of CLA through intact skin would require that the organism invades through the keratinised epithelial barrier. Such reported infections therefore possibly occurred through minute shaving cuts.

Caseous lymphadenitis induced through i/d injection and by scarification appeared more typical of the natural disease as it had no acute clinical symptoms. Although general signs of ill health have been reported in goats during the period immediately following the appearance of CLA in a herd, the disease generally takes a chronic course. The severe clinical reaction indicated that s/c is an unlikely route of natural infection.

The route of infection did not influence the onset of serological response but the extent of the response was affected. The response was higher in animals infected i/d followed by those infected s/c (Fig. 2a &b). Also in animals that seroconverted, (groups 1,2 & 3) most had positive BAT and positive HIT titres by week two and week three respectively. This indicated that the BAT can detect C. pseudotuberculosis infections one week earlier than the HIT.

Acknowledgement
This work was supported by a grant from the Kenya Agricultural Research Institute (KARI) Agricultural Research Fund.

References

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RETORETROSPACTIVE STUDIES OF FUNGAL AND BACTERIAL FLORA OF CHICKENS IN ZARIA, NIGERIA

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ETUDES RETROSPECTIVES DE LA FLORE FONGIQUE ET BACTERIENNE DES POULETS A ZARIA AU NIGERIA

Résumé
Au total, 324 échantillons prélevés des poulets étaient examinés pour détecter la présence des microorganismes pendant une période de cinq ans (1990-1994). On a fait croître ces prélevements en milieux de culture appropriés à l'aide des méthodes bactériologiques et mycologiques habituelles. Différents organismes ont été aperçus à des degrés divers et leurs niveaux de prévalence étaient évalués. Les souches observées étaient les suivantes: Staphylococcus aureus, 51 (15.7%); Escherichia coli, 104 (33.6%); Salmonella gallinarum, 14 (4.3%); Pasteurella multocida, 16 (4.9%); Pasteurella haemolytica, 10 (3.1%); Aspergillus fumigatus, 8 (2.5%); Staphylococcus epidermidis, 9 (2.8%); Mycoplasma gallisepticum, 19 (5.9%); Corynebacterium pyogenes, 19 (5.9%); Proteus spp., 30 (9.3%); Candida spp., 10 (3.1%); Pseudomonas aeruginosa, 16 (4.9%); Bacillus spp., 5 (1.5%) et Klebsiella spp., 9 (2.8%). Cette étude a révélé que les organismes bactériens le plus souvent isolés des poulets à Zaria sont Escherichia coli, Staphylococcus aureus et Proteus spp.; elle fait également état de leur type de répartition dans les divers tissus et organes.

Summary
A total of 324 samples from chickens were investigated for the presence of microorganisms for a period of five years, 1990 - 1994. The samples were cultured on appropriate media by routine bacteriological or mycological methods. Various microorganisms were incriminated at different occurrence levels, and their prevalence levels were estimated. The isolates were: Staphylococcus aureus, 51 (15.7%). Escherichia coli, 104 (33.6%), Salmonella gallinarum, 14 (4.3%), Pasteurella multocida, 16 (4.9%), Pasteurella haemolytica, 10 (3.1%), Aspergillus fumigatus, 8 (2.5%), Staphylococcus epidermidis, 9 (2.8%), Mycoplasma gallisepticum, 19 (5.9%), Corynebacterium pyogenes, 19 (5.9%), Proteus spp., 30 (9.3%), Candida spp. 10 (3.1%), Pseudomonas aeruginosa, 16 (4.9%), Bacillus spp., 5 (1.5%) et Klebsiella spp., 9 (2.8%). This study has revealed that the most frequently isolated bacterial organisms from chickens in Zaria are: Escherichia coli, Staphylococcus aureus and Proteus spp. It also gives their distribution pattern in various tissues and organs.

Introduction
During the last decade, poultry industry in Nigeria has been the source of quick supply of animal protein to man, and provides faster returns to investment than ruminants. Despite this great advantage over ruminant, the country is losing millions of Naira through death of chickens due to viral, bacterial and fungal agents.

The most important microorganisms commonly isolated from chickens are Salmonella, Streptococcus, Staphylococcus, Escherichia, Pseudomonas, Pasteurella, Proteus and Klebsiella species. Some of these organisms are saprophytes, and are always present at low levels in the intestinal tracts of chickens. They become pathogenic when chickens are under stress situations. Thus, making the organisms to give specific infections that may result into serious economic losses due to morbidity and mortality caused by these agents.

Since the knowledge of the most common microorganisms in a particular environment is of value in comprehensive flock health
programme, this study, therefore, provides information on significant microorganisms that are common in chickens in Zaria, so as to provide a useful preventive knowledge in terms of disease diagnosis and possible control measures.

**Materials and Methods**

A total of 324 samples from chickens, including spleen, liver, lungs, intestine, ovary, trachea, ocular discharges and gall bladder were submitted to the Veterinary Microbiology Diagnostic Laboratory, Ahmadu Bello University, Zaria for analysis from 1990 to 1994. These samples were either cultured on appropriate media by routine bacteriological methods as described by Edwards and Ewing\(^3\) and Bush\(^4\) within one hour or preserved at 4°C for 24 – 48 hours before culturing. Samples for mycological investigations were cultured on Sabouraud’s dextrose agar as described by Bush\(^4\).

**Results and Discussion**

Various micro-organisms were isolated from different organs or tissues during this period (Table 1). Spleen and liver were the organs where the highest numbers of microorganisms were isolated.

This represents 58.39% and 20.7% of the organisms isolated from the spleen and liver and the trachea respectively, while 0.9% were isolated from the gall bladder (Table 1).

*Escherichia coli* was the most frequent micro-organisms isolated (33.6%). It was followed by *Staphylococcus aureus* and *Proteus spp.* with 15.7 and 9.3%, respectively. *Bacillus spp.* was the least frequent, (1.5%). *Aspergillus fumigatus* and *Candida spp.*, representing 2.5 and 3.1%, respectively were the only mycotic agents isolated during the period of study.

This study shows that these organisms isolated are present in the tissues and organs of chickens Some of them become pathogenic when the host immune system is weakened. This favours rapid multiplication of these organisms, especially in the intestine. Then, they move to other parts of the body.

*Escherichia coli* constituted the highest number of microorganisms isolated in this study. It is the most frequently reported complicating infection worldwide\(^5\). It causes colisepticaemia, omphalitis, enteritis and salpingitis in birds. Uncomplicated *E. coli* infection is known to be capable of causing airsacculitis, but produces more severe disease in mixed infections with *Mycoplasma gallisepticum*.

An infection rate of 71.3% by *Mycoplasma gallisepticum* and cultured *E. coli* from over 70% chronic respiratory disease (CRD) cases have been reported in the same environment\(^6\).

Nineteen isolates of *Mycoplasma gallisepticum* were obtained, with the highest isolates from the lungs followed by the trachea. CRD is believed to be caused by *M. gallisepticum*. The disease is very common in Nigeria\(^5\), and is often complicated by other bacterial and viral infections\(^6\). In about 50% of cases of infectious sinusitis in turkeys, *E. coli* and or *Proteus spp.* were isolated together with *M. gallisepticum* in Zaria\(^7\).

*Pasteurella haemolytica* and *Pasteurella multocida* are recognised pathogens of poultry. They may act as secondary invaders to other diseases as a result of stress. These organisms complicate CRD and could make laboratory diagnosis very difficult.

*Staphylococcus aureus* and *Staphylococcus epidermidis* accounted for 15.7 and 2.8%, respectively in this study. These organisms are found in the intestinal tract, throat and on the skin as harmless commensal, but occasionally they become pathogenic under suitable conditions. *Corynebacterium pyogenes* are opportunistic invaders, which could cause chronic infection. The organisms are found in many supplicative lesions.

*Klebsiella spp.* are common saprophytes in many parts of the environment. Sometimes they could be detected as commensals in the intestine. The organisms are easily destroyed at a temperature of 60°C for about 20 minutes. The use of potent disinfectants can eliminate the organism from poultry houses.
Table 1: Bacterial and fungal flora isolated from tissues and organs of chickens in Zaria.

<table>
<thead>
<tr>
<th>Microorganisms isolated</th>
<th>Spleen &amp; liver</th>
<th>Gall bladder</th>
<th>Trachea</th>
<th>Lungs</th>
<th>Intestine</th>
<th>Eye</th>
<th>Ovary</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasteurella haemolytica</td>
<td>2</td>
<td>—</td>
<td>4</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>10</td>
<td>3.1</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>26</td>
<td>1</td>
<td>15</td>
<td>2</td>
<td>—</td>
<td>2</td>
<td>3</td>
<td>51</td>
<td>15.7</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>80</td>
<td>2</td>
<td>14</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>104</td>
<td>33.6</td>
</tr>
<tr>
<td>Salmonella gallinarum</td>
<td>14</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>14</td>
<td>4.6</td>
</tr>
<tr>
<td>Pasteurella multocida</td>
<td>6</td>
<td>—</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>16</td>
<td>4.9</td>
</tr>
<tr>
<td>Aspergillus fumigatus</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>6</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>8</td>
<td>2.5</td>
</tr>
<tr>
<td>Staphylococcus epidermidis</td>
<td>8</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>9</td>
<td>2.8</td>
</tr>
<tr>
<td>Mycoplasma gallisepticum</td>
<td>1</td>
<td>—</td>
<td>7</td>
<td>10</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>19</td>
<td>5.9</td>
</tr>
<tr>
<td>Corynebacterium pyogenes</td>
<td>13</td>
<td>—</td>
<td>4</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>19</td>
<td>5.9</td>
</tr>
<tr>
<td>Proteus spp.</td>
<td>17</td>
<td>—</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>30</td>
<td>9.3</td>
</tr>
<tr>
<td>Candida spp.</td>
<td>6</td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>10</td>
<td>3.1</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>11</td>
<td>—</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>16</td>
<td>4.9</td>
</tr>
<tr>
<td>Bacillus spp.</td>
<td>2</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>Klebsiella spp.</td>
<td>1</td>
<td>—</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>—</td>
<td>—</td>
<td>9</td>
<td>2.8</td>
</tr>
<tr>
<td>Total</td>
<td>189</td>
<td>3</td>
<td>67</td>
<td>31</td>
<td>14</td>
<td>9</td>
<td>11</td>
<td>324</td>
<td>100</td>
</tr>
<tr>
<td>Percent total (%)</td>
<td>58.3</td>
<td>0.9</td>
<td>20.7</td>
<td>9-6</td>
<td>4.3</td>
<td>2-8</td>
<td>3-4</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Of the total number of organisms isolated, 4.3% were Salmonella gallinarum. The organism causes fowl typhoid. The disease is enzootic and is recognised as an important impediment to poultry production in Nigeria. The disease is a threat to many poultry farms. It is important, therefore, that salmonella-free birds be introduced into the flock.

Aspergillus fumigatus is widespread in nature. It causes aspergillosis in chickens. High mortality rate in chickens has been reported as a result of pulmonary aspergillosis in Nigeria.

Candidiasis, caused by a species of genus Candida, is a sporadic disease of the alimentary canal of poultry sometimes having a high mortality rate. In general, it is accepted that Candida spp. may be included with the typical intestinal flora. This is because the organisms can be isolated frequently from faeces or gastro-intestinal tracts of normal birds, man and animals.

In conclusion, this study has been able to reveal that the three most commonly isolated bacterial organisms from chickens in Zaria are Escherichia coli, Staphylococcus aureus and Proteus spp. Such information will be of value for prompt diagnosis, prophylactics and even treatment of bacterial and fungal diseases of chickens. Also, this study has given an insight into the distribution of organisms in various tissues and organs of chickens. Therefore, it could serve as a guide for the isolation of organisms from various tissues and organs of chickens in the laboratory.

References

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Materials and Methods...

The disease is very common in Nigeria's animal population and is believed to be caused by M. gallisepticum. This bacteria is very sensitive to antibiotics, and its epidemiology is complex. In about 50% of cases, other bacteria are associated with the disease. A. gallinarum and E. coli are the bacteria most commonly associated with the disease. The disease is transmitted by contact, by fomites, and through aerosols. M. gallisepticum is a Gram-negative bacterium that is highly adapted to avian hosts. It is a small, comma-shaped bacterium that is motile by means of flagella. The bacterium is able to attach to the respiratory tract epithelial cells and to replicate within the cells, causing the characteristic respiratory symptoms of the disease.

The disease is often diagnosed by the presence of characteristic clinical signs, such as coughing, dyspnea, and conjunctivitis. The diagnosis can also be confirmed by the detection of M. gallisepticum in respiratory samples, such as nasopharyngeal swabs or tracheal aspirates, using laboratory techniques such as culture, PCR, or immunohistochemistry. The treatment of M. gallisepticum infection is based on the use of antibiotics, such as tetracyclines or macrolides, which are effective in reducing the bacterial load and improving clinical signs. However, the use of antibiotics is recommended for a short period of time, as the disease is self-limiting and may resolve without treatment.

The control of M. gallisepticum infection in poultry flocks is based on the use of vaccines, which are available in different types, including inactivated vaccines, live attenuated vaccines, and recombinant vaccines. The choice of vaccine depends on various factors, such as the age of the birds, the vaccination strategy, and the availability of vaccines. The use of vaccines can reduce the incidence of the disease and the shedding of M. gallisepticum in the environment, which can help to control the spread of the disease.
PROTECTION OF SOME CATTLE AGAINST LETHAL CHALLENGE WITH VIRULENT MALIGNANT CATARRHAL FEVER VIRUS (ALCELAPHINE HERPESVIRUS 1).

P. K. MIRANGI.
National Veterinary Research Centre, Kenya Agricultural Research Institute, P.O. Box 32, Kikuyu

PROTECTION DE CERTAINS BOVINS CONTRE L’INFECTION MORTELLE AVEC LE VIRUS VIRULENT DE LA FIEVRE CATARRHALE MALIGNE (ALCELAPHINE HERPESVIRUS 1)

Résumé
Seize bouvillons ont été inoculés deux fois à une semaine d’intervalles avec des titres réduits du virus 707K. Ils étaient ensuite infectés artificiellement avec le virus virulent de la fièvre catarrhale maligne, Alcelaphine herpesvirus 1 (AHV-1) souche C500. Neuf bouvillons ont survécu à l’infection, ce qui montre que le virus 707K a conféré une protection d’environ 56%. Tous les animaux immunisés avec le virus 707K ont développé un anticorps neutralisant le virus AHV-1; en revanche, l’inoculation n’avait pas d’effets sur l’issue de l’infection avec le virus virulent AHV-1. Le virus 707K n’a pas pu être isolé de nouveau des bouvillons immunisés.

Summary
Sixteen steers were inoculated twice weekly with reduced titres of 707K virus. They were then artificially challenged with virulent malignant catarrhal fever virus, Alcelaphine herpesvirus 1 (AHV-1) strain C500. Nine survived the challenge, giving protection of about 56%. All the animals immunized with the 707K virus developed serum neutralizing antibody to AHV-1 virus, which did not influence the outcome of the challenge with the virulent AHV-1. 707K virus was not re-isolated from any of the immunized steers.

Introduction
Malignant catarrhal fever (MCF) is a fatal disease of cattle and certain other ruminants, characterized by lymphadenopathy, profuse ocular, nasal discharges, anitis, and inflammation of the conjunctival, oral and nasal mucosae. The disease is caused by infection of the susceptible hosts with one of two gamma herpesvirus; AHV-1, indigenous to wildebeests (Connoch aetes species), or Ovine herpesvirus 2 (OHV-2), suspected to originate from sheep, although it has not been propagated in tissue culture from that source.

While there is no known curative or prophylactic measures available to date, animals which recover from MCF, develop solid immunity. Attempts to develop a vaccine against MCF have been largely unsuccessful. High titres of the virus 707K, which was isolated from a cow exhibiting clinical MCF, suspected to be of sheep origin, were shown to confer protection against virulent challenge, when administered in two weekly inoculations. In this work, reduced amounts of this virus were used to test for the protection against virulent unnatural challenge with virulent AHV-1 virus.

Materials and Methods

Viruses
AHV-1 virus is the causative agent of the wildebeest associated MCF (WA-MCF). In this work, virulent AHV-1, strain C500, was used to challenge the cattle immunized with 707K and WC 11 viruses. The avirulent cell-free strain of AHV-1, WC1, was used to inoculate cattle in the control experiment. 707K virus is an AHV-1 related virus initially isolated from a cow showing clinical MCF in Minnesota USA, following close association with lambing ewes.
This virus was used after 7 passages in bovine kidney cells and six passages in bovine thyroid cells.

Cattle inoculations

Twenty-two steers were screened and found negative for AHV-1 neutralizing antibody, and therefore suitable for this experiment. One steer (PM 12) was inoculated intravenously with $10^{2.0}$ TCID$_{50}$/ml of virulent AHV-1 virus. 18 steers were each immunized twice intramuscularly, with 707K virus at the titre of $10^{3.0}$ TCID$_{50}$/ml at an interval of one week. Of the remaining animals, two were each inoculated with $10^{5.0}$ TCID$_{50}$/ml of the avirulent AHV-1 virus strain WC 11 intra-muscularly, while one steer was left as unoinoculated control. All the animals in the experiment were clinically monitored on a daily basis. Rectal temperatures were recorded, and buccal membranes examined daily. Serum neutralization test was carried out in microtitre plates for all the animals in the experiment. The animals were also monitored for viraemia on a weekly basis, by culturing their respective blood buffy coats in tissue culture.

Thirty-eight days post inoculation with virulent AHV-1 virus, steer number PM 12 showed fever, with pink buccal membranes lymphadenopathy and increased lacrimation and a diagnosis of MCF was arrived at. Syncytial cytopathic effects were observed in tissue culture inoculated with buffy coats obtained from this steer. All the steers in the experiment were each inoculated intravenously with 10 ml of virulent whole blood from PM 12, 42 days after the second inoculation with 707K and WC 11 virus strains. The animals were thereafter monitored clinically on a daily basis and, for the animals that reacted, attempts were made to isolate the virus in tissue culture.

Results

No clinical entity similar to MCF was observed in any of the 18 steers immunized with the 707K virus; the two steers inoculated with WC 11, or in the uninoculated control, prior to challenge. 707K virus was not isolated from any of the immunized animals, neither was WC 11 virus isolated from the two steers inoculated with it. However steer number Pm 11, immunized with 707K virus died suddenly of bloat, while theileriosis was diagnosed in Pm 21 and the animal succumbed to it.

No serum neutralizing antibody was observed on day 0, the day of the first immunization with 707K virus and inoculation with WC 11. Equally, except in one case where only trace neutralizing antibody was observed, no development of antibody was observed on day 7 following immunizations and inoculations, when the second set of inoculations was carried out. Development of varied amounts of neutralizing antibody was thereafter observed in all animals except the uninoculated control (Table 1). Some of the animals showed only trace antibody development, as observed for Pm 10, which did not come down with MCF disease after the challenge.

Of the remaining 16 steers immunized with 707K virus, seven contracted MCF disease following challenge with virulent AHV-1, with incubation periods ranging from 18 to 30 days expected of MCF disease, and all succumbed to the disease after disease courses ranging from 9 to 12 days (Table 1). The two steers inoculated with WC 11 virus, also developed MCF disease, following challenge and succumbed to it. The uninoculated control died of MCF.

Discussion

The natural transmission of MCF virus from the wildebeest or from the sheep is largely unexplained. In the case of WA-MCF, the demonstration of cell-free MCF virus in the wildebeest calves' nasal secretions, in low titres, could suggest that, cattle are infected from aerosols from that source. Where sheep-associated MCF is concerned it is difficult to speculate the source of infection to cattle, since no virus has been isolated from the reservoir host. Be it as it may, the virus titres in this host should be very low where infection of cattle under natural conditions is concerned. The challenge system used for this experiment was
### Table 1: Steers immunized with 707K virus

<table>
<thead>
<tr>
<th>Steers</th>
<th>Day 0</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 27</th>
<th>Day 34</th>
<th>Incubation</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pm 1</td>
<td>0.0</td>
<td>0.0</td>
<td>1.05</td>
<td>0.825</td>
<td>1.05</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>Pm 2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.825</td>
<td>0.525</td>
<td>0.45</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>Pm 3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.45</td>
<td>Trace</td>
<td>Trace</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.525</td>
<td>1.05</td>
<td>0.825</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.45</td>
<td>1.135</td>
<td>1.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.825</td>
<td>1.125</td>
<td>0.75</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 10</td>
<td>0.0</td>
<td>0.0</td>
<td>Trace</td>
<td>Trace</td>
<td>Trace</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 13</td>
<td>0.0</td>
<td>0.0</td>
<td>0.45</td>
<td>0.45</td>
<td>1.05</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>Pm 14</td>
<td>0.0</td>
<td>0.0</td>
<td>0.825</td>
<td>0.525</td>
<td>0.825</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>Pm 15</td>
<td>0.0</td>
<td>0.0</td>
<td>0.525</td>
<td>0.75</td>
<td>Trace</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 16</td>
<td>0.0</td>
<td>0.0</td>
<td>0.75</td>
<td>0.45</td>
<td>Trace</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>Pm 17</td>
<td>0.0</td>
<td>0.0</td>
<td>0.825</td>
<td>N/D</td>
<td>1.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 19</td>
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<td>0.0</td>
<td>1.05</td>
<td>N/D</td>
<td>1.05</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>Pm 20</td>
<td>0.0</td>
<td>0.0</td>
<td>0.525</td>
<td>N/D</td>
<td>0.525</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 23</td>
<td>0.0</td>
<td>0.0</td>
<td>1.125</td>
<td>N/D</td>
<td>0.45</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pm 25</td>
<td>0.0</td>
<td>0.0</td>
<td>1.05</td>
<td>N/D</td>
<td>0.525</td>
<td>30</td>
<td>12</td>
</tr>
</tbody>
</table>

### Steers inoculated with WC11 virus

<table>
<thead>
<tr>
<th>Steers</th>
<th>Day 0</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 27</th>
<th>Day 34</th>
<th>Incubation</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pm 6</td>
<td>0.0</td>
<td>Trace</td>
<td>1.125</td>
<td>1.05</td>
<td>0.825</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>Pm 18</td>
<td>0.0</td>
<td>0.0</td>
<td>0.45</td>
<td>N/D</td>
<td>0.525</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>

### Uninoculated control

<table>
<thead>
<tr>
<th>Steers</th>
<th>Day 0</th>
<th>Day 7</th>
<th>Day 14</th>
<th>Day 27</th>
<th>Day 34</th>
<th>Incubation</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pm5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>20</td>
<td>9</td>
</tr>
</tbody>
</table>

N/D = Not Done
Incubation and Disease course = Days

Both unnatural and severe in that, blood at the height of fever was transfused directly from the sick animal to the steers. Further in this report, the amount of 707K virus used for the immunizations was reduced from the previously reported titre of $10^{5.0}\text{TCID}_{50}/\text{ml}$ to $10^{3.0}\text{TCID}_{50}/\text{ml}$. The original work with this virus used concentrated virus for the immunizations.

However, in spite of the stringent conditions taken in the current experiment, nine steers out of the 16 immunized with 707K virus resisted the challenge, giving approximately 56% protection rate. The development of serum neutralizing antibody did not influence the outcome of the challenge, which is expected of MCF infection. Attempts to re-isolate 707K virus from the steers was unsuccessful, while the re-isolation of virus from the virus-donating animal was achieved.

Previous work showed that animals inoculated with 707K virus for more than 3 times could develop MCF disease. As expected all the animals inoculated twice with this agent in this experiment did not develop the disease.
From the foregoing therefore, it can be concluded that 707K virus has that inherent potential to protect cattle against the disease of MCF, and that, an experiment under natural conditions should now be considered. Such work would however require proper timing and conditions to ensure that as many animals as possible are exposed to the natural challenge conditions in wildebeest-infested habitats.

Acknowledgments

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References


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PREVALENCE ET VARIATION SAISONNIÈRE DES INFECTIONS PARASITAIRES INTERNES DES BOEFS DE TRAIT DANS LA ZONE COMMUNALE D'EXPLOITATION DE CHIWESHE AU ZIMBABWE

Résumé

On a mené pendant une année une enquête sur la prévalence et la variation saisonnière des infections parasitaires internes des boeufs de trait dans la zone communale d'exploitation de Chiweshe au Zimbabwe. Au total, 162 échantillons de fèces prélevés de 10% des boeufs étaient examinés chaque mois pour déterminer le nombre d'œufs d'helminthes et d'ovocytes coccidians par gramme de fèces (EPG et OPG). La numération des larves de strongyles infectieux (L3) était déterminée après la culture des échantillons fécaux collectés.

L'espèce paramphistome (66,6%), *Fasciola gigantica* (66,4%) et les strongyles (54,5%) étaient les parasites les plus prévalents, suivis par les coccidies et *Schistosoma matthei* dont la fréquence était relative. L'infection avec *Moniezia* et *Trichuris* était très faible. En moyenne, 65,6% des boeufs de trait avaient des infections parasitaires multiples.

56,6% des animaux avaient une faible charge de *Fasciola*, 28,7% avaient une charge moyenne et 14,8% avaient une charge élevée. Par ailleurs, 93,2% des animaux avaient une faible charge de strongyles et 6,8% avaient une charge moyenne. Les larves de *Haemonchus*, *Cooperia*, de *Trichostrongylus* et d*’Oesophagostomum* ont été identifiées sur la coproculture, et la prévalence des larves des deux premiers parasites a été évaluée. Il semblerait que la prévalence de l'infection des parasites internes chez les boeufs de trait ait affecté leur indice de conversion alimentaire, leur conformation ainsi que leur rendement en tant que force de traction.

Summary

A survey of the prevalence and the seasonal variation in internal parasitic infections of draught oxen in the Chiweshe Communal Farming Area in Zimbabwe was carried out over a period of one year. A total of 162 faecal samples from 10% of the oxen were examined every month for helminth eggs and coccidial oocysts per gram of faeces (EPG and OPG). The infective strongyle larvae (L₃) were determined, following culture of pooled faecal samples.

Paramphistome species (66.6%), *Fasciola gigantica* (66.4%) and strongyle nematodes (54.5%) were the most prevalent parasites. Coccidia and *Schistosoma matthei* followed with respect to the relative frequency of occurrence. Infection with *Moniezia* and *Trichuris* was very low. An average of 65.6% of the draught oxen harboured multiple parasite infections.

Fifty-six percent of the animals had low *Fasciola* burdens, 28.7% moderate and 14.8% high. 93.2% of the animals had low strongyle burdens and 6.8% moderate. *Haemonchus*, *Cooperia*, *Trichostrongylus* and *Oesophagostomum* larvae were identified on coproculture and the prevalence of the first two calculated. The prevalence of infection of internal parasites in draught oxen was thought to affect their feed conversion, body condition and work output.

Introduction

Sixty-seven percent of the cattle herds in Zimbabwe are found in the Communal Farming Areas (CFAs)¹ and twenty-five to thirty-four percent of them are draught oxen². They form an important link in the communal farming system through the provision of inputs for crop production, as seventy-five to eighty percent of the farm power comes from animal traction³. The major source of power for the communal farmer is cattle and the preferred draught animal
is the ox, though cows and donkeys are increasingly used for draught power. Other contributions of the ox to peasant economies are transport, hiring, meat, capital and a relatively liquid asset for disposal in times of cash needs.

The main constraint in management of draught oxen is timely and adequate feed supply. It leads to the necessity of supplementary high-energy feeding about six weeks prior to the beginning of the working season. This coincides with the time of the year when nutritional levels are poor. Usually draught oxen are in poor condition at the onset of the rainy season, the time when they are most needed for land preparation. At this time they have the first access to crop residues and to the veld, which are the most important sources of their energy requirements.

Although considerable progress has been made in the control of the major contagious epidemics of cattle in Zimbabwe, the production losses caused by less visible chronic diseases such as internal parasitosis is now becoming more evident. The presence of high levels of infection by internal parasites in the communal land cattle is thought to be due to over-population, over-grazing, poor husbandry, use of dams and rivers as watering points, poor nutrition of animals and lack of helminth control. However, the importance of internal parasitism as a constraint in the health of draught oxen and its effect on their productivity are not well recognised. Since the health of oxen influences the power available to the communal farmers, internal parasitic infections should be of prime consideration for the draught power problem.

The objective of the present survey was to identify the principal internal parasites, determine their prevalence, frequency and seasonality and to classify the parasitic burdens of draught oxen in the Chiweshe Communal Farming Area (ChCFA) of Zimbabwe. This information will be of benefit in formulating treatment and advice for control measures to communal farmers and in modelling appropriate strategies to meet the power requirements of farmers using draught oxen.

**Materials and Methods**

**Study area**

The survey was carried out in the Chiweshe Communal Farming Area, situated in Northern Zimbabwe, in the Mashonaland Central Province (16°46' — 17°15'S, 30°57' — 31°—14'E, 1200 m in altitude). The area covers 86,200 ha, lying within the Zimbabwe climatic region Iia. Rainfall is confined to summer and is moderately high (880 mm). This area receives an average of 18 rainy pentads per season and normally enjoys reliable conditions, rarely experiencing severe dry spells in summer. Mean environmental temperatures vary between a daily minimum of 4.7°C in July and a daily maximum of 28.7°C in October.

The pastures consist of unimproved grassland and scrub. The grassland management practices are poorly developed and the same pastures are grazed throughout the year. The land tenure is communal.

Generally, the climatic and husbandry conditions within the ChCFA are representative of the CFAs in the Northern part of the country.

**Meteorological observations**

Daily rainfall, daily minimum and maximum temperatures were recorded at the study site.

**Animals**

The mean total number of cattle in ChCFA was 51,575, almost exclusively of the indigenous Mashona breed (*Bos indicus*), distributed in three sub-areas. Draught oxen from a dip tank from each of the sub-areas were used as survey animals. Usually they graze with other communal cattle on pastures during the day and are kraaled at night. During periods of agricultural operation the draught oxen are denied access to pastures and are provided fodder and sometimes concentrates. They drink water from the local rivers and pools and in the very dry months, from wells. During the course of the survey period the animals received no anthelmintic drugs. Anthelmintic treatment of communal cattle is either nonexistent or very occasional.
and irregular. The animals were dipped routinely in acaricide for tick control and vaccinated for anthrax.

**Parasitological analysis**

Individual faecal samples were collected from the rectum of 10% of the draught oxen, (an average of 162 animals), randomly selected once every month from February 1993 to January 1994. A total of 1,944 faecal samples were examined from the oxen at three dipping sites during the one-year period. Faecal egg counts were performed by the standard McMaster technique using a flotation medium with a specific gravity of 1.3. The McMaster technique identified coccidial oocysts, strongyle and cestode eggs, which in all cases were expressed as oocysts or eggs per gram of faeces (OpG or EpG). Faecal samples were also examined for trematode eggs by the sedimentation technique.

On the same occasions, pooled samples were cultured for harvest and identification of infective third stage nematode larvae (L₃). At least 100 L₃ were identified each month to determine the potential generic composition of the strongyle gastrointestinal nematodes. Here the term strongyle refers to both Trichostrongyliid species and *Oesophagostomum*.

Parasite burdens were classified using guidelines given by Skeerman and Hillard for faecal egg counts of *F. gigantica* and strongyles. For analysis of data, the term prevalence was defined as the percentage of hosts infected.

**Results**

The results of meteorological observations during the period of survey in relation to a 30-year period averages are presented in Fig 1. The total monthly rainfall was higher than average for February, March and November and below for December and January. Except for minor variations the temperature values were in the average ranges throughout the survey period.

---

**Fig.1. MAXIMUM AND MINIMUM MONTHLY MEAN TEMPERATURES AND TOTAL MONTHLY RAINFALL IN ChCFA DURING 1993/4 IN RELATION TO 30 - YEAR AVERAGES**

- Max temp °C (1993/4)
- Min temp °C (1993/4)
- Max temp °C (30 years)
- Min temp °C (30 years)
- Rainfall mm (1993/4)
- Rainfall mm (30 years)
The draught oxen in ChCFA examined were found to be infected with several genera of internal parasites (Table 1). More than half of the animals were infected with three genera of helminths, identified in the present survey. Table 1 clearly denotes that eggs of the trematodes of paramphistome species (66.6%) and *Fasciola gigantica* (66.4%) were the predominant ova passed by the infected animals followed by the strongyle group with an infection rate of 54.5%. Four other internal parasites namely coccidia (3.9%), *Schistosoma mattheei* (2.2%), *Moniezia benedeni* (0.2%) and *Trichuris globulosa* (0.2%) occurred at low prevalences.

**Table 1:** Prevalence and relative frequency of the various internal parasites of draught oxen in the ChCFA.

<table>
<thead>
<tr>
<th>Species</th>
<th>Prevalence</th>
<th>Relative frequency %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paramphistome species</td>
<td>66.6</td>
<td>34.3</td>
</tr>
<tr>
<td><em>Fasciola gigantica</em></td>
<td>66.4</td>
<td>34.2</td>
</tr>
<tr>
<td>Strongyle species</td>
<td>54.5</td>
<td>28.2</td>
</tr>
<tr>
<td>Coccidial oocysts</td>
<td>3.9</td>
<td>2.0</td>
</tr>
<tr>
<td><em>Schistosoma mattheei</em></td>
<td>2.2</td>
<td>1.1</td>
</tr>
<tr>
<td><em>Moniezia benedeni</em></td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td><em>Trichuris globulosa</em></td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

The mean monthly prevalences of paramphistome species, *F. gigantica* and strongyle species in faeces of draught oxen in the ChCFA are presented in Fig.2. Paramphistomes formed the most prevalent gastrointestinal parasites. Paramphistome eggs were consistently present in the faeces of oxen, with the lowest rate in June (33.5%) and a peak in January (98.3%). *F. gigantica* eggs were also consistently present in faecal samples. The lowest prevalence occurred in April (39.9%) and was highest in January (84.4%) (Fig.2).

Regarding the intensity of *F. gigantica* infection, examined oxen could be classified into low (EpG < 10), moderate (EpG 10 – 25) and high (EpG > 25) burdens, representing a total percentage of 56.5, 28.7 and 14.8% respectively. Consequently, the majority of animals had low *Fasciola* burdens.

In this survey, from 1,944 faecal samples examined 1,059 contained strongyle eggs with an overall prevalence of 54.5%. The lowest monthly percentage frequency of strongyle ova in faeces was recorded in September (40.7%) and highest in March (79.9%), Fig.2.
According to the strongyle faecal egg counts in individual samples, the animals are distributed into low (EpG < 200), moderate (EpG 200 – 700) and high (EpG > 700) intensity of infection, representing a total percentage of 93.2%, 6.8% and 0% respectively. Hence, most of the oxen harboured low strongyle burdens.

Culturing of faecal samples revealed that infective strongyle larvae representing four genera could be identified (Fig.3). The predominant genera were *Haemonchus* and *Cooperia* followed by *Trichostrongylus* and *Oesophagostomum*. The proportion of *Haemonchus* larvae was between 7% and 88% during the whole survey period. Their percentage frequency in faecal cultures was lowest in June and showed a peak in March. The relative abundance of *Haemonchus* larvae followed the same trend as that of the total monthly prevalences of strongyle eggs shed during the different seasons of the year (Figs 2 and 3). *Cooperia* larvae were the second most dominant in faecal cultures (mean 29%). They were more abundant during the dry season with the exception of August when the frequency of their distribution was low. *Trichostrongylus* and *Oesophagostomum* larvae were found in relatively low proportions. However, they increased gradually through the dry season to reach a peak in June – August.
The monthly prevalences of Coccidia oocysts and Schistosoma mattheei ova excreted in faeces of draught oxen are shown in Fig.4. Generally, the seasonality of coccidial infection reflected the rainfall pattern. Schistosoma infection was more prevalent in May and November.

Moniezia benedeni and Trichuris globulosa ova occurred in oxen faeces only occasionally in very low numbers and their levels were apparently not affected by seasonal fluctuations.

A total of 65.6% of oxen harboured multiple parasites species. The highest isolation percentage frequency was observed in animals with multiple infections by paramphistome species, F. gigantica and strongyloides species, followed by infection with paramphistomes and strongyles and by paramphistomes and Fasciola.

Discussion

The results of this survey revealed that the most predominant and commonest parasites isolated were Paramphistome spp, Fasciola gigantica and Strongyle spp, while Moniezia benedeni and Trichuris globulosa were the least prevalent. The internal parasites found in this survey were, therefore, composed of a number of helminths and internal protozoa which are common in Southern Africa16,17,18,19.

Relevant information regarding prevalence of paramphistome infection of cattle in this country is scanty. It has been reported that the species found to infect cattle in Zimbabwe are: Cotylophoron cotylophorum 20, Cotylophoron jacksoni, Calicophoron calicophorum, C. clavula, C. microbothrium, C. phillerouxi, and C. sukumum18. The pathogenic effect of paramphistomes on the physiology of the draught oxen is unknown. It is highly dependant upon severity of infection, the location of the parasites and the age of the host. Little, if any, pathogenic effect is associated with the presence of the adult paramphistomes in the rumen and reticulum. Major pathogenic effect is caused by immature flukes in the duodenum. According to the author’s observations in this survey, outbreaks of clinical disease occurred in the dry months when the grazing was available only around the watering areas. The livestock became concentrated in this diminished available grazing where the snail population was also concentrated, contaminating it heavily with metacercariae. Previous infection and the age of the host are said to afford some protection against reinfection and hence acute disease is seen in younger animals while older animals seed the environment with eggs21.

The current survey has shown that F. gigantica is widespread in occurrence in the study area and has a high percentage frequency in draught oxen. The prevalence of infection with mature F. gigantica was considerably higher than reported before in communal cattle of Zimbabwe22. However, the information on prevalence and seasonality of F. gigantica is largely anecdotal23,24,25,26. Various workers have looked into the effects of Fasciola infection on productivity in cattle but very little work has been done to identify possible associations with changes in output in draught animals. Since fasciolae are located in the liver where considerable damage occurs to the parenchyma with extensive blood loss, the liver is often compromised in its metabolic functions. This adversely affects the overall performance of individual animals27 and maybe work output also. The situation could get worse for the oxen infected with Fasciola in CFAs during the ploughing time when this coincides with lack of adequate feeding.

The higher prevalence rate of Fasciola infection from August to January may be due to the acquired infection from June to September, which coincides with the rise in the population density of the intermediate host Limnaea natalensis28. Moreover, during the dry season, the snail population concentrates around natural sources of water, and as these areas may provide the only dry season grazing, animals may become heavily infected. The relatively high frequency of low and moderate Fasciola burdens which mainly manifest as a subclinical form is not unusual for the adult indigenous cattle. Since 14.8% of the infected animals
harboured a high burden, the level of this infection may be regarded as a serious problem in work output in draught oxen. The effect of the fasciolosis in oxen can be aggravated further by the malnutrition and the intensive use of animals as draught power.

Although the oxen had relatively low strongyle egg counts, the prevalence rate of this infection was high (Fig. 2). The distribution of strongyle egg excretion reflected the known rainfall pattern. The high prevalence of strongyle infection may also be regarded as a potential problem in productivity of draught oxen due to helminth stress which could lead to malnutrition.

The animals were infected with different strongyle species, but *Haemonchus* was predominant, especially in wet weather. It is known that *Haemonchus* is the nematode of greatest economic importance in the tropics and is a prolific egg producer.

The prevalence rate of coccidial infection was low, with peaks occurring during the rainy season. Generally, coccidiosis is age dependent and the disease is observed mainly in young calves in this country.

*Schistosoma mattheei* infection in draught oxen was of low prevalence (2.2%) although it seems to be a fairly common parasite of cattle in Zimbabwe. The seasonal pattern of *Schistosoma* egg excretion largely depended on seasonal fluctuation of vector snails.

The occurrence of *Moniezia benedeni* infection in oxen with a low prevalence of 0.2% is not surprising due to the advanced age of these animals. *Trichuris globulosa* was another parasite that occurred with low prevalence in draught oxen in ChCFA.

It is noteworthy that the majority of oxen in this area are infected by more than one type of parasite, predominantly with paramphistomes, *Fasciola* and strongyles. This indicates that multiple parasite infections may also have multiple pathogenic effects. On the other hand it may suggest that multiple parasite species do not interfere with each other with respect to level of infection and parasite survival. To maximize food nutrient intake and improve the work output of the draught oxen, treatment of animals suffering from such multiple parasite infections should be carried out. It is recommended that such treatment of oxen in ChCFA should start in July when the burdens of internal parasite are relatively low, and before animals are prepared for the ploughing season. Two further treatments in November and in mid-January may also be advocated. Broad spectrum anthelmintic should be used for effective treatment of animals against this multiple parasite infection. Anthelmintic treatments should reduce the parasite egg load and the chances of infecting other categories of communal cattle, especially the more susceptible younger animals. However, control measures in CFAs will have to be related to stock density, the existing husbandry practices, the general lack of resources of communal area farmers and their cultural norms.

**Acknowledgements**

The author is grateful to the people of Chiweshe Communal Farming Area for their cooperation. I am indebted to the staff of the Veterinary Training Institute, Mazowe for collecting samples and the staff of the Helminthology section at Veterinary Research Laboratory, Harare for technical support. Many thanks go to Dr P Gamble for his help in illustration of the results. I thank also Mrs E Zvaita, who typed the manuscript.

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**References**


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MALACHITE GREEN-MEDICATED DRINKING WATER: A PROPHYLAXIS AGAINST FOWL TYPHOID

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Key Words: Malachite green in fowl typhoid, disease, poultry, water

EAU POTABLE CONTENANT DE LA MALACHITE VERTE: UNE PROPHYLAXIE CONTRE LA TYPHOSE AVIAIRE

Résumé
Cent vingt poulets de gril Cobb étaient répartis au hasard dans six cases. A l’âge de six semaines, ils recevaient de l’eau potable contenant de la malachite verte (E-MV) aux taux progressifs de 0,005%; 0,05%; 0,5% et 5%. Quatre jours après l’administration de E-MV, les poulets étaient servis de nourritures contaminées avec S. gallinarum pendant trois jours consécutifs. Trois semaines après l’infection (p.i.), les résultats ont montré que les poulets ont survécu à des concentrations plus faibles, en revanche ils sont morts à des concentrations plus fortes. Chez les sujets-témoins positifs (eau non-medicamentée + aliments non-contaminés), 90% ont survécu, tandis que chez les sujets-témoins négatifs (eau non-médicamentée + aliments contaminés), tous les poulets sont morts.

Les examens post-mortem et l’analyse bactériologique étaient utilisés comme outils de diagnostic. Il a été conclu que les poulets pourraient être protégés contre l’infection orale de la typhose aviaire, avec de l’eau contenant de la malachite verte à des concentrations faibles, à savoir: 0,005% et 0,05%.

Summary
One hundred and twenty Cobb-broiler chicks were randomly distributed in twenties into six pens. At the age of six weeks their drinking waters were medicated with graded levels (0.005%, 0.05%, 0.5%, and 5%) of malachite green (MG). On the fourth day on MG - water, they received S. gallinarum contaminated feed for three consecutive days. At three weeks post infection (PI) results showed that the birds survived at lower concentrations but died at higher concentrations. In the positive control (unmedicated water + uncontaminated feed), 90% survived whilst in the negative control (unmedicated water + contaminated feed) all died.

Postmortem examinations and bacteriological analysis were employed as diagnostic tools. It was concluded that birds could be protected from oral fowl typhoid infection with MG - drinking water at low concentrations 0.005% and 0.05%

Introduction
In poultry, especially in the developing countries, economic losses due to debilitating diseases and mortalities are enormous. In addition to these are other factors such as malnutrition, poor husbandry, lack of infrastructure and market bottle-necks. If poultry must be raised economically these negative factors should be reduced to a minimum or possibly eliminated. In the case of diseases. prevention would be the best approach. It is known that disinfectants contribute a lot in both prevention and control of diseases, hence malachite green (MG) was chosen for trial against fowl typhoid infection in this experiment.

Fowl typhoid is a disease of poultry routinely vaccinated against (usually at 6th - 8th weeks of age) in Nigeria. The economic losses caused by fowl typhoid are noticed mainly through high mortality, debility, carrier status, reduced egg production and in preventative medication among other factors. Mortalities up to 75% with 50%
being common has been reported. Because of its various modes of transmission, through the ovary, incubator/hatchery, water, feed and other fomites it has always posed eradication problems in the tropics. Besides, the aetiologic organism (*Salmonella gallinarum*) can survive for fairly long periods of about two months in the litter and soil.

MG is a dye disinfectant employed in the treatment of wounds or burns. It is effective against gran-positive organisms, less so against gram-negative but ineffective against acid-fast organisms and bacterial spores. In veterinary medicine, a 0.05% to 0.10% solution in water is given for calf scours and canine dysentery. The dosage of 15-60g in water for calves and 5-15 mg for dogs are also in use. It is used at levels of 0.005% in drinking water or 0.002% - 0.02% in feed in the treatment of infectious synovitis of poultry. A solution of 2mg/L is prescribed as a flush or bath for one hour for disinfecting eggs and 1% solution as lesion swab for live fish whilst 67mg/L as dip for 1 min or 0.015mg/L for prolonged immersion still for live fish. It is incorporated into some selective media for the isolation of *Dermatophilus congolensis*. With the above details in view, it was therefore decided to test the efficacy of MG-mediated drinking water against fowl typhoid infection.

**Materials and Methods**

One hundred and twenty day-old Cobb-broilers reared together in one pen for five weeks were randomly distributed in twenties into six pens (M1 to M6). They had received prophylactic medication in the preceding weeks against coccidiosis and Newcastle disease using Amprolium and Lasota Newcastle vaccine respectively. The pens were at least 61 meters apart, and except M5 and M6 they were placed on different concentrations of MG-medicated drinking water, as follows: M1 - 0.005%; M2 - 0.05%; M3 - 0.5%; and M4 - 5.0% (Table 1). They were on MG-medicated water for three consecutive days before introduction of contaminated feed. The feed was contaminated with overnight nutrient broth cultures of *S. gallinarum* (Vom vaccine strain, Batch 20, 1981) and fed to the chickens (except M6), for four consecutive days. The pens were attended to daily for 24 days, always starting from M6 and descending orderly to M1. Sick birds were observed closely whilst dead birds were promptly posted and bacterial cultures aseptically made from their liver and spleen specimens on MacConkey and Desoxycholate citrate agar (DCA) plates and incubated aerobically at 37°C for 24-48 hours. Results were appropriately recorded in the process.

**Results**

There was great reluctance to drink water in pens M3 and M4 as the water level in the troughs remained nearly static for three days. Thereafter they drank very sparingly and their beaks painted green.

All the birds in M3, M4 and M5 were observed sick post infection (PI) on the 5th, 4th and 6th days respectively. In M3 and M4 the symptoms were not specific — exhibiting dullness, anorexia, diarrhoea and dehydration, followed by death. (Table 2). Mortality was 75% in M3 and 100% in M4 and M5. In M5 the symptoms included dullness, anorexia and greenish-yellow diarrhoea especially soiling the vent and the surrounding feathers. Postmortem lesions of birds from M5 showed, splenomegaly, hepatomegaly and copper-like discoloration of the liver after some time of exposure in the atmosphere. In M3 and M4 the gut mucosa was greenish and the skeletal muscles looked blanched. The survival rates were as follows: M1 - 95%, M2 - 90%, M3 - 25%, M4 - 0.00%, M5 - 0.00% and M6 - 90%.

MacConkey and Desoxycholate citrate agar plates cultured from spleen and liver specimens of dead birds from M1, M2, M3, M4 and M6 showed no growth for *S. gallinarum* whereas M5 had abundant growth of *S. gallinarum* as was confirmed by the following reactions to tests: gram negative, glucose fermentation with gas production and ornithine carboxylase negative.
Table 1: Malachite Green Treatment

<table>
<thead>
<tr>
<th>Pens</th>
<th>No. of Birds</th>
<th>Conc of MG(%)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>20</td>
<td>0.005</td>
<td>Medicated water + contaminated feed</td>
</tr>
<tr>
<td>M2</td>
<td>20</td>
<td>0.05</td>
<td>*</td>
</tr>
<tr>
<td>M3</td>
<td>20</td>
<td>0.5</td>
<td>*</td>
</tr>
<tr>
<td>M4</td>
<td>20</td>
<td>5.00</td>
<td>*</td>
</tr>
<tr>
<td>M5</td>
<td>20</td>
<td>0.00</td>
<td>Unmedicated water + contaminated feed</td>
</tr>
<tr>
<td>M6</td>
<td>20</td>
<td>0.00</td>
<td>Unmedicated water + uncontaminated feed</td>
</tr>
</tbody>
</table>

Discussion

The sudden introduction of greenish water (M3 and M4 especially) and perhaps also the change in taste, for birds hitherto on normal water for past five weeks might have upset the birds and so caused them to reject this water initially, but compelled later by severe thirst to drink it, even sparingly. The limited drinking resulted in dehydration which compounded the toxicity of MG to cause death. The difference in toxicities in M3 and M4 is shown by both the differences in the rate and total number of deaths (Table 2), hence all birds in M4 had died by 8th day PI whereas 25% survived in M3 at the end of the experiment (Table 2).

The survival rates in M1 (95%), M2 (90%) and M6 (90%) are very close to usual expectations in poultry husbandry (5% mortality is not unusual).

With such results as noticed in M1 and M2, MG at concentrations of 0.005% — 0.05% in drinking water is protective to birds against oral infection with fowl typhoid organisms. It is therefore recommended for routine use. Moreover, the effectiveness at these very low concentrations, give MG additional economic advantage of field application.

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A SURVEY OF POISONOUS PLANTS OF LIVESTOCK IN SWAZILAND

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UNE ENQUETE SUR LES PLANTES VENENEUSES POUR LE BETAIL AU SWAZILAND

Résumé

Le grave problème que constituent les plantes venèneuses pour l'industrie animale en Afrique doit être pris au sérieux. Rien qu'en Afrique australe, il existe 600 plantes locales venimeuses. Cette communication dresse la liste de quelque 25 espèces de plante pouvant être venimeuses pour le bétail en paturage au Swaziland. La liste qui est loin d'être exhaustive, a été dressée après des enquêtes sur le terrain et après consultation avec les gardiens de parcs, le personnel vétérinaire et les propriétaires de bétail dans tout le pays. La communication contient également une brève description de la botanique de ces plantes et fait état de leur existence dans la région, de leur toxicologie ainsi que du traitement et des mesures de prévention.

Summary

The importance of poisonous plants to the livestock industry of Africa cannot be overestimated. Up to 600 indigenous poisonous plants are known to occur in southern Africa alone. This paper lists some 25 species which were found to be potentially poisonous to grazing livestock in Swaziland. The list, which is by no means complete, was compiled after field surveys and consultations with game wardens, veterinary staff and livestock owners countrywide. A brief description of their botany, occurrence, toxicology, treatment and preventive measures are also included.

Introduction

Poisonous plants are a principal cause of economic loss to the livestock industry of many countries. Estimates of stock losses due to plant poisoning in southern Africa range from 10-25% annually. Such losses may be attributed to direct capital losses from mortalities, veterinary fees and expenses in plant eradication. They may also be due to indirect losses associated with lower animal production, chronic illness and debilitation, photosensitization, abortion and other birth defects.

Overgrazing and sporadic drought periods tend to favour the growth of poisonous plants at the expense of the more desirable ones. These two factors are probably responsible for the majority of livestock losses from poisonous plants in Swaziland and other neighbouring countries such as Botswana, Mozambique, Zimbabwe and South Africa. Most of the grazing livestock in Swaziland are traditionally reared under extensive conditions, on rangeland that is frequently denuded by overstocking, soil erosion and uncontrolled fires. Under these conditions the animals often graze vegetation, including poisonous plants, which they would normally avoid. Very limited information is currently available on plant toxicology in Swaziland not only because there are few veterinarians with hardly any specimen preservation facilities, but also because livestock are rarely taken for post-mortem examinations while most poisoning episodes are seldom confirmed. The study reported in this paper therefore concentrated on plant identification and mapping of important species which occur in large numbers over wide areas in Swaziland.

Methodology

Information on poisonous plant problems, species identification and distribution was obtained through discussions with most of the veterinary officers, veterinary assistants and senior game rangers in the country. Over 1,000 livestock owners countrywide were also involved. Plant species identified during the discussions were confirmed through field visits.
to the expected locations and ‘relic’ climax vegetation areas. Using this procedure, 25 species were identified as being potentially important. Notes on toxicology, treatment and prevention are based on survey findings together with information obtained from the Veterinary Research Institute at Onderstepoort in South Africa.

Results

From the survey findings, the following plant species were identified as being potentially poisonous to livestock in Swaziland:

*Lantana camara*

*Description:* *Lantana camara* (tickberry, cherry pie or Lantana) belongs to the family Verbenaceae. Locally known as bukhwebeletane, it is a branched shrub which grows up to 3 m high. The leaves are opposite, toothed on the margins and rough to touch on the upper surface and slightly hairy beneath. The flowers are in terminal clusters with the outer ones red while the inner ones are yellow. Sometimes all the flowers are white. The fruits also occur in clusters. They are usually round, fleshy and purple black.

*General:* *Lantana* is often planted as an ornamental shrub but in Swaziland it has taken over much of the valuable grazing land. The successful distribution pattern of this plant is due to the fact that birds relish the fruits and the seeds are spread by them.

*Toxicology:* *Lantana* which has gone wild is far more toxic than the cultivated hybrid variety. The toxic compounds cause severe liver damage and high mortality in livestock.

*Datura stramonium*

*Description:* Datura or thorn apple or stinkblaar is in the Solanaceae family. It is a robust plant which grows to a height of 1 — 1.5 m. It is easily recognized by its large pale leaves and large funnel shaped white flowers. The fruit is large, green and spiny. It contains numerous dark brown (unripe) to black (ripe) seeds.

*General:* *Datura stramonium*, locally known as lijoye, is a common annual weed in Swaziland. It often invades deserted places like old kraals and abandoned residential areas. Individual plants or clusters may grow close to a home or along roadsides. *Datura* poisoning appears to be generally rare because of its repugnant smell and unpleasant taste. Animals eat it only from accidental inclusion in hay or when they are too hungry, for example, early in the morning when they are first released from the kraal.

*Toxicology:* All parts of the plant are known to be toxic; the seed being the most poisonous and the young leaf next. The toxicity diminishes as the leaf dries. Humans are most susceptible to *Datura* poisoning. Cattle, goats and horses may also be poisoned.

*Solanum*

*Description:* *Solanum* also belongs to the family Solanaceae. *S. incanum* (intufuma) is a perennial highly branched shrub growing to about 1 m high. The stems and leaves are covered with numerous thorns. The flowers are purplish like those of a potato. The unripe fruits are green while the ripe fruits are yellow. Another common indigenous species *S. nigrum* (umsobo) differs from *S. incanum* in that it is an annual or biennial with white drooping flowers instead of purple. The fruits are round berries which turn black when ripe instead of yellow.

*General:* Both *S. incanum* and *S. nigrum* are widespread in Swaziland especially on roadides and disturbed areas such as trampled veld. They also occur as annual weeds on arable land. An introduced species, *S. mauritianum* (bugweed) is also common. Stock are only rarely poisoned by these species. However, many wild species of *Solanum* are known to be toxic to grazing livestock.
Toxicology: The green fruit is usually more poisonous than the ripe fruit. In fact the ripe fruits of *S. nigram* are so harmless that some societies eat them fresh or cooked. The most common symptoms include irritation of the digestive lining, salivation, diarrhoea, rapid breathing and eventual paralysis.

**Urginea**

*Description:* Urginea, commonly known in southern Africa as slangkop or itch-egg belongs to the family Liliaceae. Locally, they are called lukhovu. Two species of *Urginea* are common on grazing land in Swaziland: *Urginea ultissima* and *U. epigea*. *U. ultissima* tends to grow in colonies from large bulbs which lie just below the surface of the soil. The bulbs are brown from the outside but white inside. The stem is fairly long reaching 2.5 m. The flowers are white while the seeds are black and glossy. The flowers of many *Urginea* species appear before the leaves. From a distance, the young inflorescences resemble a snake’s head and parts of the body.

**General:** Slangkop is found in a wide variety of habitats, e.g. on black peat soils at the margins of vleis, in soil pockets among rocks and in many exposed situations. It starts flowering shortly before the first rains and the flowering lasts from around September to January.

Toxicology: Slangkop poisoning usually occurs in early spring when the flowers appear. Toxicity declines rapidly after the flower has matured or died. The most vulnerable animals seem to be cattle and sheep.

**Ornithogalum**

*Description:* *Ornithogalum ornithogaloides*, a lily, belongs to the family Liliaceae. It is a bulbous plant standing to about 0.4 m high. The bulb is small, onion like, white and enclosed in small scales. Another common species in Swaziland is *O. saundersiae* which is much taller (up to 1 m). The bulb is larger and surrounded by soft papery scales. The flowers are arranged like an inverted pyramid. Each flower is pale yellow and star shaped. The three chambered fruits contain many flat black seeds.

**General:** Lilies grow almost exclusively in high rainfall areas and damp places such as mountain slopes, marshes, stream banks, tree shades and open veld. Livestock poisoning usually occurs when they are accidentally grazed together with normal forage grasses or when hay is contaminated by these plants.

Toxicology: All parts of both *O. ornithogaloides* and *O. saundersiae* seem to be poisonous to grazing livestock. Sheep and cattle are normally poisoned in the pastures when they graze the green plants. Symptoms include severe diarrhoea and general weakness accompanied specifically by blindness in cattle. In one case of *Ornithogalum* poisoning during August/September 1962 near Malkerns, Swaziland, it was reported that 70 out of 126 head of cattle developed signs with 15 deaths. The herd had been grazing on broken veld heavily infested with *O. saundersiae* that grew abundantly in the shade of trees or between rocks. According to the owner, almost all the severely intoxicated cattle became temporarily blind.

**Morea**

*Description:* Morea (tulp) belongs to the Iris family Iridaceae. A common species in Swaziland is *Moraea mogii* (indolotsi). It has perennial underground parts or corms and annual aerial parts which remain green in summer but die in winter. It has narrow grass-like leaves. The flowers are light blue to bluish purple. The inner petals point upwards while the outer ones hang downwards giving a typical iris-like appearance.

**General:** Tulp species are widely distributed in Swaziland. They may be found in cultivated fields, in open veld, along stream banks or in marshy areas. They are particularly common in overgrazed veld.
Toxicology: Tulp poisoning occurs in winter or early summer when the sprouting parts might be the only green forage present on the barren veld. Young plants are more toxic as compared to the old plants and corms appear to be less toxic than the leaves and stems. Tulp poisoning usually affects cattle, sheep and goats. It seems as if animals which grow up in tulp infested areas can avoid the plants unless grazing becomes too scarce or when they are moved to a new area. Trek animals, newly introduced stock or hungry animals therefore tend to be most susceptible.

Asclepias
Description: Common species of Asclepias (family Asclepiadaceae) include A. adscendens, A. crispa and A. densiflora. They are perennial branched shrubs growing up to 1.5 m high all typically producing a white latex. The flowers are in dense clusters at the tips of the branches. The fruit is inflated, balloon-like and covered with numerous hair-like processes. The seeds turn from brown to black as they ripen.

General: Milkweeds (umdzayana) are common in many parts of Swaziland especially on disturbed soils, trampled veld and along roadsides and waterways.

Toxicology: Poisoning rarely takes place under normal grazing since the plant is unpalatable. It is only eaten in the absence of other forage when it is then highly toxic. All parts of the plant are potentially poisonous. Cattle and sheep are most susceptible.

Sarcostema viminal
Description: The common names for Sarcostema viminal (family Asclepiadaceae) are melktou, caustic bush or caustic vine. It is locally known as ingotjwa. It is a succulent leafless climber which grows into or over trees, sometimes smothering them. Without support, it forms a dense bush about 1 m high. The main stem is pencil thin with many branches. When cut, the plant contains a white latex which is not irritating. The flowers are star shaped, yellow and sweet smelling. The fruits resemble a pair of goat's horns and are packed with white seeds.

General: Sarcostema is widely distributed in Swaziland particularly in the hot drier parts of the lowveld and rocky parts of the highveld. Flowering time is chiefly in the summer months. Death from this plant is sporadic indicating that there may be a poisonous strain which is comparatively rare in occurrence.

Toxicology: Poisoning usually takes place during times of grazing shortage. Also when trees in which the plant grows are felled, animals may gain access to sufficient quantities of Sarcostema to cause poisoning.

Acacia
Description: Acacia belongs to the family Leguminosae. There are many species of Acacia on Swaziland ranges. Two species of special interest are Acacia nilotica or scented thorn (sitfweftwe) and A. sieberana or paper bark thorn (inkambane). A. nilotica grows up to 10 m. Its spines are robust and may be straight or slightly curved. The flowers are yellow. The pods contain many seeds which are arranged like a string of beeps. A. sieberana also stand up to 10 m but has a round or flat top. The spines are straight and the flowers are pale yellow fading to white. The pod is large containing few seeds.

General: Both Acacia species are widely distributed in Swaziland. They are mostly found in valleys and on hillsides and mountain slopes. They also occur on open grassland. Flowering takes place between September and January depending on the habitat. In some countries, the pods of A. sieberana are milled and given to livestock as fodder during drought.

Toxicology: Acute poisoning by A. nilotica occurs most frequently when hungry goats consume
large quantities of the pods. The poisoning is caused by an unidentified agent. As for *A. sieberana*, poisoning is associated with a high content of prussic acid. Animals are usually poisoned after consuming large quantities of young wilted leaves and stems which are brought down by a heavy storm.

**Amaranthus**

*Description:* *Amaranthus* belongs to the pigweed family Amaranthaceae. The common names are pigweed, redroot or cockscob. The Siswati name is imbuya. Many of the approximately 150 described species of *Amaranthus* occur as weeds in tropical and sub-tropical countries. Some exotic species are excellent vegetables for human consumption. In Swaziland, *A. thurnbergii* and *A. caudatus* are reported to be poisonous to livestock. They are erect annuals generally with a rough prickly appearance. The leaves are pale green while the dense network of flowers vary in colour from green to pink to purple.

*General:* Pigweeds are usually abundant in rich soils around cattle kraals, ash heaps and gardens. They can tolerate wet conditions hence they may be found in the silt of canals and irrigation furrows.

*Toxicology:* Pigweeds contain nitrates which, in ruminants, are converted to highly toxic nitrates by the micro-organisms present in the rumen. The common ruminants affected are cattle and goats. In monogastric animals, which lack the necessary micro-organisms in their stomachs, the toxic nitrates are not found. Man and pigs are therefore rarely poisoned by consumption of *Amaranthus*. Exceptionally high nitrate concentrations are usually found in plants growing near cattle pens or in fields which have been treated with fertilizers rich in nitrates. Such plants tend to be particularly poisonous.

**Ricinus communis**

*Description:* The castor oil plant, *Ricinus communis*, belongs to the family Euphorbiaceae.

It is known locally as umhlafutfo. It is a much branched shrub or small tree growing up to 4 m in height. The stems are reddish or pale green with large hand-shaped leaves borne on long petioles. The seeds are green, brown or red. The seed is hard and glossy, somewhat resembling a tick in shape.

*General:* *Ricinus* is a widespread weed in Swaziland along roadsides, cultivated lands and other disturbed places. It is grown in many tropical countries as an ornamental or as a crop plant for the production of castor oil which is used as an industrial lubricant or as a purgative in medicine. The plants are rarely consumed by livestock but poisoning sometimes occurs through accidental ingestion of the seed. Cases of stock poisoning from accidental inclusion of castor seed cake in rations are common in southern Africa.

*Toxicology:* All parts of the plant are potentially poisonous especially the seeds. In humans, the ingestion of one seed can produce very distressing symptoms including vomiting, diarrhoea and profuse sweating. Animal species vary in their susceptibility to *Ricinus* poisoning; horses being the most susceptible followed by sheep, cattle, goats, pigs and poultry respectively.

**Euphorbia**

*Description:* Generally *Euphorbia* species (family Euphorbiaceae) are perennial bushes or shrubs which produce plenty of milky latex. The flowers are much reduced and almost inconspicuous. The best known representatives of the genus in Swaziland are *Euphorbia ingens* and *E. evansii* both referred to as umhloholo. *E. ingens* is a much branched tree about 10 m high. The branches emerge fairly low down the trunk where they grow out fairly upright into a dense round crown. Each branch is 4 angled with short spines along the margins of the angles.

*General:* Many *Euphorbia* species or candelabra trees or milk bushes have a cactus-like habit
preferring dry localities. They are widespread in Swaziland especially in the low veld. The plants are usually avoided by livestock although they may be eaten if the latex and seed are mixed with hay.

Toxicology: The latex is highly irritating. A drop in the eye can lead to severe inflammation and temporary or permanent blindness. Exposure of the skin to the latex may lead to severe burns.

Crotonaria

Description: C. burkeana and C. globifera are common species in Swaziland. They belong to the family Leguminosae and are popularly known as wild lucerne or rattlebush. C. globifera is a low-spreading bush with trifoliate leaves and yellow flowers which are borne at the top of the shoot. The pods are short and swollen with a number of brown kidney-shaped seeds. C. burkeana differs from C. globifera in that the whole plant is covered with long brown hairs which are particularly noticeable in young branches and flowers.

General: The genus Crotonaria is interesting in that while some species are responsible for the production of serious intoxication in livestock, some are used medicinally, some are regarded as potential fodder crops and yet others make delicious dishes in some countries. Wild Crotonaria species are usually found on roadsides, in disturbed areas and on overgrazed veld.

Toxicology: The toxic compounds in Crotonaria species are found mostly in the leaves; the concentration depending on stage of maturity of the plant and on the soil and climatic conditions. The symptoms of Crotonaria poisoning include inflammation and excessive growth and elongation of the hoof. The animal suffers great pain when walking and as a result prefers to lie down rising occasionally with difficulty.

Pteridium aquilinum

Description: Pteridium aquilinum or bracken fern belongs to the family Polypodiaceae. It is a perennial which grows up to 1.5 m. It has branched underground stems called rhizomes which are covered by a mat of thick reddish hairs. The leaves are glossy green changing to brown as they die. The spores which resemble a rusty powder are borne in a dense mass on the underside of the leaf.

General: Bracken fern (lihlindzafuku) is commonly found in the high veld around forest edges, near water, or on mountain terrain. The plant is not normally eaten by livestock on account of its poor palatability. It may be consumed when there is a shortage of good quality forage and even then a very large amount must be taken before symptoms of poisoning become apparent. The plants are eaten mainly in spring or after a veld fire when young leaves predominate. They are particularly a problem where bush has been cleared for grazing.

Toxicology: Poisonous parts include the fresh and dry leaves, and to a lesser extent the erect stems. The spores seem to be harmless. Cattle are most generally affected but the horse and sheep are also susceptible.

Senecio

Description: Senecio (compositae family) has many common names including ragwort, groundsel, Dan’s cabbage or staggerers bush. Important species in Swaziland include Senecio latifolius and S. retorsus. These two species vary so much in their growth habit and other characteristics that there is no easy basis for distinction. They are basically perennial herbs with annual stems which usually die off in winter. The stems grow up to 0.6 m and are erect and unbranched except at the top where they form many branches. The stems and the leaves that they carry are smooth (almost hairless). The leaves have no leaf stalks. Their margins are composed of short prickly teeth. The flowers occur in clusters and are small and yellow.
General: Ragwort is widely distributed in Swaziland. It is locally abundant in pastures and waste places in open veld, on mountain slopes and in marshy areas. It may become particularly numerous and invasive where the natural grass cover has been reduced as a result of drought or overgrazing. Livestock usually avoid Ragwort because of its poor palatability. Poisoning tends to occur when it is grazed in the absence of better quality forage or through accidental ingestion with other pasture plants or if mixed with hay. Outbreaks of poisoning may also occur after veld fires have destroyed the vegetation and the animals are exposed to the young leafy shoots.

Toxicology: Ragwort seems to be most toxic during the active growing stage just before flowering. Young shoots appear around September and it is at this stage that the plant is most poisonous. The active ingredient is a powerful liver poison.

Oxalis

Description: The sorrels (\textit{Oxalis spp.}) are annual or perennial herbs; sometimes stemless. The leaves are usually compound with 3 leaflets. The leaflets are photosensitive, i.e. they fold at night and open during the day. The flowers can be white, pink, red or yellow. Common species in Swaziland include \textit{O. smithiana}, \textit{O. pescaprae} and \textit{O. obliquifolia}, all referred to as simunyane or simunyamunyane.

General: They are usually associated with damp places in the highveld and moist middleveld. They are common weeds of cultivated fields and gardens.

Toxicology: The sorrels contain oxalic acid and oxalates which cause poisoning in livestock. The compounds seem to be found in all aerial parts of the plants. Oxalate poisoning is more common in sheep and goats than in cattle. When \textit{Oxalis} is grazed over a long time, the animals seem to develop kidney and bladder stones. Castrated animals are most affected because their ureters are narrower than those of female and uncastrated male animals.

Discussion

Compared to the large number of poisonous plant species that have been described in Botswana\textsuperscript{3}, Zimbabwe\textsuperscript{4} and South Africa\textsuperscript{5}, those listed above for Swaziland are relatively few. The list can be further reduced when attention is focussed on a specific ranch unit or a communal grazing area. In this case, only rarely would more than one or two species dangerous to livestock be found.

It is also important to note that an increase in the number of poisonous plants in an area is usually a sign of poor management. Good range management is therefore one of the most effective ways to combat the danger of plant poisoning in an area. Herding stock, fencing off infested areas or eradication by uprooting may also be effective. From the treatment side, activated charcoal administered at the rate of 2 g/kg of the animal’s body weight can be lifesaving. Intravenous treatment of affected animals with a 4% solution of methylene blue at a level of 4 mg/kg body weight can also reduce the poisonous effect (T.S. Kellerman, personal communication).

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EFFECTS OF XYLAZINE, KETAMINE, AND THEIR COMBINATION ON BODY TEMPERATURE IN DONKIES

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EFFETS DE LA XYLAZINE, DE LA KETAMINE ET DE LEUR ASSOCIATION SUR LA TEMPERATURE CORPORELLE DES ANES

Résumé
Trois groupes de cinq ânes chacun étaient soumis à trois sortes de traitement. Le premier groupe (Groupe 1) était injecté avec de l’hydrochlaurure de xylazine à raison de 2 mg/kg, le deuxième groupe (Groupe 2) a reçu une injection d’hydrochlore de kétamine à la dose de 4,4 mg/kg et le troisième groupe (Groupe 3) était injecté avec une association médicamenteuse xylazine/kétamine (xylazine: 2 mg/kg et kétamine: 4,4 mg/kg dans la même seringue). Toutes les injections étaient faites par voie intramusculaire et on a enregistré les changements de température rectale. L’hydrochlorure de xylazine a entraîné une baisse de la température rectale moyenne de 0,2°C chez les ânes du groupe 1 et ce, 45 minutes après l’injection. L’hydrochlorure de kétamine a produit une augmentation de la température rectale moyenne de 0,6°C chez les ânes du groupe 2 pendant le même laps de temps. L’association xylazine/kétamine a provoqué une augmentation de la température rectale moyenne de 0,4°C en l’espace des 45 premières minutes après son injection. Cependant, tous ces changements de température n’étaient pas statistiquement significatifs (P > 0,05). Il a été conclu que la xylazine, la kétamine et leur association aux doses administrées ont provoqué des changements minimaux de la température corporelle sans aucune conséquence clinique.

Summary
Three groups of five donkeys each were subjected to three regimens of treatment. The first group (Group 1) was injected with 2.0 mg/kg of xylazine hydrochloride, the second group (Group 2) was injected with 4.4 mg/kg of ketamine hydrochloride and the third group (Group 3) was injected with the drug combination xylazine-ketamine (xylazine 2.0 mg/kg and ketamine 4.4 mg/kg) in the same syringe. All the injections were given intramuscularly and changes in rectal temperature of the donkeys recorded.

Xylazine hydrochloride caused a decrease in mean rectal temperature of 0.2°C in group 1 donkeys within 45 minutes following its administration. Ketamine hydrochloride caused an increase in mean rectal temperature of 0.6°C in group 2 donkeys over the same period. The drug combination xylazine-ketamine was associated with an increase in mean rectal temperature of up to 0.4°C within the first 45 minutes following its administration. However, all these changes were not statistically significant (P>0.05). It was concluded that xylazine, ketamine, and their combination at the dosages given caused minimal changes in body temperature with no evidence of clinical consequence.

Introduction
During anaesthesia and surgery, several factors combine to interfere with normal thermoregulation. These include abolition of behavioural responses, attenuated hypothalamic function, reduced metabolic rate, reduced effector responses and abnormally large internal stresses1. With the exception of ketamine, all general anaesthetic agents and other agents given during anaesthesia impair thermoregulation and thermal balance1.

Xylazine hydrochloride, a potent α2-adrenergic agonist is an analgesic as well as a sedative and skeletal muscle relaxant2. It has variable effects on body temperature and this has been reported in various animal species3,4,5,6,7,8,9,10.
Ketamine is an injectable dissociative anaesthetic agent that is noted for its analgesia and lack of cardiovascular depressant effects in therapeutic doses\textsuperscript{11}. Its lack of cardiorespiratory depression is unequalled by any other general anaesthetic currently available\textsuperscript{12}. The effects of ketamine on body temperature in various animal species as reported by various authors,\textsuperscript{11,13,14,15} is variable.

Xylazine-ketamine combination caused no change in body temperature in sheep\textsuperscript{16} while it has been associated with a rise in body temperature in horses\textsuperscript{11} and a decrease in body temperature in goats\textsuperscript{15}. This article reports on the effects of xylazine, ketamine and their combination on body temperature in donkeys.

**Materials and Methods**

A total of fifteen healthy donkeys of both sexes, aged between 2 and 11 years and weighing between 80 and 200 kg were used in this study. They were randomly divided into three groups of 5 animals each. Water and food were provided \textit{ad libitum}. The donkeys were fasted for 18 hours before the drugs were administered. All the trials were carried out in an environmental temperature of between 24 and 27°C.

**Treatments**

On the day of the study, rectal temperature readings were taken using a clinical thermometer 15 minutes before the injection of any drug or the drug combination. The time when the individual drugs or drug combination was administered was designated as time zero. All the injections were made intramuscularly into the left lateral muscles of the neck. The drug combination was administered in the same syringe. The first group of donkeys (group 1) was injected with xylazine hydrochloride (Rompun, Bayer) at 2.0 mg/kg, the second group (group 2) with ketamine hydrochloride (Ketalar, Park Davis) at 4.4 mg/kg and the third group with the xylazine-ketamine drug combination at xylazine 2.0 mg/kg and ketamine 4.4 mg/kg. The rectal temperature was recorded at time zero and every 15 minutes subsequently for 3 hours.

**Data Management**

The results were analyzed by analysis of variance and covariance with repeated measures. Significance level was set at $P < 0.05$.

**Results**

Table 1 and Figure 1 show the mean rectal temperature (°C) changes in the three groups of donkeys under the different regimens of treatment. There was a slight decrease in the mean rectal temperature in group 1 donkeys injected with xylazine within the first 45 minutes following its administration. An increase in mean rectal temperature of 0.6°C was recorded in group 2 donkeys injected with ketamine over the same period.

The drug combination xylazine-ketamine was associated with an increase in mean rectal temperature of 0.4°C within 45 minutes of its administration in group 3 donkeys. However, all these changes were not statistically significant ($P > 0.05$).

**Figure 1:** Mean rectal temperature (°C) changes for the three groups of donkeys
Table 1: Means ± sd of rectal temperature (°C) for the three groups of donkeys.

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<tr>
<th>Time (Mins)</th>
<th>Group 1 xylazine</th>
<th>Group 2 ketamine</th>
<th>Group 3 xylazine + ketamine</th>
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<tr>
<td>0</td>
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<td>37.4 ± 0.8</td>
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</tbody>
</table>

Discussion

The slight decrease in mean rectal temperature recorded in group 1 animals following xylazine administration is contrary to other findings in the same species, in which a rise in body temperature was reported. Xylazine-induced hypothermia has been reported in rats and cats. The decrease in body temperature by xylazine has been attributed to its ability to depress thermoregulation through possible interference with the release of noradrenaline presynaptically in the central nervous system. The central nervous system activation or stimulation of α-adrenoceptors such as α₂-adrenergic receptors by xylazine decreases sympathetic discharge and reduces the release of norepinephrine. Decreased sympathetic discharge can also cause increased body heat loss to the environment via peripheral vasodilation.

There is no report in the literature on effects of ketamine on body temperature in donkeys. Increase in body temperature following ketamine administration has been reported in the dog. In this study, an increase in body temperature was recorded in group 2 donkeys injected with ketamine. All the donkeys in this group had muscle tremors and continuously paddled their limbs. They raised and lowered their heads frequently and on standing, they staggered for a protracted time. These actions may be due to the effects of ketamine on the limbic-hypothalamic centres or due to increased skeletal muscle movements.

The increase in body temperature seen in donkeys injected with the xylazine-ketamine combination is similar to what has been reported in horses during recovery period. The increase in body temperature in this group of donkeys corresponded to the period of recovery. These animals made repeated attempts to stand and when they stood, they staggered for some time. The increase in temperature may be attributed to increased muscular tone caused by repeated attempts to stand and the staggering that followed.

In conclusion, xylazine, ketamine, and their combination have variable effects on the body temperature in donkeys. At the dosages given, the changes in body temperature are minimal with no evidence of clinical consequence.

References


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SHORT COMMUNICATION

GASTRO-INTESTINAL PARASITES OF PIGS IN THE SEMI-ARID REGION OF NORTHEASTERN NIGERIA

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Gastro-intestinal parasitism constitutes an important constraint to pig production in most parts of the world. In Nigeria, they have been associated with severe pathological changes and enormous economic losses in the pig industry. Although several studies have been done on the prevalence of gastro-intestinal parasites of pigs on the Jos Plateau and Southwestern Nigeria, there are no reports on the situation in the semi-arid region of the North-eastern part of the country; a region known to have a considerable number of pigs (NWosu, C.O. unpublished data). The present study was therefore conducted to provide preliminary information on the prevalence of gastro-intestinal parasites of pigs in Maiduguri, the largest urban centre in the semi-arid region of North Eastern Nigeria. The region is characterised by a short rainy season (June to September) followed by a prolonged dry season of more than 8 months duration.

Faecal samples were collected per rectum from 59 cross breed (improved exotic X indigenous Nigerian) pigs maintained under semi-intensive conditions of management at the Customs and Maimalari military barracks in Maiduguri between January and March 1995. The faecal samples were examined for helminth ova and coccidian oocysts using saturated solutions of sodium chloride (specific gravity, 1.20), sodium nitrate (sp. gravity, 1.36) and zinc sulphate (sp. gravity, 1.24) as described by Anon.

Following slaughter and evisceration, intact gastro-intestinal tracts were collected from 21 other pigs randomly selected from the slaughter slabs of the Customs and Maimalari military barrack during the same period. The different actions of the gastro-intestinal tract were separated by ligature, placed in plastic containers and transported to the laboratory for routine examination and identification of the parasites.

Out of 21 gastro-intestinal tracts examined, 16 (76.2%) had naturally acquired infections with one or more gastro-intestinal parasites (Table 1). All helminths recovered were nematode species. Mixed infections with 2 or 3 species were encountered in 5 (23.8%) of the pigs.

<table>
<thead>
<tr>
<th>Helminth</th>
<th>No. Positive</th>
<th>% Positive</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascarops strongylina</td>
<td>12</td>
<td>57.1</td>
<td>22.7</td>
<td>2 - 76</td>
</tr>
<tr>
<td>Physcocephalus sexalatus</td>
<td>1</td>
<td>4.8</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td>Physcocephalus sp.</td>
<td>8</td>
<td>38.1</td>
<td>7.0</td>
<td>1 - 199</td>
</tr>
<tr>
<td>Ascaris suum</td>
<td>1</td>
<td>4.8</td>
<td>1.0</td>
<td>1</td>
</tr>
<tr>
<td>Oesophagostomum dentetum</td>
<td>6</td>
<td>28.6</td>
<td>59.0</td>
<td>2 - 211</td>
</tr>
</tbody>
</table>

*Correspondent author
Physcocephalus species believed to be different from *P. sexalatus* were encountered in 8 (381\%) of the pigs. These species were much larger (12.80–20.60 x 0.40–0.47 mm) and with longer spicules (0.23–0.45 mm) and pharynxes (0.38–0.44 mm) than *P. sexalatus* (7.02–14.63 x 0.38–0.43 mm, 0.22–0.31 mm and 0.24–0.28 mm respectively). They could not be identified to species level due to paucity of literature.

Of the 59 faecal samples examined by the various salt solutions, 11 (18.6\%) were positive for nematode ova and/or coccidial oocysts. *Ascaris* and strongyline type eggs occurred in 4 (6.8\%) of the samples each while 3 (5.1\%) had coccidial oocysts. Faecal egg and oocyst counts using the various salt solutions showed that saturated sodium nitrate solution floated the most eggs and oocysts followed by zinc sulphate and sodium chloride solutions respectively (Table 2).

The results of this study show that pigs in the semi-arid region of Nigeria harbour a high prevalence of natural infection with a variety of nematode parasites. The parasites encountered during the study have been recorded previously in pigs in some other parts of the country. However, *Trichuris suis*, *Strongyloides ransomi*, *Globocephalus urosubulatus* and *Hyostongylus rubidus* which were consistently recorded in high prevalence on the Jos Plateau\(^1,2,4\) and Southwestern Nigeria\(^5,6\) were conspicuously absent in this study. It is possible that differences in climatic conditions and method of animal management may be responsible for the absence of these parasites in pigs in the semi-arid region of Nigeria.

Most of the parasites encountered during this study are pathogenic and have been associated with mortality, reduced productivity and condemnation of affected parts at meat inspection\(^1,2,10\). However, during the present study, only *Ascaris* and *Oesophagostomum* species occurred in relatively large numbers to be of any pathogenic significance. Routine prophylactic anthelmintic medication, especially in the early and late rainy season coupled with good management practices such as improved general hygiene and adequate feeding of animals, should effectively control porcine helminthiasis in the semi-arid region of Nigeria.

Among the various salt solutions investigated, saturated sodium nitrate floated the most number of nematode eggs and coccidial oocysts. Similar observations were reported by Basu *et al*\(^2\) who associated this superior quality to the salt's higher specific gravity and relatively short flotation time. The findings of this study confirm that sodium nitrate is an ideal floating fluid for the detection of helminth eggs and coccidial oocysts in faecal specimens.

**Acknowledgements**

We are grateful to Prof. G.C. Srivastava who supervised this work and to Malam Ali Mohammed for technical assistance.

**References**


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**Table 2:** Detection of nematode ova and coccidial oocysts using different salt solutions

<table>
<thead>
<tr>
<th>Salt</th>
<th>Solution</th>
<th>Crystallization</th>
<th>Number of eggs or oocysts/low power field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium nitrate</td>
<td>much</td>
<td>15–20</td>
<td>4–6</td>
</tr>
<tr>
<td>Zinc sulphate</td>
<td>less</td>
<td>11–15</td>
<td>2–4</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>less</td>
<td>8–15</td>
<td>1–2</td>
</tr>
</tbody>
</table>

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Helminth infections are among the most common parasitic diseases of tropical livestock. In Guangzhou, China, helminths, especially Hymenolepis diminuta, have long been recognized as important factors in productivity of small ruminants. However, accurate and up-to-date statistics of their socio-economic impact are lacking for many regions of Kenya. It is generally believed that these helminths reduce milk yield, carcass and offal condemnations, and impede reproductive efficiency. Therefore, control is necessary in terms of labour and costs. Chemotherapy is often a significant part of production systems.

To develop strategic programmes against helminthiasis, it is imperative to have fairly precise knowledge of the actual epidemiology of helminth infections in this region. The helminth infections of small ruminants have been investigated in different climatic environments of Kenya. However, no data are available on the spectrum of nematode species parasitising sheep kept by smallholders (V. Khoma). Of the data on epidemiology is based on a monthly egg count (PEC) to estimate the average worm burden. Since PEC varies during the seasons, it is more relevant to discuss the individual worm burden by examination of faecal samples, particularly during the dry season.

Between August 1995 and June 1996, 10 indigenous sheep were purchased from Torton Market, Kangundo Division, and housed in individual pens. According to the recommendations of the Kenya Ministry of Agriculture (1993), the faecal material was collected, dried, and stored for 4 weeks. The faecal samples were examined for helminth eggs using the Kato-Katz technique (Kato, 1955). The results were analysed to determine the prevalence of helminthiasis and the intensity of infection.
Of the 50 faecal samples tested, all except five displayed a luxuriant population of nematode eggs and/or adult worms. Ascaris and strongyloides type eggs were absent (5.0%) of the samples each while 30.0% displayed a mixed cytoxenosis. Faecal egg counts using various salt solutions indicated that saturated sodium nitrate solution killed the most eggs and coxycytes followed by magnesium and sodium chloride solutions respectively (Table 2).

The results of this study show that ascariasis is a problem in the semi-arid region of Nigeria. Furthermore, high prevalence of helminthic infections with a variety of nematodes has been observed. The parasites were acquired during the study have been recorded in sites in some other parts of the country. However, Trichuris, Strongyloides, Giardia, Entamoeba, and Cyathostomum are which were comparatively recorded in high prevalence on the Jos Plateau and Southwestern Nigeria were conspicuously absent in this study. It is possible that differences in climatic conditions and method of animal management may be responsible for the absence of these parasites in the semi-arid region of Nigeria.

<table>
<thead>
<tr>
<th>Salt</th>
<th>Sodium nitrate</th>
<th>Zinc sulphate</th>
<th>Sodium chloride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cystocidal</td>
<td>Weak</td>
<td>Good</td>
<td>Strong</td>
</tr>
<tr>
<td>Number of eggs or coccycytes per gram</td>
<td>4-6</td>
<td>4-2</td>
<td>4-8</td>
</tr>
</tbody>
</table>

Acknowledgements

We are grateful to Prof. G.O. Obiristern who supervised this work and to Malam Ali Mohammed for technical assistance.

References

SHORT COMMUNICATION

HELMINTH PARASITE INFECTIONS OF SHEEP IN KANGUNDO DIVISION OF MACHAKOS DISTRICT, KENYA

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Helminth infections and their associated diseases are among the most prevalent and widely distributed of all the enzootic parasitoses of tropical livestock.1,2. Gastrointestinal helminths, especially Haemonchus contortus, have long been recognised as a major problem in productivity of small ruminants in Kenya3,4. However, accurate and up-to-date estimates of its socio-economic impact are lacking in most regions of Kenya but economic losses are believed to arise through mortality, poor growth rate and feed conversion, reduced meat and milk yield, carcass and offal condemnation and impaired reproductive efficiency2,5,6. The cost of control in terms of labour and prophylactic chemotherapy is often a significant factor in production costs4,9.

To develop strategic preventive measures against helminthosis, it is necessary to have a fairly precise knowledge of the seasonal epidemiology of helminth infections of an area8,9. The helminth infections of small ruminants have been investigated in different climatic environments of Kenya10,11,12,13,14. However, little data are available on the spectrum of helminths parasitising sheep kept by small holders. Much of the data on epidemiology is based on faecal egg count (FEC) to estimate corresponding worm burdens5. Since FEC varies with seasons15, it is more reliable to quantify the worm burden by postmortem examination, particularly during the dry season16.

Between August 1995 and July 1996, 60 indigenous sheep were purchased from Tala Market, Kangundo Division of Machakos District, about 50 km south of Nairobi, Kenya. The climate is tropical with little seasonal variation in temperature which varies from a mean maximum of 25°C to a mean minimum of 20°C. The annual rainfall is about 1000 mm and has a bimodal pattern with the long rains occurring between March and May while the short rains fall from October to December17.

Six batches of 10 animals, coinciding with the different seasons of the year in the study area, were examined as follows: July and August, corresponding to the cold dry season; September and February, corresponding to the late dry season; November and April, corresponding to the rainy seasons. All the animals were maintained under a traditional management system. The ages (by number of permanent incisors) of the animals ranged from 6 months to more than 3 years. Forty-two (70%) sheep were between 6 and 18 months; 39 were female and 21 male. At each collection period, sheep were purchased from the owners and housed for 3 weeks in pens with concrete floors in a manner which precluded any chance of their re-infection with helminths.

At slaughter, the gastrointestinal tract was removed from the carcass, and abomasum, small and large intestines were separated, opened and washed within 5 h, according to standard procedures18. Worm counts were performed on 10% of total washing. To estimate the number of early fourth larval (EL₄) stage, the mucosa of the abomasum was scraped off and digested in 1% pepsin solution containing 2% concentrated HCL at 37°C for 4-6 h19. The identification of the EL₄ stage, suggestive of the hypobiotic stage, was based on the descriptions

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of Soulsby and Thomas and Probert. Faecal samples were taken from the rectum and examined for parasite eggs using a modified McMaster technique and expressed as eggs per gram of faeces (epg). The faecal material of each batch of animals was pooled and cultured at 27°C for 7–10 days to harvest the third stage (L₃) larvae which were identified to generic level as described by Keith.

Analysis of variance (ANOVA) was used to examine for differences in worm burdens and faecal strongyle egg counts between age classes based on logarithmic transformation similar to that of Field et al.

The worms found and their prevalence, mean burdens and ranges are presented in Table 1. Seven nematodes, 2 cestodes and 2 trematodes were encountered in this study. All sheep examined were infected by more than one species of nematodes. H. contortus, Trichostrongylus colubriformis, T. axei, and Oesophagostomum columbianum were the most common species, followed by Strongyloides papillosus, Cooperia curticei and Trichuris ovis which, however, were generally found in more moderate numbers.

The intensity of nematode infection was high in some animals, the overall mean nematode count was 4637 (range 209–17,300) and the overall mean faecal strongyle egg count was 4800 epg. H. contortus, Trichostrongylus spp. and O. columbianum accounted on average, for 52.1%, 31.5% and 7.4% respectively, of the total nematode burden. There was no influence of age on total nematode worm burden (P > 0.05). However, younger animals had significantly high S. papillosus (P < 0.05) counts. Faecal strongyle egg counts were not influenced by age.

The mean and range values of the proportion of the larval (L₃) population of H. contortus, Trichostrongylus spp., Cooperia spp. Strongyloides spp. and Oesophagostomum spp. were 55.7 (43–75), 29.2 (17–39), 2.6 (0–6), 4.5 (0–20) and 8.0 (8–18)%, respectively. Haemonchus (> 65%) and Trichostrongylus spp. (> 30%) L₃ were prevalent in high proportions during the rainy months of November and April.

The total nematode burden was at its lowest during the dry months (Fig. 1). However, it increased gradually through the rainy seasons to reach a peak in April and subsequently followed by a decrease in July. The proportion of EL₄ of H. contortus was between 0 and 28.3% during all the periods, except August when an average of 44.2% of worms were at the EL₄ stage (Fig. 2). The relative abundance of H. contortus, Trichostrongylus spp. and O. columbianum followed the same trend as that of the total worm burden during the different seasons of the year.

<table>
<thead>
<tr>
<th>Helminths species</th>
<th>Prevalence (%)</th>
<th>Average</th>
<th>Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemonchus contortus</td>
<td>97.3</td>
<td>2817</td>
<td>61–12100</td>
</tr>
<tr>
<td>Trichostrongylus axei</td>
<td>80.8</td>
<td>635</td>
<td>17–3870</td>
</tr>
<tr>
<td>Trichostrongylus colubriformis</td>
<td>94.3</td>
<td>1075</td>
<td>39–5615</td>
</tr>
<tr>
<td>Cooperia curticei</td>
<td>19.4</td>
<td>115</td>
<td>11–699</td>
</tr>
<tr>
<td>Strongyloides papillosus</td>
<td>61.6</td>
<td>290</td>
<td>21–1475</td>
</tr>
<tr>
<td>Oesophagostomum columbianum</td>
<td>9.5</td>
<td>400</td>
<td>9–1715</td>
</tr>
<tr>
<td>Trichuris ovis</td>
<td>21.5</td>
<td>79</td>
<td>3–412</td>
</tr>
<tr>
<td>Moniezia expansa</td>
<td>8.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stilesia hepatica</td>
<td>14.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasciola gigantica</td>
<td>33.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calicophoron microbothrium</td>
<td>13.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Range of positive cases.
Fasciola gigantica was more prevalent (33.3%) than the rumen fluke Calicophoron microbothrium, which was found in only 8 animals (13.7%). The prevalence of Moniezia expansa and Stilesia hepatica was 8.3 and 15.0%, respectively.

The investigation revealed the helminth spectrum and the seasonality of gastrointestinal nematode infections in naturally infected sheep purchased from Tala market of Kangundo Division in Machakos District, Kenya. A nematode infection rate of 100% and an average burden of over 4500 worms indicated that helminthosis forms a highly prevalent infection in Kenyan sheep as observed earlier by Carles.6 Most sheep were infected with several species among which H. contortus, T. colubriformis, T. axei and O. columbianum were predominant. With regard to both prevalence and burden, H. contortus was the most common nematode as reported by others.3,10. A relatively short generation interval probably enables H. contortus to take rapid advantage of favourable climatic conditions.25. This is also reflected in the
present study (Fig. 1). The climatic conditions in the study area also seem to be well suited to the development and survival of the free-living stages of _Trichostrongylus_ spp. and _O. columbiaum_.

Of the nematode species encountered, _H. contortus_ and _O. columbiaum_ are among those which are serious pathogens of small ruminants and therefore of considerable economic importance. Heavy infections (2000–3000 adult worms) of _H. contortus_ are very common in the rainy season elsewhere in Africa. In the case of _O. columbiaum_, which is more common in the late wet season, 200–300 adult worms constitute a severe infection. Also, nematode parasites like _Trichostrongylus_ and _Cooperia_ spp. present in the intestinal tract cause digestive and metabolic disturbances and as a result there is usually general weakness, emaciation and loss of condition to such an extent that the affected animals are usually very susceptible to other illnesses.

Worm burdens were as high in old as in young animals and, age did not have any effect on egg counts. Elsewhere, evidence of immunity build-up to nematode was shown in lambs from the age of 6 months onwards. However, factors such as nutritional deficiencies may have interfered with immunity build-up in sheep examined. It was observed that the nutritional state of most animals brought to Tala market was poor.

The postmortem and faecal examination results showed that the adults of the various gastrointestinal nematodes were present throughout the year. Thus, it appears that the succession of parasites is due to persistence of mature worms in the host all year round. It is envisaged that the free-living stages of the nematode survive for a sufficient length of time to be picked up by the animals, thus maintaining a continuous cycle of infection between the host and the pasture.

The trematode and cestode fauna was not very different from that in previous reports in Kenya. However, _F. gigantica_ was found in the lungs of 8.3% of animals slaughtered. The lungs had haemorrhagic foci which on cutting revealed immature flukes. Demidov reported similar findings in sheep with an acute form of fasciolosis. The prevalence of _S. hepatica_ in this study was much lower than that in an abattoir survey around Nairobi, where 29.9% of sheep and goats were found to be infected.

It was concluded that relatively heavy infections were found in sheep of all age classes in the area of study. To increase the productivity of sheep, serious efforts should be made towards the control of these worm infections.

**Acknowledgements**

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**References**

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Worm burdens were at high levels in young animals and, age did not have any effect on egg counts. Examinations revealed that build-up to nematode load was slow in animals less than the age of 6 months on the farm. Measuring risk factors such as nutritional deficiencies that are associated with immunity indicates that this data was examined. It was observed that the prevalence rate of most nematodes brought to the farm was poor.

The postmortem and tissue examination results showed that the adults of the various gastrointestinal nematodes were present throughout the year. Thus, it appears that the succession of parasites is due to persistence of mature worms in the host all year round. It is observed that the free-living stages of the nematode survive for a sufficient length of time to be picked up by the environment, thus maintaining a continuous cycle of infection between the host and the pasture.

The nematode and cestode fauna was not very different from that in previous reports in Kenya. However, E. granulosus was found in the lungs of 8.2% of animals slaughtered. The

References

Abnormalities of perineal conformation of animals may be fatal if no corrective measures are given in time. A fistula is an abnormal passage leading from an internal organ to the exterior or between endothelial or epithelial lined cavities. These abnormal openings may be produced intentionally or may be as a result of injury (trauma) or congenital defects, and in some cases infection of organ may result in the development of a fistula.

Perineal fistula may arise due to degeneration or penetration of sharp objects into the muscles of the pelvic diaphragm which supports the lateral walls of the rectum and seals the pelvic inlet from abdominal cavity.

Congenital and acquired fistulae have been reported in horses and other species of domestic animals. In domestic animals where fistulae are found, in some cases, the cause may be difficult to determine.

From available literature, this, to our knowledge, is the first case of traumatic perineal fistula reported in the Sudanese cross mare in Zaria, Nigeria.

A 5-year-old Sudanese cross mare weighing about 300 kg was presented dead for necropsy. It was necropsied at the necropsy unit of the Department of Veterinary Pathology and Microbiology, Ahmadu Bello University, Zaria, Nigeria.

Standard postmortem procedures were performed. At necropsy, the animal was examined critically and systematically. The postmortem examination revealed rupture of the perineal area (Fig.1), involving the skin and muscles of the pelvic diaphragm. The intestine...
protruded through the fistula which was about 6 cm in diameter. All the major organs except the intestine were normal. The intestine was congested, soft and bulging with haemorrhagic areas on the mucosa surface (Fig.2).

The traumatic perineal fistula reported in this case might have been caused by severe kick from another horse or by penetrating objects. The sudden vascular constriction due to external pressure from the ruptured skin and muscles of pelvic diaphragm on the intestine and its contents might have resulted in complete ischaemia, and even necrosis of the intestine. Death of the mare might have resulted from severe pain and haemorrhage as a result of the fistula.

References

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SHORT COMMUNICATION

BODY CONFORMATION, GROWTH AND PUBERTY RELATIONSHIP IN WEST AFRICAN DWARF PRE-PUBERTAL KIDS IN NIGERIA

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The West African dwarf goats are predominantly indigenous breed found in all ecological zones and all types of agricultural systems in Southern Nigeria. They are adaptable to the humid environment and can subsist on low quality roughage with mineral concentrate supplements. Yet the value of this breed of goats as a hardy animal whose performance should be looked into has only recently begun to be widely appreciated in some areas.1,2,3 Even though a few authorities have recognised their value, relatively little attention has been focussed on their reproductive performance4. There is information on the physiology of puberty on the female goat with scanty or none on the male5. The provision of information on some morphological and sexual related traits and their relationships with growth of kids at the pre-pubertal stage will be useful in predicting weight for age and hence sexual maturity of these animals. The age at which male kids attain puberty is an important factor that will aid in preventing inbreeding.

In males, the scrotal circumference is an easily taken measurement that has a direct relationship to testicular functions. Positive correlation between testes circumference or testes weight with sperm production was reported6. It is therefore the primary objective of this study to examine the relationship that exists between some morphological traits, growth and age in pre-pubertal kids with the aim of predicting weight for age at sexual maturity of the West African dwarf goat.

The goats used for this study were reared at the University of Benin Farm Project, Benin City, in the humid rain forest zone of Southern Nigeria. It has an annual rainfall and temperature of 2,429.5 mm and 28.5°C with a range of 1,285 – 3574 mm and 24.5°C – 32.7°C respectively. The average relative humidity and average daily sunshine were 73.5% and 6 to 7 hours respectively.

The goats were reared on an open range in addition to green chop and grasses within the paddocks attached to their pens to which they were allowed access for the period of the experiment. The animals were also fed with yam peels and Panicum maximum.

Data were collected from ten goats that were four months old for 8 weeks. At this age it is assumed the animals were close to age at puberty when the physiological processes that are related to reproduction would have matured or have developed since goats have been reported to be sexually matured at 6 months7. Weekly measurements taken were: Live body weight (BWT); Heart girth (HGT); Scrotal Circumference (SCF) and Testicular length (TCT).

The data were analysed using the general linear model (GLM) procedure8. Weight for age was predicted using the regression equation for age and age at puberty was predicted using the regression equation for SCF assuming puberty is attained at 50 – 70% of adult body weight8 where acceptable adult body weight of West Africa dwarf male goat is 20 – 25 kg8.

Correlation coefficients between the following pairs of variables were highly significant (p ≤ 0.01): scrotal circumference and body weight (r = 0.91), scrotal circumference and testicular length (r = 0.87), scrotal circumference and age (r = 0.75), body weight and heart girth (r = 0.77), body weight and testicular length (r = 0.84), heart girth and age (r = 0.82), testicular length and age (r = 0.81) except body weight
and age which had a moderate correlation (r = 0.50). Table 1 shows various prediction equations. A unit change in SCF brought about the highest change in BWT (.34 kg) while Age had the least (.12 kg) in pre-puberty WAD male goats. The prediction value of weight for age are shown in Table 2. All regressions were significant (P < 0.05). The predicted values were slightly higher than reported value in literature. When puberty was assumed to be attained at 50 – 70% of live weight of an adult male goat (20 – 25 kg) as previously reported weight for age were 10 – 12.5 kg for 7 – 11 months and 14 – 17.5 kg for 14 – 21 months respectively with an average of 11.25 – 16.25 kg and 8.5 – 17 months.

Table 1: Prediction equations for estimating body weight in WAD pre-pubertal kids.

<table>
<thead>
<tr>
<th>Traits</th>
<th>Regression equation</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCF</td>
<td>Y = 2.98+.34x</td>
<td>.77</td>
</tr>
<tr>
<td>TLT</td>
<td>Y = 6.56+.24x</td>
<td>.70</td>
</tr>
<tr>
<td>HGT</td>
<td>Y = −3.80+.25x</td>
<td>.75</td>
</tr>
<tr>
<td>AGE</td>
<td>Y = 6.53+.12x</td>
<td>.26</td>
</tr>
</tbody>
</table>

Y = BWT : X the traits.

Table 2: Predicted weight for age in West African Dwarf goat.

<table>
<thead>
<tr>
<th>Age</th>
<th>weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 week (3 months)</td>
<td>7.97</td>
</tr>
<tr>
<td>26 week (6 months)</td>
<td>93.61</td>
</tr>
<tr>
<td>36 week (9 months)</td>
<td>11.16</td>
</tr>
<tr>
<td>52 week (12 months)</td>
<td>12.77</td>
</tr>
<tr>
<td>64 week (15 months)</td>
<td>14.24</td>
</tr>
<tr>
<td>Puberty</td>
<td></td>
</tr>
<tr>
<td>7 months</td>
<td>10 – 12.5</td>
</tr>
<tr>
<td>14 – 21 months</td>
<td>14 – 17.5</td>
</tr>
</tbody>
</table>

Puberty assumed to be attained at 50 – 70% of adult male live body weight (20 – 25 kg).

The results of the study showed that the relationship between the measurements was very high. Scrotal circumference had the highest correlation with other measurements followed by heart girth, testicular length and body weight. All correlation values were above 0.74 except that of body weight to age which was 0.50. It could therefore be assumed that any of these measurements could be used to assess scrotal circumference value but the most suitable measure being that of heart girth which had a very high and positive correlation (r = 0.91) with scrotal circumference and even with other measurements (0.77 – 0.84). The results also showed that during growth, body weight of goats had greater influence on the growth of the reproductive organs than the chronological age, hence sexual maturity should be based on weight rather than age.

The regression equations showed that morphological measurement of male reproductive organ influenced body weight more at pre-pubertal ages than chronological age since a unit change in scrotal measurement yielded .34 kg change in body weight as against .12 kg by age. This observation agreed with the finding that growth of male sexual organ had greater influence on body weight than the chronological age. The high correlation value obtained for scrotal circumference and testicular length indicates that scrotal circumference can be used to determine the testicular weight.

The predicted weight for age results were higher than reported values in literature. A weight of 11.16 and 12.77 kg obtained for 9 and 12 months respectively were generally higher than corresponding 6.0 ± 1.58 and 9.5 ± 3.16 obtained at similar ages for WAD goats. Such disparity may be due to the fact that the predicted values took environmental influence into consideration. However, the 12 months values fit well when the standard error is considered.

Results of this study indicated that pre-pubertal body size was influenced most by scrotal circumference as it had the highest regression coefficient. The implication being that if puberty is a function of weight it will best be determined through scrotal circumference measurements than age.
References


Received for publication on 31st January, 1996
Table 1: Regression equations for estimating body weight at NAIZ pre-pubertal age.

<table>
<thead>
<tr>
<th>Time</th>
<th>Regression equation</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>60dF</td>
<td>Y = 2.96 + 0.34x</td>
<td>.77</td>
</tr>
<tr>
<td>3LT</td>
<td>Y = 6.56 + 0.34x</td>
<td>.70</td>
</tr>
<tr>
<td>1GJ</td>
<td>Y = 4.80 + 0.25x</td>
<td>.76</td>
</tr>
<tr>
<td>AG 6</td>
<td>Y = 6.65 + 1.2x</td>
<td>.83</td>
</tr>
</tbody>
</table>

Y = EWT - X: eels made

Table 2: Predicted weight for age in kg for WAD goats.

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 weeks (3 months)</td>
<td>7.62</td>
</tr>
<tr>
<td>21 weeks (6 months)</td>
<td>10.61</td>
</tr>
<tr>
<td>30 weeks (9 months)</td>
<td>11.66</td>
</tr>
<tr>
<td>36 weeks (12 months)</td>
<td>12.73</td>
</tr>
<tr>
<td>45 weeks (15 months)</td>
<td>14.24</td>
</tr>
</tbody>
</table>

The predicted weight for age results were higher than reported values in literature. A weight of 11.16 and 12.77 kg obtained for 9 and 12 months respectively were generally higher than corresponding 6.0 ± 1.58 and 9.5 ± 3.15 obtained at similar ages for WAD goats. Such disparity may be due to the fact that the predicted values lack environmental influence into consideration. However, the 12-month values fit well when the standard error is considered.

Results of the study indicated that pre-pubertal body size was influenced most by scrotal circumference as it had the highest regression coefficient. The implication being that if puberty is a function of weight it will best be determined through scrotal circumference measurements than age.
SHORT COMMUNICATION

EFFECT OF PLANE OF NUTRITION ON REPRODUCTIVE ACTIVITY AND KID MORTALITY IN WEST AFRICAN DWARF (WAD) GOATS

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*Department of Veterinary Pathology, University of Ibadan, Ibadan, Nigeria.

The West African Dwarf (WAD) goat is perhaps the most important livestock species in the forest zone of Southern Nigeria because of its numerical strength over other livestock species1 and its relative trypanotolerance2. It was observed that the goat owes its survival capabilities to some specific physiological properties such as acclimatization capacity, ability to consume and digest high raw fibre forage and high fertility3. Many studies of the productive performance of WAD goats provide information on the general causes of kid losses5,6.

One of the most extensive analysis of goat mortality was carried out in government farms and other farms in India7.

While goats may be highly prolific, high mortality rates constitute a limiting factor to the growth of this industry. Some of the factors associated with mortality include birth weight, milk production of dam, management system, predators, diseases and accidents. It was stated that mortality is most critical from birth to weaning or maturity1.

The objective of this study was to find out the effect of plane of nutrition of dams on fertility, prolificacy and on kid mortality.

The study was carried out at the small Ruminant Research Unit of the Department of Veterinary Surgery and Reproduction, University of Ibadan. The data used in this study consist of parturitions observed between 3rd September 1992 and 12th December 1993.

Thirty-five adult does of mixed parities were assigned to three nutritional groups (A, B and C) of 11 does in group A and 12 animals each in groups B and C after equalization of weights. Each group consisted of 6 primiparous and 6 pluriparous does in B and C while A had 5 pluriparous does. Group A and B were supplemented with corn-based concentrate ration at the rate of 1.0 kg and 0.5 kg/head/day, respectively, while group C received no concentrate supplementation. The basal diet consisted mainly of Centrosema, Gilricida and Cynodon species and dry cassava peelings. Fresh water was available ad libitum.

Does were bred naturally with mature bucks raised in the unit. Kids were weighed within 12 hours post-partum and weekly thereafter until weaning at 90 days. All kids, post-weaning were fed with a 0-25 kg/head/day of a corn-based concentrate. Weekly weight determinations were continued until animals were one year old. Clinical examinations and treatments were instituted and postmortem examination of carcasses were carried out when indicated. Faecal flotation method was used to identify helminth eggs8.

Routine medication consisted of annual vaccination of adult does with Tissues Culture Rinderpest vaccine (TCRV) medication against endoparasites with Barminth F(r) suspension and ectoparasitic bath with Assunto(r). Differences in observed parameters were subjected to student “t” test and Chi square for the establishment of significance9.

The total mortality rates (MR) in the three nutritional groups and the phases of mortality is depicted in Table 1. While 66.66% MR was observed in group A, the corresponding values in B and C were 85% and 92.31% respectively, indicating a progressive increase in kid mortality as the nutritional plane decreased. Between
the groups, pre-weaning mortality that is death between day 0 – 90 was significantly lower (p < 0.05) in A than B and C. Higher pre-weaning mortalities of 54% and 55% in Indian and tropical breeds of goats, respectively has been reported. The rate observed in group A in this present study was similar to earlier reports in the WAD goats. The higher MR in group B and C confirms the similar work that indicated supplementary feeding of goats during pregnancy with a view to reducing MR during the pre-weaning period. Mortality rate was generally high irrespective of the plane of nutrition. The results were at variance with the report in small East African goats where post-weaning MR was 25.7% compared with a rate of 40.6% of the pre-weaning period.

The occurrence of more kids with low birth weights in group A was due to the higher rate of multiple births which is negatively correlated with litter size. Irrespective of nutritional regimes, there was a progressive decrease in MR as birth weights increased. At every level of nutrition the reduction in MR was significantly lower (p < 0.05) in group A. The association between birth weight and MR is consistent with several reports.

The significance of the cause of mortality is presented in Table 1. Pneumonia, pneumoenteritis and starvation were outstanding causes of post-weaning mortality in the groups. The significant cause of death in the present study was pneumonia, accounting for 25.7% and 71.4% in group A and C respectively.

### Table 1: Table showing effect of birthweight, planes of nutrition frequency distribution of cause of mortality in WAD goat kid.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n(%)</td>
<td>n(%)</td>
<td>n(%)</td>
<td></td>
</tr>
<tr>
<td>Number of kids</td>
<td>27</td>
<td>20</td>
<td>13</td>
<td>60</td>
</tr>
<tr>
<td>Number of death/group</td>
<td>18</td>
<td>17</td>
<td>12</td>
<td>47</td>
</tr>
<tr>
<td>Mortality rate within group %</td>
<td>(66.65)*</td>
<td>(85.00)</td>
<td>(92.31)</td>
<td>(78.33)</td>
</tr>
<tr>
<td>Mortality rate per total kids</td>
<td>(30.00)*</td>
<td>(28.33)</td>
<td>(20.00)</td>
<td>(78.33)</td>
</tr>
<tr>
<td>Pre-weaning mortality (0 – 90 days), %</td>
<td>(22.22)</td>
<td>(60.0)</td>
<td>(46.16)</td>
<td>(40.00)</td>
</tr>
<tr>
<td>Postweaning mortality (90 days), %</td>
<td>(44.44)</td>
<td>(25.00)</td>
<td>(46.15)</td>
<td>(38.33)</td>
</tr>
<tr>
<td>Low birthweight (0.5 – 0.9 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number in group</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Percentage of death and %</td>
<td>(75)*</td>
<td>(100)*</td>
<td>(100)*</td>
<td>(83.33)</td>
</tr>
<tr>
<td>Medium birthweight (1.0 – 1.39 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number in group</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Percentage of death (%)</td>
<td>(66.67)*</td>
<td>(86.67)*</td>
<td>(90)*</td>
<td>(80.00)</td>
</tr>
<tr>
<td>High birthweight (~ 1.40 kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number in group</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Number of death, (%)</td>
<td>(62.5)*</td>
<td>(75)*</td>
<td>(100)*</td>
<td>(71.43)</td>
</tr>
<tr>
<td>Helminthiasis</td>
<td>(11.11)</td>
<td>(5.88)</td>
<td>(16.67)</td>
<td>(8.33)</td>
</tr>
<tr>
<td>Coccidiosis</td>
<td>(16.67)</td>
<td>(0)</td>
<td>(16.67)</td>
<td>(8.33)</td>
</tr>
<tr>
<td>Pneumonia and Pneumoenteritis</td>
<td>(50.00)</td>
<td>(29.41)</td>
<td>(50.00)</td>
<td>(33.33)</td>
</tr>
<tr>
<td>Starvation</td>
<td>(22.22)</td>
<td>(64.71)</td>
<td>(16.67)</td>
<td>(28.33)</td>
</tr>
</tbody>
</table>

*Number in parenthesis indicate percentages
n: Number of observations
a, b, c, number differently lettered differs significantly (p < 0.05).
as the major causes of mortality in WAD goats. However, the results are consistent with the report that malnutrition may affect the dam and indirectly affect kid birthweight and viability. Although confirmatory diagnosis was not done, like virus isolation, clinical symptoms and serological features of the infection indicated that PPR characterised by pneumonia and enteritis was the major cause of kid mortality in this study. Recent reports have ascribed serious kid mortalities to pneumonia and enteric infections. It is necessary to note that annual vaccination against PPR confers protection and reduced mortality rate with a consequent increase in village flock numbers. The main handicap of clinicians and extension workers in the livestock sector in Nigeria is the difficulty of accessing PPR vaccines, complicated by the number of animals that an ampoule of PPR vaccine can cover. Presently a vial of the vaccine gives protection to 100 animals, while the small scale farmers have about five animals per household.

This study concludes that kid mortality in WAD goats constitutes a limiting factor to the expansion of the goat industry. Measures arrived at ameliorating the problem include adequate nutrition with concentrate supplementation of pregnant and nursing does, veterinary care, especially the control of PPR, helminthiasis and coccidiosis.

Received for publication on 24th November, 1994

References

### Receiving for publication on 3/1/1969

#### Percentage of death in each group

<table>
<thead>
<tr>
<th>Medium birthweight (lbnow)</th>
<th>Number in group</th>
<th>Percentage of death (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (&lt; 2,000)</td>
<td>15</td>
<td>(5.30)</td>
</tr>
<tr>
<td>Medium (2,000 - 2,499)</td>
<td>15</td>
<td>(3.33)</td>
</tr>
<tr>
<td>High (&gt; 2,500)</td>
<td>15</td>
<td>(6.67)</td>
</tr>
</tbody>
</table>

**Note:**
- Number in parentheses indicate percentages.
- Number of observations: 15, 15, 15.
SHORT COMMUNICATION

GASTRIC INVAGINATION OF THE PYLORIC ANTRUM IN A PUP

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Invagination of a portion of the gastro-intestinal tract into another portion, known as intussusception, is most commonly reported in dogs at the ileocolic junction.1,2,3 Intussusception in the small intestine occurred frequently in the jejunum and ileum and rarely in the duodenum.1,2 Cecocolic intussusception involving the invagination or inversion of the caecum into the colon had been reported in few dogs.4,5,6 Gastroesophageal intussusception in the dog is an uncommon condition in which the stomach invaginates into the distal oesophagus, but the spleen, duodenum, pancreas and omentum may follow the intussusceptum.7,8,9 Only two cases of gastrogastric intussusception seemed to have been reported so far and the pyloric antrum was the intussusceptum.10 In this paper, the first known case of gastric invagination of the pyloric antrum diagnosed at postmortem in a Nigerian pup is reported.

A Nigerian mongrel male dog aged 2 months and weighing 2.5 kg was presented at the Veterinary Teaching Hospital, University of Maiduguri, Maiduguri, with the complaints of anorexia, vomiting, brownish foul-smelling diarrhoea and weight loss. On further clinical examination, the pup was found to have slight swelling of the peripheral lymph nodes and serous ocular discharge. The pup was weak and had no fever. Parvoviral enteritis was suspected and supportive treatment consisted of fluid therapy (5% dextrose saline), antibiotic (5% oxytetracycline hydrochloride) and vitamin B complex. The pup responded to treatment with the vomiting and diarrhoea abating, but the appetite did not improve. The animal continued to be weaker and died 9 days after the initial presentation.

At postmortem examination, the carcass was highly dehydrated and emaciated. The pyloric antrum was invaginated into the stomach. The proximal duodenum was inside the intussusceptum with parts of the omentum. The stomach was empty, and after it was washed in running water, it was fixed in 10% formalin. A sagittal incision was made through the longitudinal axis of the intussusceptum. The lumen of the proximal duodenum from the pylorus to 2.5 cm distally was constricted by the muscular wall of the pyloric antrum (Figure 1) giving an impression of an apparent duodenal obstruction. In the intestine, 4 adult hookworms (Ancylostoma caninum) were found attached to hyperemic mucous membrane with frank blood around them.

Figure 1: Illustration of the pyloric invagination (arrow) in an intact stomach (A) and a mid-sagittal section of the intussusceptum (B)

*Corresponding author
One of the previous reported cases of gastrogastric intussusception was in a 3-year-old intact male Rottweiler\textsuperscript{10}, but the present case occurred in a pup. Generally, intussusceptions occurred most frequently in young animals\textsuperscript{1}. Specific predisposing factors have not been implicated in most canine intussusceptions\textsuperscript{1,3,10}, but kinking of the bowel wall from unknown causes in conjunction with hypermotility and diarrhoea have been suggested\textsuperscript{1,2}. In gastroesophageal intussusception, congenital esophageal dilation was implicated\textsuperscript{7,8}, but where such disorder was absent, vomiting was presumed to be the cause\textsuperscript{8,9}. In the present case, vomiting was the most likely predisposing factor for the pyloric invagination. The initial cause of the vomiting was not obvious. After the intussusception, the ensuing duodenal obstruction might have led to further vomiting by reflex vagal stimulation. The brownish diarrhoea observed in the pup might have been caused by the hookworm infection. Diarrhoea was reported in several cases of intestinal intussusception as a predisposing factor\textsuperscript{2}. The persistent anorexia and inanition, coupled with fluid loss and, perhaps, disturbances in acid-base balance were factors that could have led to the death of the pup. The obvious lapses in the case management included absence of treatment against hookworms and failure to use radiography and ultrasound in the early diagnosis with surgical correction of the intussusception as were done previously in a similar case\textsuperscript{10}.

References


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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 qu'il n'a pas encore été proposé ailleurs; il faudra l'objet de quelques modifications par le Comité de Rédaction.

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

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Les manuscrits doivent respecter les conditions suivantes:
Le titre doit être concis et ne pas dépasser plus de 15 mots, il est suivi du (des) nom(s) de l'auteur (ou des auteurs) et des établissements ou le travail a été effectué, ainsi que de l'adresse pour les correspondances si elle n'est pas la même.
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L'introduction expose le but de la recherche.
Le matériel et les méthodes utilisés.
Les résultats présentés brièvement.
Un débat sur l'importance de l'article.
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Bibliographie: les références bibliographiques doivent être numérotées dans l'ordre, telles qu'elles apparaissent dans le texte. L'identification des références dans le texte se fera à l'aide de numéros (entre parenthèses) et non pas par les noms des auteurs.
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