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IN AFRICA

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EN AFRIQUE

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GUIDANCE FOR AUTHORS

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

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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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Escherichia coli Serotypes Isolated from Dead-in-Shell Chicken Embryos from Nigeria

L.J.E. ORAJAKA and K. MOHAN
Faculty of Veterinary Medicine, University of Nigeria, Nsukka

SEROPTYPES D’ESCHERICHIA COLI ISOLES DES POUSSINS MORT-NESS AU NIGERIA

Resume
Des poussins mort-nés dans deux couvoirs de l’Etat d’Anambra au Nigeria ont été examinés afin d’en isoler l’Escherichia coli. Les cultures bactériennes ont été faites avec 79 échantillons réunis contenant 632 poussins mort-nés. Dans ces échantillons, 23 souches d’E. coli parmi lesquelles les sérogroupes 01, 02, 055, 08, 086 et 0111, qui sont en général associés aux lésions pathologiques chez la volaille, ont été isolés. Les résultats de cette recherche montrent que des souches d’E. coli peuvent avoir provoqué la mortalité embryonnaire et diminué le nombre de poussins nés bien portants dans les fermes étudiées.

Summary
Dead-in-shell chicken embryos from two commercial hatcheries in Anambra State of Nigeria were investigated for isolation of Escherichia coli. The bacterial cultures were made from 79 pooled samples containing 632 dead-in-shell embryos. From these samples, 23 strains of E. coli among which serogroups 01, 02, 055, 08, 086 and 0111 which are known to be associated with pathologic lesions in poultry were isolated. The results of this investigation suggest that E. coli isolates may have contributed to embryonic mortality and reduced hatchability in the farms investigated.

Introduction
Hatchery losses associated with embryonic mortality may result from bacterial infections of incubated eggs(1). Escherichia coli is one of such bacteria known to induce embryonic mortality and losses due to early chick mortality (2,3). In Nigeria, dead-in-shell embryos appear to account for significant losses resulting from lowered hatchability. The hatchery records of the two farms investigated registered dead-in-shell losses of 14.36% and 17.60% for the eggs incubated over a year. Many workers have not investigated the bacterial aetiology of dead-in-shell embryos except Falade(4,5) who isolated E. coli serotypes 0141 and 0139 from dead-in-shell chicken embryos from hatcheries in Oyo State.

This investigation was, therefore, undertaken to ascertain the incidence of E. coli in dead-in-shell chicken embryos from two of the three hatcheries existing in Anambra State of Nigeria.

Materials and Methods
The samples used for this investigation were collected from a commercial hatchery in Anambra State and the hatchery unit, Department of Animal Science, University of Nigeria, Nsukka. Set eggs for hatching were candled on the sixth day of incubation to eliminate the infertile eggs. The eggs were again candled on the eighteenth day of incubation to select those that had died between the sixth and the eighteenth days of incubation. Samples of embryos that were dead and those that failed to hatch at the termination of incubation were randomly selected over a period of 1½ years. All the samples were critically examined and those with cracks and the ones from which the embryos pipped the shell but failed to emerge were discarded to minimise the incidence of extraneous contamination. The eggs were washed with disinfectant, after which they were allowed to dry, before the shells were further disinfected by mopping them with ethyl alcohol. Then the eggs were opened by making a circular cut with sterile scissors along the outline of their air space before the contents were aseptically pooled into a sterile beaker but with the albumen discarded in each case. Contents of eight eggs were pooled
together to form one sample used for bacterial culture. Where the embryos were fully developed, only the yolks were harvested. Then the pooled yolks and embryos were homogenised.

The homogenised samples were cultured to isolate *E. coli*. The bacterial isolates were identified on the basis of their colonial, morphological, cultural, physiological and biochemical properties as detailed by Cruickshank *et al* (6) and Cowan and Steel (7). Eighteen out of the 23 strains of *E. coli* isolated were serotyped in detail at the International Escherichia and Klebsiella Reference Centre, Copenhagen, Denmark.

**Results**

In all, 23 strains of *Escherichia coli* were isolated from 79 pooled samples containing 632 dead-in-shell chicken embryos. The *E. coli* strains formed 25% of the total bacterial strains isolated and was obtained in pure culture from 11 samples, while from 12 samples it was isolated in association with other bacterial species (Table 1a).

**Table 1a: The Pattern of Isolation of Escherichia coli from Samples Cultured**

<table>
<thead>
<tr>
<th>Isolation in pure culture</th>
<th>Isolation in mixed culture</th>
<th>Total No. Isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>11</td>
<td>47.89</td>
<td>12</td>
</tr>
</tbody>
</table>

Of these, eight strains were from pooled samples taken on the eighteenth day of incubation while 15 were from samples taken at the termination of incubation (Table 1b).

**Table 1b: The Two Sampling Periods of Incubation and Number of Escherichia coli Isolated**

<table>
<thead>
<tr>
<th>Isolates on the 18th day of incubation</th>
<th>Isolates on the hatching day</th>
<th>Total No. isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>8</td>
<td>34.78</td>
<td>15</td>
</tr>
</tbody>
</table>

The detailed characteristics of the *E. coli* isolates are summarised in Table 2.

| Table 2: Some Properties of Escherichia coli Isolated from Dead-in-Shell Chicken Embryos |
|-----------------------------------------------|-------------------------|
| Tests                                         | N/D Reaction |
| Mortality                                     | 23/0                   |
| Growth on MacConkey's agar                    | 23/0                   |
| Growth in KCN broth                          | 0/23                   |
| Utilisation of citrate as C source           | 0/23                   |
| Urease production                             | 0/23                   |
| Lysine decarboxylase                          | 23/0                   |
| Carbohydrate acid production from:           | 23/0                   |
| Glucose acid and gas                          | 23/0                   |
| Mannitol                                      | 23/0*                  |
| Lactose                                      | 23/0*                  |
| Arabinose                                     | 23/0*                  |
| Trehalose                                     | 23/0*                  |
| V.P. test                                     | 0/23                   |
| M.R. test                                     | 23/0                   |
| Indole test                                   | 23/0                   |
| Catalase production                           | 23/0                   |
| H₂S production                               | 0/23                   |

The figures in nominator (N) indicate the number of strains giving positive reaction, while the denominator (D) represents strains giving negative reaction.

*Acid production only.*

Table 3 outlines the details of *E. coli* serotypes. One of the isolates was rough (reacted with all sera); five strains were

**Table 3: The Serotypes of the E. coli Isolates from Dead-in-Shell Chicken Embryos**

<table>
<thead>
<tr>
<th>Culture No.</th>
<th>Serogroups</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>025: K-H11</td>
</tr>
<tr>
<td>13</td>
<td>'01-0164: K + ?: (H10)</td>
</tr>
<tr>
<td>16</td>
<td>02: x 104': H8</td>
</tr>
<tr>
<td>19</td>
<td>091: K + ?: (H10)</td>
</tr>
<tr>
<td>21</td>
<td>'01-0164: K + ?: (H10)</td>
</tr>
<tr>
<td>22</td>
<td>0111: K-H11</td>
</tr>
<tr>
<td>24</td>
<td>'01-0164 K +?: (H10)</td>
</tr>
<tr>
<td>26</td>
<td>01: K + H45</td>
</tr>
<tr>
<td>30</td>
<td>0154: K-H32</td>
</tr>
<tr>
<td>33</td>
<td>08K-H19</td>
</tr>
<tr>
<td>34</td>
<td>0154: K-H32</td>
</tr>
<tr>
<td>38</td>
<td>086: K-H11</td>
</tr>
<tr>
<td>45</td>
<td>(025): K +?: H12</td>
</tr>
<tr>
<td>52</td>
<td>'0: K83 H7</td>
</tr>
<tr>
<td>53</td>
<td>055: K-H11</td>
</tr>
<tr>
<td>54</td>
<td>'01-0164: K-H12</td>
</tr>
<tr>
<td>55</td>
<td>075: K +?: H42</td>
</tr>
<tr>
<td>57</td>
<td>'01-0164: K83 H7</td>
</tr>
</tbody>
</table>

*** Not Spontaneous agglutination in sera x104* Not yet established K antigen

* The titre with 025 and H10 antiserum was low.

** Negative in sera for internationally recognised serotypes 01-0164

O Somatic antigen

K Capsular antigen

H Flagella antigen

Isolates 5 to 34 — Chukwurah Hatchery

Isolates 38 to 57 — University Hatchery.
negative to sera for internationally recognised serotypes 01-0164; two each belong to 025 and 0154 serogroups and one each belong to serogroup 01, 0111, 02, 075, 08, 086, 055, and 091.

**Discussion**

The 23 strains of *E. coli* isolated in this investigation typically represented the species. Eighteen of these strains were serologically typed in detail. Strains belonging to serogroup 02 are isolated most frequently from infections in poultry followed by 01 and 078(8). In this investigation, it is significant to note that both the serogroups 02 and 01 have been isolated. Among the Nigerian workers, only Falade (5) subjected his *E. coli* isolates to serotyping and he isolated 0141 and 0139 serogroups which are not among the known serogroups normally associated with pathologic lesions in poultry. None of these serogroups was isolated in this investigation.

Serogroup 55 has been isolated in this study. This serogroup is known to be highly pathogenic for 3-5 day old chicks (3). Besides this, 055 and 086 groups isolated in this investigation are among the known enteropathogenic *E. coli* known for their pathogenicity for infants. This is suggestive of the possible zoonotic effect of some of the *E. coli* serogroups associated with dead-in-shell embryos. Also isolated was serogroup 08 which has been associated with hatchery losses and early chick mortality (9).

It would thus appear that the *E. coli* serogroups isolated in this study corresponds to what has generally been found elsewhere in the world. This appears to be the first report of isolation of several serogroups of *E. coli* associated with dead-in-shell chicken embryos from Nigeria.

It was beyond the scope of this study to trace the source of infection. However, *E. coli* is known to cause yolk sac infection in embryos and early chick and embryonic mortality (10, 11). A higher incidence of bacterial contamination with *E. coli* was observed in samples taken on the termination of incubation than in those of the 18th day of incubation (Table 1b). It may thus be reasonable to assume that infection of embryos by these strains might have contributed to the embryonic mortality at this stage and that some infections of the embryos may have taken place at the late stage of incubation.

**Acknowledgement**

We are grateful to the Director, International Escherichia and Klebsiella Centre, Stateus Seruminstytut, Copenhagen, Denmark for serotyping the *E. coli* isolates. We also wish to thank the School of Postgraduate Studies, University of Nigeria, Nsukka for partly financing this research project.

**References**


*Received for publication on 24th August 1984*
Diarrhoea Caused by *E. coli* 0149 and its Management in Piglets

A.I. ADETOSOYE and O.J. ODUYEMI
Department of Veterinary Microbiology and Parasitology, University of Ibadan, Ibadan, Nigeria

DIARRHEE DUE A *E. COLI* 0149 ET SON TRAITEMENT CHEZ LES PORCELETS

**Resume**

L’électrolyte du glucose de glycine a été utilisé avec succès pour traiter la diarrhée provoquée par l’entéotoxine thermolabile produisant *E. coli* 0149 K88 aCH⁺ qui résiste à l’ampicilline, au chloramphénicol, à la néomycine et au triple sulfaïdme. On recommande la réhydratation par voie orale pour les patients souffrant de la diarrhée.

**Summary**

Glycine glucose electrolyte solution was used effectively to control diarrhoea in piglets caused by heat labile enterotoxin producing *E. coli* 0149 K88aCH⁺ resistant to ampicillin, chloramphenicol, neomycin and triple Sulpha. The use of oral rehydration in diarrhoeic patients is advocated.

**Introduction**

Infectious diarrhoea is often caused by enterotoxigenic strains of *Escherichia coli* which produced two types of toxins, namely heat labile (LT) and heat stable (ST) enterotoxins. Heat labile enterotoxin causes uninhibited adenylate cyclase cyclic AMP (CAMP) leading to fluid loss as well as sodium and chloride ion losses from the mucosal cells of the jejunum (1). Heat stable enterotoxin (ST) causes an immediate hypersecretion by stimulating intestinal guanylate cyclase activity which leads to a rise in cyclic guanosine 3′5′ monophosphate thus blocking absorption of chloride ions and water by mucosal cells (2). Diarrhoea in piglets was initially treated with antibiotics such as streptomycin (3) and ampicillin (4). Soon after the introduction of antibiotics as feed additives, prophylactic agents as well as chemotherapeutic agents in the livestock industry, the intestinal microorganisms and extra-intestinal pathogens developed resistance to them (5,6,7,8,9). Many of the resistant bacteria including *E. coli*, *Salmonella* sp and *Pseudomonas* sp. have been reported to harbour R-factors which are transferable to sensitive recipients (8,10,11,12,13). Serious public health implications might arise should any of these resistant bacteria harbouring R-plasmid contaminate food or water meant for animals and man, or blood meant for transfusion in hospitals.

This investigation reports the characteristics of *E. coli* isolated from diarrhoeic piglets and the management of the diarrhoea.

**Materials and Methods**

**Bacterial Isolates**

During the rainy season of 1983 (May to August) 24 *E. coli* isolates were isolated from diarrhoeic piglets using standard procedures (14).

**Biochemical Characteristics**

Each bacterial isolate was inoculated respectively into adonitol, dulcitol, maltose, glucose, xylose, mannitol, potassium cyanide, sucrose, raffinose, sorbitol, inositol, rhamnose, gelatine, salicin, indole, lactose, ammonium glucose, ammonium citrate, potassium nitrate, lead acetate paper, Christensen’s urea agar, glucose phosphate peptone water (GPPW), malonate and semi-solid agar slant for motility at 30°C and 37°C.

**Serology**

The *E. coli* isolates were serologically grouped according to the method described by Ørskov and Ørskov (15).

**K88 Determination**

Each *E. coli* isolate was examined for the presence of K88 antigen using the slide agglutination test. K85, K88ab, K89,
### Table 1: Biochemical Characteristics of *E. coli* Isolated from Diarrhoeic Piglets

<table>
<thead>
<tr>
<th>Reagents</th>
<th>Isolate Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Adonitol</td>
<td>-</td>
</tr>
<tr>
<td>Dulcitol</td>
<td>+</td>
</tr>
<tr>
<td>Sorbitol</td>
<td>+</td>
</tr>
<tr>
<td>Raffinose</td>
<td>-</td>
</tr>
<tr>
<td>Xylose</td>
<td>+</td>
</tr>
<tr>
<td>Rhamnose</td>
<td>+</td>
</tr>
<tr>
<td>Maltose</td>
<td>+</td>
</tr>
<tr>
<td>Salicin</td>
<td>+</td>
</tr>
<tr>
<td>Lactose</td>
<td>+</td>
</tr>
<tr>
<td>Inocitol</td>
<td>-</td>
</tr>
<tr>
<td>Sucrose</td>
<td>+</td>
</tr>
<tr>
<td>Mannitol</td>
<td>++</td>
</tr>
<tr>
<td>Glucose</td>
<td>++</td>
</tr>
<tr>
<td>Indole</td>
<td>+</td>
</tr>
<tr>
<td>KCN</td>
<td>-</td>
</tr>
<tr>
<td>H₂S</td>
<td>-</td>
</tr>
<tr>
<td>Gelatine</td>
<td>-</td>
</tr>
<tr>
<td>Ammonium citrate</td>
<td>-</td>
</tr>
<tr>
<td>Ammonium glucose</td>
<td>+</td>
</tr>
<tr>
<td>KNO₃</td>
<td>+</td>
</tr>
<tr>
<td>Voges Proskauer</td>
<td>-</td>
</tr>
<tr>
<td>Methyl red</td>
<td>-</td>
</tr>
<tr>
<td>Urea</td>
<td>+</td>
</tr>
<tr>
<td>Malonate</td>
<td>-4</td>
</tr>
<tr>
<td>Motility at 37°C</td>
<td>+++</td>
</tr>
<tr>
<td>Motility at 30°C</td>
<td>+++</td>
</tr>
</tbody>
</table>

**++ Acid and gas; - negative; + positive; +++ very motile.**
K88ac, K9, K88ac sera were used for the slide agglutination test.

**Enterotoxin Determination**
Ten isolated colonies from each pure culture were touched with a sterile loop and inoculated into 25 ml trypsinase soy broth (TSB) containing 0.6% yeast extract and incubated at 37°C for 18 hours, after which the culture was centrifuged at 14000 rev/min. The filtrates were kept at -20°C in 5 ml aliquot parts. LT enterotoxin was determined in rabbits according to the method described by Gyles (16) while ST enterotoxin was determined in infant mice (17). *E. coli* 36004, an LT & ST producing strain obtained from Dr K.M.S. Aziz, ICDDR, B, Dacca, Bangladesh was used as positive control.

**Antibiotic Sensitivity Testing**
Antibiotic disc diffusion test was done as described by Walton (18) with little modification. Ten single isolated colonies of each *E. coli* were touched with a wire loop and inoculated into 5 ml TSB and incubated for 8 hours after which 0.01 ml of the 5 ml culture was delivered into 4 ml sterile trypsinase soy broth (Oxoid) to give a dilution of 1:2000. A diagnostic test agar plate was flooded with this diluted culture. Excess fluid was drained off. The plate was allowed to dry on the bench. Then Oxoid multidosic (Code 3784) containing oxytetracycline (OT50 mcg), chloramphenicol (Cs50 mcg), furazolidone (FR30 mcg), neomycin (N300 mcg), nalidixic (NA30 mcg), ampicillin (PN25 mcg), streptomycin (Sl0 mcg), triple sulphua (S300 mcg) was placed on the diagnostic test agar plate. The plate was allowed to stay on the bench for 30 min before incubation at 37°C for 18 hours. Then the results were recorded. *E. coli* ATCC 29522 was used as control. The zone of inhibition was measured with a ruler and Oxoid zone reader. The MICs of the antibiotics except that of furazolidone to which all the isolates showed resistance were determined using the microtitre method described by Adetosoye et al (19). The MIC of furazolidone was done according to the method described by Ojo and Ahanihu (20).

**Plasmid Transfer**
Plasmid transfer was performed according to the method described by Walton (6) using *E. coli* J5K12 as sensitive recipient and the *E. coli* isolates having "r" determinants as donors.

**Management of Diarrhoea**
All the 24 diarrhoeic piglets were supplied with glycine glucose electrolyte ad lib for 5 days. The composition is made up of glucose 22.960 g/litre, glycine 3.502 g/litre, potassium citrate 0.71 g/litre, sodium chloride 4.862 g/litre, citric acid 3.502 g/litre, potassium dihydrogen phosphate 2.312 g/litre.

**Results**
*Escherichia coli* were isolated from each piglet. Table 1 shows the biochemical characteristics of the *E. coli* isolates. They were resistant to oxytetracycline, streptomycin, triple sulphua, chloramphenicol, ampicillin, neomycin and furazolidone in decreasing order (Table 2a). The MIC of these antibiotics are shown in Table 2b. None of the isolates transferred its r determinants to sensitive *E. coli* J5 K12. The *E. coli* isolates belong to serogroup 0149, K88 aCh⁺. They produced LT but no ST was demonstrated. All the diarrhoeic piglets recovered from the diarrhoea on exposure to glycine glucose electrolyte and there was no mortality.

**Discussion**
In diarrhoea there is loss of electrolyte and water from the mucosal cells of the jejunum. In order to treat diarrhoeic conditions the fluid and electrolyte loss must be replaced. Rehydration with electrolyte, a process during which the rate of absorption of water and electrolyte exceeds the rate of loss, has been used successfully (21,22,23). Nalin et al (24) claimed that for every case of diarrhoea, oral rehydration is at present the method of choice in its treatment. The glycine glucose electrolyte was well-tolerated by the piglets. The diarrhoea stopped 72 hours after the piglets were given access to the solution. Other workers (25) used chlorpromazine combined with trimethoprim and oral rehydration to shorten the duration of diarrhoea in piglets. In another investigation conducted in this laboratory (Ojo,
Table 2a: Antibiotic Susceptibility Patterns of *E. coli* Strains Isolated from Diarrhoeic Piglets

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>No. tested</th>
<th>No. sensitive</th>
<th>% sensitivity</th>
<th>No. resistant</th>
<th>% resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxytetracycline (OT₅₀mcg)</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>100</td>
</tr>
<tr>
<td>Streptomycin (S₅₀mcg)</td>
<td>24</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>100</td>
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<td>Triple sulpha (S₃₀₀mcg)</td>
<td>24</td>
<td>1</td>
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<td>23</td>
<td>95.9</td>
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<tr>
<td>Chloramphenicol (C₅₀mcg)</td>
<td>24</td>
<td>3</td>
<td>12.5</td>
<td>21</td>
<td>87.5</td>
</tr>
<tr>
<td>Ampicillin (PN₅₀mcg)</td>
<td>24</td>
<td>9</td>
<td>37.5</td>
<td>15</td>
<td>62.5</td>
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<tr>
<td>Neomycin (M₅₀mcg)</td>
<td>24</td>
<td>16</td>
<td>16.6</td>
<td>8</td>
<td>39.3</td>
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<tr>
<td>Nalidixic acid (NA₃₀mcg)</td>
<td>24</td>
<td>16</td>
<td>16.6</td>
<td>8</td>
<td>39.3</td>
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<tr>
<td>Furazolidone (FR₅₀mcg)</td>
<td>24</td>
<td>20</td>
<td>84.0</td>
<td>4</td>
<td>16.0</td>
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</table>

Table 2b: Minimum Inhibitory Concentrations of Different Antimicrobial Agents (mcg/ml) for *E. coli* Isolates

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>500</th>
<th>250</th>
<th>125</th>
<th>62.5</th>
<th>31.25</th>
<th>15.625</th>
<th>7.8</th>
<th>3.9</th>
<th>1.9</th>
<th>0.9</th>
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<tr>
<td>Oxytetracycline</td>
<td>6</td>
<td>8</td>
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<td></td>
<td>4</td>
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<td>2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Streptomycin</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>6</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>10</td>
<td></td>
<td>6</td>
<td></td>
<td>4</td>
<td>4</td>
<td>2</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>2</td>
<td></td>
<td>8</td>
<td></td>
<td>8</td>
<td>8</td>
<td>2</td>
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<td></td>
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<tr>
<td>Neomycin</td>
<td></td>
<td></td>
<td>14</td>
<td></td>
<td>8</td>
<td>8</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furazolidone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adetosoye and Olowookorun, unpublished data), chlorpromazine, when given intramuscularly at 2mg/kg bodyweight to diarrhoeic piglets which were also given access to electrolyte solution, produced 100% success. The *E. coli* isolates in this investigation were resistant to oxytetracycline, streptomycin and triple sulphapyridazine, the most commonly used antimicrobial agents in livestock in Ibadan and environs (12). Such highly resistant *E. coli* have been reported (5,26,27). The results of the antibiotic sensitivity testing pointed out that antibiotic therapy would produce no useful results and furthermore it would result in serious economic losses to the farmer even though none of the resistant *E. coli* transferred their r determinant to *E. coli* K12. From this investigation it is concluded that oral rehydration would help a lot to control diarrhoea in piglets. If oral rehydration is adopted as a method of control of diarrhoea it is hoped that it would also reduce the incidence of antibiotic resistance and transfer of antibiotic multi-resistance factors and ent+ plasmids which have been well reported in *E. coli* strains in pigs (28).

Acknowledgement

We wish to express our profound gratitude to Mr J. Ola Bankole for typing the manuscript and to Dr Aziz for supplying *E. coli* 36004.

References

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Maintenance of a Herd of Breeding Cattle in an Area of Trypanosomiasis Challenge

A Study on the Chemotherapy of Bovine Trypanosomiasis at Lugala, Uganda from 1972 to 1978

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Uganda Trypanosomiasis Research Organisation, P.O. Box 96, Tororo

ELEVAGE DE BOVINS DANS UNE ZONE A TRYPANOSOMIASE

Resume

Un troupeau de zébus de race pure et de croisements de zébus a été élevé dans une région fortement infestée de glossoirs avec un traitement régulier à l'acéturate de diminazène (Bérénil, Farbwerc Hoochst AG) pendant plus de sept ans. Une attention particulière a été accordée à l'effet de l'infection et du traitement répétés sur la productivité du troupeau évaluée selon la performance, les taux de survie et de croissance, et le développement de la résistance à la trypanosomiasis.  
Pendant la première année, la production d'élevage était faible, mais elle s'est nettement améliorée à partir de la deuxième année. La mortalité des veaux était élevée les deux premières années, mais elle a fortement baissé à partir de la troisième année et est restée faible pendant toute la durée de l'étude. Les bouvillons zébus nés à Lugala atteignaient un poids moyen à l'abattage de 300 kg à l'âge moyen de quatre ans et les génisses zébus nées à Lugala venaient pour la première fois à l'âge moyen de 42 mois. A l'Est de l'Ouganda, les bouvillons zébus nés dans une région indemne de tsétés atteignaient un poids moyen à l'abattage de 300-400 kg à l'âge moyen de 39,7 mois. Les croisements de zébus ne pouvaient pas survivre à Lugala. Bien qu'aucune résistance notable à la trypanosomiasis ne se soit développée chez le troupeau, il semble que le traitement administré aux animaux les ait aidés à subsister dans les conditions écologiques de Lugala. Les trypanosomes à Lugala n'ont pas acquis de résistance à l'acéturate de diminazène après une utilisation constante et fréquente de ce produit pendant plus de sept ans.

Summary

A herd of pure Zebu and Zebu cross-bred was maintained in an area of very high tsetse challenge with periodic diminazine aceturate (Berenil; Farbwerc Hoochst AG) treatment for over 7 years. Particular attention was paid to the impact of constant repeated infection and treatment on the productivity of the herd; as measured by breeding performance, survival and growth; and on the development of resistance to trypanosomiasis.  
During the first year, the breeding performance of the herd was low but improved significantly from the second year onwards. Calf mortality was high during the first 2 years but dropped markedly from the third year and remained low throughout the period of study. Zebu steers born at Lugala attained mean slaughter weight of 300 kg at mean age of 4 years and Zebu heifers born at Lugala, first calved at an average age of 42 months. In Eastern Uganda, Zebu steers raised in tsetse free areas attain slaughter weight ranging from 300 to 400 kg at a mean age of 4 years and Zebu heifers born at Lugala, first calved at an average age of 42 months. In Eastern Uganda, Zebu steers raised in tsetse free areas attain slaughter weight ranging from 300 to 400 kg at ages ranging from 5 to 6 years (unpublished observations) and it was observed that Zebu heifers first calved at an average age of 39.7 months. Zebu cross-breds failed to thrive at Lugala. Though no significant resistance to trypanosomiasis developed in the herd, drug treatment appeared to have assisted the herd to stabilise to Lugala conditions. Trypanosomes at Lugala did not develop resistance to diminazine aceturate after constant and frequent use for over 7 years.

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Introduction

About 10 million square kilometres of tropical Africa south of the Sahara is infested by tsetse, resulting in trypanosomiasis in the livestock. Economic modern animal production in this region is still limited due partly to this environmental constraint. Since the turn of the century a number of methods have been applied to alter this constraint with varying and sometimes disappointing degrees of success. Methods used to control tsetse are expensive and sometimes impractical. Control of trypanosomes by immunisation is not yet a practical proposition. Chemotherapy and chemoprophylaxis remain important means being applied to control African animal trypanosomiasis and hence making some of the tsetse infested land available for productive animal husbandry.

In Uganda and in other East African countries, ranching schemes have been developed in, and adjacent to, tsetse infested lands with the help of drug treatment regimes to control animal trypanosomiasis. This necessitates more work on long-term studies on chemotherapy of bovine trypanosomiasis and on the effect of constant infection and treatment on the performance of cattle raised in tsetse and trypanosomiasis endemic areas.

Since the discovery of trypanocides, many workers have published reports on the use of drug treatment regimes to maintain cattle in tsetse infested areas (1,2,3,4,5). The results obtained by these workers were affected by the environmental conditions to which the animals were exposed(6). More recently, general observations were published (7) on the performance of a large herd of beef cattle maintained on a ranch situated in a tsetse area in Tanzania and emphasised the need for further records of this type on the performance of cattle kept in tsetse areas with the assistance of trypanocidal drugs. Well documented observations were published (6,8) on the performance of cattle maintained in a tsetse area and their results also indicated the need for further well documented long term studies on the use of trypanocides to maintain breeding herds of cattle in tsetse and trypanosomiasis endemic areas. Published information based on studies of this nature in East Africa is still scanty though drugs have been in use to control trypanosomiasis for several decades.

In 1970, a herd of East African Zebu cattle was introduced into a high tsetse and trypanosome challenge area at Lugala, South Busoga, Uganda. Diminazine aceturate was used to control trypanosomiasis in this herd for a period of over 7 years. It was hoped that immunity would develop in some members of the herd using this drug regime.

Materials and Methods

Study Area

This work was carried out at UTRO Field Station, Lugala. Lugala has been described elsewhere (6,9).

Experimental Herd

A herd of East African Zebu breeding cows and heifers totalling 61 animals were introduced to Lugala from April 1970 to May 1971. These animals were derived from Uganda Trypanosomiasis Research Organisation (UTRO) herd which had been built up gradually since the late 1950's. Two bulls, a pure Zebu from UTRO herd and a Friesian-Jersey cross bought from Kenya, were introduced to the herd in 1971. The herd grazed during the day and at night were confined in a boma. No supplementary feed was given throughout the period of study. The animals had free access to water from the lake shore and swamps. No acaricide was used to control ticks. Free mating was practised but a herd breeding record was kept. Abortions, still and premature births and normal calving were recorded. All calves were weighed within 24 hours of birth. They were numbered and grouped into pure Zebu and Zebu crosses as guided by records of mating. From 1974, a periodic culling of unproductive cows were carried out. All female animals which were over 4 years old and had not calved and all cows which did not give birth to live calves for over 2 years were declared infertile and hence unproductive.

For comparative purposes the
following data were collected in the herd at UTRO during the same period: calving interval; calving rate; calf mortality including abortions, still and premature births; age at first calving; slaughter weight and slaughter age.

**Routine Examinations and Treatments**

The weekly examinations of the herd described below were conducted throughout the period of study.

1. Jugular blood from all animals was examined for detection of trypanosomes by haematocrit centrifugation technique (HCT) (10). thick and thin films and by inoculation into mice.
2. Measurement of the blood packed cell volume percentage (PCV) using a microhaematocrit centrifuge (Hawksley, London) was carried out.
3. All calves and young stock were weighed.

The drug requirement was assessed on the basis of clinical examination of adult animals, their PCV measurement and on the history of previous treatment. Animals, in which the PCV fell below 20% and had not been treated the previous week or which were clinically ill, were weighed and treated. From mid-1974 all serving bulls and calves below the age of 8 months were treated every 14 days. Pregnant cows which were 3 months to term were treated whenever they were parasitaemic. Diminazine aceturate prepared as 7% w/v solution in distilled water, was administered intramuscularly in gluteal muscles at a dose of 7 mg/kg bodyweight.

Each year, tests in cattle were carried out to detect any development of diminazine resistant strains of trypanosomes at Lugala as outlined by Wilson et al (8). Trypanosomes used in these tests were isolated from break-through infections which were detected within 14 days of diminazine treatment.

**Intercurrent Diseases**

All animals in Lugala and UTRO herds were vaccinated yearly against anthrax and foot-and-mouth diseases. Blood films taken from cattle at Lugala were examined for tick-borne disease parasites. Other disease conditions were recorded.

**Results**

*The Disease Prevalence in The Cattle*

High trypanosome infections in the herd at Lugala were detected throughout the period of study. All the three major species of trypanosomes which are pathogenic to cattle in East Africa were detected in the herd. Table 1 shows the incidence of the detectable infections in the cattle at different stages of the experiment. At the beginning of the study *Trypanosoma vivax* caused the highest detectable infections (42%) followed by mixed infections (30.7%). While *Trypanosoma brucei* caused the least detectable infections (8.0%). However, the relative frequency of *T. vivax*, *T. congolense* and *T. brucei* reversed after the first treatment. By the end of the first year of the study *T. congolense* had become more dominant than *T. vivax* while the frequency of *T. brucei* had dropped markedly. The *T. congolense* ratio continued to rise in subsequent years while that of *T. vivax* remained at a low but significant level since the mixed

<table>
<thead>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><em>T. congolense</em></td>
<td>19.3</td>
<td>63.8</td>
<td>70.5</td>
<td>80.2</td>
<td>82.0</td>
<td>85.1</td>
<td>87.6</td>
</tr>
<tr>
<td><em>T. brucei</em></td>
<td>8.0</td>
<td>1.5</td>
<td>1.1</td>
<td>0.8</td>
<td>0.4</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td><em>T. vivax</em></td>
<td>42.0</td>
<td>22.5</td>
<td>10.4</td>
<td>9.1</td>
<td>11.5</td>
<td>8.9</td>
<td>10.1</td>
</tr>
<tr>
<td>Mixed</td>
<td>30.7</td>
<td>12.2</td>
<td>17.9</td>
<td>9.9</td>
<td>6.0</td>
<td>5.8</td>
<td>1.9</td>
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</table>
infections were mainly of *T. congolense* and *T. vivax*. Figure 1 shows trypanosoma infection rates in the herd. Higher infection rates generally correspond with increased fly activity at Lugala which occurs during and just after the long and short rain peaks. There was a noticeable gradual drop of infection rates in the herd in successive years. More than 30% of the cattle were infected for most part of the year during the first 2 years of the study. This percentage declined in subsequent years (see Fig. 1).

![Mean Monthly Trypanosome Infection Rates in Lugala Cattle](image)

*Figure 1: Mean monthly trypanosome infection rates in Lugala cattle.*

**Efficiency of the Diagnostic Methods**

Table 2 compares the efficiency of the methods used to detect 3,505 infections in cattle after introduction to Lugala or after drug treatment. Mouse inoculation detected most *T. brucei* infections while the thick film method detected most *T. vivax* infections. The three methods were nearly equally efficient in detecting *T. congolense* infections. HCT was clearly superior in detecting mixed infections.

**Table 3: The Mean Number of Treatments to Ensure Survival, Over 6 Years in Adult Cattle**

<table>
<thead>
<tr>
<th>Time after introduction</th>
<th>0-1</th>
<th>1-2</th>
<th>2-3</th>
<th>3-4</th>
<th>4-5</th>
<th>5-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>8.4</td>
<td>8.5</td>
<td>9.6</td>
<td>9.2</td>
<td>8.9</td>
<td>9.4</td>
</tr>
<tr>
<td>Range</td>
<td>6-10</td>
<td>6-10</td>
<td>4-14</td>
<td>5-13</td>
<td>6-13</td>
<td>3-14</td>
</tr>
<tr>
<td>% requiring less than 6 treatments</td>
<td>4.2</td>
<td>4.8</td>
<td>5.4</td>
<td>5.9</td>
<td>6.3</td>
<td>7.9</td>
</tr>
</tbody>
</table>

treatments to ensure survival over the 6 years. There was no drop in drug requirements in the herd over the period of study but a number of different animals (10% in each year) required less than six treatments per year to survive.

**Drug Tests**

Lugala trypanosomes tested in cattle at UTRO responded to diminazine aceturate treatment at a dosage rate of 3.5 mg/kg. Sheep and goats which were used to multiply trypanosome doses for the test also responded to diminazine aceturate at the same dosage rate.

**Intercurrent Diseases**

Sporadic cases of anaplasmosis were diagnosed in the herd from time to time and caused deaths despite treatments with recommended doses of tetracycline (Terramycin). In mid-1974 the exotic bull died of acute anaplasmosis. Ticks, mainly the *Amblyoma* species, infested the cattle in large numbers sometimes causing wounds and painful swellings in inguinal regions of the animals especially in crossbred cattle. In 1976 an outbreak of
demodicetic mange occurred in the herd, severely affecting the cross-bred cattle. Most of the cross-bred cattle died and the remaining few were withdrawn from Lugala. The infection in the Zebus was easily controlled by diazinon topical application followed by Py-grease hand dressing.

Production Performance

1. Breeding: The breeding performance of the herd at Lugala is compared with the corresponding data from UTRO in Tables 4 and 5. During the first year, fertility in diminazine aceturate treatments every 14 days, leading to the near zero calvings in 1977.

2. Growth: Growth rates of groups of Lugala and UTRO calves up to one year old were described elsewhere (6). Lugala steers reached mean slaughter weight of 300 kg (range 275-350 kg) at an average age of 4 years (range 3-5 years). Zebu steers in tsetse free areas of Eastern Uganda with good grazing, attain average slaughter weights ranging from 300 to 400 kg at ages ranging from 5 to 6 years (unpublished observations).

Table 4: Reproduction Performance in the Lugala Herd from 1972 to 1978 Compared to UTRO Herd

<table>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cows in sample</td>
<td>46</td>
<td>41</td>
<td>35</td>
<td>33</td>
<td>29</td>
<td>22</td>
<td>120</td>
<td>85</td>
</tr>
<tr>
<td>No. of live calves born</td>
<td>15</td>
<td>24</td>
<td>14</td>
<td>26</td>
<td>27</td>
<td>17</td>
<td>79</td>
<td>59</td>
</tr>
<tr>
<td>No. of abortions</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Calf mortality (%)</td>
<td>33.3</td>
<td>20.8</td>
<td>21.4</td>
<td>11.5</td>
<td>9.2</td>
<td>11.8</td>
<td>3.7</td>
<td>3.5</td>
</tr>
<tr>
<td>No. of live calves/cows</td>
<td>0.32</td>
<td>0.58</td>
<td>0.40</td>
<td>0.79</td>
<td>0.93</td>
<td>0.77</td>
<td>0.65</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Table 5: Ages of Lugala and UTRO Heifers at First Calving Following Unrestricted Mating

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of animals</th>
<th>Age at first calving (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>Lugala-born</td>
<td>8</td>
<td>36-45</td>
</tr>
<tr>
<td>Lugala introduced</td>
<td>9</td>
<td>49-60</td>
</tr>
<tr>
<td>UTRO</td>
<td>82</td>
<td>34-49</td>
</tr>
</tbody>
</table>

Cross-bred animals at Lugala did not thrive well. They showed retarded growth compared to the Zebus and were generally in poor bodily condition. They were more sensitive to intercurrent diseases than the pure Zebu.

Discussion

The density of tsetse flies at Lugala, their infection rates and trypanosomiasis challenge are very high (6,9). Considering reproduction, growth and survival as the main production parameters in Zebu cattle and assuming that the production performance for the UTRO herd is economically sound, then the results from the Lugala herd can be examined more meaningfully. Despite frequent drug treatments, trypanosomiasis still affected the reproduction performance of the Lugala herd during the first years of the study. The herd fertility was markedly lower during the first year and heifers introduced to Lugala were sexually mature at a much older age than is traditional for Zebus in Eastern Uganda. Increased intercalving periods were observed (11) in N'dama cattle exposed to
trypanosomiasis and this was attributed to the delay to come to heat after calving. N'dama cattle tolerate effects of trypanosomiasis better than Zebus (12,13,14,15). Trypanosomiasis in livestock retards growth. In the growth of the first group of calves of the Lugala herd marked retardation was reported (6). In subsequent years, the retardation in growth of calves and young stock of the Lugala herd became less marked. On the average, Lugala heifers were sexually mature only 2.3 months later than UTRO heifers following unlimited mating; the slaughter weight and slaughter age of Lugala steers was compared to that traditionally expected of Zebu steers in Eastern Uganda. Taking into consideration the high tsetse and trypanosome challenge the Lugala herd was exposed to, its production performance became progressively encouraging over the period of study.

After 7 years of continuous use of diminazine aceturate to control trypanosomiasis in a herd of cattle exposed to natural challenge there was apparently no development of immunity (in the strict use of the term) to the disease. There was no decrease in drug treatment requirement to ensure survival over the years; no increase in aparasitaemic periods and losses due to trypanosomiasis still occurred in the herd. Fienes (16) described increased resistance to trypanosomiasis in a herd exposed to natural challenge for more than 2 years; and Wilson et al (17) described development of immunity in groups of steers maintained in medium to light trypanosome challenge by use of drugs for 29 months Wilson et al (6) expressed the opinion that the frequent use of diminazine aceturate reduces the trypanosome antigenic stimulus and thus affects the development of immunity. The trypanosome challenge at Lugala by the criteria of Whiteside (4) is very high. It may be that high challenge overwhelms the effect that the drug may have on the animal’s own mechanism to develop immunity to trypanosomes. In most reports where inducement of immunity to cattle by use of drugs was described, the authors either conducted their work in medium to light challenge or used prophylactic anti-

trypanosomal agents (e.g. 1,2,3,16,17). Wilson et al (6) reporting on the performance of the Lugala herd for the first 2 years of the study, assumed that the longer prepatent period of the calves as compared with the adults indicated a temporary increased resistance to trypanosomes which is rapidly lost. Losses in the Lugala herd were very high during the first year. However, the survival rate and productivity of the herd improved markedly over the successive years. The infection rate in the herd also dropped from the fourth year. It could be assumed that the Lugala herd either developed some degree of tolerance to trypanosomes after some period of exposure, or stabilised to the Lugala conditions solely due to the drug treatment regime.

In using a drug regime to control trypanosomiasis in endemic areas, drug resistance can become a big problem to contain especially where cyclic transmission in the flies occurs. The methods described by Whiteside (18) to control a resistant strain under such conditions cannot be practical in large-scale ranching schemes, and Gray & Roberts (19) did not produce any evidence to indicate any decrease in drug resistance in trypanosomes undergoing cyclic transmission in the absence of drugs. Strains of trypanosomes resistant to diminazine aceturate have been reported (20,21,22,23). Lugala trypanosomes did not develop resistance to diminazine aceturate during 8 years of continuous use of this drug to control trypanosomiasis in cattle kept under very high tsetse and trypanosome challenge. Weisenhunter (24) also used this drug at 3.5 mg/kg for a period of 3 years and did not notice any evidence of drug resistance Wilson et al (6) explained that the reported cases of resistance could have arisen due to cross-resistance with other anti-trypanosomal agents since quinapyramine resistant strains also tend to be resistant to diminazine (18). Under laboratory conditions in cattle Bauer (25) did not succeed in inducing diminazine resistance by repeated underdosing and Whiteside (26) only succeeded with difficulty. In this study diminazine aceturate proved safe to use in a very high
tsetse and trypanosome challenge area over a long period.

Acknowledgements

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References


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Growth of Mycoplasma F38 in Medium B (Modified Hayflick) and Newings Tryptose Medium

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Veterinary Research Laboratory, Kabete, Kenya and
Department of Veterinary Pathology and Microbiology, University of Nairobi, Kenya

CROISSANCE DE MYCOPLASMA F38 EN MILIEU B (MODIFIED HAYFLICK) ET EN MILIEU TRYPTOSE NEWINGS

Resume
Trois bouillons de culture de Mycoplasma, à savoir milieu B (Modified hayflick), tryptose Newings et milieu biphasique SP4 ont fait l'objet d'une expérience visant à déterminer leur capacité de supporter la croissance des souches caprines Mycoplasma F38. Les deux milieux (B et tryptose Newings) supportaient la croissance des souches F38 de la même manière à 37°C. La croissance en milieu solide était visible après trois jours en moyenne, tandis qu'en milieu liquide elle atteignait une phase logarithmique le cinquième jour d'incubation. La morphologie de la colonie se présentait sous forme d'oeuf sur le plat. Le milieu SP4 supportait mal la croissance des souches F38 testées. Les colonies passaient sept jours ou plus avant d'apparaître sur la plaque; leur morphologie n'avait pas l'aspect d'oeuf sur le plat et elles étaient très petites.

Summary
Three mycoplasma media namely medium B (Modified Hayflick medium), Newings tryptose and biphasic SP4 medium were tested for their ability to support growth of caprine Mycoplasma F38 strains. Both medium B and Newings tryptose supported the growth of the F38 strains equally at 37°C. Growth in the solid media was evident at an average of 3 days, while growth in liquid media reached the logarithmic phase on the fifth day of incubation. The colony morphology was the characteristic fried-egg type. SP4 medium poorly supported the growth of the F38 strains tested. Colonies took 7 days or more to appear on plate and their morphology lacked the fried-egg appearance and were very small in size.

Introduction
The F38 group of Mycoplasma are a relatively new species. They were first isolated from acute contagious caprine pleuropneumonia (CCPP) in Kenya(1). Subsequently they were documented to be the main etiological agents of CCPP in Kenya (2). Mac Owan (3) found the F38 organisms slow growing fastidious and grew best in medium called Viande Foie Goat (VFG) containing about 50% goat or horse serum. Due to the very high amount of serum required in VFG to support growth of the F38 organisms a need arose to investigate other mycoplasma media with less animal serum for their ability to support good growth and also effect easy initial isolation of F38. Three media namely namely medium B (modified Hayflick medium B (modified Hayflick medium) supplemented with 20% horse serum (4), Newings tryptose containing 20% pig serum (5) and biphasic SP4 medium containing 20% foetal calf serum (6) were selected and tested.

Materials and Methods

Mycoplasma Strains
Three F38 isolates recovered from CCPP outbreaks which occurred in different geographical locations in Kenya were used. The isolates were G368b/78 isolated in 1978, from an outbreak which occurred at Eldama Ravine area of Baringo District, and from G280/80 and G316A/80 recovered from outbreaks which occurred at Rumuruti and Karatina area of Laikipia and Nyeri Districts respectively. The Mycoplasma strains had been passed three times previously in Viande Foie Goat (VFG) medium before being used in this study.
Media
Three types of mycoplasma media were used, i.e. medium B (Modified Hayflick medium) (4), Newings tryptose medium (5) and biphasic SP4 medium (6).

Culture Procedure and Gaseous Requirements
The culture procedures used were those previously described (4). Briefly stock cultures of the three isolates were serially diluted (tenfold) to the $10^{-6}$ dilution. Two sets of plates for each medium were inoculated with 0.01 ml of each culture and one set of plates was incubated anaerobically while the other was incubated in an atmosphere containing 8% carbon dioxide. All the media were incubated at 37°C and checked for growth every 24 hours for a total period of 10 days. The growth curves of each isolate were determined by inoculating liquid media 2 ml with single colonies then the viable counts were determined as described by Miles and Misra (7).

Results
Growth of the F38 isolates was visible on the plate within 3 days of incubation in both medium B and Newings tryptose incubated anaerobically and in 8% carbon dioxide. The colony morphology at this state was not fried-egg in appearance. The colonies were very small, smooth, raised, convex and without the central nipple. From the fourth day of incubation the central nipple with light peripheral zone became apparent. The central nipple appeared more conspicuous than the peripheral zone of growth. As was expected growth appeared first on plates seeded with lower dilutions of the culture ($10^0$ to $10^{-3}$). Visible growth on these plates occurred after an average of 3 days of incubation. Growth in plates seeded with higher dilutions ($10^{-4}$ to $10^{-5}$) appeared from the fourth day onwards. No growth appeared in plates inoculated with culture dilutions of $10^{-6}$. There were no major differences in growth of plates incubated anaerobically and in 8% CO₂ except that colonies on plates of Newings tryptose medium incubated anaerobically were larger in size than those incubated in 8% CO₂.

The F38 isolates did not grow well in biphasic SP4 medium irrespective of the gaseous condition employed. Growth of the isolates appeared on the plates after 5 days of incubation, even for lower dilutions. Growth for dilutions higher than $10^{-3}$ appeared after 7 days of incubation. The colonies in this medium remained very small (less than 1 mm diameter) even up to 10 days of incubation, and they were not fried-egg in appearance.

The logarithmic phase of three isolates in liquid medium B and Newings tryptose was reached at 5 days of incubation. The highest growth realised was on average 1 x $10^7$ cfu/ml. Growth in biphasic SP4 never exceeded 1 x $10^6$ cfu/ml.

Discussion
The F38 strains grew well in medium B and Newings tryptose medium. Growth on solid media was evident within 3 days of incubation. This indicated that the two media are capable of supporting good growth of the F38 strains and could possibly be used for routine cultivation of these organisms. Indeed medium B is known to support growth of Mycoplasma species of bovine and caprine origin (4,8,9). MacOwan (3) cultivated the original F38 strains of a medium called Viane Foie Goat (VFG). VFG medium requires the addition of about 50% animal serum (goat). Erno et al. (10) successfully cultivated the original F38 strain in medium B to which 20% horse serum was incorporated. The present study confirms the findings of Erno et al. (10) and at the same time shows that Newings tryptose can be used to grow F38 strains. Our experience however, has been that freshly isolated F38 strains need to be sub-cultured more than once in these media before they grow well.

Newings tryptose medium supported good growth of the F38 strains irrespective of the gaseous condition employed. These findings agree with those of MacOwan (3) who observed that the original F38 strains grew in an atmosphere of 5% carbon dioxide and in normal atmospheric air while using VFG medium. These organisms have also been shown to grow well in Newings tryptose medium
under atmospheric air (unpublished observations).

The F38 strains did not grow well in biphasic SP4 medium Tully et al (6) found that while using biphasic SP4 medium with other mycoplasma medium, more isolations of Mycoplasma pneumoniae from throat washings, from people with atypical pneumonia, were made with biphasic SP4 medium. It was expected that a medium like SP4 would support growth of the strains since this medium contains all necessary growth requirements for Mycoplasma. Its failure to support the growth of the strains agrees with observations made on other media such as medium B by Erno and Stipkovits (4), who found that although medium B could support growth of many animal Mycoplasma it failed to support good growth of Mycoplasma dispar.

Exogenous deoxyribonucleic acid (DNA) was believed to be necessary for the growth of Mycoplasma in artificial media (11,12). Motty-Sabry and Atefa (13) found that media to which exogenous DNA was incorporated gave better chances of isolating Mycoplasma from the genital tract of farm animals than media without it. In the present study Mycoplasma F38 strains grew well in both medium B to which exogenous DNA was incorporated as well as in Newings tryptose medium B to which exogenous DNA was incorporated as well as in Newings tryptose medium without exogenous DNA. The fact that the F38 strains grew equally well in the two media indicated that it is not necessary to add an external source of DNA for the growth of the F38 strains. Our findings confirm those of MacOwan and Tully et al (3) and (6) who used media without exogenous DNA and realised good growth of the Mycoplasma they were growing.

The findings that the F38 strains grew well in both medium B and Newings tryptose medium indicate that the two media can be used in vaccine production. The short period of time it takes to get luxuriant growth of the F38 strains in both media suggests that large quantities of F38 cultures can be grown in a relatively short period of time especially when the strains have adapted in the media. The simple composition of Newings tryptose medium with its ingredients being readily available would make it the best medium for vaccine production.

Acknowledgements

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References


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Diurnal Variation in the Haematological Values of West African Dwarf Goats

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VARIATION DIURNE DES VALEURS HEMATOLOGIQUES CHEZ LES CHEVRES NAINES DE L’AFRIQUE DE L’OUEST

Resume

Des recherches ont été menées sur les changements des paramètres hématologiques des chèvres naines de l’Afrique de l’Ouest à différents moments de la journée. L’importance de la variation relative aux concentrations de l’hémoglobine (Hb), à numération des globules blancs (GB), aux hématocrites, en fonction des changements de la température ambiante et de l’humidité relative au cours de la journée, a été également examinée. Les valeurs des hématoïdes (GR) ne semblaient pas varier de façon significative à différentes heures de la journée chez les animaux qui ont fait l’objet d’expérience.

Summary

Changes in the haematological parameters of healthy West African Dwarf female goats at different time periods during the day were investigated. The significance of the variation in haemoglobin (Hb) concentrations, white blood cell (Wbc) counts, packed cell volume (PCV) associated with changes in ambient temperature and relative humidity during the day were also discussed. The red blood cell (Rbc) values were found not to vary significantly during the different hours of the day in the animals studied.

Introduction

In recent years food scarcity, especially of animal protein sources, has engulfed many countries of the world, particularly Nigeria. Goats in Nigeria are raised principally for meat production. Intensifying local goat meat production therefore, demands that the animals be kept as healthy as possible to slaughter weights. One of the common criteria for assessing the health status of an animal is the examination of its blood.

Haematological values vary between and within breeds of animals and depend also on the locality, environmental conditions, heredity, nutritional status and a host of other factors. Some reports in the literature dealt with the haematological parameters of normal goats in the temperate climates (1,2). Oduye (3) reported some haematological values in West African Dwarf (WAD) goats when the blood samples were collected in the morning. Olusanya (4) recorded some seasonal variation in the haematological values of Nigerian White Fulani cows. However, there has been no report on the diurnal variation in the haematological parameters of normal WAD goats and this investigation was intended to provide a baseline for assessing deviation from normal in goats in the tropics at different time periods of the day, as Oduye (3) has earlier observed that such baselines on haematological data are needed for the assessment of the health status of WAD goats.

Materials and Methods

Ten healthy female West African Dwarf (WAD) goats with ages ranging between 3 and 3½ years, and that had kidded once or twice before, were used for this investigation. The animals were obtained from the University of Ibadan Teaching and Research Farm. They were housed in pens. The animal management included
grazing on improved grass/legume pastures. Feeding was supplemented with concentrates consisting of ground maize and yam peelings in their feed boxes. Mineral lick and water were provided ad libitum. The animals were treated against intestinal worms with thiabendazole at a dose rate of 66 mg/kg bodyweight, 3 weeks before the commencement of this study.

Each animal was bled from the jugular vein at 2-hour intervals from 8.00 a.m. in the morning to 10.00 p.m. in the night. About 2 ml of blood was collected each time from each goat into bijou bottles containing disodium salts of ethylenediamine-tetra-acetic acid (EDTA) as anticoagulant.

The packed cell volume (PCV) was determined by the microhaematocrit method without correction for trapped plasma. Haemoglobin (Hb) values were estimated by the cyanmethaemoglobin method (5). The red blood cell (Rbc) and total white blood cell (Wbc) counts were estimated by the microscopic method in an improved Naubauer haemocytometer counting chamber.

Data on diurnal changes in ambient temperature and relative humidity were obtained from the Meteorological Department, University of Ibadan.

Results

Table 1 shows the changes in ambient temperature, relative humidity and haematological values during the day.

Table 1: Mean Haematological Values of West African Dwarf Goats at 2 hour Intervals from 8.00 a.m. to 10.00 p.m. (10 animals 3-3% years of age)

<table>
<thead>
<tr>
<th>Time of day</th>
<th>8.00</th>
<th>10.00</th>
<th>12.00</th>
<th>2.00</th>
<th>4.00</th>
<th>6.00</th>
<th>8.00</th>
<th>10.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.m.</td>
<td>a.m.</td>
<td>noon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature (°C)</td>
<td>25.00</td>
<td>30.80</td>
<td>33.50</td>
<td>35.00</td>
<td>33.00</td>
<td>30.50</td>
<td>28.50</td>
<td>27.80</td>
</tr>
<tr>
<td>Relative humidity (%)</td>
<td>90.00</td>
<td>75.00</td>
<td>56.00</td>
<td>47.00</td>
<td>45.00</td>
<td>64.00</td>
<td>72.00</td>
<td>81.00</td>
</tr>
<tr>
<td>Haematocrit (PCV)</td>
<td>28.08</td>
<td>25.08</td>
<td>29.75</td>
<td>25.75</td>
<td>25.83</td>
<td>26.25</td>
<td>26.17</td>
<td>27.30</td>
</tr>
<tr>
<td>% ± SD</td>
<td>±4.51</td>
<td>±3.66</td>
<td>±3.39</td>
<td>±4.58</td>
<td>±2.07</td>
<td>±3.42</td>
<td>±2.60</td>
<td>±3.70</td>
</tr>
<tr>
<td>Rbc (10⁶/mm³)</td>
<td>11.05</td>
<td>11.39</td>
<td>11.50</td>
<td>11.87</td>
<td>12.62</td>
<td>12.65</td>
<td>11.60</td>
<td>12.72</td>
</tr>
<tr>
<td>± SD</td>
<td>±3.05</td>
<td>±1.54</td>
<td>±1.36</td>
<td>±2.18</td>
<td>±1.46</td>
<td>±1.73</td>
<td>±1.29</td>
<td>±2.18</td>
</tr>
<tr>
<td>Wbc (10³/mm³)</td>
<td>9.23</td>
<td>10.36</td>
<td>12.18</td>
<td>11.37</td>
<td>11.90</td>
<td>9.90</td>
<td>11.83</td>
<td>9.82</td>
</tr>
<tr>
<td>± SD</td>
<td>±1.71</td>
<td>±2.18</td>
<td>±2.81</td>
<td>±2.85</td>
<td>±2.41</td>
<td>±3.25</td>
<td>±1.32</td>
<td>±1.49</td>
</tr>
<tr>
<td>Haemoglobin (g%)</td>
<td>±8.88</td>
<td>±7.67</td>
<td>±8.62</td>
<td>±9.01</td>
<td>±9.65</td>
<td>±8.82</td>
<td>±9.64</td>
<td>±8.96</td>
</tr>
<tr>
<td>± SD</td>
<td>±1.20</td>
<td>±1.14</td>
<td>±1.08</td>
<td>±1.50</td>
<td>±0.97</td>
<td>±0.97</td>
<td>±0.93</td>
<td>±0.93</td>
</tr>
</tbody>
</table>

SD = Standard deviation.

The sequential haemograms during the different time periods are graphically depicted in Figure 1.

Figure 1: Sequential haemograms of the West African Dwarf Goats during the day.
The daily ambient temperature increased steadily from 8.00 a.m. and reached a peak at 2.00 p.m. after which it decreased gradually. The relative humidity decreased from 8.00 a.m. through to 12 noon and was lowest at 4.00 p.m. It then rose gradually after 4.00 p.m. to a second peak at 10.00 p.m.

The PCV values fell from 8.00 a.m. to 10.00 a.m. Thereafter, the PCV rose reaching a peak at 12 noon. The PCV at noon was significantly higher than at 10.00 a.m. (P < 0.01). There was a fall in PCV again at 2.00 p.m. The difference between the PCV value at 2.00 p.m. and 10.00 p.m. was not significant (P > 0.50).

Although the Rbc counts were not significantly affected by changes in the time of day and ambient temperature, the Wbc count was significantly higher at 12 noon than at 8.00 a.m. (P > 0.01 < 0.02). The difference between the erythrocyte counts at 4.00 p.m. and 10.00 p.m. was insignificant (P > 0.05).

The Hb concentration was highest at 4.00 p.m. and when compared with the value obtained at 10.00 a.m., the difference was significant (P < 0.01). The Hb concentration at 8.00 p.m. was also significantly higher than at 8.00 a.m. (P < 0.01). Also, there was a significantly higher Hb value at 10.00 p.m. than at 10.00 a.m. (P < 0.01). Thereafter, the difference between the Hb values at 2.00 p.m. and 6.00 p.m. was not significant (P > 0.20 < 0.50).

Discussion

The mean PCV of 25.08 ± 3.36% at 10.00 a.m. in the present study was not significantly different from those reported in goats by other workers. Millson et al. (1) observed a range of 26.00 to 39.00% for the PCV in goats, while Holman and Dew (2) reported a value of 28.66 ± 4.58%. Oduye (3) found a mean PCV of 26.10 ± 4.50% in Nigeria goats. If PCV is really a reflection of the total red cell volume and if the latter is an indication of the oxygen carrying capacity of blood, then it would appear that the significantly higher PCV of 29.75 ± 3.39% at noon than at 10.00 a.m. would be suited to the hot humid environment (Table 1), because the metabolic activity and oxygen consumption would be greater at noon than in the morning.

Although the observed Rbc count of 12.65 ± 1.73 x 10^5 at 6.00 p.m. agreed with the erythrocyte count of 12.73 ± 2.63 x 10^5 for the 2-year-old female goat reported by Holman and Dew (2), there was no significant diurnal variation in the erythrocyte counts of the WAD goats.

The highest Wbc count of 12.18 ± 2.81 x 10^3 recorded at 12 noon was not significantly different from the range of 9 x 10^3 to 15 x 10^3 observed by Millson et al. (1) in goats, but was significantly lower than the leucocyte count of 16.14 ± 4.77 x 10^3 reported for WAD goats by Oduye (3). Although Oduye (3) suggested a high level of subclinical parasitic infection as partly responsible for the higher Wbc count in WAD goats, the lower count in our study could possibly suggest that there are some seasonal variations in the leucocyte counts of the goats, as the present investigation was carried out in January. This parameter in WAD goats needs further investigation. While the leucocyte count was not significantly different between 4.00 p.m. (11.90 ± 0.97) x 10^3 and 10.00 p.m. (9.82 ± 1.49 x 10^3), it was significantly higher at 12 noon (12.18 ± 2.81 x 10^3) than at 8.00 a.m. (9.23 ± 1.71 x 10^3). It is difficult to explain the increase in Wbc count at noon. It may be due to some other major physiological factors such as greater struggling at noon involving greater muscular activity when the animals were being restrained and bled (6).

The Hb values observed throughout the day in the WAD goats (Table 1) were significantly lower than the values reported in other goats (Table 2). Emmons (7) reported a mean Hb value of 90.00 g% in goats while Millson et al. (1) observed a range of 9.50 g% to 13.60 g% Holman and Dew (2) recorded a mean Hb value of 11.09 ± 1.78 g% while Schalm (8) reported a range of 8.00 g% to 14.00 g% in goats. Our results agreed with the Hb value of 8.52 ± 1.29 g% reported by Oduye (3) in Nigerian goats. This finding serves to emphasize how greatly the blood picture of goats alters with different families and with different environments, as well as other workers except Oduye (3) made their observations in
Table 2: Comparison of Some Normal Haematological Values in Some Breeds of Goats

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2 - 3 years</td>
<td>20-22 months</td>
<td>Adult</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Female</td>
<td>Male and Female</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>Time of day</td>
<td>10.00 a.m.</td>
<td>—</td>
<td>Morning</td>
<td></td>
</tr>
<tr>
<td>Rbc (10^6/mm^3)</td>
<td>12.73 ±2.63 (66)</td>
<td>12.00-18.00 (10)</td>
<td>12.20±2.20 (40)</td>
<td>15.00</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>28.66±4.58 (97)</td>
<td>26.00-39.00 (10)</td>
<td>19.50-38.50 (40)</td>
<td>38.00</td>
</tr>
<tr>
<td>Wbc (10^3/mm^3)</td>
<td>8.08±2.51 (90)</td>
<td>9.00-15.00 (10)</td>
<td>4.00-13.00 (40)</td>
<td>16.14±4.77 (40)</td>
</tr>
<tr>
<td>Haemoglobin (g%)</td>
<td>11.09±1.78 (62)</td>
<td>9.50-13.60 (10)</td>
<td>8.00-14.00 (40)</td>
<td>8.52 ± 1.28 (40)</td>
</tr>
</tbody>
</table>

Mean and standard deviation (±) shown.

*Results are expressed in ranges.

Figures in brackets denote the numbers of animals used.

 temperate climates and on breeds different from the WAD goats. In our work, the Hb value was significantly higher at 10.00 p.m. (8.95 ± 0.93 g%) than 10.00 a.m. (7.67 ± 1.14 g%). This could be explained by the changes in the water content of the blood and blood viscosity as total body water decreases with a decrease in water intake. There would be lower water intake at 10.00 p.m. than 10.00 a.m. due to lower ambient temperature (9). The recorded ambient temperatures in our study were 27.80°C and 30.80°C at 10.00 p.m. and 10.00 a.m. respectively. The lower water intake would lead to haemocentration which results therefore in relatively higher Hb value at 10.00 p.m. than at 10.00 a.m.

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References


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Etude de la Caudophagie Chez les Porcs: Cas de la Ferme Lwanika, Lubumbashi (Zaïre)

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An Investigation of Caudophagia in Pigs at Lwanika Farm, Lubumbashi, Zaire

Summary
Mismanagement in some swine production units is one of the causes which restrain the rise of stock-farming in many developing countries. With this aim in view, we have studied the frequency of caudophagia in swine in a well organised modern farm — Lwanika, Lubumbashi (Zaïre). We have suggested some simple and effective methods to prevent the frequency of caudophagia such as caudefotomia or use of hay to divert attention.

Resume
La mauvaise gestion de certaines unités de production constitue un des problèmes majeurs qui freinent l'essor de l'élevage dans les pays en voie de développement. C'est dans ce but que nous avons étudié la fréquence de la caudophagie dans la ferme Lwanika à Lubumbashi, l'une des exploitations porcines les plus modernes du Zaïre, afin de proposer des méthodes assez simples et pouvant permettre de prévenir ce vice, à même d'entrainer des compliaciones locales et générales; il s'agit de la caudefotomie et de la diversion à l'aide de paille.

Introduction
La Ferme Lwanika a retenu notre attention pour son importance et son système d'exploitation. Nous avons d'abord fait des observations générales sur les conditions d'exploitation, puis des observations cliniques sur les victimes de la caudophagie. Ces observations ont porté sur tout l'effectif de la ferme au moment de nos investigations, soit 3.907 porcs.

Ensuite, notre travail expérimental a consisté dans la caudefotomie de 120 porcelets et la distribution de paille dans un box de 19 porcelets, comme moyen de distraction.

Les observations nous ont permis d'étudier les causes de la caudophagie dans cette ferme, tandis que le travail expérimental nous a amené à établir les moyens de prévention de ce vice.

Matériel et Méthodes

Matériel
La Ferme Lwanika, où nous avons procédé à nos investigations, est située à environ 12 km au sud-est du centre de la ville de Lubumbashi.

Du point de vue de l'effectif et des installations, cette ferme est la première du Shaba et se trouve parmi les plus importantes du Zaïre. Les porcheries sont du type danois et les animaux sont les produits de croisement entre les races Landrace, Large White et Pietrain. On y applique une monte libre en donnant 8 à 12 truies à un verrat. Le choix des reproducteurs se fait par la sélection massale (sur performance propre).

Toutes les installations de cette ferme nous ont servi dans nos observations sur les conditions de vie des animaux. Mais, nous ne nous sommes intéressés qu'aux facteurs qui influencent l'apparition de la caudophagie. Nos observations cliniques ont porté sur les 3.907 porcs qui constituent l'effectif de la ferme et repartis comme suit: 167 verrats; 625 truies; 1.348 porcs à l'engrais; 616 porcs à la croissance; 1.151 porcelets.

Méthodes
Pour l'observation des conditions générales de l'exploitation de la Ferme Lwanika, nous sommes passés dans tous les secteurs et dans tous les boxes. Cela nous a permis d'étudier l'alimentation et l'ambiance des animaux ainsi que les conditions d'hygiène des locaux, car ces facteurs peuvent conduire à l'apparition de la caudophagie.

Nous avons ensuite enregistré toutes
les victimes de la caudophagie, aussi bien les cas récents que les anciens, non seulement dans les secteurs de la croissance et de l’engraissement où apparaît généralement ce vice, mais dans tout l’élevage. Les résultats de ces observations sont présentés dans les tableaux représentant la fréquence de la caudophagie par secteur et par sexe.

Comme moyen de lutte, nous avons utilisé la caudectomie et la distraction.

1. Caudectomie: 120 porcelets nous ont servi pour la prévention de la caudophagie par la caudectomie. 70 de ces porcelets étaient âgés d’un à deux jours, tandis que les 50 autres avaient 1 mois ½. 84 porcelets repartis dans trois boxes nous ont servi de témoins lors de leur introduction dans le secteur de la croissance. Deux de ces boxes-témoins avaient plus de 30 porcelets tandis que le troisième en avait moins de 25. Les boxes-témoins ont été placés dans les mêmes conditions que tous les autres.

2. Distraction: 19 porcelets âgés de 3 mois ont été placés dans un box du secteur de la croissance et nous avons distribué chaque jour de la paille longue et sèche pour les distraire.

Un autre box du même secteur, occupé par 29 porcelets, nous a servi de box-témoin. Les résultats obtenus après distribution de la paille aux porcelets se trouvent dans le Tableau 2 (secteur de l’engraissement) car lors de l’enregistrement de ces résultats, ces porcelets étaient déjà à l’engraissement.

Résultats
Dans le secteur de croissance, 12 mâles sur 353 sont atteints, soit 3,39% de mâles de ce secteur, et 21 femelles sur 364, soit 5,76%. Les femelles sont donc les plus affectées.

Pour le secteur d’engraissement, 252 mâles sont atteints, soit 54,54% de mâles de ce secteur, et 541 femelles sur 802, soit 67,45% de femelles de ce secteur. Les femelles atteintes sont aussi plus nombreuses que les mâles.

Dans le secteur de la croissance, 8 mâles sur 360 sont atteints, soit 2,22% mâles de ce secteur, et 6 femelles sur 256 sont atteintes, soit 2,34% de femelles de ce secteur. Une fois de plus, les femelles atteintes sont plus nombreuses que les mâles. Dans le 12ème box où nous avons incorporé 9 porcelets caudectomisés, un seul cas de caudophagie a été relevé. Dans les 6ème, 9ème, 14ème et 18ème boxes où des porcelets caudectomisés ont été incorporés, aucun cas de caudophagie n’a été constaté. Dans les 5ème et 15ème boxes (boxes-témoins), nous avons constaté respectivement 1 et 3 cas de caudophagie. Ce dernier chiffre est le plus élevé pour la caudophagie dans le secteur de la croissance.

Dans le secteur de l’engraissement, 107 mâles sur 531 sont atteints, soit 20,15% de mâles de ce secteur, et 271 femelles sur 820 sont atteintes, soit 33,04% de femelles de ce secteur. Encore une fois, les femelles sont plus atteintes que les mâles. Dans le 39ème box où nous avons distribué de la paille, aucun cas de caudophagie n’a été signalé parmi les 19 porcs constituant ce lot. Alors que dans le 37ème box (box-témoin), tous les porcelets ont été mordus. De même que dans les 2ème, 35ème, 36ème et 44ème boxes où nous avons incorporé des porcelets caudectomisés, aucun cas de

<table>
<thead>
<tr>
<th>Secteur de croissance</th>
<th>Nombre d’observations</th>
<th>Effectifs</th>
<th>Mâles</th>
<th>Femelles</th>
<th>Total</th>
<th>Nombre de porcs atteints</th>
<th>Mâles</th>
<th>Femelles</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23</td>
<td>353</td>
<td>364</td>
<td>717</td>
<td></td>
<td>12</td>
<td>21</td>
<td></td>
<td>33</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pourcentages de porcs atteints</td>
<td>3,39</td>
<td>5,76</td>
<td>4,60</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>462</td>
<td>802</td>
<td>1264</td>
<td></td>
<td>252</td>
<td>541</td>
<td>793</td>
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<td></td>
<td></td>
<td></td>
<td>Pourcentages de porcs atteints</td>
<td>54,54</td>
<td>67,45</td>
<td>62,73</td>
</tr>
</tbody>
</table>
Caudophagie Chez les Porcs à la Ferme Lwanika, Lubumbashi 167

Tableau 2: Fréquence de la caudophagie dans les secteurs de la croissance et de l'engraissement à la fin des observations

<table>
<thead>
<tr>
<th>Secteur</th>
<th>Nombre d'observations</th>
<th>Effectifs</th>
<th>Nombre de porcs atteints</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mâles</td>
<td>Femelles</td>
<td>Total</td>
</tr>
<tr>
<td>Secteur de la croissance</td>
<td>19</td>
<td>360</td>
<td>256</td>
</tr>
<tr>
<td></td>
<td>Pourcentages de porcs atteints</td>
<td>2,22</td>
<td>2,34</td>
</tr>
<tr>
<td>Secteur de l'engraissement</td>
<td>44</td>
<td>531</td>
<td>820</td>
</tr>
<tr>
<td></td>
<td>Pourcentages de porcs atteints</td>
<td>20,15</td>
<td>33,04</td>
</tr>
</tbody>
</table>

caudophagie n’a été signalé. Dans le 31ème box, 10 des 16 porcelets caudectomisés ont été victimes de la caudophagie. Ces 10 porcelets avaient la queue coupée à plus ou moins 2 cm de la base. Les 6 autres porcelets caudectomisés à 1 cm de la base de la queue n’ont pas été mordus.

Discussion et Recommandations

Des résultats obtenus, nous avons retenu les points suivants comme éléments intervenant d’une façon ou d’une autre dans l’apparition de la caudophagie.

1. Alimentation
La ferme dans laquelle nous avons effectué nos investigations, quoique disposant de vastes étendues cultivables et des machines à traiter les aliments, n’arrive pas encore à produire de grandes quantités de maïs ou de tout autre aliment de base. C’est ainsi qu’elle se trouve dans l’obligation d’importer les compléments alimentaires et la plupart des sous-produits d’origine animale, vu l’insuffisance de la production tant locale que nationale en farine et céréales.

Cette situation amène l’éleveur à utiliser des rations alimentaires de moindre valeur sans tenir compte de la catégorie des animaux. En réalité, la composition idéale de l’aliment n’est que très rarement respectée et on distribue fréquemment le même aliment aux porcelets et aux reproducteurs.

Le problème de l’alimentation, qui paraît crucial, trouverait pourtant une solution si l’on pouvait récupérer les milliers de litres de sang que l’on jette dans les abattoirs de la ville. On éviterait ainsi l’achat d’un aliment concentré qui coûte très cher et qui se fait aussi rare sur le marché.

2. Surpeuplement
Dans la grande majorité des cas, le nombre de porcs constituant les boxes des secteurs de la croissance et de l’engraissement dépasse 25, chiffre indiqué comme limite pour la constitution des lots (1,2). Ce surpeuplement serait donc à la base de l’agressivité des animaux. Cependant, nos résultats montrent qu’il y a des lots de plus de 30 porcs où la caudophagie n’a pas été signalée. Toutefois, le nombre de ces lots étant très limité, il faudra penser à l’association du surpeuplement avec un autre facteur, tel que la différence de taille des animaux constituant un lot, car dans la plupart des cas, les lots sont constitués sans tenir compte de ce facteur.

3. Température
Elle semble participer à l’apparition de la caudophagie. En effet, du début de nos observations en janvier jusqu’au mois d’avril, la température n’a baissé que rarement aux environs de 25°C. On voit que cette température ne favorise pas le repos du porc qui exige 12-18°C pour rester calme et dormir après avoir mangé. Par contre, la température qui règne dans la maternité n’est pas favorable aux porcelets nouveau-nés qui ont besoin d’au moins 30-32°C. L’éleveur devra donc chauffer les porcelets aussi bien en saison sèche que pendant la saison des pluies au lieu de limiter le chauffage à la saison sèche, période durant laquelle les porcelets risquent de rester chétifs et facilement agressés par les plus grands.

4. Manque de distraction et psychisme
Le manque de distraction est général à la ferme Lwanika. La paille n’est
distribuée qu’aux truies parturiantes et dans le seul but de leur assurer une litière. Les résultats que nous avons obtenus avec la distribution de la paille et les idées partagées par plusieurs auteurs montrent que la paille constitue néanmoins un bon moyen de prévention de la caudophagie. Chez les porcs âgés de plus de 2 mois, le manque de distraction et les loges surpeuplées sollicitent leur psychisme qui semble se manifester par la tendance qu’ils ont à briser la monotonie en cherchant d’abord à s’amuser avec les queues des voisins et puis en les mordant. Chez les truies par contre, le psychisme ne nous a pas semblé jouer un rôle dans la caudophagie car, durant nos observations, nous n’avons enregistré aucune mauvaise mère ni parmi les primipares ni parmi les truies ayant souffert lors de la parturition.

5. Caudectomie
Nous ne pensons pas, comme l’indiquent quelques auteurs (1, 2) qu’il soit plus intéressant d’effectuer la caudectomie dès la naissance des porcelets qu’un peu plus tard, car les résultats que nous avons obtenus avec les porcelets caudectomisés à l’âge d’un mois ½ nous ont paru aussi intéressants que ceux obtenus avec les porcelets caudectomisés à 1-2 jours de la naissance.

En outre, contrairement à ce que pensent les éleveurs de la place, qui s’opposent à la pratique de la caudectomie, au cours de nos observations, nous n’avons remarqué ni de morsure des oreilles faisant suite à la caudectomie, ni des complications des plaies opératoires, toutes les plaies s’étant cicatrisées en une semaine tout au plus. La caudectomie reste donc un moyen sûr pour prévenir la caudophagie, mais elle doit être effectuée avant l’âge de l’apparition de ce vice.

6. Hérédité
Elle semble jouer aussi un rôle dans l’apparition de la caudophagie si on considère que dans les loges où nous avons observé ce vice, ce n’étaient pas tous les porcs qui mordaient leurs congénères, mais quelques uns seulement, qui étaient toujours les mêmes et issus d’une même famille.

Bibliographie


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Ascorbic Acid Versus Oil Dipping for Prolonging Shelf Life and Improving Internal Qualities of Eggs

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ACIDE ASCORBIQUE VS IMMERSION DANS L'HUILE POUR AUGMENTER LA RESISTANCE DE LA COQUILLE ET AMELIORER LES QUALITES INTERNES DES OEUFS

Resume
Les effets de l'utilisation de 0, 1, 3 et 5% de solutions d'acide ascorbique sur la qualité de l'oeuf (%), le jaune, le pH de l'albumen (blanc d'oeuf) et le pourcentage de perte de poids ont fait l'objet de recherches à quatre périodes de stockage. Le traitement par l'acide et les différentes périodes précitées avaient tous les deux un effet significatif sur les paramètres considérés.

L'effet du graissage à la suite de l'immersion dans l'acide sur les mêmes facteurs a été également observé à quatre périodes de stockage. Le graissage n'exerçait aucune influence (P > 0,05) sur la qualité de l'oeuf, le jaune, pH de l'albumen ni pour le groupe-témoin ni pour les œufs baignés dans l'acide. Cependant, le graissage semblait avoir un effet (P ≤ 0,05) sur le poids des œufs des deux groupes. Tous les paramètres considérés diminuaient P < 0,05) à mesure que s'allongeait la période de stockage.

Les traitements à l'acide ont été utilisés pour maintenir la qualité du jaune d'oeuf (55-72%), du pH de l'albumen et limiter le pourcentage de perte de poids pendant 14 jours, tandis que le graissage et/ou la réfrigération visaient à maintenir les mêmes paramètres pendant 21-28 jours.

Summary
The effect of 0, 1,3 and 5% ascorbic acid solutions as a cleaning agent on egg Haugh units, yolk index, albumen pH and percentage weight decrease was investigated for four storage periods. Both acid treatment and periods of storage had significant effects on all the parameters considered.

The effect of oiling following acid immersion on the factors considered was investigated for four storage periods. Oiling had no effect (P > 0.05) on Haugh units, yolk index, albumen pH for either control or acid washed eggs. However, oiling was observed to have an effect (P < 0.05) on percentage egg weight changes for both control and acid treated eggs. All parameters considered decreased (P < 0.05) with increasing storage period.

Acid treatments were used to maintain A quality eggs (55-72 Haugh units), yolk index, albumen pH and percentage weight decrease for 14 days while oiling and/or refrigeration were used to maintain the same parameters for 21-28 days.

Introduction
Various methods of shell treatment designed to preserve internal quality have been tried from time to time. The relatively short shelf life of fresh poultry eggs is a serious problem to the poultry industry in hot weather. Refrigeration of poultry eggs is the most important single factor in extending shelf life of eggs.

Preservation of poultry carcasses and eggs by the use of dilute edible and non-edible acids has been demonstrated by several workers (1,2,3,4,5,6,7).

Shell treatment by oiling has also been documented as a method of preserving internal egg quality. Oiling provides a seal for the shell to prevent water and carbon dioxide loss. Schwall et al (8) found dipping of eggs in oil to be superior to spraying in maintaining egg quality at a storage temperature above 21.1°C for 2 weeks. Heath and Owens, Hill and Hall (9) and (10) reported that oiling of eggs immediately after laying maintains the best interior quality. Imai (11) showed that the shelf life of shell eggs could be prolonged by coating with an emulsion consisting of fermented starch and vegetable oil. Although refrigeration of poultry eggs is the most important factor in extending the shelf life of eggs, yet under various situations, other storage methods might be sought. Hence the objective of this study was to study the effect of acid treatment, oiling after acid immersion and refrigeration on egg quality.
Materials and Methods

Eggs were collected within 4 hours of laying from a flock of Brown Shavers. All eggs weighed between 45.2g and 72.2g and were distributed by weight into experimental groups. Eggs with cracked shells were discarded. Eggs were immersed in 0, 1, 3 and 5% solutions of ascorbic acid for 4 min, allowed to air dry before being stored in egg flats. Half of the control and acid treated eggs were dipped in vegetable oil and were stored in egg flats at room temperature (22°C) for 7, 14, 21 and 28 days. Fresh eggs were refrigerated at 0°C for four similar storage periods. The eggs refrigerated were neither acid treated nor oil immersed.

Haugh units as a measure of interior quality were determined as described by Stadleman and Cotterill (12). Yolk index as a measure of the standing-up quality of the yolk was obtained by its average diameter. The hydrogen ion concentration expressed as pH was obtained with a pH meter. Egg weight loss was determined and expressed as a percentage of initial egg weight.

Data were subjected to analysis of variance employing a completely randomised design (13) and significant differences of the pooled means were identified using the multiple range test (14).

Results and Discussion

The ambient temperature of the storage room that prevailed during the trials ranged between 28.8° and 30°C. The temperature of the oil used for dipping was 26°C. Mean and standard errors for Haugh units (Hu), yolk index, albumen pH and percentage weight decrease of eggs dipped in varying strengths of ascorbic acid and examined after 7, 14, 21 and 28 days are shown in Table 1.

Table 1: Mean (± SE) Haugh Units, Yolk Index, Albumen pH and Percentage Egg Weight Decrease of Uncoated Eggs Stored at Room Temperature (25.8-30°C) for 7, 14, 21 and 28 Days Following Dipping in Ascorbic Acid Solutions

<table>
<thead>
<tr>
<th>Ascorbic acid (%)</th>
<th>7</th>
<th>14</th>
<th>21</th>
<th>28</th>
<th>Pooled mean</th>
</tr>
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<tr>
<td><strong>Haugh units</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0 (control)</td>
<td>52.69 ± 2.61</td>
<td>43.68 ± 4.14</td>
<td>43.21 ± 1.99</td>
<td>42.56 ± 1.79</td>
<td>45.54 ± 2.40&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>1</td>
<td>65.79 ± 2.85</td>
<td>61.19 ± 2.42</td>
<td>48.14 ± 6.40</td>
<td>45.00 ± 4.53</td>
<td>55.03 ± 5.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>69.52 ± 2.43</td>
<td>64.56 ± 3.31</td>
<td>54.15 ± 0.95</td>
<td>48.46 ± 1.91</td>
<td>59.17 ± 4.80&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>5</td>
<td>65.02 ± 4.60</td>
<td>62.21 ± 1.21</td>
<td>58.29 ± 1.18</td>
<td>46.01 ± 3.01</td>
<td>57.88 ± 4.19&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pooled mean</td>
<td>63.26 ± 3.66&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>57.91 ± 1.80&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>50.95 ± 3.32&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>45.51 ± 1.22&lt;sup&gt;c&lt;/sup&gt;</td>
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</tr>
<tr>
<td><strong>Yolk Index</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>0</td>
<td>0.25 ± 0.013</td>
<td>0.22 ± 0.018</td>
<td>0.16 ± 0.011</td>
<td>0.15 ± 0.009</td>
<td>0.20 ± 0.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>1</td>
<td>0.35 ± 0.012</td>
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<td>0.30 ± 0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
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<tr>
<td>3</td>
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<td>0.32 ± 0.012</td>
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<td>0.32 ± 0.02&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>5</td>
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<td>0.31 ± 0.004</td>
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<td>0.30 ± 0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>Pooled mean</td>
<td>0.32 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.30 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.26 ± 0.003&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.23 ± 0.03&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td><strong>Albumen pH</strong></td>
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<tr>
<td>0</td>
<td>8.26 ± 0.02</td>
<td>8.54 ± 0.09</td>
<td>8.62 ± 0.10</td>
<td>9.00 ± 0.21</td>
<td>8.61 ± 0.15&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>8.18 ± 0.04</td>
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<td>8.18 ± 0.15&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>3</td>
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<tr>
<td>5</td>
<td>7.89 ± 0.11</td>
<td>8.16 ± 0.05</td>
<td>8.10 ± 0.04</td>
<td>8.28 ± 0.02</td>
<td>8.11 ± 0.08&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pooled mean</td>
<td>7.94 ± 0.11&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.27 ± 0.09&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>8.36 ± 0.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.52 ± 0.16&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
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<tr>
<td><strong>Egg Weight Decrease (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>0</td>
<td>1.58 ± 0.07</td>
<td>3.99 ± 0.25</td>
<td>6.61 ± 0.30</td>
<td>9.06 ± 0.24</td>
<td>5.31 ± 1.62&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
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<td>1.24 ± 0.13</td>
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<td>5.53 ± 0.23</td>
<td>7.69 ± 0.53</td>
<td>4.38 ± 1.41&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>3</td>
<td>1.10 ± 0.11</td>
<td>2.66 ± 0.19</td>
<td>2.49 ± 0.19</td>
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<td>3.38 ± 1.34&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>5</td>
<td>0.97 ± 0.05</td>
<td>2.14 ± 0.09</td>
<td>3.35 ± 0.27</td>
<td>4.45 ± 0.46</td>
<td>2.73 ± 0.75&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>Pooled mean</td>
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<td>7.12 ± 0.97&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
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</table>

Pooled means within a column or row for each parameter and without a common superscript are different (P ≤ 0.05).
Each mean represents three replicates of 10 eggs each.
Study 1

Haugh units. Differences in Haugh units widened as days in storage increased. Haugh unit values were significantly greater (P ≤ 0.05) for eggs stored for 7 days than those stored for 14, 21 or 28 days. Haugh units did not differ for eggs immersed in 0 or 1% ascorbic acid solution. Similarly Haugh units of eggs washed in 3 or 5% ascorbic acid solution were not different. Although differences in Haugh units due to acid immersion were small, Haugh unit values were significantly greater for eggs washed in 3 or 5% acid solutions than 0 or 1% acid solutions. Eggs in the control group were very susceptible to deterioration as Haugh units had dropped to B quality (52.69 ± 2.61 Hu) at day 7 of storage. Rapid decline of Haugh units of eggs in the control group was an indication that the holding temperature (25-30°C) was not optimum for internal quality maintenance; however, the use of dilute ascorbic acid tended to reduce the rate of quality decline. Similar results were reported by Heath and Wallace (5) although acetic acid was used instead of ascorbic acid.

Yolk index. Effect of days in storage on yolk index was examined. The yolk index of eggs stored for 7 or 14 days did not differ (P ≥ 0.05). The mean yolk index declined significantly from 0.32 to 0.23 by day 28 in storage. The yolk index was similar (P ≥ 0.05) for eggs immersed in 1 or 5% acid solution but greater than the control group and slightly smaller than those eggs dipped in 3% acid solution.

Rapid decline of yolk index of eggs in the control group with increasing storage days probably resulted from increase in weight of the yolk due to absorption of water from egg white, thereby making the yolk flaccid and the vitelline membrane weaker. It was observed that eggs with a calculated yolk index of 0.25 and below possessed very weak yolk membranes which broke easily.

Albumen pH. Hydrogen ion concentration of fresh egg white expressed as pH has been variously reported to vary from 7.6 to 8.2 whereas that of eggs held for some time may be low enough to give a pH value of 9.5(15). Albumen pH values reported herein for the four storage periods fell below 9.5. Albumen pH of eggs stored for 7 and 14 days, and those stored for 21 and 28 days did not differ (P ≥ 0.05). Nonetheless albumen pH of eggs at day 7 was smaller (P ≤ 0.05) than those stored for 21 and 28 days respectively. Acid immersion effected a decrease in pH as acid concentration increased. Albumen pH of the control eggs was higher (P ≤ 0.05) than the acid treated eggs. Egg albumen in the control group was slightly more alkaline than that of acid washed eggs. The turbidity of thick white was observed to disappear gradually with increasing storage days. The gradual increase in alkalinity of egg albumen made egg white under this condition one of the most alkaline of natural biological fluids, and this probably resulted directly from the loss of carbon dioxide which tended to reach equilibrium with the concentration in the egg white and that in the air which surrounded the eggs.

Weight decrease. Washing of eggs in the acid solutions tended to reduce the amount of egg weight loss. Weight loss increased as days in storage increased. Weight loss due to the effect of days in storage differed (P ≤ 0.05) among treatment groups. Weight decrease at day 28 was higher (P ≤ 0.05) than for days 7, 14 and 21.

Contrary to the effect of storage period on weight decrease, weight loss diminished as acid strength increased. Weight loss of eggs immersed in 3 and 5% solutions was not significantly different. Overall, weight loss of the control group was significantly greater than the acid treated groups. This result was in harmony with that of Heath and Wallace (5).

Study 2

In study 2, the effect of dipping eggs in vegetable oil following acid immersion on parameters considered in study 1 was examined (Table 2).

Haugh units. Haugh units at day 7 of storage were higher (P ≤ 0.05) than those obtained at day 21 or 28. Haugh units decreased with increasing storage days. However, Haugh units due to the effect of acid were inconsistent. Differences in Haugh units due to acid immersion were not significant among treatment groups. The control maintained very high Haugh
Table 2: Mean (± SE) Haugh Units, Yolk Index, Albumen pH and Percentage Egg Weight Decrease of Oiled Eggs Stored at Room Temperature (25.8-30°C) for 7, 14, 21 and 28 Days Following Dipping in Ascorbic Acid Solutions.

<table>
<thead>
<tr>
<th>Ascorbic acid (%)</th>
<th>Days stored</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>14</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Haugh Units</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>77.74 ± 0.81</td>
<td>71.84 ± 2.23</td>
<td>60.60 ± 2.02</td>
<td>51.51 ± 4.39</td>
<td>65.42 ± 5.84a</td>
</tr>
<tr>
<td>1</td>
<td>65.55 ± 3.43</td>
<td>63.37 ± 3.75</td>
<td>62.54 ± 4.08</td>
<td>52.39 ± 3.75</td>
<td>61.71 ± 3.38a</td>
</tr>
<tr>
<td>3</td>
<td>73.86 ± 4.17</td>
<td>67.72 ± 4.17</td>
<td>63.84 ± 4.96</td>
<td>55.84 ± 3.04</td>
<td>65.32 ± 3.77a</td>
</tr>
<tr>
<td>5</td>
<td>76.79 ± 2.32</td>
<td>69.96 ± 2.45</td>
<td>60.88 ± 4.62</td>
<td>60.19 ± 1.48</td>
<td>66.96 ± 3.96a</td>
</tr>
<tr>
<td>Pooled mean</td>
<td>74.24 ± 2.07</td>
<td>68.22 ± 1.82ab</td>
<td>61.97 ± 0.76bc</td>
<td>54.98 ± 1.97c</td>
<td></td>
</tr>
<tr>
<td><strong>Yolk Index</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0.36 ± 0.01</td>
<td>0.34 ± 0.08</td>
<td>0.29 ± 0.002</td>
<td>0.26 ± 0.009</td>
<td>0.31 ± 0.02a</td>
</tr>
<tr>
<td>1</td>
<td>0.37 ± 0.006</td>
<td>0.36 ± 0.009</td>
<td>0.31 ± 0.019</td>
<td>0.26 ± 0.005</td>
<td>0.33 ± 0.03a</td>
</tr>
<tr>
<td>3</td>
<td>0.37 ± 0.013</td>
<td>0.32 ± 0.01</td>
<td>0.31 ± 0.01</td>
<td>0.26 ± 0.011</td>
<td>0.32 ± 0.02a</td>
</tr>
<tr>
<td>5</td>
<td>0.38 ± 0.015</td>
<td>0.34 ± 0.006</td>
<td>0.31 ± 0.006</td>
<td>0.28 ± 0.007</td>
<td>0.33 ± 0.02a</td>
</tr>
<tr>
<td>Pooled mean</td>
<td>0.37 ± 0.03a</td>
<td>0.34 ± 0.01b</td>
<td>0.31 ± 0.01c</td>
<td>0.27 ± 0.01d</td>
<td></td>
</tr>
<tr>
<td><strong>Albumen pH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>7.90 ± 0.05</td>
<td>8.12 ± 0.05</td>
<td>8.11 ± 0.02</td>
<td>8.04 ± 0.10</td>
<td>8.04 ± 0.05a</td>
</tr>
<tr>
<td>1</td>
<td>7.68 ± 0.07</td>
<td>8.00 ± 0.03</td>
<td>8.04 ± 0.03</td>
<td>7.97 ± 0.04</td>
<td>7.92 ± 0.08a</td>
</tr>
<tr>
<td>3</td>
<td>7.87 ± 0.05</td>
<td>8.02 ± 0.05</td>
<td>8.14 ± 0.02</td>
<td>7.91 ± 0.05</td>
<td>7.99 ± 0.06a</td>
</tr>
<tr>
<td>5</td>
<td>7.96 ± 0.05</td>
<td>7.98 ± 0.04</td>
<td>8.04 ± 0.03</td>
<td>7.94 ± 0.02</td>
<td>7.98 ± 0.02a</td>
</tr>
<tr>
<td>Pooled mean</td>
<td>7.85 ± 0.06b</td>
<td>8.03 ± 0.03a</td>
<td>8.08 ± 0.03a</td>
<td>7.97 ± 0.03a</td>
<td></td>
</tr>
<tr>
<td><strong>Egg Weight Decrease (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0.17 ± 0.05</td>
<td>0.42 ± 0.05</td>
<td>0.65 ± 0.07</td>
<td>0.69 ± 0.13</td>
<td>0.48 ± 0.12a</td>
</tr>
<tr>
<td>1</td>
<td>0.17 ± 0.04</td>
<td>0.31 ± 0.06</td>
<td>0.66 ± 0.11</td>
<td>0.46 ± 0.05</td>
<td>0.40 ± 0.10a</td>
</tr>
<tr>
<td>3</td>
<td>0.08 ± 0.01</td>
<td>0.21 ± 0.06</td>
<td>0.28 ± 0.09</td>
<td>0.86 ± 0.42</td>
<td>0.36 ± 0.17b</td>
</tr>
<tr>
<td>5</td>
<td>0.02 ± 0.003</td>
<td>0.21 ± 0.04</td>
<td>0.36 ± 0.05</td>
<td>0.31 ± 0.06</td>
<td>0.23 ± 0.13c</td>
</tr>
<tr>
<td>Pooled mean</td>
<td>0.11 ± 0.04b</td>
<td>0.29 ± 0.05ab</td>
<td>0.49 ± 0.10a</td>
<td>0.58 ± 0.12a</td>
<td></td>
</tr>
</tbody>
</table>

Pooled means within a column or row for each parameter and without a common superscript are different (P ≤ 0.05).

Each mean represents three replicates of 10 eggs each.

---

unit values which compared well with eggs immersed in 3 or 5% acid solution. The similarity of Haugh unit values of the control and the 3 or 5% acid solution was probably due to the effect of oil applied in washing the eggs. The results contradicted those observed in study 1. The results were slightly lower than the data reported by Heath and Wallace (5).

**Yolk index.** Although differences in yolk index due to days in storage were small, yolk indices were different (P ≤ 0.05) among treatments. Yolk index decreased with increasing storage days. However, oiling of eggs resulted in essentially no significant difference in yolk index between control and acid treated groups. Heat is the principal cause of loss in egg quality. Oiling tended to make egg yolk remain firm.

**Albumen pH.** Albumen pH was lower (P ≤ 0.05) at day 7 than at day 14, 21 and 28 of storage. With respect to acid treatment, albumen pH did not differ (P ≥ 0.05) among the treatments. **Percentage egg weight decrease.** Egg weight loss increased with increasing storage days. Although differences in percentage weight loss due to days in storage were small, nonetheless percentage weight loss was significantly lower at day 7 than at the other sampling days. Acid immersion had a contrary effect on the egg weight loss. Egg weight loss decreased with increasing acid strength. Percentage weight loss was significantly lower for eggs washed in 5% acid solution than control, 1 and 3% acid solutions. Overall, oiling tended to improve the parameters considered in
study 1, as significant improvements were observed. Weight decrease obtained in this study was similar to that reported by Heath and Wallace, Hill and Hall, and Imai. (5), (10) and (11).

Table 3 describes the simple correlations of the egg quality deciding factors for un-oiled and oiled eggs. Simple correlation coefficients of the egg quality deciding factors measured for un-oiled eggs revealed that the Haugh unit value was significantly related to yolk index, albumen pH and percentage weight decrease. A significant relationship \((r = + 0.89)\) between yolk index and albumen pH was found. Yolk index was also significantly correlated with percentage weight decrease. The very high significant correlation coefficient of albumen pH of un-oiled eggs observed in this study, indicated that eggs held for a long time at a fairly high temperature, precipitated loss of carbon dioxide which ultimately affected albumen structure and subsequently lowered Haugh units with a concomitant increase in percentage weight decrease.

For oiled eggs, albumen was significantly related to yolk index and percentage weight decrease. A significant relationship between yolk index and percentage weight decrease was also found. With oil treatment, no effect was found attributable to pH change which was probably due to the effect of oiling which prevented the pH from increasing to a level that could be detrimental to albumen structure.

Study 3

In study 3, the effect of refrigerating eggs at 0°C for 7, 14, 21 and 28 days on Haugh units, yolk index, albumen pH, and percentage weight decrease was examined (Table 4). The holding temperature (0°C) was the optimum for quality maintenance of neither oiled nor acid treated eggs. Refrigerated eggs remained in the AA (72 Hu +) range for

| Table 3: Correlations \((r)\) Among Egg Quality Deciding Factors of Un-oiled and Oiled Eggs |
|-----------------------------------------------|---------------|---------------|---------------|
| Parameters                     | Haugh Units   | Yolk Index    | Albumen pH    | Egg Weight Decrease (%) |
|--------------------------------|---------------|---------------|---------------|
| **Un-oiled**                   |               |               |               |                         |
| Haugh units                    | 1.00          | 0.87*         | -0.86*        | -0.82*                   |
| Yolk index                     |               | 1.00          | 0.89*         | -0.80*                   |
| Albumen pH                     |               |               | 1.00          | 0.83*                    |
| Egg wt. decrease (%)           |               |               |               | 1.00                     |
| **Oiled**                      |               |               |               |                         |
| Haugh units                    | 1.00          | 0.90*         | -0.24         | -0.77*                   |
| Yolk index                     |               | 1.00          | 0.36          | -0.80*                   |
| Albumen pH                     |               |               | 1.00          | 0.34                     |
| Egg wt. decrease (%)           |               |               |               | 1.00                     |

* Significant at \(P \leq 0.05\)

<p>| Table 4: Mean (± SE) Haugh Units, Yolk Index, Albumen pH and Percentage Egg Weight Decrease of Eggs Refrigerated at 0°C for 7, 14, 21 and 28 Days |
|-----------------------------------------------|---------------|---------------|---------------|---------------|---------------|</p>
<table>
<thead>
<tr>
<th>Parameters</th>
<th>7</th>
<th>14</th>
<th>21</th>
<th>28</th>
<th>Pooled mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haugh units</td>
<td>80.59 ± 3.05</td>
<td>76.08 ± 3.44</td>
<td>73.33 ± 2.93</td>
<td>72.50 ± 1.35</td>
<td>75.63 ± 1.82</td>
</tr>
<tr>
<td>Yolk index</td>
<td>0.38 ± 0.03</td>
<td>0.37 ± 0.01</td>
<td>0.35 ± 0.005</td>
<td>0.34 ± 0.007</td>
<td>0.36 ± 0.01</td>
</tr>
<tr>
<td>Albumen pH</td>
<td>7.84 ± 0.08</td>
<td>7.90 ± 0.05</td>
<td>8.08 ± 0.02</td>
<td>8.05 ± 0.04</td>
<td>7.97 ± 0.06</td>
</tr>
<tr>
<td>Weight decrease (%)</td>
<td>0.56 ± 0.05</td>
<td>1.11 ± 0.11</td>
<td>1.83 ± 0.11</td>
<td>1.95 ± 0.12</td>
<td>1.36 ± 0.33</td>
</tr>
</tbody>
</table>

Each mean represents three replicates of 10 eggs each.
the four storage periods. Both yolk index and albumen pH remained within the range of fresh eggs. The lower temperature reduced egg weight loss as expected. The weight loss increased gradually as the storage days increased.

Table 5 describes the mean differences between un-oiled, oiled and refrigerated eggs during four storage periods on parameters studied.

<table>
<thead>
<tr>
<th>Storage method</th>
<th>Days in storage</th>
<th>7</th>
<th>14</th>
<th>21</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haugh Units</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Un-oiled</td>
<td>63.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>57.91&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50.95&lt;sup&gt;a&lt;/sup&gt;</td>
<td>45.51&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Oiled</td>
<td>74.24&lt;sup&gt;b&lt;/sup&gt;</td>
<td>68.22&lt;sup&gt;b&lt;/sup&gt;</td>
<td>61.97&lt;sup&gt;b&lt;/sup&gt;</td>
<td>54.98&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Refrigerated</td>
<td>80.59&lt;sup&gt;c&lt;/sup&gt;</td>
<td>76.08&lt;sup&gt;c&lt;/sup&gt;</td>
<td>73.33&lt;sup&gt;c&lt;/sup&gt;</td>
<td>72.50&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Yolk Index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Un-oiled</td>
<td>0.32&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Oiled</td>
<td>0.37&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.34&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.31&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.27&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Refrigerated</td>
<td>0.38&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.37&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.35&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.34&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Albumen pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Un-oiled</td>
<td>7.94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.27&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.36&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.52&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Oiled</td>
<td>7.85&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.97&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Refrigerated</td>
<td>7.84&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7.90&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.08&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>Percentage Weight Decrease</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Un-oiled</td>
<td>1.22&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.96&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.50&lt;sup&gt;a&lt;/sup&gt;</td>
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<td></td>
</tr>
<tr>
<td>Oiled</td>
<td>0.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.49&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.58&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Refrigerated</td>
<td>0.56&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.11&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.83&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.36&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Means in columns with different letters are statistically different (P ≤ 0.05)

Haugh unit values of un-oiled eggs were lower (P ≤ 0.05) than either oiled or refrigerated eggs in all four storage periods. Comparison of the yolk index values between the three storage methods showed notable differences after 7 days in storage. Oiled eggs compared fairly well with refrigerated eggs although refrigeration resulted in a significant (P ≤ 0.05) increase in the yolk index from day 14 to day 28 in storage.

Since eggs were stored in a well ventilated environment, the results observed suggest that increase in alkalinity was a gradual process, as significant (P ≤ 0.05) changes between un-oiled, oiled and refrigerated eggs were only shown on day 7 of storage. These data indicated that both oiling and refrigeration would maintain albumen pH within the range of that of fresh eggs for up to 4 weeks, as no significant differences in pH were noted during the periods except for the differences noted on day 14.

Oiling reduced (P ≤ 0.05) weight loss as compared to un-oiled or to refrigerated eggs for all four storage periods. The weight loss for un-oiled eggs increased in geometric progression as storage time increased. The reason for the lower weight loss of oiled eggs probably resulted from the oil forming a good seal that reduced the escape of carbon dioxide and water from the egg contents.

Results from these investigations suggest that a quality eggs (55-72 Hu) can be maintained for 14 days in storage after using up to 5% ascorbic acid solutions to clean the eggs. As an alternative to refrigeration, dipping of eggs in vegetable oil (any edible oil) can be used to prolong the shelf life of eggs for 3-4 weeks when held at high ambient temperature.

References


Received for publication on 23rd January 1984
Isolation and Characterisation of *Streptococcus* Species from Caprine Pneumonic Lungs

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Faculty of Veterinary Medicine, University of Nigeria, Nsukka

**Resume**

Des recherches ont été menées pour isoler des espèces de streptocoque dans les poumons des caprins atteints de pneumonie et pour déterminer la fréquence de ces espèces dans des échantillons collectés dans les régions de Nsukka et d’Enugu dans l’Etat d’Anambra au Nigeria. Sur un total de 350 poumons pneumoniques échantillonnés, 123 (34,86%) avaient des espèces de streptocoque.

Les symptômes macroscopiques et histopathologiques des poumons pneumoniques à partir desquels des espèces de streptocoque ont été isolées étaient notamment: l’hépatisation, la consolidation, la congestion, l’emphysème et l’infiltration cellulaire affectant surtout les leucocytes neutrophiles, les lymphocytes et les monocytes. L’importance étiologique probable de cet organisme dans la pneumonie caprine est examinée.

**Summary**

An investigation was carried out to isolate *Streptococcus* species from caprine pneumonic lungs and to determine its frequency of occurrence in such samples in Nsukka and Enugu areas of Anambra State, Nigeria. Out of a total of 350 pneumonnic lungs sampled, 123 (34.86%) yielded *Streptococcus* species.

Gross and histopathological changes in pneumonic lungs from which *Streptococcus* species were isolated included hepatisation, consolidation, congestion, emphysema and cellular infiltration involving mainly the neutrophils, lymphocytes and monocytes. The possible aetiologic significance of this organism in caprine pneumonia is discussed.

**Introduction**

That caprine pneumonia is highly prevalent in Nigeria especially during the rainy and harmattan seasons has been emphasised (1). While recognising that the symptomatology of caprine pneumonia is by-and-large similar, it is evident that the aetiology of pneumonia in goats is rather varied and complex (2,3).

Attempts made by previous investigators in northern and western states of Nigeria have led to the isolation of bacterial pathogens from caprine pneumonic lungs, namely: *Pasteurella haemolytica*, *Pasteurella multocida*, *E. coli*, *Klesbiella* species, *Staphylococcus* spp. and *Mycoplasma* spp. (4,1,5,6).

Because of the paucity of literature on bacterial flora of pneumonic lungs of goats in eastern states of Nigeria, this investigation was undertaken to isolate and characterise *Streptococcus* spp. from caprine pneumonic lungs in Enugu and Nsukka areas of Anambra State. The frequency of occurrence of this species in caprine pneumonic lungs and its possible aetiologic role in caprine pneumonia are highlighted.

**Materials and Methods**

**Animals**

Most of the pneumonic lung specimens were collected from goats slaughtered at Nsukka slaughter slabs. Others were from cases presented to the Veterinary Teaching Hospital, Nsukka and Veterinary Clinic, Enugu. The goats for the investigation included West African dwarf, Red Sokoto and Fulani breeds. Their age varied from 6 months to 5 years.
Specimen Collection
Immediately after slaughter, the diaphragms of the goats were opened and pieces of lungs collected aseptically into sterile bijoux bottles. A total of 350 pneumonic lung samples were collected. In addition, pieces of pneumonic lung specimen were cut from the same anatomic area and collected in universal bottles containing 10% buffered formalin for histopathological examination.

Isolation Procedures
After routine examination of Gram-stained smears, inoculum obtained from pneumonic lung samples was streaked over blood agar and chocolate agar plates and incubated for 24 hours under aerobic and micro-aerophilic conditions at 37°C. The colonial and microscopic morphology of the organisms were studied.

Physiological and Biochemical Tests
1. Haemolysis: Streptococcus isolates were inoculated into 5% sheep blood agar and incubated for 24 hours at 37°C aerobically.

2. Catalase test: This was conducted by mixing one drop of 3% hydrogen peroxide solution with a drop of culture suspension.

3. Oxidase test: A freshly prepared 1% solution of tetrathymethyl-p-phenylene diamine dihydrochloride was poured onto the nutrient agar with drops of serum on which Streptococcus spp. had been grown.

4. Motility test: The Streptococcus isolates were inoculated into bijoux bottles containing peptone water with some drops of serum and incubated for 6 hours at 37°C aerobically.

5. Growth at 45°C. The isolates were plated on blood agar plates, incubated aerobically for 24 hours at 45°C and examined as recommended by Carter (7).

6. Growth on MacConkey agar. The Streptococcus isolates were streaked on MacConkey agar plates, incubated at 37°C for 24 hours and examined.

7. H2S production: The Streptococcus isolates were heavily inoculated on Kligler iron agar (KIA) and incubated aerobically at 37°C for 24 hours.

8. Indole production test: The isolates were inoculated into peptone water containing an adequate quantity of nutrient tryptophane and incubated for 48 hours at 37°C aerobically. Subsequently, three drops of Kovac’s reagent were added.

9. Voges-Proskauer (VP) test: Streptococcus isolates were inoculated into MR-VP media and incubated aerobically at 37°C for 48 hours; 0.6 ml of 5% naphthol solution and 0.2 ml of 40% solution of potassium hydroxide were added.

10. Citrate utilisation test: The isolates were inoculated on Simon’s citrate agar slopes in MacCathney’s bottles and incubated for 3 days at 37°C.

11. Oxidation-fermentation test: The oxidation-fermentation test was conducted by growing each Streptococcus isolate in two universal bottles of Hugh-Leifson’s medium. The composition of the medium and the method of test are as outlined by Cowan and Steel (8).

12. Sugar tests: Peptone sugars were prepared according to the method outlined by Cowan and Steel (8). Andrade’s indicator was used and the following sugars were incorporated separately, namely: glucose, lactose, mannitol, sorbitol, sucrose and trehalose. The preparation of lung specimens for histopathology was done by trimming the specimens, embedding in paraffin wax which was cut at 6 μm, mounted on glass slides with albumin fixative and stained with haematoxylin-eosin.

Results
Based on morphological, haemolytic, physiological and biochemical properties, Streptococcus spp. were recovered from 122 out of 350 caprine pneumonic lungs sampled. Isolates from 119 cases were identified as Streptococ-
*Streptococcus viridans* while three isolates were characterised as beta-haemolytic *Streptococcus* (Table 1).

| 1. Haemolysis | α (119) β (3) |
| 2. Catalase | - (122) |
| 3. Oxidase | - (122) |
| 4. Motility | - (122) |
| 5. Growth at 45°C | - (122) |
| 6. Growth on MacConkey agar | - (122) |
| 7. H₂S production | - (122) |
| 8. Indole production | - (122) |
| 9. V.P. | - (122) |
| 10. Citrate utilization | + (122) |
| 11. O-F test | F (122) |
| 12. Sugar Tests | |
| Acid in glucose | + (122) |
| Sucrose | + (122) |
| Lactose | + (122) |
| Maltose | + (122) |
| Salicin | + (122) |
| Trehalose | - (3) + (119) |
| Sorbitol | - (3) + (119) |

- Negative; + positive; F, fermentative; α, alpha haemolysis; β, beta haemolysis; O, oxidative.

**Discussion**

Streptococci species have been associated with many pathological conditions in animals (5) and streptococcal infections constitute a major economic loss in farm animals all over the world (9).

From the results of this investigation, the level of occurrence of *Streptococcus* species in caprine pneumatic lungs is high (34.86%) in Nsukka and Enugu areas of Anambra State, Nigeria. In his investigation, Ojo (1) did not isolate *Streptococcus* species from diseased lungs, although this genus was recovered from the nasopharynx of the diseased respiratory tract and from normal lungs.

In this investigation, the streptococci were grouped into alpha and beta-haemolytic following the procedures described by Gowan and Steel (8). The beta-haemolytic streptococci are common pathogens of man and animals; the alpha-haemolytic streptococci include pneumococci and viridans groups which inhabit the respiratory tract and oral cavity of man and animals but also are associated with blood borne infections (8).

According to Green (10) and Gupta (11) the isolation of microorganisms from the lungs is commonly regarded as significant as normal lung is known to be bacteriologically sterile.

**Histopathological changes in** pneumatic lungs from which beta-haemolytic *Streptococcus* spp. were isolated, included congestion of blood vessels, oedema and cellular infiltration involving the neutrophils, lymphocytes and monocytes (Fig. 1).

![Figure 1: Pneumonic lung specimen from which Streptococcus sp. was isolated. Note the oedema and cellular infiltration.](image-url)
Although no actual pathogenicity studies were conducted using the caprine streptococcal isolates, it does appear that these organisms are important in the aetiology of caprine pneumonia considering the high level of occurrence and the high degree of correlation with pathological lesions produced in pneumonic lungs from which they were recovered.

Acknowledgements

The author is indebted to Mr E.E. Erojikwe and Mr C. Ezimoha for technical advice. The excellent secretarial assistance of Mrs G.I.N. Akobundu is appreciated.

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References

The Isolation of Infectious Bronchitis Virus from a Disease Outbreak in Chickens in Eastern Sudan

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ISOLEMENT DU VIRUS DE LA BRONCHITE INFECTIEUSE D'UNE MALADIE AVIARE DANS LA PARTIE EST DU SOUDAN

Resume
Une recrudescence de maladie respiratoire chez les poulets a été signalée dans une ferme gouvernementale à l'Est du Soudan. Elle a donné lieu au premier isolement du virus de la bronchite infectieuse au Soudan. L'infection expérimentale des poulets et des embryons ainsi que le test de neutralisation du virus ont révélé l'identité du virus isolé comme étant le virus de la bronchite infectieuse.

Summary
A severe outbreak of respiratory disease in chickens on a Government farm in Eastern Sudan is reported. This resulted in the first isolation of infectious bronchitis virus in Sudan. Experimental infection of chickens and chick embryos and virus neutralisation tests indicated the identity of the isolated virus to be infectious bronchitis virus.

Introduction
Infectious bronchitis is an acute, highly contagious disease of poultry caused by a coronavirus. In young chickens it is characterised by tracheal rales, coughing and sneezing. In adults, the respiratory signs are mild or absent and in layers, sharp drop in egg production and poor quality eggs are the most important effects of the disease.
The disease was first reported by Schalk and Hawn (1) in the United States. Several distinct serotypes exist but the Massachusetts serotype prevails in most poultry producing areas of the world. There has been no report of infectious bronchitis in Sudan, neither in imported nor in local breeder stocks.
Respiratory diseases of chickens are of great concern as they constitute some difficulty in differential diagnosis because the clinical signs and the disease course are modified by concurrent and secondary infections. This makes it important to resort to virus isolations for accurate diagnosis. In Sudan, however, only Newcastle disease and fowl pox viruses were identified and characterised systematically (2,3,4). The recent development of the poultry industry and the enormous importation of various poultry breeds raises the possibility of introduction of some exotic diseases not known before.
The present communication describes the first isolation of infectious bronchitis virus from disease outbreaks in the Sudan.

Materials and Methods
The Outbreak
An outbreak of a respiratory disease occurred in a number of grower flocks of the central provincial Kassala poultry farm. The birds originated from crosses of Nera Holland x White Leghorn. Their ages were between 1 and 5 weeks; those of 4 weeks of age were vaccinated against NDV with the Komarov strain. The outbreak occurred during the cold dry
winter in February 1981. The disease was characterised by severe gasping, coughing, dyspnoea and nasal discharge. The course of the disease was 4-7 days, and losses were more than 3,000 (Table 1). Treatment with oxytetracycline and vitamin supplementation did not affect the course of the disease.

Table 1: The Incidence of IB Outbreak in Kassala Central Poultry Farm

<table>
<thead>
<tr>
<th>Week after incidence</th>
<th>Involved</th>
<th>Deaths</th>
<th>Disposals</th>
<th>Mortality rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9781</td>
<td>640</td>
<td>350</td>
<td>6.5</td>
</tr>
<tr>
<td>2</td>
<td>7841</td>
<td>1962</td>
<td>170</td>
<td>25.0</td>
</tr>
<tr>
<td>3</td>
<td>1400</td>
<td>130</td>
<td>150</td>
<td>9.2</td>
</tr>
</tbody>
</table>

Samples
Whole birds at varying stages of the disease were taken to the regional laboratory at Kassala for examination.

**Virus Isolation**
1. **Inoculum**: Samples were collected aseptically from various tissues and were cut with scissors into small fragments. Ten per cent suspensions were made, centrifuged at 3,000 rev/min and the supernatant fluids were used for inoculation.

2. **Pathogenicity of chicken embryos**: Fertile eggs obtained from the laboratory farm known to be free of any disease were incubated for 9-10 days, then inoculated with 0.2 ml via the allantoic route using 4-5 eggs/dilution. Infected eggs were candled and surviving chicks were allowed to hatch. The end point titres expressed as ELD50 were calculated according to the method of Reed and Muench (5).

3. **Pathogenicity of chickens**: Twelve 1-week-old chicks and 12 birds aged 4 weeks were inoculated intranasally with 0.2 of stock virus (allantoic fluid) that contained $10^3$ ELD50/0.2 ml. Five birds aged 4 weeks were similarly inoculated with normal saline and kept as control.

**Haemagglutination**
The conventional plate method was employed. The test was performed at 4°C, 37°C and room temperature with erythrocytes of chickens.

**Neutralisation and Identification**
Fifty six random samples of the sera collected from the farm were tested for IB antibodies. Neutralisation tests were performed in 10-day old embryos, undiluted serum samples were tested against 10 ELD50/0.2 ml virus.
For titration of antibody levels in selected sera the constant serum and varying virus dilution method (10-fold dilutions) was used; the mixtures were incubated at 37°C for 45 min before being injected into chicken embryos. Inoculations were carried out in the same manner as described above.
Identification of the virus isolate was carried out with known IB antisera* using the same method as described above. The neutralisation index was expressed as the log titre of virus incubated with negative control serum minus the log titre following exposure to test serum. Indexes higher than 0.8 were regarded as positive.

**Results**

**Ten-day-old chicken embryos** inoculated with 10-fold dilution of 10% suspension of trachea or lung were shown to induce dwarfing and curling of embryos within 48 hours and death of all infected embryos after 48 hours; whereas embryos inoculated with 10% suspension of kidney and liver hatched normally. The titres of the three experiments are shown in Table 2.

Table 2: Experimental Infection of Chicken Embryos with Suspensions of Organs from Chickens Suspected of Infectious Bronchitis Virus Infection

<table>
<thead>
<tr>
<th>Materials</th>
<th>Virus isolated from experiment No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Trachea</td>
<td>2.5</td>
</tr>
<tr>
<td>Lung</td>
<td>3.5</td>
</tr>
<tr>
<td>Kidney</td>
<td>0</td>
</tr>
<tr>
<td>Liver</td>
<td>0</td>
</tr>
</tbody>
</table>

*50% egg lethal dose/0.2 ml.
0 = No virus isolated.

*IB antisera were obtained from Weybridge Laboratory, England, courtesy of Mr. Gareth Evans.
Pathogenicity for Chickens
Both age groups of experimentally infected birds developed sickness 4-6 days after infection. The clinical signs fitted exactly the description given by Jones (6): severe moist rales, head shaking and laboured breathing. However, in the present experiment all infected birds died in less than 10 days after infection. Control birds inoculated with normal saline remained healthy.

Identification
The identity of the virus isolate was confirmed with known IBV antiserum as is shown in Table 3. Reduction in titres were more than 1.0 log ELD50 (Table 3).

Table 3: Confirmed as IBV by Neutralisation in Chicken Embryos

<table>
<thead>
<tr>
<th>Experiment No.</th>
<th>Antigen</th>
<th>Neutralisation index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P1</td>
<td>12.0</td>
</tr>
<tr>
<td>2</td>
<td>P2</td>
<td>2.0</td>
</tr>
<tr>
<td>3</td>
<td>P3</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* virus passage levels
† log 10 reduction in titre.

Neutralisation
Of 56 serum samples tested 17 were positive for neutralising antibody to IB virus isolate (33%).

Haemagglutination
Haemagglutinating activity was not demonstrated with erythrocytes of chicken at 4°C, 37°C or room temperature.

Discussion
The present work has shown that infectious bronchitis virus exists in the Sudan. However, the report provides no evidence as to whether the agent existed before or has been recently introduced into the country with foreign breeds. Such epidemiological investigation is vital, particularly when establishing an eradication policy. Because agents other than IB virus are always associated with the disease (7,8), such complications could explain why the virus had not been isolated in Sudan previously. In the present work the role of organisms such as plasma or E. coli was not investigated and their probable participation as precipitating agents cannot be ruled out. Adler et al (9) has shown that damage to the tracheal epithelium occurs as a result of IB infection enhanced by multiplication of Mycoplasma gallisepticum. On the other hand the severity of the outbreak described in our report might have been aggravated by the extreme dry cold weather and overstocking. The fact that the pathogenicity of the virus isolate was not modified by passage in chicken embryos and the mortality of all the experimentally infected birds together with the behaviour of the agent in chicken embryos were indications that the present isolate was a virulent one.

References

Received for publication on 5th October 1984
Characteristics of Streptococci and Staphylococci Isolated from Cows with Mastitis at Iwo Road Dairy, Ibadan, Nigeria and the Enterotoxigenicity of \textit{B. cereus} Isolated from Cheese Made from the Milk from the Dairy Cows

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\textbf{Resume}

Des études bactériologiques menées sur des échantillons de lait obtenus de vaches souffrant de mastite dans une ferme laitière près d’Ibadan ont permis de collecter 13 souches de streptocoque des groupes C et D, qui étaient résistantes à la streptomycine et à la pénicilline et aussi 13 souches de \textit{Staphylococcus aureus}, dont quatre résistaient à l’ampicilline, à la pénicilline, à la tétracycline ou au mélange de ces médicaments. Les souches de staphylocoque étaient identifiées d’après les phages bovins utilisés. Deux des filtrats de \textit{B. cereus} dilataient les anses intestinales ligaturées de lapin avec accumulation de liquide.

\textbf{Summary}

Bacteriological studies of milk samples obtained from cows with mastitis in a dairy near Ibadan yielded 13 strains of streptococci groups C and D, which were resistant to streptomycin and penicillin, and also 13 strains of \textit{Staphylococcus aureus}, four of which were resistant to ampicillin, penicillin, tetracycline or a combination thereof. The staphylococcal strains were typable by the bovine phages used. Two of the \textit{B. cereus} filtrates dilated ligated intestinal loops of rabbit with accumulation of fluid.

\textbf{Introduction}

The most commonly isolated pathogenic bacteria in bovine mastitis are \textit{Streptococcus agalactiae}, \textit{S. dysgalactiae}, \textit{S. uberis} and \textit{S. pyogenes} (1,2,3,4). Infections of the udder by these pathogens result in low milk yield (5).

The work reported here shows the characteristics of pathogens isolated from the udder of cows with mastitis in Iwo Road dairy farm and the enterotoxigenicity of \textit{B. cereus} isolated from cheese made from milk collected from the mastitic cows.

\textbf{Materials and Methods}

Fresh milk samples were obtained aseptically into sterile universal bottles
from each quarter of the udder of 62 cows located at Iwo Road dairy farm in Oyo State.

The quarters were thoroughly washed with soap and disinfected with 70% alcohol before milk samples were collected.

The first sample of milk was allowed to run off before the samples used in this investigation were obtained. The samples were centrifuged at 3,000 rev/min and the supernatant discarded. The deposit obtained from each milk sample was used to seed 5% sheep blood agar and MacConkey agar plates. The plates were incubated aerobically at 37°C for 18 hours. Isolates were identified according to the methods described by Cowan and Steel (8). Cheese made from the milk was also studied bacteriologically for the isolation of pathogenic organisms using standard methods.

**Antibiotic Sensitivity Test**

The antibiotic sensitivity of each isolate was determined according to the method of Walton (7) with some modifications. Each isolate was inoculated into 5 ml of nutrient broth and incubated aerobically at 37°C for 18 hours. To 4 ml of nutrient broth was added 0.01 ml of each culture. The mixture was vigorously shaken and this gave a dilution of 1:2,000. A sensitivity test agar plate was flooded with each mixture and excess fluid was allowed to drain off. The plates were left on the bench for 30 min after which Oxoid multodisk (Code 3857E) containing the following antibiotics, oxytetracycline (OT: 30 mcg); streptomycin (S: 10 mcg); neomycin (N: 30 mcg); nalidixic acid (NA: 30 mcg); chloramphenicol (C: 30 mcg); furazolidone (FR: 10 mcg); ampicillin (Pn: 25 mcg); and compound of sulphonamide (S3: 300mcg) was applied on to the surface of the test plates for Staphylococcus. Single (Oxoid) discs consisting of tetracycline (T: 30 mcg); ampicillin (Pn: 25 mcg); chloramphenicol (C: 30mcg); penicillin (P: 1.5 units) and cloxacillin (OB: 5mcg) were used for sensitivity testing of Streptococcus pyogenes on blood agar plates.

Each plate was left on the bench for 15 min to allow the antibiotics to diffuse into the agar. The plates were incubated aerobically at 37°C for 18 hours and results later recorded.

**Serotyping**

The bacterial isolates were screened for group A streptococci by examining them for sensitivity on human blood agar and with bacitracin.

Fuller's method (8) and the Lancefield method (9) were employed for serotyping the streptococcal isolates. Wellcome's Streptococcus grouping antisera C,D,E and N were used for screening the isolates.

The staphylococcal isolates were also examined for D'Nase (10); fibrinolysin (11) and mercuric chloride sensitivity (12).

**Bacteriophage Typing**

This was done by flooding nutrient agar plates, 3cm thick, with overnight broth cultures of the Staphylococcus aureus to be typed. Excess fluid was drained off with a sterile Pasteur pipette. After allowing the plates to dry, 0.01 ml of bovine typing phages 78, 116, 117, 102, 84, 167, 118 was aseptically delivered respectively over the squares of the grid marked on the bottom of the plate. The pipette was not allowed to touch the surface of the agar plate. One sterile pipette was used for each of the phages. The inoculated plates were allowed to dry and later incubated at 37°C for 6 hours after which the results were recorded.

**Rabbit Ileal Loop Test**

Pure cultures of B. cereus Nos. 249, 250, 397, 35 and 36 were inoculated respectively into trypticase soya broth (TSB) and incubated at 37°C for 20 hours in a water bath. The filtrates were centrifuged at 3000 rev/min for 30 min. New Zealand rabbits, 10 weeks old, were deprived of food for 48 hours but water was given ad lib. Each rabbit was anaesthetised with sodium barbitone, the stomach opened up and the gut ligation test was performed according to Gyles (13) using Vibrio cholerae as positive control and TSB as negative control. B. cereus Nos. 249, 250 and 397 filtrates were tested along with B. cereus 35 and 36 filtrates;
### Table 1: Characteristics of Streptococci Isolated from Cow's Milk at Iwo Road Dairy Farm

<table>
<thead>
<tr>
<th>Strain No.</th>
<th>Bacitracin</th>
<th>OT&lt;sub&gt;30&lt;/sub&gt;</th>
<th>PN&lt;sub&gt;25&lt;/sub&gt;</th>
<th>C&lt;sub&gt;30&lt;/sub&gt;</th>
<th>OB&lt;sub&gt;5&lt;/sub&gt;</th>
<th>P&lt;sub&gt;1.5 l.u.&lt;/sub&gt;</th>
<th>S&lt;sub&gt;25&lt;/sub&gt;</th>
<th>Sorbitol</th>
<th>Salicin</th>
<th>Lactose</th>
<th>Arabinose</th>
<th>Trehalose</th>
<th>Serogroup</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 126</td>
<td>R</td>
<td>10</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>10</td>
<td>0</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>D</td>
<td>S. uberis</td>
</tr>
<tr>
<td>H 110 (1)</td>
<td>R</td>
<td>12</td>
<td>11</td>
<td>8</td>
<td>10</td>
<td>8</td>
<td>0</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>D</td>
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</tr>
<tr>
<td>H 110 (2)</td>
<td>R</td>
<td>8</td>
<td>10</td>
<td>0</td>
<td>11</td>
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<td>0</td>
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<tr>
<td>H 110 (3)</td>
<td>R</td>
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<td>13</td>
<td>9</td>
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<td>9</td>
<td>0</td>
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<td>A</td>
<td>A</td>
<td>A</td>
<td>D</td>
<td>&quot;</td>
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<tr>
<td>X 146 (1)</td>
<td>R</td>
<td>9</td>
<td>16</td>
<td>10</td>
<td>8</td>
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<td>0</td>
<td>—</td>
<td>A</td>
<td>A</td>
<td>A</td>
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<td>S. bovis</td>
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<td>10</td>
<td>12</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>—</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>D</td>
<td>S. uberis</td>
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<tr>
<td>X 151</td>
<td>R</td>
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<td>9</td>
<td>12</td>
<td>10</td>
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<td>0</td>
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<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>D</td>
<td>S. dysgalactiae</td>
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<tr>
<td>H 168 (1)</td>
<td>R</td>
<td>9</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>0</td>
<td>0</td>
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<td>D</td>
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<tr>
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<td>10</td>
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<tr>
<td>H 359 (2)</td>
<td>R</td>
<td>12</td>
<td>11</td>
<td>12</td>
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<td>0</td>
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<tr>
<td>H 476 (1)</td>
<td>R</td>
<td>13</td>
<td>10</td>
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<tr>
<td>H 476 (2)</td>
<td>R</td>
<td>10</td>
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<td>0</td>
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<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>D</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

OT = oxytetracycline; PN = ampicillin; C = chloramphenicol; OB = chloroxacillin; P = penicillin.
R = resistant; A = acid produced; — = no fermentation; l.u. = international units; 0 = no inhibition.

### Table 2: Characteristics of Staphylococcus aureus Strains Isolated from Cow's Milk at Iwo Road Dairy Farm

<table>
<thead>
<tr>
<th>Strain No.</th>
<th>OT</th>
<th>S&lt;sub&gt;10&lt;/sub&gt;</th>
<th>N&lt;sub&gt;30&lt;/sub&gt;</th>
<th>NA&lt;sub&gt;30&lt;/sub&gt;</th>
<th>PN&lt;sub&gt;25&lt;/sub&gt;</th>
<th>C&lt;sub&gt;50&lt;/sub&gt;</th>
<th>S&lt;sub&gt;300&lt;/sub&gt;</th>
<th>FR&lt;sub&gt;10&lt;/sub&gt;</th>
<th>P&lt;sub&gt;1.5 l.u.&lt;/sub&gt;</th>
<th>D'Nase</th>
<th>Fibrinolysin</th>
<th>HgCl&lt;sub&gt;2&lt;/sub&gt; 1/27,000</th>
<th>78</th>
<th>116</th>
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<th>Lytic</th>
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</tbody>
</table>

OT = oxytetracycline; S = streptomycin; N = neomycin; Na = nalidixic acid; Pn = ampicillin; C = chloramphenicol; S3 = triple sulph; FR = furazolidone; P = penicillin.
L.u. = international units; 0 = no inhibition.
1 ml of each was inoculated into ligated loops respectively. The incision was closed up and the rabbit kept in a warm place for 24 hours after which it was anaesthetised with sodium barbitone. The incision was opened and the result recorded. The test was repeated three times.

Results

The characteristics of the 13 streptococci and 13 Staphylococcus aureus isolated from the milk samples collected at Iwo Road are shown in Tables 1 and 2. On the basis of the biochemical and serological results obtained in this investigation, the streptococci were classified as belonging to Lancefield groups C and D.

The streptococcal isolates were resistant to both streptomycin and penicillin whilst the Staphylococcus aureus isolated were sensitive to nearly all the antibiotics used except for two strains which showed resistance to tetracycline and four strains which showed multiple resistance to ampicillin and penicillin.

At the time this investigation was carried out the pasteurising machine at Iwo Road dairy farm broke down. Some of the milk was fed to calves as fresh milk while some was used to make cheese. On bacteriological examination of the cheese, Bacillus cereus was isolated. Filtrates of two B. cereus isolates dilated the ileal loop of rabbit (Fig. 1).

Table 3: Gut Ligation Test in Rabbit for Filtrates of B. cereus

<table>
<thead>
<tr>
<th>Strain</th>
<th>Length (cm)</th>
<th>Volume (ml)</th>
<th>V/L</th>
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<td>V. cholerae filtrate</td>
<td>8</td>
<td>24</td>
<td>24/8 = 3</td>
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<tr>
<td>TSB</td>
<td>8</td>
<td>0</td>
<td>0/8 = 0</td>
</tr>
<tr>
<td>B. cereus 249 filtrate</td>
<td>8</td>
<td>0</td>
<td>0/8 = 0</td>
</tr>
<tr>
<td>&quot; &quot; 250 &quot; &quot;</td>
<td>8</td>
<td>0</td>
<td>0/8 = 0</td>
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<td>&quot; &quot; 36 &quot; &quot;</td>
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<td>8/8 = 1</td>
</tr>
<tr>
<td>&quot; &quot; 35 &quot; &quot;</td>
<td>8</td>
<td>8</td>
<td>8/8 = 1</td>
</tr>
<tr>
<td>&quot; &quot; 397 &quot; &quot;</td>
<td>8</td>
<td>1</td>
<td>1/8 = 0.1</td>
</tr>
</tbody>
</table>

Discussion

The bacterial isolates from the samples from Iwo Road dairy farm confirm the findings obtained by Donovan et al (2), Kaira + Dittanda (3) and King (14) who isolated Streptococcus dyslactiae, Streptococcus uredis and Staphylococcus aureus from milk of cows with mastitis. The staphylococcal strains isolated from latent mastitis had some virulence factors which make them potentially dangerous (Table 2).

Some staphylococcal strains are toxic producers while many strains elaborate enzymes that enhance their pathogenicity. According to Pattison (1), staphylococci were observed to multiply outside the duct system and were found to produce more serious pathological changes and established themselves in different foci where they multiply and cause extensive damage in their immediate vicinity. The presence of pathogenic staphylococci and other virulent microorganisms in the duct makes milking much more difficult and painful to the cow resulting in reduction of milk yield. In addition streptococci multiply within the duct and then pass through the duct walls into adjacent lymphatic vessels. Thus the presence of staphylococci and streptococci infections in the udder may constitute an economic loss to the milk industry.
There was good correlation between the mercuric chloride test and antibiotic sensitivity testing with all the staphylococcal isolates. This was also true of coagulase and D’Nase activities of all the staphylococcal isolates. Filtrate of Bacillus cereus was found to produce an accumulation of fluid in the ligated intestinal ileal loop of rabbit (15). Filtrates of two Bacillus cereus isolated from the cheese were found to dilate the ileal loop of rabbit (Fig. 1, Nos. 35, 36) with accumulation of fluid. Bacillus cereus has been associated with food poisoning in man (16). Should B. cereus isolated from the cheese made from the milk at Iwo Road dairy be eaten by man, it might result in a serious health problem which would be difficult to diagnose on time in a society like Nigeria where medical services and efficient diagnostic laboratories are very limited.

All the Staphylococcus aureus strains were lysed by the set of bovine phages used at routine test dilution (RTD).

The resistance of the streptococci to penicillin and streptomycin may be evidence of misuse of these antibiotics. Judicious application of these antimicrobial agents in livestock would possibly reduce the incidence of drug resistance. It is hoped that with better milking procedures and proper hygienic maintenance of the cows on Iwo Road dairy farm, the incidence of mastitis could be curtailed.

Acknowledgement

We are grateful to Dr Dosun Adekeye for supplying the bovine phages.

References


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Blood Chemistry, Haematology, Rumen Microorganism Populations and Carcass and Offal Yields of Sheep Fed Diets Containing Varying Levels of Cocoa Pod Husk

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*Department of Animal Science, U.S.T. Kumasi, Ghana and  
†Cocoa Research Institute of Ghana, Tafo, Eastern Region, Ghana

COMPOSITION CHIMIQUE DU SANG, HEMATOLOGIE, POPULATIONS DE MICRO-ORGANISMES DANS LE RUMEN, PERFORMANCE A L'ABATTAGE ET RENDEMENT EN ABATS DES MOUTONS NOURRIS DE REGIMES CONTENANT DIFFERENTES PORTIONS DE CABOSSE DE CACAO

Resume

Des rations contenant différentes portions de cabosse de cacao (60, 45, 30, 15 et 0%) ont été servies à cinq groupes de moutons et de brebis de races Djallonké et Sahel élevés en claqustration. On a observé que la portion de cabosse de cacao dans les rations n'avait aucun effet sur la composition du sang, la flore du rumen et le rendement à l'abattage. Les organes des animaux étaient aussi d'une grosseur normale à l'exception du foie qui a diminué de volume chez les animaux nourris de ration contenant 60% de cabosse de cacao. Cependant, cette réduction du volume du foie n'affecte pas ses fonctions d'après les niveaux de sang de la phosphatase alcaline et de l'oxalo-transaminase glutamique du sérum. Les niveaux de phosphatase alcaline étaient plus élevés (P<0.005) chez les femelles que chez les mâles. La race Sahel avait des niveaux de protéine totale et de globuline plus importants (P<0.05) que la race Djallonké.

Summary

Rations containing different levels of cocoa pod husk (60, 45, 30, 15 and 0%) were fed to five groups of confined Sahel and Djallonke breeds of sheep of both sexes. It was found that the level of cocoa pod husk in the rations had no effect on the level of blood constituents, ruminal flora and dressing percentage. Organ sizes of the animals were also normal except the liver which was reduced in size in animals fed the ration containing 60% cocoa pod husk. This reduction in size of the liver however did not affect its functions as measured by blood levels of serum glutamic oxalo-transaminase and alkaline phosphatase. Females had significantly (P<0.005) higher levels of alkaline phosphatase than males. The Sahel breed had significantly (P<0.05) higher levels of total protein and globulin than the Djallonke breed.

Introduction

It has been advocated that if ruminants are to be kept intensively in the tropics, agro-industrial by-products including crop discards should form the bulk of their diets (1). In Ghana, cocoa pod husk could be used for feeding ruminants. Although some work has been carried out to evaluate the cocoa pod husk as a feed ingredient in Ghana (2,3), none of the workers reported on its effects on the physiology of the animals fed. In this experiment the effects of inclusion of cocoa pod husk in the diets of sheep on some blood constituents, organs and rumen microbial populations were assessed.

Materials and Methods

Location and Period of Study

The experiment was conducted on the livestock farm of the Department of Animal Science, University of Science and Technology, Kumasi, Ghana. The climate and vegetation of the area have been described (4) and (5). The
experiment was started in April 1982 and ended in May 1983.

Animals
Forty-six male and female sheep (weighing between 5 and 15 kg) of the Djalonneke and Sahel breeds were used because sufficient numbers of animals of the same sex or breed or weight could not be obtained. The sheep were bought from villages around Kumasi, their ages were not known but they were young growing animals. The animals were allotted at random, but as much as possible balancing for sex and breed, to five dietary treatments. The animals were ear-tagged on their arrival at the farm. They were weighed after being fasted for 18 hours on their arrival, and weekly thereafter.

Housing
The animals were kept in individual pens measuring 3 m long by 1 m wide in a building with wooden slatted floors.

Disease Control and Treatments
All the animals were treated against internal parasites and dipped in an acaricide to control ectoparasites. They were also given antibiotic treatments on their arrival at the farm against any possible subclinical infections.

Rations
There were five rations containing different levels of cocoa pod husk. The cocoa pod husk was prepared from fresh ripe pods of different varieties, mainly Amazon and Amelonado, at the fermentary of the Cocoa Research Institute of Ghana, Tafo. The husk was sliced into flakes, dried in the sun and then in a mechanical drier at about 80°C to a moisture content of 10-12%. For incorporation into the rations the dried husk (as well as the maize and the dried Guinea grass) was milled using a hammer mill with a sieve size 6 mm. The rations were formulated to be isonitrogenous and isoenergetic. The quantities of the various ingredients used are shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Composition of the Rations (% DM basis)</th>
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<tbody>
<tr>
<td>Ingredients</td>
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<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Cocoa pod husk</td>
</tr>
<tr>
<td>Dried Guinea grass</td>
</tr>
<tr>
<td>Maize</td>
</tr>
<tr>
<td>Dried brewers spent grains (Guinness)</td>
</tr>
<tr>
<td>Common salt</td>
</tr>
<tr>
<td>Bone meal</td>
</tr>
<tr>
<td>*Trace mineral-vitamin premix</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>CP% (calculated)</td>
</tr>
<tr>
<td>CP% (analysed)</td>
</tr>
<tr>
<td>TDN% (calculated)</td>
</tr>
<tr>
<td>Ash% (analysed)</td>
</tr>
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</table>

*The composition of the trace mineral-vitamin premix (per kg) given by the manufacturers was as follows:
Vit. A 6,000,000 i.u.; vit. D 3 1,200,000 i.u.; vit. E 2,000 mg; vit. B 400 mg; vit. B 2 2,400 mg; vit. B 6 400 mg; vit. B 12 8 mg; vit. K 3 800 mg; vit. B 3 6,000 mg; niacin 12,000 mg; choline chloride 80,000 mg; iron 20,000 mg; Zn 16,000 mg; Cu 2,500 mg; Mn 36,000 mg; Co 400 mg; 1 800 mg; Se 25 mg; Mg 20,000 mg; antioxidant 5,000 mg; antibiotic 8,000 mg; D-L methionine 20,000 mg; L-lysine 20,000 mg.

Feeding
The animals were allowed an adjustment period of 2 weeks. During the experimental period the animals were fed ad libitum. They were fed twice daily at 0800 h and 1500 h. Water was provided in plastic buckets (10 litres) ad libitum.

Measurements of Blood Constituents
At four weekly intervals, blood samples were taken from the animals for the determination of total protein, albumin, globulin, sugar, urea, packed cell volume (PCV), haemoglobin, calcium, inorganic phosphorus, total leucocyte count, lymphocytes, eosinophils, neutrophils, serum glutamic oxalo-transaminase (SGOT) and alkaline phosphatase. The methods described by Tuah and Klusey (6) were used in the analysis of the samples.

Carcass Studies
Only the male animals were slaughtered at the end of the feeding trial. The females were kept for studies on the effect of feeding cocoa pod on
reproduction. They were supposed to be slaughtered when they attained body-weights of 20 kg but some of them could not reach the targeted weight due to shortage of feed. The animals were slaughtered 3 hours after the morning feeding. The pH of the rumen and abomasal digesta samples was measured immediately the gastro-intestinal tract was removed. Samples of the rumen digesta were also taken for rumen bacteria and protozoa counts based on the direct count methods of Hungate (7).

The carcass was weighed. The dressed carcass was the part of the animal remaining after the removal of head, feet, skin, tail, testicles and all the internal viscera. The dressing percentage was calculated as:

\[
\text{dressed weight x 100} \quad \frac{\text{liverweight at slaughter}}{\text{liveweight at slaughter}}
\]

The offal components and the internal organs were weighed and expressed as percentages of liveweights of the animal. The offal or organ percentage =

\[
\frac{\text{offal or organ weight x 100}}{\text{liveweight of the animal at slaughter}}
\]

components and the internal organs consisted of liver, kidney, heart, pluck, stomach, intestines, head, feet or shanks, tail, skin and testicles.

**Experimental Design and Statistical Analysis**

For the blood constituents the factorial design (5 x 2 x 2) with five rations, two sexes and two breeds, was used with unequal numbers of animals per treatment. For the carcass studies the randomised block design (RBD) with five rations and two breeds was used. All the data were subjected to statistical analysis using analysis of variance and Scheffe's test (8).

**Results and Discussion**

**Blood Chemistry and Haematology**

The levels of the blood constituents are shown in Table 2. None of the blood constituents was significantly (P > 0.05) affected by the level of cocoa pod husk in the rations except alkaline phosphatase which was significantly (P < 0.05) greater in animals fed ration 3 than those fed ration 1 containing the highest level of cocoa pod husk. This is an indication that there were no toxic substances in the cocoa pod husk which would adversely affect the physiology of the animals. The reasons for the higher levels of alkaline phosphatase in animals fed ration 3 compared to those fed ration 1 are not clear.

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Rations</th>
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<tr>
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<tr>
<td>Total protein (mg/100 ml)</td>
<td>9.92</td>
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<tr>
<td>Albumin (g/100 ml)</td>
<td>5.48</td>
<td>5.83</td>
</tr>
<tr>
<td>Globulin (g/100 ml)</td>
<td>4.34</td>
<td>4.88</td>
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<tr>
<td>Blood sugar (mg/100 ml)</td>
<td>50.29</td>
<td>46.60</td>
</tr>
<tr>
<td>Blood urea (mg/100 ml)</td>
<td>34.84</td>
<td>32.65</td>
</tr>
<tr>
<td>Packed cell volume (%)</td>
<td>27.96</td>
<td>28.06</td>
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<tr>
<td>Haemoglobin (g/100 ml)</td>
<td>11.91</td>
<td>12.91</td>
</tr>
<tr>
<td>Total leucocyte (10³/mm³)</td>
<td>9.20</td>
<td>8.95</td>
</tr>
<tr>
<td>Lymphocytes (%)</td>
<td>62.99</td>
<td>62.15</td>
</tr>
<tr>
<td>Eosinophils (%)</td>
<td>3.24</td>
<td>4.60</td>
</tr>
<tr>
<td>Neutrophils (%)</td>
<td>33.06</td>
<td>31.88</td>
</tr>
<tr>
<td>SGOT (K-A units)</td>
<td>7.90</td>
<td>7.40</td>
</tr>
<tr>
<td>Alkaline phosphatase (K-A units)</td>
<td>3.92</td>
<td>4.61</td>
</tr>
<tr>
<td>Inorganic phosphate (mg/100 ml)</td>
<td>4.69</td>
<td>4.55</td>
</tr>
<tr>
<td>Calcium (mg/100 ml)</td>
<td>9.58</td>
<td>9.85</td>
</tr>
</tbody>
</table>

* Significant at 5% level; NS — not significant.
Generally the blood levels of total protein, urea, globulin and albumin were higher than the values reported for ovine species (9,10,11). The reported normal values for sheep by the above mentioned workers are: total protein 6-7.5 g/100 ml, globulin 2.85 g/100 ml, albumin 2.96 g/100 ml and blood urea 8-20 mg/100 ml. Higher levels of total protein, albumin and globulin are associated with multiple myeloma and anhydremia, while higher levels of blood urea are associated with nephritis (12). The animals used in this experiment were normal and were not suffering from the diseases mentioned. Similar high values of these constituents were also reported by Tuah and Klusey (6). Turner (13) also reported higher values of blood urea for Zebu crosses than for temperate breeds of cattle in Australia.

Except for alkaline phosphatase, sex did not significantly (P > 0.05) affect the levels of the measured blood constituents. The females (4.71 KA units) had higher levels of alkaline phosphatase than males (4.37 KA units). Breed of the sheep did not significantly (P > 0.05) affect the levels of the blood constituents except for the levels of total protein and globulin. The Sahel breed had significantly (P < 0.05) higher levels of total protein (10.78 vs 10.11 g/100 ml) and globulin (4.89 vs 4.51 g/100 ml) than the Dжалонке breed.

It is unfortunate that the blood levels of sodium and potassium could not be measured due to lack of facilities. Cocoa pod husk ash is reported to be very rich in potassium (14).

**Percentage of Some Internal Organs of Liveweight**

Table 3 contains the percentages of some internal organs of liveweight.

<table>
<thead>
<tr>
<th>Ration</th>
<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>Significance</th>
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</thead>
<tbody>
<tr>
<td>Pluck (%)</td>
<td>1.01</td>
<td>1.40</td>
<td>1.03</td>
<td>1.26</td>
<td>1.15</td>
<td>NS</td>
</tr>
<tr>
<td>Spleen (%)</td>
<td>0.11</td>
<td>0.19</td>
<td>0.10</td>
<td>0.13</td>
<td>0.11</td>
<td>NS</td>
</tr>
<tr>
<td>Heart (%)</td>
<td>0.27</td>
<td>0.34</td>
<td>0.31</td>
<td>0.40</td>
<td>0.30</td>
<td>NS</td>
</tr>
<tr>
<td>Liver (%)</td>
<td>0.77</td>
<td>1.12</td>
<td>1.22</td>
<td>1.25</td>
<td>1.24</td>
<td>*</td>
</tr>
<tr>
<td>Kidney (%)</td>
<td>0.26</td>
<td>0.23</td>
<td>0.24</td>
<td>0.27</td>
<td>0.28</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Significance at 5% level; NS — not significant.

Except for the percentage of liver of liveweight, ration and breed of sheep did not significantly (P > 0.05) affect the relative sizes of the internal organs.

The percentage of liver of liveweight decreased significantly (P < 0.05) when the animals were fed the ration containing 60% cocoa pod husk. This observation is difficult to explain. The size of the liver is reduced in terminal fibrosis (11). The animals fed the ration containing 60% cocoa pod husk were not suffering from terminal fibrosis as alkaline phosphatase level, which is increased in fibrosis, was not increased. In fact the levels of alkaline phosphatase were significantly (P < 0.05) greater in animals fed ration 3 than in those fed ration 1. The size of the liver is also reduced when animals are suffering from hepatic necrosis, and there is resultant rise in the level of SGOT in the blood. In this experiment the level of cocoa pod husk did not significantly (P > 0.05) affect the level of SGOT in the blood. The animals fed ration 1 were not suffering from hepatic necrosis. The livers of the animals fed the other rations were not abnormally large. The percentage of liver of the liveweight was in fact lower than the values reported by Frandson (9) (1.5% of liveweight).

The percentage of spleen, kidney, and heart of liveweight were similar to the values reported by Frandson (9) (0.17%, 0.2% and 0.4% for spleen, kidney and heart, respectively).

**Rumen Bacteria and Protozoa Counts, Rumen pH and Abomasal pH**

The values of rumen bacteria and protozoa counts, rumen pH and abomasal pH are shown in Table 4. Except for abomasal pH, none of these parameters was affected significantly (P > 0.05) by ration.

Feeding cocoa pod did not inhibit microbial growth in the rumen and hence might not have adversely affected the digestion of the feed in the rumen. This might partially explain the non-significant difference between the rations containing the cocoa pod husk and the control (0% cocoa pod husk) with respect to dry matter digestibility reported by Tuah et al (15).
Table 4: Mean Rumen pH, Abomasal pH, Rumen Bacteria and Protozoa Populations

| Parameter          | 1   | 2     | 3     | 4     | 5     | Significantly:
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rumen pH</td>
<td>6.6</td>
<td>6.33</td>
<td>5.98</td>
<td>5.98</td>
<td>6.13</td>
<td>NS</td>
</tr>
<tr>
<td>Abomasal pH</td>
<td>2.88</td>
<td>3.37bc</td>
<td>3.50bc</td>
<td>3.50bc</td>
<td>3.27ac</td>
<td>*</td>
</tr>
<tr>
<td>Rumen bacteria x 10⁶</td>
<td>6.32</td>
<td>7.40</td>
<td>7.78</td>
<td>8.10</td>
<td>9.21</td>
<td>NS</td>
</tr>
<tr>
<td>Rumen protozoa x 10³</td>
<td>4.19</td>
<td>7.69</td>
<td>4.69</td>
<td>3.70</td>
<td>4.25</td>
<td>NS</td>
</tr>
</tbody>
</table>

† Figures refer to number of animals.
* Significant at 5% level; NS — not significant.

Generally, the bacteria and protozoa populations were less than the values reported (16): (15-80 billion rumen bacteria per ml and 200,000-2 billion protozoa per ml or rumen fluid) Church (16) reported that bacteria populations were at their peaks 4-8 hours after feeding while the population of rumen protozoa was at its peak 2 hours after feeding. In this trial the animals were slaughtered 3 hours after feeding, as a compromise between the times for detecting the peak populations of bacteria and protozoa. There are no available records on the normal populations of microorganisms in the rumen of the West African breeds of sheep used in the present trial. A more detailed study on the populations of rumen microorganisms, including fungi, of these West African breeds of sheep is needed.

The values of abomasal pH reported in this study were similar to the values reported by other workers (17,18,19,20). Hill (20) and Phillipson (19) observed that for efficient digestion of protein abomasal pH should be about 2 to 3. Lee (17) reported abomasal pH values of 3.20 ± 0.20 for animals fed wheat diet and 3.40 ± 0.33 for animals fed lucerne diet. Wheeler and Noller (18) reported abomasal pH values of 2.74 ± 0.185 for sheep fed 80% corn diet. The animals fed ration 1 had significantly (P < 0.05) lower abomasal pH values than those fed rations 3 and 4. The abomasal pH values of the Sahel breed (3.5) was significantly (P < 0.05) greater than that of the Djallonke breed (3.2). The reasons for the differences in the abomasal pH values due to ration and breed of sheep are being investigated. The effects of the differences on the abomasal pH values on the digestion of protein are also being investigated.

The rumen pH values were similar to the values reported by Church (16) (4.35-6.5, 2-6 hours after feeding).

Dressing Percentage and Percentages of Some Offal Components of Liveweight

The dressing percentage and the percentages of some offal components of liveweight are shown in Table 5. Ration or breed did not significantly (P > 0.05) affect any of the parameters measured. This is an indication that cocoa pod husk, even up to 60% level, could be fed to sheep without affecting the yield of meat.

Table 5: Mean Dressing Percentage and Percentages of Some Offal of Liveweight

<table>
<thead>
<tr>
<th>Ration</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dressing (%)</td>
<td>39.0</td>
<td>41.0</td>
<td>43.32</td>
<td>40.06</td>
<td>39.68</td>
<td>NS</td>
</tr>
<tr>
<td>Head (%)</td>
<td>8.45</td>
<td>6.84</td>
<td>7.23</td>
<td>7.09</td>
<td>7.30</td>
<td>NS</td>
</tr>
<tr>
<td>Feet (%)</td>
<td>12.29</td>
<td>2.11</td>
<td>2.06</td>
<td>2.31</td>
<td>2.27</td>
<td>NS</td>
</tr>
<tr>
<td>Tail (%)</td>
<td>0.15</td>
<td>0.21</td>
<td>0.22</td>
<td>0.19</td>
<td>0.16</td>
<td>NS</td>
</tr>
<tr>
<td>Skin (%)</td>
<td>6.56</td>
<td>7.72</td>
<td>7.78</td>
<td>7.00</td>
<td>5.91</td>
<td>NS</td>
</tr>
<tr>
<td>Stomach (empty) (%)</td>
<td>3.04</td>
<td>3.24</td>
<td>3.35</td>
<td>3.17</td>
<td>3.21</td>
<td>NS</td>
</tr>
<tr>
<td>Intestines (empty) (%)</td>
<td>3.96</td>
<td>3.67</td>
<td>4.15</td>
<td>3.99</td>
<td>3.99</td>
<td>NS</td>
</tr>
<tr>
<td>Testicles (%)</td>
<td>2.04</td>
<td>1.67</td>
<td>1.59</td>
<td>1.91</td>
<td>1.67</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS — not significant.

Conclusions

Cocoa pod husk could be fed safely to sheep up to 60% level without affecting blood metabolites and sizes of organs except that of liver. There are also no deleterious effects of feeding cocoa pod husk on the populations of rumen microorganisms. The level of potassium in the blood of animals fed cocoa pod husk, however, should be investigated since cocoa pod husk ash is very rich in potassium. There is also the need to study in detail the rumen microbial populations of West African breeds of sheep.

Acknowledgements

The authors are grateful to the Heads of the Cocoa Research Institute of Ghana and the University of Science and
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References


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The Effect of Genotype and Stocking Density on Growth Performance of Broilers in the Humid Tropics

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LES EFFETS DU GENOTYPE ET DE LA DENSITÉ D'OCUPATION SUR LE TAUX DE CROISSANCE DES POULETS DE GRIL SOUS LES TROPIQUES HUMIDES

Resume

299 poulets issus chacun d’un croisement de deux races de broiler ont été répartis à des densités d’occupation de 0,070; 0,093; 0,116 et 0,140 m² par oiseau et nourris ad libitum dès l’âge de 5 à 13 semaines. La consommation alimentaire a été notée et les poids vifs de chaque poulet ont été relevés chaque quinzaine. Le gain moyen quotidien, l’efficience alimentaire et le taux de mortalité ont été calculés dès l’âge de 5 à 13 semaines. D’après les résultats des analyses, il y avait un effet notable de la race et de la densité d’occupation sur le gain pondéral et le gain moyen quotidien et un effet considérable de l’interaction de la race x densité d’occupation sur le gain moyen quotidien et les taux de mortalité. Les analyses des rapports entre les traits distinctifs et la période d’évaluation ont montré que le poids vif et le gain moyen quotidien étaient mieux décrits par un polynôme du troisième degré. La race ou la densité d’occupation n’avait pas d’effet important sur le taux de mortalité.

broiler = poulet de gril

Summary

Two hundred and ninety-nine chicks of each of two strains of broilers were assigned to stocking densities of 0.070, 0.093, 0.116 and 0.140 m²/bird and fed ad libitum from 5 to 13 weeks of age. Feed consumption was determined and individual bodyweights were taken every 2 weeks. Average daily gain, feed efficiency and mortality rate were calculated for the period from 5 to 13 weeks of age. Results of analyses showed that there were significant strain and stocking density effects on bodyweights and average daily gains, and significant effects of strain x stocking density interaction on average daily gain and mortality rates. Analyses of relationship between the traits studied and period of measurement showed that bodyweight and average daily gain were best described by a third degree polynomial. There was no significant effect of strain or stocking density on mortality rate.

Introduction

Bodyweight and feed efficiency of broilers reported in Nigeria are quite inferior compared to those reported in temperate areas (1,2,3,4). Several factors, both genetic and environmental, are known to affect growth performance of broilers. Although Bolton et al (5) reported decreased growth rate for broilers when stocking density was increased. Gonzalez et al (6) reported no significant effect of stocking density on all performance characters studied. Andrew and Godwin (7) reported significant strain effect on body weight and feed conversion efficiency of broilers.

There are very few reports dealing with the effect of strain and stocking density on the performance of broilers in the humid tropics. Oluwemote et al (8) reported differences in bodyweight and meat characteristics that depended on breed and systems of management. Olatunji (9) reported that there was no significant strain effect on all traits studied and no stocking density effect on all traits except feed consumption, when two broiler hybrids were placed on stocking densities of 0.399, 0.299 and 0.239 m² per bird. The present study was carried out to determine the effect of strain and stocking density on body-weight, feed consumption, feed efficiency, and mortality rates of broilers in a humid tropical environment.
Materials and Methods

The two strains used were Cobb broilers (strain A) and Ross broilers (strain B). Broiler chicks were raised on the conventional littered floor, supplied with heat to maintain a temperature of about 32°C at day-old, fed broiler starter ration and given fresh water *ad libitum*. At 5 weeks of age, chicks were weighed and randomly assigned to each of the following densities: 0.070, 0.093, 0.116 and 0.140 m² per bird. Each stocking density was replicated three times and there were 299 birds of each strain. Birds were fed *ad libitum* with weighed quantities of broiler finishing ration (Table 1). Feed consumption was determined and individual bodyweights were taken every 2 weeks.

Table 1: Composition of Broiler Finishing Ration Fed from 5 to 13 Weeks of Age

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>% in ration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow maize</td>
<td>62.90</td>
</tr>
<tr>
<td>Groundnut cake</td>
<td>15.55</td>
</tr>
<tr>
<td>Fish meal</td>
<td>3.50</td>
</tr>
<tr>
<td>Brewer's dry grain</td>
<td>15.00</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1.00</td>
</tr>
<tr>
<td>Oyster shell</td>
<td>1.00</td>
</tr>
<tr>
<td>*Vitamin/mineral premix</td>
<td>0.50</td>
</tr>
<tr>
<td>Amprolium</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>100.00</td>
</tr>
</tbody>
</table>

Calculated Nutrient Composition

Metabolisable energy (kcal/kg) 3017.75
Crude protein (%) 16.62
Calcium (%) 0.79
Phosphorus (%) 0.59
Methionine (%) 0.33
L-lysine (%) 0.72

*When mixed in ration, 1 kg of diet contains: 25,000 i.u. vit. A; 2,500 i.u. vit. D₃; 5 i.u. vit. E; 5 mg vit. K; 12.5 mg riboflavin; 27.5 mg pantothenic acid; 62.5 mg niacin; 750 mg choline chloride; 0.025 mg antioxidant; 312.5 mg procaine penicillin; 25 mg bacitracin; 200 mg Mn; 125 mg Zn; 3 mg Iodine; 0.5 mg cobalt; 5 mg copper and 62.5 mg iron.

Initial weight was the weight of each bird taken at 5 weeks of age. Average daily gain, feed efficiency and mortality rate were calculated for the period between 5 and 13 weeks of age.

The analyses on initial and final bodyweight and average daily gains were carried out using a mixed model in which strain, stocking density, and strain x stocking density interaction were regarded as fixed effects while groups within strain x stocking density were regarded as random. The model for analyses on feed consumption, feed efficiency and mortality was similar except that groups were excluded. The relationship between period and feed consumption, feed efficiency, and mortality were described by fitting a cubic function of the form.

\[ Y = a + b_1 x + b_2 x^2 + b_3 x^3 \]

where Y is the trait and x is the period (10,11). The highest degree polynomial found significant was chosen as the one that best characterised the relationship between the trait and period. Statistical significance of mean differences were determined using Duncan's new multiple range test (12).

Results and Discussion

Means and standard errors for bodyweight, daily gain, feed consumption, feed conversion efficiency and mortality rates are shown in Table 2. Table 3 shows the mean squares of analyses of variance for the linear, quadratic and cubic time effects on bodyweight, rate of gain, feed consumption, feed efficiency and mortality rate.

Bodyweight and Rate of Growth

There were significant (P < 0.01) strain differences in final bodyweight and daily gains (Table 2). Stocking density had no significant effect (P > 0.05) on feed efficiency and mortality rate but had an effect (P < 0.01) on final bodyweight, average daily gain and feed consumption. Birds on 0.116 and 0.140 m² per bird stocking density had heavier final weight, consumed more and gained faster than those on 0.070 and 0.093 m² per bird (Table 2). There was a significant (P < 0.01) strain x stocking density interaction on average daily gain. While strain A birds on 0.116 and 0.140 m² per bird gained faster than those on other stocking densities, strain B birds showed no growth rate differences due to stocking density. The relationship of bodyweight and average daily gain with time was best
### Table 2: Unweighted Means and Standard Errors for Bodyweight, Rate of Gain, Feed Consumption, Efficiency and Mortality

<table>
<thead>
<tr>
<th>Strain</th>
<th>Stocking rate (m²/bird)</th>
<th>Initial bodyweight (kg)</th>
<th>Final bodyweight (kg)</th>
<th>Av. daily gain (g/day)</th>
<th>Feed consumption (g/bird/day)</th>
<th>Feed gain/g feed</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strain A</td>
<td>0.070</td>
<td>0.59</td>
<td>0.04</td>
<td>2.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.05</td>
<td>22.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>97.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.093</td>
<td>0.61</td>
<td>0.05</td>
<td>2.05&lt;sup&gt;b&lt;/sup&gt;&lt;sup,a&lt;/sup&gt;</td>
<td>0.04</td>
<td>22.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>103.9&lt;sup&gt;b&lt;/sup&gt;&lt;sup,c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.116</td>
<td>0.60</td>
<td>0.05</td>
<td>2.22&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.05</td>
<td>27.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>118.5&lt;sup&gt;b&lt;/sup&gt;&lt;sup,c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.140</td>
<td>0.59</td>
<td>0.06</td>
<td>2.18&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.05</td>
<td>24.3&lt;sup&gt;b&lt;/sup&gt;&lt;sup,a&lt;/sup&gt;</td>
<td>126.7&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Strain B</td>
<td>0.070</td>
<td>0.69</td>
<td>0.05</td>
<td>2.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.06</td>
<td>21.2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>108.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.093</td>
<td>0.77</td>
<td>0.06</td>
<td>2.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.06</td>
<td>22.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>112.5&lt;sup&gt;a&lt;/sup&gt;&lt;sup,c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.116</td>
<td>0.77</td>
<td>0.06</td>
<td>2.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.06</td>
<td>24.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>141.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.140</td>
<td>0.82</td>
<td>0.07</td>
<td>2.50&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.07</td>
<td>23.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>128.1&lt;sup&gt;b&lt;/sup&gt;&lt;sup,c&lt;/sup&gt;</td>
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<tr>
<td>Strain means</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strain A</td>
<td>0.80</td>
<td>0.02</td>
<td>2.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.02</td>
<td>24.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>111.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.90</td>
</tr>
<tr>
<td>Strain B</td>
<td>0.75</td>
<td>0.03</td>
<td>2.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.03</td>
<td>22.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>122.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.90</td>
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<td>Stocking density means</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strain A</td>
<td>0.070</td>
<td>0.64</td>
<td>0.02</td>
<td>2.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.03</td>
<td>21.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>102.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Strain B</td>
<td>0.093</td>
<td>0.69</td>
<td>0.02</td>
<td>2.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.04</td>
<td>22.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>108.2&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.116</td>
<td>0.69</td>
<td>0.03</td>
<td>2.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.03</td>
<td>26.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>129.9&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0.140</td>
<td>0.64</td>
<td>0.02</td>
<td>2.36&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.04</td>
<td>26.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>127.4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*In each column and within each subclass, means with at least one common superscript are not different (P < 0.05).

### Table 3: Mean Squares of Analyses of Variance for Linear, Quadratic and Cubic Time Effects

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>d.f.</th>
<th>Bodyweight</th>
<th>Average daily gain</th>
<th>Feed consumption</th>
<th>Feed efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear time effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strain (S)</td>
<td>1</td>
<td>6.88</td>
<td>10809.17</td>
<td>20.81</td>
<td>0.037</td>
</tr>
<tr>
<td>Stocking density (D)</td>
<td>3</td>
<td>13.82*</td>
<td>2345.14</td>
<td>1359.80</td>
<td>0.212**</td>
</tr>
<tr>
<td>S x D</td>
<td>3</td>
<td>10.88</td>
<td>4697.37</td>
<td>26169.50*</td>
<td>0.102**</td>
</tr>
<tr>
<td>Group/S x D</td>
<td>16</td>
<td>3.69</td>
<td>22839.53*</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Residual</td>
<td>+</td>
<td>2.73</td>
<td>2582.13</td>
<td>5392.28</td>
<td>0.015</td>
</tr>
<tr>
<td>Quadratic time effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strain</td>
<td>1</td>
<td>1.1</td>
<td>29022.07**</td>
<td>360.84</td>
<td>0.139</td>
</tr>
<tr>
<td>Stocking density</td>
<td>3</td>
<td>0.84*</td>
<td>3037.82**</td>
<td>2710.68</td>
<td>0.007</td>
</tr>
<tr>
<td>S x D</td>
<td>3</td>
<td>0.51</td>
<td>1652.15</td>
<td>8444.78*</td>
<td>0.006</td>
</tr>
<tr>
<td>Group/S x D</td>
<td>16</td>
<td>1.99**</td>
<td>1127.04*</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Residual</td>
<td>+</td>
<td>0.26</td>
<td>584.19</td>
<td>2347.04</td>
<td>0.051</td>
</tr>
<tr>
<td>Cubic time effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strain</td>
<td>1</td>
<td>6.10**</td>
<td>1894.14</td>
<td>2963.93</td>
<td>0.142</td>
</tr>
<tr>
<td>Stocking density</td>
<td>3</td>
<td>0.67**</td>
<td>24622.38**</td>
<td>14467.18**</td>
<td>0.111</td>
</tr>
<tr>
<td>S x D</td>
<td>3</td>
<td>0.22</td>
<td>2271.90</td>
<td>1877.55</td>
<td>0.036</td>
</tr>
<tr>
<td>Group/S x D</td>
<td>16</td>
<td>0.24</td>
<td>3369.77</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Residual</td>
<td>+</td>
<td>0.11</td>
<td>3562.71</td>
<td>8199.66</td>
<td>0.079</td>
</tr>
</tbody>
</table>

* Significant (P < 0.05).
** Significant (P < 0.01).

Residual degree of freedom was 574 for bodyweight and average daily gain, and 16 for others.

++ Factor not included in the model.
characterised by a third degree polynomial. Also, there were significant (P < 0.01) stocking density differences between cubic effects on final bodyweight and daily gains.

These results agree with reports by Andrew and Godwin (7) and Bolton et al. (5) who reported slower growth rate among birds on higher stocking densities, and significant strain effect on bodyweight. However the observations contradict those of Gonzalez et al. (6), who found no significant effect on stocking density on bodyweights and average daily gains.

The observed significant strain effect reflects genetic differences between strain in bodyweight characteristics as shown in this study, by differences in bodyweight at all ages, and rate of gain from 5 to 13 weeks of age. High stocking densities would bring about greater competition for space and feed, and might result in physiological stress and reduced feed consumption. Table 2 shows that more feed was consumed per bird by birds on lower stocking densities, and suggests that reduced feed consumption was probably a factor in the observed slower growth rates and lower bodyweights of birds on higher stocking densities. Significant strain x stocking density interaction effects on rate of gain suggest that strains responded differently under various stocking density treatments. This genotype x environment interaction has important implications on breeding policy in relation to the environment in which stock will be expected to be used for production.

Feed Consumption and Efficiency

Stocking density had a significant (P < 0.01) effect on feed consumption with birds on 0.140 m² per bird consuming 22 and 27g of feed per day, respectively more than those on 0.093 m² and 0.070 m² per bird (Table 2). There was a significant strain effect on feed efficiency with strain A being more efficient than strain B. Table 3 shows that the relationship of feed consumption with time was best characterised by a third degree polynomial but the rate of change varied with stocking density. There were highly significant stocking density and strain x stocking density interactions between linear effects on feed efficiency. Strain A birds were more efficient than strain B. Also, while strain A birds on 0.070 m² per bird were slightly more efficient than those on other stocking densities, there were no differences due to stocking density with respect to strain B.

These results agree partly with the reports Bolton et al. (5) who reported increased feed consumption and improved feed efficiency at lower stocking densities. However, Castro et al. (13) found that there were no significant differences in feed efficiency when birds were housed at various stocking densities.

Mortality Rate

There was no significant strain effect or stocking density differences on mortality rates (P > 0.05), but there was a significant strain x stocking density interaction effect (P < 0.05). Table 2 shows the reaction of birds to various stocking densities in terms of mortality rate differences between strains. Thus among strain A, birds on 0.116 m² per bird had a lower mortality rate than others while among strain B, birds on 0.116 m² per bird showed a higher mortality rate than birds on 0.070 and 0.140 m² per bird.

The observations in the present study agree substantially with those of Balaji et al. (14) and Gonzalez et al. (6) who reported what stocking density had no significant effect on mortality rate of broilers. This indicates that the response to the range of stocking densities had not drastically affected survival rate. However the differential response to stocking densities observed in the present study on rate of gain, further accentuates the fact that genotype x environment interaction is an important factor in broiler production in humid tropics.

References

Genotype and Density and the Growth of Broilers in the Humid Tropics 201

Received for publication on 20th November 1984

Summary

Clinical records at the Enugu Veterinary Clinic in the south-eastern part of Nigeria reveal that circulating microfiliariae are found in the peripheral blood of dogs presented with dermatitis. No case of filariasis was recorded in 1975. In 1976, there was one case of philharisis in a dog presented for routine examination. In 1977 three cases of philharisis were recorded in dogs. One animal was presented for routine examination and was presented because the owner observed a skin eruption in the legs and one was presented because the owner observed a heavy discharge from the nose and that very dark lesions were being placed by the animal in 1975. No case of filariasis was recorded in 1978. Three cases were reported in 1979, all three cases with the dog. A dental complaint was the chief complaint, (21) without any cutaneous and systemic signs to support the diagnosis.

References

Canine Filariasis in Southeastern Nigeria

BERYL P. KAMALU
Department of Veterinary Pathology and Microbiology, University of Nigeria, Nsukka

FILARIOSE CANINE DANS LE SUD-EST DU NIGERIA

Resume

À Enugu, au sud-est du Nigéria, la filariose canine existe. D’après les recherches qui y ont été menées, les microfilaries du sang périphérique ont la même taille que celles du Dirofilaria repens.

Bien que le nombre de cas de Dirofilaria ne soit pas important du point de vue statistique, il y a une tendance croissante de filariose canine.

Summary

In Enugu, southeastern Nigeria, filariasis exists in dogs. Investigation revealed that the microfilariae in the peripheral blood conform to the measurements of the microfilariae of Dirofilaria repens (1).

Even though the number of cases of Dirofilaria infestation appear to be not statistically significant, there is a trend toward an increase in filariasis among dogs.

Introduction

Clinical records at the Enugu Veterinary Clinic in the southeastern part of Nigeria reveal that circulating microfilariae are found in the peripheral blood of dogs presented with complaints which bear no obvious relationship with filariasis. No case of filariasis was recorded in 1975. In 1976, there was one case of filariasis in a dog presented for a routine examination. In 1977 three cases of filariasis were recorded in dogs. One animal was presented for routine examination, one was presented because the owner observed worms in the faeces and one was presented because the owner observed a bloody discharge from the prepuce and that very dark faeces were being passed by the animal. In 1978, no case of filariasis was recorded. In 1979, three cases were recorded; the owner's complaints were: (1) wounds, (2) tumour on the tail and anorexia, (3) ocular discharge. The animals at the time of presentation were between 4 and 5 years of age and only one was female. The animals were all treated with diethylcarbamazine as a falaricide for a period of 1 month. In August 1980 all the cases were still alive. In general, the occurrence of filarial infestation in Nigeria is established by finding microfilariae in blood samples, but further information either on the type of microfilariae or the adult species is rare. The study reported here was carried out in order to identify the type of microfilariae found in the southeastern parts of Nigeria.

Materials and Methods

Four owners of the recorded cases allowed blood to be taken from their animals for examination. Three of the cases were presented in 1979 and one was presented in 1977. The blood
samples were examined for microfilariae. Five ml of the blood was allowed to clot in test tubes at room temperature for 4 hours. The serum separated from each sample was added to 5 ml of 3% acetic acid and centrifuged at 1,500 rev/min for 5 min. The supernatant was carefully discarded and the sediment resuspended in an equal volume of 1:1000 methylene blue and centrifuged once more. The sediment was examined on a glass slide. The microfilariae were examined for their general morphological features and for their width and length.

Results

The microfilariae were sheathless, the cephalic ends were blunt and the tails were straight. The width measurement of the microfilariae at the point of maximum width varied between 7.5 μ and 8 μ. The length measurement varied from 340 μ to 353 μ.

The measurements of the microfilariae were within the range of the microfilariae of *Dirofilaria repens* (1).

Discussion

Kellas and Weber (2) identified adult *Dirofilaria repens* in the connective tissue superficial to the gluteus superficialis and biceps femoris muscle of two lions in Sudan. According to Nelson (3) *Dirofilaria repens* is found in the subcutaneous connective tissue of the dog and cat in Southern Europe, India, USSR, the Far East and in the lion in Kenya. Heisch (4) reported *Dirofilaria repens* in the dog and cat in Kenya. Based on a microfilarial survey conducted in the Zaria area in the northern part of Nigeria, Schillhorn and Blotkamp (5) reported that *Dirofilaria repens* is the commonly occurring filaria parasite of dogs in that area. Of 188 dogs examined by them, 9.4% showed microfilariae of *Dirofilaria repens* in their peripheral blood. Adult specimens of *Dirofilaria repens* were first reported in Nigeria at Zaria in the north by Schillhorn (6). The microfilariae of *Dirofilaria repens* have a periodicity peak around midnight. The number of microfilariae present in the peripheral blood during the day is about 20% or less of the maximum number at night. Any animal showing circulating microfilariae during the day in a fresh direct smear must therefore be considered to be heavily infested.

All these cases presented at the Enugu Veterinary Clinic were traced and found to be still alive in August 1980. Based on the fact that diethylcarbamazine is ineffective against both the adult and the microfilariae of *Dirofilaria repens* and that alopecia, pruritus and eczematous skin lesions were present on the abdomen and thigh of the animals presented in 1976 and 1977, it was diagnosed that all the animals presented were still suffering from *Dirofilaria repens* infestation. When the total number of canine cases presented at the Enugu Veterinary Clinic is considered, it is found

<table>
<thead>
<tr>
<th>Year</th>
<th>Total No. of dogs treated</th>
<th>No. of filarial infested dogs discovered</th>
<th>No. of previous cases of filariasis</th>
<th>No. of deaths among known filarial cases</th>
<th>Total No. of known filarial cases</th>
<th>Percentage of filarial cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975 Sept.-Dec.</td>
<td>340</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1976 Feb.-Dec.</td>
<td>619</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.016</td>
</tr>
<tr>
<td>1977 Jan.-Dec.</td>
<td>813</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>0.49</td>
</tr>
<tr>
<td>1978 Jan.-Dec.</td>
<td>931</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0.49</td>
</tr>
<tr>
<td>1979 Jan.-Dec.</td>
<td>838</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>7</td>
<td>0.83</td>
</tr>
</tbody>
</table>
that in 1975, the percentage of dogs heavily infested with *Dirofilaria repens* in the community was 0.0%; in 1976 it was 0.016%; in 1977 it was 0.49%; in 1978 it was 0.49%; and in 1979 the percentage was 0.83. The importance of these findings lies in the fact that though the number of animals heavily infested by *Dirofilaria repens* is not statistically significant, there is a trend towards an increase in the canine population and this indicates that the incidence of the infestation could be much higher than is reflected in the records of the clinic (Table 1).

More studies are being carried out to determine the prevalence of *Dirofilaria repens* in the southeastern part of Nigeria.

This study shows that *Dirofilaria repens* is found in the Enugu area in the southeastern part of Nigeria. This, however, does not preclude the existence of other species of the filarial parasites in this area.

**Acknowledgements**

I wish to thank Professor M. M. Ikeme Professor of Veterinary Parasitology, University of Nigeria, Nsukka, with whom I held useful discussions; and Mr A. B. Chime, Chief Laboratory Technologist for his assistance. I wish to thank the staff of the Enugu Veterinary Clinic for allowing me to use their records and for providing some of the blood samples.

**References**


Received for publication on 2nd February 1982
Short Communication

An Outbreak of Porcine Mange from Mixed Infestation

D.R. Nawathe* and S.S. Bhagwat†
Disease Investigation Laboratory, Nagpur, India

Mange in pigs is ubiquitous in distribution but records of mixed infestation with mange mites, Sarcopes scabei var. suis and Demodex phylloides are rare (1). One such outbreak was observed at the Government Piggery at Nagpur, where Middle White Yorkshire (MWY) pigs, those of indigenous breed and their crosses were housed together. On clinical examination 7 out of 24 of MWY breed, 8 out of 19 crossbreds and 2 out of 6 indigenous sows were found to be affected. The source of infection was not traced, but it was thought that indigenous pigs being somewhat resistant to mange may have acted as carriers. The skin of the affected pigs in the region of the head, ears, back and abdomen had become erythematous and thickened. Alopecia was noticed in the inflamed area. The continuous itching and irritation made the pigs scratch crazily against the walls, mangers and fencing. Pigs had declined in condition while young ones failed to pick up condition.

Deep skin scrapings taken from individual pigs were examined as potassium hydroxide preparation. All stages of mange mites (Sarcopes scabei var. suis and Demodex phylloides) were seen under the microscope. No fungus was seen under the microscope nor recovered by inoculation onto Sabouraud’s agar. In two piglets secondary infection with coagulase positive Staphylococcus aureus was observed.

Dusting affected pigs with 5% Gammaxane powder did not yield the expected results of reduction in lesions and weight again. On the other hand treatment with 1% aqueous spray of Malathion (50% emulsion supplied by Cyanamid Ltd) was tried twice with a 10 day interval. All pigs, whether affected or otherwise, were sprayed. Three weeks later no mites were seen on microscopic examination of the skin scrapings, and pigs rapidly picked up condition.

Mange in pigs is not a serious disease but infection of this kind may reduce profits considerably. Prompt treatment is therefore very necessary. Since it is difficult to segregate those infected subclinically, both the affected and the healthy pigs should be treated.

The authors wish to thank the Professor of Parasitology, Nagpur Veterinary College, for confirmation of the diagnosis of mange mites.

Reference


Present addresses: *National Veterinary Research Institute, Vom, Nigeria; † Nagpur Veterinary College, Nagpur, India.

Received for publication on 6th August 1984
Distribution géographique: FIEVRE APHTEUSE en Afrique

Geographical Distribution of FOOT-AND-MOUTH DISEASE in Africa

- Foci reported
  Foyers signalés
- Widespread
  Répandu dans le pays
- Enzootic/sporadic but no foci reported
  Enzootique/sporadique mais pas de foyers signalés
- No official information available
  Pas d'information officielle disponible

Geographical Distribution of RABIES in Africa

Distribution géographique: RAGE en Afrique

OAU/STRC
CSTR/OAU
INTERAFRICAN BUREAU FOR ANIMAL RESOURCES
BUREAU INTERAFRICAIN DES RESSOURCES ANIMALES

MAP/CARTE NO. 535
1985

- Foci reported
  Foyers signalés

- Widespread
  Répandu dans le pays

- Enzootic/sporadic but no foci reported
  Enzootique/sporadique mais pas de foyers signalés

- No official information available
  Pas d’information officielle disponible

Geographical Distribution of RINDERPEST in Africa

Distribution géographique: PESTE BOVINE en Afrique

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OAU/STRC
CSTR/OUA
INTERAFRICAN BUREAU FOR
ANIMAL RESOURCES
BUREAU INTERAFRICAIN DES
RESSOURCES ANIMALES
MAP/CARTE NO. 536

1985
- Foci reported
  Foyers signalés
- Widespread
  Répandu dans le pays
- Enzootic/sporadic but no foci reported
  Enzootique/sporadique mais pas de foyers signalés
- No official information available
  Pas d’information officielle disponible

Geographical Distribution of LUMPY SKIN DISEASE in Africa

Distribution géographique: DERMATOSE NODULAIRE en Afrique

OAU/STRC
CSTR/OUA
INTERAFRICAN BUREAU FOR ANIMAL RESOURCES
BUREAU INTERAFRICAIN DES RESSOURCES ANIMALES

MAP/CARTE NO. 537
1985

- Foci reported
  Foyers signalés

- Widespread
  Répandu dans le pays

- Enzootic/sporadic but no foci reported
  Enzootique/sporadique mais pas de foyers signalés

- No official information available
  Pas d'information officielle disponible

Geographical Distribution of AFRICAN HORSE SICKNESS in Africa

Distribution geographique: PESTE EQUINE AFRICAINE en Afrique

OAU/STRC
CSTR/OUA
INTERAFRICAN BUREAU FOR
ANIMAL RESOURCES
BUREAU INTERAFRICAIN DES
RESSOURCES ANIMALES
MAP/CARTE NO. 538
1985

■ Foci reported
Foyers signalés

X Widespread
Répandu dans le pays

☑ Enzootic/sporadic but no foci
reported
Enzootique/sporadique mais pas de foyers signalés

☑ No official information
available
Pas d'information officielle disponible

Geographical Distribution of BLUETONGUE in Africa

Distribution géographique: FIEVRE CATARRHALE OVINE en Afrique

OAU/STRC
CSTR/OUA
INTERAFRICAN BUREAU FOR ANIMAL RESOURCES
BUREAU INTERAFRICAIN DES RESSOURCES ANIMALES

MAP/CARTE NO. 539
1985

- Foci reported
  Foyers signalés
- Widespread
  Répandu dans le pays
- Enzootic/sporadic but no foci reported
  Enzootique/sporadique mais pas de foyers signalés
- No official information available
  Pas d’information officielle disponible

ABSTRACTS

Vol. 34 No. 3, No. 46-65

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62. Immunisation Active Anti-gonadolibérine Chez le Bélier Pré-pubère.

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46

Phagocytic and Bactericidal Properties of Bovine Macrophages from Non-lactating Mammary Glands.


AUTHORS' SUMMARY: Macrophages were isolated from the mammary glands of non-lactating (dry) cows and their ability to phagocytose and kill staphylococci in vitro assessed. Normal bovine serum enhanced the uptake of staphylococci and was required for optimal killing in the bactericidal test. Dry gland secretion interfered with uptake. Secretions taken progressively into the dry period became more inhibitory. The phagocytic ability of macrophages was significantly less than that of neutrophils present in the same gland preparation when tested in the presence of dry gland secretion. A marked variation in the antibacterial activity of macrophages from different cows was noted.

47
IBAR/1985  Shinji Takai and Shiro Tsubaki

The Incidence of Rhodococcus (Corynebacterium) equi in Domestic Animals and Soil


AUTHORS' SUMMARY: Three hundred and eight and 194 Rhodococcus (Corynebacterium) equi strains were isolated from 1,129 domestic animal samples and 224 soil samples examined, respectively.

48
IBAR/1985  G.M. Allan, M.S. McNulty, D Todd and J.B. McFerran

The Rapid Detection of Aujeszky's Disease Virus in Pigs by Direct Immunoperoxidase Labelling


AUTHORS' SUMMARY: Direct immunoperoxidase labelling on impression smears of brain and pharynx was compared with virus isolation and direct immunofluorescence for the detection of Aujeszky's disease virus in experimentally-infected pigs. Immunoperoxidase labelling was as sensitive as immunofluorescence and more sensitive than virus isolation for tissue that had been stored at room temperature (approximately 20°C) for up to 114 hours.

49

Variation in Foot-and-Mouth Disease Virus Isolates in Kenya: An Examination of Field Isolates by T1 Oligonucleotide Fingerprinting


AUTHORS' SUMMARY: Ribonuclease T1 oligonucleotide maps of strains of four of the endemic serotypes of foot-and-mouth disease virus isolated in Kenya between 1964 and 1982 have been compared with data obtained in complement-fixation and neutralisation tests. There was a continual change in the oligonucleotide maps obtained for all the serotypes examined. This genetic heterogeneity was generally associated with antigenic variation. Viruses isolated during the 12-month course of an epidemic of the SAT 1 serotype showed few changes in their oligonucleotide fingerprints, and were serologically related. These maps form a data base that will be useful in future epidemiological studies on the maintenance and spread of foot-and-mouth disease virus in this region.

50
IBAR/1986  A. Ghram and H. Minocha

Propagation of Infectious Bovine Rhinotracheitis (Bovine Herpes-1) Virus in Murine Primary Cell Cultures


AUTHORS' SUMMARY: Virus synthesis in BALB/C mouse lung and kidney primary cultures infected with infectious bovine rhinotracheitis (IBR) virus started between 6 and 8 hours after virus inoculation and reached a maximum titre of 5.5 log10 plaque forming units (PFU) at 48 hours post-infection (p.i.). Cytopathic effect (CPE) in cell cultures occurred at 8-10 hours and over 90% of the cells had CPE by 48 to 72 hours p.i. The bulk of the newly replicated virus (60-80%) was cell-associated as determined by
plaque assay of extracellular and intracellular virus. Pulse-chase experiments demonstrated incorporation of radioactive precursors into viral DNA and protein macromolecules. Viral DNA synthesis was initiated between 2 and 4 hours p.i. and was maximum at 4-6 hours. Viral proteins were detected at 4 hours and peaked between 6 and 8 hours p.i. Enzyme-linked immunosorbant assay (ELISA) confirmed synthesis of specific viral proteins, which gradually increased during the virus growth cycle.

51
IBAR/1984 M.L. Kaeberle and D.E. Reed

The Effect of Some Common Inactivation Procedures on the Antigens of Bovine Herpesvirus 1


AUTHORS’ SUMMARY: Bovine embryonic kidney cells were infected with bovine herpesvirus 1 (BHV1) or were sham-inoculated. When cytopathic effect was apparent, the cells were treated with beta-propiolactone, formalin heat (56°C), or ultraviolet irradiation until the virus was inactivated. Infected-treated, infected-untreated (IU) and sham-inoculated cultures were solubilised using Triton X-100 detergent. Resulting preparations were tested by two-dimensional, and fused rocket, immunoelectrophoresis and were evaluated for their ability to inhibit virus neutralisation by BHV1 antiserum.

Eleven viral antigens were detected consistently in IU preparations, which strongly inhibited virus neutralisation. Eight or more IU antigens were detected in beta-propiolactone-treated, formalin-treated and heat-treated preparations; these inhibited virus neutralisation less strongly than the IU preparations. No IU antigens were detected in ultraviolet-treated preparations, nor did this material inhibit virus neutralisation. One of the IU antigens was reduced preferentially by all treatments. The selective destruction of antigens by the various treatments might allow antigen-specific serological testing to distinguish vaccinated from naturally-exposed cattle.

52
IBAR/1985 Max Murray and S.J. Black

African Trypanosomiasis in Cattle: Working with Nature’s Solution


AUTHORS’ SUMMARY: Both acquired and innate resistance to African trypanosomiasis can occur in cattle. The former raises the possibility of a vaccine against tsetse-transmitted metacyclic trypanosomes which have been shown to have a smaller repertoire of variable antigens than bloodstream parasites. The latter provides two further avenues of approach: firstly, trypanotolerant breeds are being increasingly exploited and improved by conventional management and breeding methods including embryo transfer; secondly, research is being carried out into the factors associated with their innate resistance, i.e., the control of trypanosome growth, the development of effective immune responses and resistance to anaemia. If the mechanisms underlying these factors are identified it might be possible by immunisation, by specific drug treatment or by transfection of appropriate genes to produce highly productive cattle resistant to trypanosomiasis.

53
IBAR/1985 J. Owen and D. Slcombe

Pathogenesis of Helminths in Equines


AUTHORS’ SUMMARY: This review summarises information on the clinical signs, gross and microscopic lesions associated with nematode and cestode infections and discusses the development of these conditions in the equine host.

54
IBAR/1985 J.V. Ernst, H. Ciordia and J.A. Stuedemann

Coccidia in Cows and Calves on Pasture in North Georgia (USA)


AUTHORS’ SUMMARY: The prevalence and abundance of coccidian oocysts were determined in a herd of beef cows and calves on fescue pastures in the Piedmont area of Georgia during four consecutive grazing seasons. Twelve species of _Eimeria_ were found in the faeces of the calves and 10 species were found in the faeces of the cows. _Eimeria bovis_ was the most prevalent species found in both the calves and cows. It occurred in 72.5% of 1,090 samples from the calves and 10.2% of 719 samples from cows. _Eimeria bovis_ also comprised the majority of oocysts present in the faecal samples from the calves and cows. The greatest number of _E. bovis_ in a sample was 45,800 oocysts per gram of faeces (opg) from a calf and 1,900 opg from a cow. No cases of clinical coccidiosis were seen in any of the animals sampled during the survey.
55
IBAR/1985  H.S. Hussein and S.E. El Sammani

Onchocerca raillieti: Prevalence and Pathology in Sudanese Donkeys


AUTHORS' SUMMARY: Onchocerca raillieti was found to be prevalent in Sudanese donkeys. The parasite was reported from Central, Northern, Western and Eastern Sudan and was most predominant in the last locality. The pathological changes produced by adult worms in the ligamentum nuchae are mostly chronic and do not seem to cause any clinical manifestations. Likewise, the microfilariae, though found in high densities in the skin with a 'spill over' into the eyes, produce no pathological changes in either the skin or eyes.

56
IBAR/1985  P.R. Utley and R.E. Hellwig

Feeding Value of Peanut Skins Added to Bermuda-grass Pellets and Fed to Growing Beef Calves


AUTHORS' SUMMARY: The processing requirements and feeding value of pellets made from dehydrated Bermuda-grass forage with 5 or 10% added peanut skins was evaluated. Peanut skins served as a lubricant and reduced the energy required to pellet Bermuda-grass forage. However, levels greater than 5% reduced bulk density and pellet durability. Dry matter and calculated total digestible nutrient values were greater (P < 0.05) for the pellet diet containing 10% peanut skins than for the Bermuda-grass pellet diet without added peanut skins. Ether extract digestibility was higher for the 10% peanut skin diet, intermediate for the 5% added peanut skin diet and lowest for the diet without added peanut skins (P > 0.05). Sixty-two steer calves were individually fed the three pelleted diets to compare animal performance. Calves fed the 90% Bermuda-grass and 10% peanut skin pellet diet gained 27% faster (P < 0.05) than control animals. Average daily feed intake, feed required per unit of gain and average total digestible nutrients required per unit of gain were not different (P > 0.05) because of diet treatment.

57
IBAR/1985  F. Geoffroy, P. de Lavigne, Y. Mahe, G. Saminadl and C. Paul-Urbain-Georges

Utilisation de l'Ensilage de Déchets de Conserverie d'Ananas pour l'Engraissement d'Agneaux et de Taurillons


RESUMEE DES AUTEURS: Les possibilites d'utilisation de l'ensilage de déchets de conserverie d'ananas pressés (MS sortie de presse = 24-26 P.100) pour l'engraissement des ruminants ont été testées sur agneaux et taurillons. L'ensilage complémenté en azote a permis d'obtenir des croissances de l'ordre de 180 g par jour avec les agneaux et de 1 000 g avec les taurillons en réduisant très significativement les coûts de production. La valeur énergétique des déchets d'ananas calculée à partir de ces résultats et des besoins des animaux serait comprise entre 0,95 et 1,1 UFV.

58
IBAR/1985  J.B. Coulon

Grazing Behaviour of Charolais Cross Bred Cattle in Tropical Wet Country


AUTHOR'S SUMMARY: Diurnal grazing behaviour of four lots of growing European type cattle was observed in Santo (Vanuatu, South Pacific), during two periods with different climatic conditions. Mean diurnal grazing time was 265 min in period 1 (hot and wet season; 27°C, mean insololation 7 h/d) and 380 min in period 2 (cool season; 25°C, cloudy sky). During period 1, grazing occurred mainly between 6 a.m. and 8 a.m. and between 4 p.m. and 6 p.m., whereas during period 2 it was spread over the whole day. Diurnal grazing time varied little from one animal to another in the same lot, as well as from one lot to another. Grazing distribution was more variable, mainly in period 2.

59
IBAR/1985  M. Contrepols et Martine Vannetzel avec la collaboration de Y. Ribot, D. Robin et P. Debyale

Isolement de Colibacilles Résistants à la Gentamicine Chez les Veaux Charolais


RESUME DES AUTEURS: La gentamicine est l'antibiotique du dernier recours pour le traitement des diarrhées colibacillaires du veau. Il est important de contrôler l'apparition des résistances à cet antibiotique. A la suite de l'isolement d'un colibacille résistant à la gentamicine en février 1984, chez un veau de 24 h (A), une recherche plus complète a été faite dans l'élevage, quatorze
semaines plus tard. Le même colibacille résistant à la gentamicine était toujours présent chez le veau A et chez d'autres animaux de l'élevage. Nous souhaitons attirer à nouveau l'attention sur les dangers d'un usage abusif de la gentamicine.

60
IBAR/1985  Helene Combrisson

Les Hétérosides Cardiotoniques: Bases Pharmacologiques


RESUME D'AUTEUR: Les hétérosides cardiotoniques (HC) se fixent sur une enzyme membranaire, la Na + K ± ATP ase, inhibent son activité. Ils modifient de ce fait un certain nombre de transferts ioniques, ce qui explique leurs actions directes sur la fibre myocardique. Les effets pharmacologiques des HC découlent de leur action directe mais également pour d'autres organes. Enfin, l'utilisation des HC est envisagée. Ils sont indiqués pour le traitement des troubles du rythme auriculaire et de l'insuffisance cardiaque. Cependant, cette utilisation peut exposer à certains phénomènes toxiques et des précautions doivent être prises pour les éviter.

61
IBAR/1985  G. Lorgue, Ch. Mally et K. Nahas

Traitement de l’Intoxication par la Bromadiolone Rodonticide Anticoagu-ulant Chez le Chien


RESUME DES AUTEURS: Sur des chiens Beagle, recevant par os, en administrations unique (20 et 100 mg/kg) ou répétées (0,75 mg/kg/48 heures en cinq prises) de Bromadiolone, raticide anticoagulant, la vitamine K1, par voie intraveineuse (5 mg/kg) entraîne, dans tous les cas, un retour à la normale du temps de quick et du taux de prothrombine, en une heure.

62
IBAR/1985  St. Chaffaux, Christine Crochet, C. Carelli et F. Deleatang

Immunisation Active Anti-gonadoli- bérine Chez le Bélier Pré-pubère


RESUME DES AUTEURS: Quatre injections de GnRH couplée à de la thyroglobuline éмуllifiée dans de l’adjuvant complet de Freund (FCA) ont provoqué l’apparition d’anticorps spécifiques anti- GnRH à des taux importants chez cinq béliers pré-

pubères. Lorsque ce taux d’anticorps atteint un niveau élevé, on constate une régression testiculaire qui dure environ quatre mois. Par contre, aucune différence significative n’a été observée en ce qui concerne les taux plasmatiques de LH et de Testostérone, bien que ces taux semblent être inférieurs chez les animaux immunisés comparés aux témoins tant que le titre d’anticorps anti-GnRH reste élevé. D’autre part, une très légère diminution de gain de poids a été observée chez ces animaux par rapport aux témoins. Ceci peut être expliqué par le stress provoqué par l’adjuvant complet de Freund qui a d’ailleurs été à l’origine de plusieurs abcès aux points d’injection.

Cette expérimentation a donc permis de confirmer la possibilité de castrer immunologique- ment des animaux mâles pré-pubères. Cependant, pour une application pratique courante, un adjuvant de l’immunité, une protéine porteuse et un protocole d’immunisation adaptés restent à déterminer.

63
IBAR/1985  Toshiaki Murakami, Norio Hirano, Akira Inoue, Ken-Ichi Chitose, Kotaro Tsuchiya, Katsuhiko Ono and Yoshihisa Naito

Transfer of Antibodies Against Viruses of Calf Diarrhoea from Cows to Their Offspring via Colostrum


AUTHORS’ SUMMARY: Serum and lacteal secretion of cows and neonatal calf serum were examined for antibody titres against bovine rotavirus, bovine coronavirus, and bovine viral diarrhoea — mucosal disease virus and immunoglobulin concentrations after inoculation with inactivated viruses during pregnancy. The booster effect was slight. Correlation was observed between maternal serum, lacteal and neonatal serum antibody titres as well as duration of the antibody titre in lacteal secretion. The biological half lives of antibody titres in calf serum were about 22.0 days for rotavirus and 20.8 days for coronavirus.

64

Application de l’Electrosynérèse à la Sérologie de la Peste des Petits Ruminants

Associated with Natural Infection with Rotavirus


**AUTHORS' SUMMARY:** A case of neonatal calf diarrhoea associated with natural infection with rotavirus was investigated morphologically. No obvious gross lesions could be seen. Histologic examination revealed degeneration and desquamation of epithelial cells near the tips of villi in the small intestines, and degeneration and necrosis of follicle-associated epithelial cells in the ileum. Electron microscopically, atrophy and loss of microvilli, and budding of virus particles into cisternae of rough endoplasmic reticulum and tubular structures were observed. Among the changes observed, the presence of the tubular structures appeared to be characteristic of viral infection.
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NOTICE

International Workshop on Goat Production in the Humid Tropics

A workshop on Goat Production in the Humid Tropics jointly hosted by the University of Ife, Nigeria, the National Agricultural University of Wageningen, The Netherlands, and the International Livestock Centre for Africa, Addis Ababa, Ethiopia, will be held at the University of Ife, Nigeria, from Monday July 20th to Thursday July 23rd 1987. Topics to be discussed at the workshop include: management systems, nutrition, breeding, reproduction and health. English and French will be the two workshop languages. Full contributed papers must be received by February 28th, 1987. For additional information contact:

H.G. Bosman, Department of Animal Science, University of Ife, Nigeria.
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Objet
Le Bulletin de la Santé et de la Production Animales en Afrique publie des articles de recherches originales sur les activités de production et de santé animales visant à développer l'industrie de l'élevage en Afrique et à mieux utiliser les ressources animales du Continent. La revue est un périodique trimestriel.

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


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

Genres d'articles publiés dans le Bulletin
— des communications originales
— des brèves communications
— analyse des articles proposée par le Rédaacteur
— 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 où le travail a été effectué, ainsi que de l'adresse pour les correspondances si elle n'est pas la même.
Le résumé ne doit pas excéder 200 mots. Son texte bref et concis comprendra les principaux résultats et la (les) conclusion(s) de l'étude.
L'introduction expose le but de la recherche
Le matériel et les méthodes utilisés
Les résultats présentés brièvement
Un débat sur l'importance de l'article
Remerciements éventuels
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3. Rapport annuel
Le nom du pays, l'année faisant l'objet du rapport, puis le nom du service ou de l'organisation, le numéro de la première page.

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

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