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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Two copies of articles should be sent to the Editor, Organisation of African Unity/Inter-African Bureau for Animal Resources, P.O. Box 30786, Nairobi, Kenya.
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Abstract not exceeding 200 words giving a synopsis of the findings presented and the conclusion(s) reached.

Introduction stating the purpose of the work.

Materials and Methods used.

Results presented concisely

Discussion of significance.

Acknowledgments.

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

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

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I  ORIGINAL ARTICLES

YILKAL ASFAW, BAYLEYEGN MOLLA, KARL-HANS ZESSIN and AZAGE TEGEGNE 217

2. Dematiaceous Fungi Isolated from Goat Droppings
UMEH, C.N. and K.I. ANEKWE 225

3. Dynamique Saisonnière Des Nematodes Gastro-Intestinaux Des Petits Ruminants Dans La Préfecture De Kindia (Guinée)
M.B. DIALLO 229

4. A Survey of the Causes of Lamb Mortality in Maiduguri and its Environs
J.A. AMEH, G.O. EGWU, M.M. ALIYU and H.B. TUKUR 233

5. Causes of Illness and Death in Cattle Managed Traditionally in Northern Nigeria
A.C. KUDI, J.U. UMHO, L.O. EDUVIE and J.O. GEFU 239

6. Effect Of Salinity Level on the Drinking Rate in Atropical Teleost, Oreochromis andersoni
C.N. KAMUNDE1, E. M. ONYANG02, N. HAZON3, G. CRAMB3 and A.M. WALKER3 245

7. Response of the Malawi Local Chicken to Commercial Feed Up to Eight Weeks of Age
A.C.I. SAFALA0H 249

II  SHORT COMMUNICATIONS

8. Reproductive Performance of Cows in Settled Cattle Herds in Zaria, Nigeria

9. Pathogenicity of Salmonella enteritidis Isolates Isolated from Table Eggs and Chicken Carcasses in Zambia
HANG'OMBE, B.M., SKJERVE, E., TUCHILI, L.M. and SHARMA, R.N. 259
10. *Escherichia coli* 053: K+ Extraintestinal Outbreaks in Laying Flocks in Nsukka, South-East Nigeria

CHAH, K.F and OBOEGBULEM, S.I. .................................................................................................................. 263

11. Comparative Efficacies of Levamisole, Ivermectin, Rafoxanide and Benzimidazoles Against Natural Nematode Infections of Small Ruminants in Central Kenya

R.M. WARUIRU, W.K. MUNYUA and J.K. KOGI .......................................................................................... 265

12. Evaluation of Three Breeds of Rabbits for Litter Characteristics in South-West Nigeria

S.O. OSENI and I.K. ODUBOTE .................................................................................................................... 271
A CROSS-SECTIONAL STUDY OF BOVINE BRUCELLOSIS AND TEST PERFORMANCE IN INTRA-AND PERI-URBAN PRODUCTION SYSTEMS IN AND AROUND ADDIS ABABA, ETHIOPIA

YILKAL ASFAW1, BAYLEYEGN MOLLA1, KARL-HANS ZESSIN2 and AZAGE TEGEGNE3

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ETUDE TRANSVERSALE DE LA BRUCELLOSE BOVINE ET PERFORMANCE DES TESTS DANS LES SYSTEMES DE PRODUCTION INTRA-ET-PERIURBAINS A L'INTERIEUR ET DANS LES ENVIRONS D'ADDIS-ABBEA EN ETHIOPIE

Résumé
Une étude transversale de la brucellose bovine a été entreprise de mai à octobre 1997 dans 42 fermes laitières situées à Addis-Abéba, à Sébeta, à Kalti et à Debre Zeit en Ethiopie. On a relevé un taux global d'infection du troupeau de 33,3%. S'agissant des systèmes de production, 100%, 30% et 12,5% des fermes étaient infectées respectivement dans les systèmes de production périurbains, intra-urbains (villes secondaires) et intraurbains. Chez les animaux individuels, le taux global de prévalence était de 8,1%. Le taux de prévalence le plus élevé de 9,8% était observé dans le groupe d'âge 2 - 4 ans. Des taux d’infection de 9,1% et 3,3% ont été notés dans les fermes ayant un effectif supérieur à 100 têtes de bétail et inférieur à 50 têtes respectivement.

Les taux d’infection étaient très différents entre les groupes d’âge ≤2 ans et >2 ans (P<0,05). On a déterminé une proportion inégale (OR) de 2,14 (Intervalle de confiance (IC): 1,04 - 4,83) entre l’âge et l’infection par Brucella et OR de 2,99 (IC: 1,29 - 8,06) entre la taille du troupeau et l’infection par Brucella. La concordance (valeurs kappa) entre les tests RBPT+/CFT+ et MRT était de 0,31 (premier MRT), 0,43 (premier et deuxième MRT, résultats regroupés) et 0,58 (premier, deuxième et troisième MRT, résultats regroupés). Une bonne concordance (k = 0,74) a été obtenue entre le test en série RBPT+ et RBPT+/CFT+. La sensibilité et la spécificité de MRT étaient de 57,1% et 89,3%, celles de RBPT étaient de 100% et 94,6% respectivement. Une OR de 1,58 (IC: 1,72 - 79,16) était calculée pour l’association entre les avortements et l’infection par Brucella.

Abstract
A cross-sectional study of bovine brucellosis was carried out from May to October 1997 on 42 dairy farms located in Addis Ababa, Sebeta, Kaliit and Debre Zeit, Ethiopia. An overall herd infection rate of 33.3% was established. With respect to the production systems, 100%, 30% and 12.5% of the farms were infected in peri-urban, intra-urban secondary town and inter-urban systems, respectively. In individual animals, the overall prevalence rate was 8.1%. Highest prevalence rate of 9.8% was observed in the age group 2 to 4 years. Infection rates of 9.1% and 3.3% was observed in farms that keep more than 100 animals and less than 50 animals, respectively. The infection rates were significantly different between the age group ≤2 years and >2 years (p<0.05). An odds ratio (OR) of 2.14 (CI: 1.04-4.83) between age and Brucella infection, and 2.99 (CI: 1.29-8.06) between herd size and Brucella infection were determined. Agreement (kappa values) between RBPT+/CFT+ and MRT tests was 0.31 (first MRT), 0.43 (first and second MRT results pooled) and 0.58 (first, second and third MRT results pooled). Good agreement (k = 0.74) was found between RBPT+ and RBPT+/CFT+ serial testing procedure. The sensitivity and specificity of MRT were 57.1% and 89.3%, and RBPT 100% and 94.6%, respectively. An OR of 15.58 (CI: 1.72-79.16) was calculated for the association between abortions and Brucella infection.

*Corresponding author

Introduction
Over the past two decades, sub-Saharan Africa experienced relatively low growth rates in production of dairy products compared to the average production level for all developing countries'. Total consumption of dairy products, however, grew relatively faster during the same period. It is frequently cited that the causes of
low productivity in cattle in Africa are feed shortage, poor genetic potential for production traits, insufficient technology, poor reproductive efficiency and animal health problems. Abortions, infertility and sub-fertility are some of the major health problems recorded in many farms in Africa. It is indicated that brucellosis causes abortions and infertility in cattle. Brucellosis also affects human beings. Brucellosis is perhaps the most widespread and economically important disease in tropical and sub-tropical regions. The direct loss of meat (as a result of abortion, infertility and weight loss) in infected herds of cattle was estimated to be 15% and for milk (reduction in milk production) at 20% per infected cow and human brucellosis, as a geomedical survey has shown, is known to exist in 75.5% of African countries.

Brucellosis is a serious cattle health problem in East Africa. The prevalence in Djibouti was 4%, in Somalia 11.9%, in Kenya 10%, in Rwanda 34.9%, in Sudan 6.5-22.5%, in Uganda 1.8%. In Ethiopia, a growing tendency for intensification of dairy cattle around major cities is observed. This is particularly evident around Addis Ababa, the capital city. According to Nauheimer et al. these dairy units constitute urban and peri-urban livestock production systems. The status of brucellosis in these production systems is unknown. This study was, therefore, carried out to determine the prevalence, establish the role of risk factors and estimate the effect of the level of intensification on bovine brucellosis. Evaluation of the performance of different serological tests was also conducted.

**Materials and Methods**

**Study area, design and data collection**

A cross-sectional investigation of bovine brucellosis was carried out between May and October 1997 in central Ethiopia in a 50 km radius around Addis Ababa. Four study sites were identified: Addis Ababa, Sebeta, Kaliti and Debre Zeit.

A bulk milk sample from a maximum of 8 cows from each herd (farm) was collected in May, July and October. Blood samples were collected once in June. Prevalence rates with respect to risk factors: age, sex, parity, herd size and production system were determined. Herds were stratified into three strata based on size: farms that keep 1-50 animals, 51-100 animals and more than 100 animals. The performance of serological tests was evaluated by calculating the kappa values. A questionnaire was administered to collect information on farm management practices.

A multi-stage sampling procedure was used to select a sample of 147 farmers from the Addis Ababa milk shed, the area supplying milk to the Addis Ababa market. These farmers were then surveyed using a questionnaire covering 45 measures of farm resources and parameters reflecting farm functioning. The analyses identified seven production systems. Next, a cluster sampling procedure was used and three production systems were selected, peri-urban producers in secondary towns (Kaliti and Sebeta), intra-urban farms (Addis Ababa) and intra-urban farms in secondary towns (Debre Zeit). Using a random sampling procedure 45 farms were selected. Nine hundred fifty (950) non-vaccinated breeding Holstein-Zebu crosses above 6 months of age were used for this study.

**Milk Ring Test (MRT)**

The MRT test method of MacMillan was followed. The MRT antigen was obtained from the Federal Institute for Health Protection of Consumers and Veterinary Medicine (BfVV), Berlin, Germany. A positive reaction was indicated by the appearance of a coloured blue cream ring on the top layer of the milk column in a test tube.

**Rose Bengal Plate Test (RBPT)**

Blood samples were collected from the coccygeal or jugular veins using plain vacutainer tubes. The tubes in the laboratory were set tilted on a table for one hour at room temperature. The clotted blood in the tubes was centrifuged to obtain a clear serum. The serum was used for both RBPT and Compliment Fixation Test (CFT).
The RBPT antigen was obtained from BgVV. The RBPT test method of MacMillan\textsuperscript{15} was followed. Any observed agglutination was regarded as positive.

**Complement Fixation Test**

In the CFT, all reagents were evaluated by titration. The method of CFT was done according to protocols of the BgVV Service Laboratory.\textsuperscript{69} All control sera, CFT antigen, complement, and amboceptor were obtained from BgVV. The CFT antigen had a titre of 1:640++ against ISABS (International Standard for Anti-\textit{Brucella abortus} Serum). In the test proper, sera with 75\% (3+) fixation of complement at a dilution of 1:57 and at least with 50\% (2+) fixation of complement at a dilution of 1:10 and above were classified as positive.\textsuperscript{12}

**Data analysis**

A rate was used to calculate prevalence and test properties. Chi-square and odds ratio values were calculated using the computer program Epi Info Version 6.02. The kappa statistic was calculated using the computer program Win Episcope Version 1.0.

**Results**

**The MRT, RBPT and CFT**

Samples from 6 farms (14.3\%) were positive during the first sampling. When the results of all three sample dates were pooled, samples from 11 farms reacted positive (26.2\%) (Table 1).

In the RBPT, 124 (13.1\%) reacted positive. When those sera positive in the RBPT were further tested by CFT, 77 (8.1\%) were confirmed positive (Table 2).

### Table 1: Results of the bulk MRT

<table>
<thead>
<tr>
<th>Prod. System</th>
<th>District</th>
<th>No. farms</th>
<th>Pos. in MRT 1</th>
<th>Pos. in MRT 2</th>
<th>Pos. in MRT 3</th>
<th>Pos. farms total</th>
<th>Pos. farms in RBPT+/CFT+</th>
<th>MRT pos. farms confirmed by RBPTI/CFT+</th>
<th>Proportion of lactating cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-urban secondary towns</td>
<td>Debre Zeit</td>
<td>20</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3 (7.1%)</td>
<td>15%</td>
<td>6 (14.3%)</td>
<td>30%</td>
</tr>
<tr>
<td>Peri-urban</td>
<td>Kaliti</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3 (7.1%)</td>
<td>10%</td>
<td>3 (7.1%)</td>
<td>100%</td>
</tr>
<tr>
<td>*Sebeta</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3 (7.1%)</td>
<td>100%</td>
<td>3 (7.1%)</td>
<td>100%</td>
<td>3</td>
</tr>
<tr>
<td>Total peri-urban</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>6 (14.3%)</td>
<td>100%</td>
<td>6 (14.3%)</td>
<td>100%</td>
<td>5</td>
</tr>
<tr>
<td>Intra-urban A/A²</td>
<td>16</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>2 (4.8%)</td>
<td>12.5%</td>
<td>2 (4.8%)</td>
<td>12.5%</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>42*</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>11 (26.2%)</td>
<td>26.2%</td>
<td>14 (33.3%)</td>
<td>33.3%</td>
<td>8</td>
</tr>
</tbody>
</table>

(1: production; 2: positive; 3: Addis Ababa)

*two farms were closed and one farm dropped out at the middle of the study

### Table 2: Results of the RBPT and CFT serological tests

<table>
<thead>
<tr>
<th>Production System</th>
<th>District</th>
<th>No. Serum samples</th>
<th>RBPT</th>
<th>No. reactors</th>
<th>Prevalence rate (% &amp; 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-urban secondary town</td>
<td>Debre Zeit</td>
<td>124</td>
<td>7</td>
<td>24</td>
<td>5.6 (1.6-9.6)</td>
</tr>
<tr>
<td>Peri-urban</td>
<td>Kaliti</td>
<td>190</td>
<td>23</td>
<td>37</td>
<td>8.9 (6.8-10.9)</td>
</tr>
<tr>
<td>*Sebeta</td>
<td>423</td>
<td>64</td>
<td>74</td>
<td>42</td>
<td>9.9 (7.1-12.7)</td>
</tr>
<tr>
<td>Total peri-urban</td>
<td>613</td>
<td>87</td>
<td>111</td>
<td>59</td>
<td>9.6 (7.3-11.9)</td>
</tr>
<tr>
<td>Intra-urban</td>
<td>Addis Ababa</td>
<td>213</td>
<td>30</td>
<td>34</td>
<td>5.2 (2.2-8.9)</td>
</tr>
<tr>
<td>Total</td>
<td>950</td>
<td>124</td>
<td>169</td>
<td>77</td>
<td>8.1 (6.4-9.8)</td>
</tr>
</tbody>
</table>
Test agreement
The kappa values, used to assess agreement between different test combinations, are given in Table 3.

<table>
<thead>
<tr>
<th>Test combination</th>
<th>k value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBPT</td>
<td>CFT</td>
</tr>
<tr>
<td>R13PT</td>
<td>RBPT+/CFT+</td>
</tr>
<tr>
<td>MRT I</td>
<td>RBPT+/CFT+</td>
</tr>
<tr>
<td>MRT I &amp; II</td>
<td>RBPT+/CFT+</td>
</tr>
<tr>
<td>MRT, I, II &amp; II</td>
<td>RBPT+/CFT+</td>
</tr>
</tbody>
</table>

Key: I is perfect agreement; >0.81: almost perfect agreement; 0.61-0.80: substantial agreement; 0.41-0.60: moderate agreement; 0.21-0.40: fair agreement; 0-0.20: slight agreement; 0: poor agreement

Sensitivity, specificity and predictive values
Three (3) of the farms were not confirmed for brucellosis considering RBPT+/CFT+ as "gold standard". These, thus, constitute false-positives in the pooled MRT. Six (6) farms positive in the RBPT+/CFT+ confirmation were not detected by pooled MRT. These constitute false-negative findings. The resulting sensitivity and specificity were 571% and 89.3%, respectively, when the three MRT results were pooled. In individual animals, considering the RBPT+/CFT+ as "gold standard", false-negative animals were encountered in the RBPT. This resulted in a sensitivity of 100% and specificity of 94.6%, respectively. The positive predictive values of pooled MRT and of RBPT were 72.7% and 62.1%, respectively.

Prevalence rates
The overall herd infection rate was 33.3%. With respect to the production systems, all (100%), 30% and 12.5% of the herds were infected in the peri-urban, intra-urban secondary town and intra-urban systems, respectively. The within-herd prevalence ranged from 0.16-7.7%. One or two reactors were recorded in 64.3% of the farms. The individual animal prevalence rate was determined by using the RBPT+/CFT+ serial testing results. The total individual antibody prevalence (sero-positivity) was 8.1%. The infection rates were 0.1% and 8% for male and female sexes, respectively. This difference was not significant (p>0.05). Infection rates were higher in older age groups. Comparing the age groups, animals aged 2-4 years had the highest prevalence rate of 9.8%. Prevalence in animals above four years age group was 8.9% and in the age group 6 months to two years 4.5%. The infection rates were significantly different between the age group ≤2 years and >2 years (p<0.05). An odds ratio (OR) of 2.14 (CI: 1.044-8.83) between age and Brucella infection was calculated. The difference in prevalence rate between animals with no parturition and at least one parturition was significant (p≤0.1). Statistically significant differences in prevalence rate were not observed among production systems and districts studied (Table 4).

Herd size
A Brucella infection rate of 9.1%, 6.5% and 3% were found in farms that kept 1-50, 51-100 and >100 animals, respectively. On a herd basis, all herds (100%) were infected in farms that kept more than 50 animals. The rate in farms that kept less than 50 animals, in contrast, was 17.6% (Table 5). The OR for the association between herd size and brucellosis infection was 2.99 (CI: 1.29-8.06), Table 4.

Associations
Analyses of the questionnaire investigation revealed that occurrence of abortions and the use of natural service were associated with Brucella infection in farms (p<0.05) (Table 6). An OR of 15.58 (CI: 1.72-79.16) was calculated for the association between abortions and Brucella infection.
### Table 4: Intrinsic and extrinsic risk factors

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Prevalence rate(%)</th>
<th>CI (95%)</th>
<th>p-value</th>
<th>OR (CI 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.1</td>
<td>0-30.5</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>female</td>
<td>8.0</td>
<td>6.3-9.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.6 ≤2 years</td>
<td>4.5</td>
<td>1.8-7.2</td>
<td>0.04</td>
<td>2.14 (1.04-4.83)</td>
</tr>
<tr>
<td>2- ≤4 years</td>
<td>9.8</td>
<td>5.5-14.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 4 years</td>
<td>8.9</td>
<td>5-11.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 2 years</td>
<td>9.2</td>
<td>6.72-11.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Parity</strong></td>
<td></td>
<td></td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>no parturition</td>
<td>2</td>
<td>0.9-3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>single parturition</td>
<td>1.7</td>
<td>0.71-2.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>more than one parturition</td>
<td>4.2</td>
<td>2.65-5.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at least one parturition</td>
<td>5.7</td>
<td>4.2-7.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>District</strong></td>
<td></td>
<td></td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>Debre Zeit</td>
<td>5.6</td>
<td>1.6-9.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kaliti 8,9</td>
<td>6.8-10.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sebeta</td>
<td>9.9</td>
<td>7.1-12.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Addis Ababa</td>
<td>5.2</td>
<td>2.2-8.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Production system</strong></td>
<td></td>
<td></td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>intra-urban</td>
<td>5.2</td>
<td>2.2-8.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>intra-urban secondary town</td>
<td>5.6</td>
<td>1-10.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>peri-urban</td>
<td>9.6</td>
<td>7.3-11.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Herd size</strong></td>
<td></td>
<td></td>
<td>0.01</td>
<td>2.99 (1.29-8.06)</td>
</tr>
<tr>
<td>&lt; 50</td>
<td>3.3</td>
<td>0.9-5.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 100</td>
<td>7.8</td>
<td>6.05-9.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 5: Relationship of herd size and brucellosis infection rate

<table>
<thead>
<tr>
<th>Herd size</th>
<th>No. animals</th>
<th>No. farms</th>
<th>No. infected animals</th>
<th>%infected animals &amp; confidence interval</th>
<th>% infected farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-50</td>
<td>438</td>
<td>2</td>
<td>40</td>
<td>9.1% (6.4-11.8)</td>
<td>2 (100%)</td>
</tr>
<tr>
<td>51-100</td>
<td>461</td>
<td>6</td>
<td>30</td>
<td>6.5% (4.2-8.8)</td>
<td>6 (100%)</td>
</tr>
<tr>
<td>&gt;100</td>
<td>215</td>
<td>34</td>
<td>7</td>
<td>3.3% (0.9-5.7)</td>
<td>6 (17.6%)</td>
</tr>
<tr>
<td>Total</td>
<td>1114</td>
<td>42</td>
<td>77</td>
<td>6.9% (5.4-8.4)</td>
<td>14 (33.3%)</td>
</tr>
</tbody>
</table>
Table 6: Relationship of management activities with brucellosis status

<table>
<thead>
<tr>
<th>Farm management activities</th>
<th>Percentage of farms affected</th>
<th>p-value</th>
<th>OR (CI 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abortions</td>
<td>23/41 (56.1)</td>
<td>0.009</td>
<td>15.58 (172-79.16)</td>
</tr>
<tr>
<td>use of natural mating</td>
<td>18/41 (43.9)</td>
<td>0.009</td>
<td>0.06 (0-0.61)</td>
</tr>
<tr>
<td>use of artificial insemination</td>
<td>8/41 (19.5)</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>no knowledge of brucellosis</td>
<td>36/41 (87.8)</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td>presence of parturition pens</td>
<td>2/41 (4.9)</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>separation of cows during parturition</td>
<td>11/41 (26.8)</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>cleaning and disinfection</td>
<td>12/41 (29.3)</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>after birth not disposed</td>
<td>23/41 (56.1)</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>stock replaced from outside source</td>
<td>9/41 (21.9)</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>culling of infected animals</td>
<td>6/41 (14.6)</td>
<td>0.47</td>
<td></td>
</tr>
</tbody>
</table>

Discussion

In this study 42.9% of RBPT+/CFT+ farms were also detected by MRT, taking the results of the first sampling. In Uganda, only 25% of the CFT-positive herds were detected by the MRT. The variation is because one milk sample was taken from a pool of 8 lactating animals. With increasing herd size, the ability of the MRT to detect one infected animal in a herd decreases due to the dilution effect.

The agreement between MRT and RBPT+/CFT+ results was improved when MRT sampling was repeated. It is recommended that for the MRT test to be effective samples should be taken at intervals of 14-16 weeks or at least three times annually. This is because new animals are added or withdrawn and the number of lactating cows fluctuates from time to time. The agreement between RBPT and RBPT+/CFT+ was good. The explanation for the false-positive results in the MRT could be the effect of colostrum milk and mastitis. In these farms a high percentage of mastitic cows has been reported. It is reported that the mean prevalence of sub-clinical mastitis was 37.6% and of clinical mastitis 1.2%. The false-negative results, in contrast, relate to the low proportion of lactating cows and the low within-herd prevalence. The sensitivity of the MRT test was low. In order to determine point prevalence rates, it is therefore preferable to screen the population, using blood samples. RBPT is a highly sensitive but less specific test system. The sensitivity of RBPT ranked second among six serological tests. Dohoo et al. reported a 97.9% sensitivity for RBPT. A report on investigations of infected animals exists whereby the RBPT detected all culturally positive animals, whereas the SAT (Serum Agglutination Test) failed to detect nearly half of these. The false-positive result in the RBPT could be due to cross reactions with other bacteria. Cross reactions of Brucella with Yersinia enterocolitica, E. coli, Salmonella and Pasteurella have been reported. By using RBPT as a screening test and CFT as a confirmatory test, the number of false-positives was reduced. Such serial testing procedure does maximize the specificity of the test system. The use of the serial testing procedure improves the efficiency of detecting brucellosis. Improvements in the specificity are particularly useful in control programs when the strategy is removal of positive reactors. RBPT as a screening test is cheap and technically not complicated which may explain its wide use. The positive predictive values (PPV)
of both pooled MRT and RBPT tests were low in this study. In another investigation at a herd prevalence rate of 0.67\%, the positive predictive value of the MRT was 8\% and of the RBPT 18\%. PPV and prevalence rate are directly proportional.

In this baseline investigation, the high overall herd and individual prevalence clearly indicate the importance of bovine brucellosis in the Addis Ababa milk shed. In Arsi region, a prevalence rate of 8.26\% was detected in crosses using the RBPT. Tariku detected a prevalence rate of 22\% using RBPT and SAT in Chaffa state farm, Wollo region. In dairy cattle owned by IAR (Institute of Agricultural Research) a prevalence of 38.7\% was found using RBPT and SAT. The relatively high prevalence rate in this study is explained by a number of factors. Except one farm, vaccinated ten years ago, vaccination has not been practiced so far in all the farms. In a questionnaire investigation, 43.9\% of the farms use natural mating. Only bulls in government farms are tested for brucellosis. Bulls serve a number of cows indiscriminately. There are conflicting reports on the role of the bull in the transmission of brucellosis. Manethei and Carter reviewed controlled and field studies on natural service and artificial insemination. They concluded that transmission to susceptible cows by natural service has not been demonstrated. However, Seifert stated that brucellosis is an important venereal disease and can be transmitted by natural service. The other reasons are: that 87.7\% of owners do not have knowledge about brucellosis, in 36.6\% of cases general farm hygiene is poor for example in 56.1\% of farms the placenta is left on the ground or fed to dogs, and cleaning of cow sheds with disinfectants is practiced only in 4.9\% of the farms. Separate parturition pens are not present in most of the farms (95.1\%). Under intensive systems of cattle husbandry, the use of parturition pens has been shown to reduce the level of infection markedly.

Clear differences in infection rates were demonstrated when animals are stratified according to herd size. The OR value of 2.99 shows that farms with more than 100 animals were almost three times more likely to be affected than small farms that keep less than 50 animals. In Rukungiri district in Uganda, the majority of CFT reactors were detected only in large and medium sized herds. Kerr, too, had observed that infection with brucellosis was greater in herds with more than 25 cows than in those with fewer numbers. Intensive dairy farms enhance the exposure potential, especially following an abortion through increased contact and common feeding, promoting transmission. Large herd sizes often are maintained further on by the introduction of replacement cattle from outside sources. In this study, 21.9\% of the farms acquired replacement stock from outside sources. The animals may have originated from multiple sources increasing the probability of introducing infected cattle. Another explanation for the association between herd size and infection with Brucella relates to logistic and managerial problems that occur in controlling the disease as herd size increases. Control of brucellosis in larger herds often demands concerted managerial inputs which may be difficult to implement.

In conclusion, bovine brucellosis investigation in the Addis Ababa milk shed showed a relatively high prevalence rate. The relatively higher prevalence in younger animals shows brucellosis is in the incubative stage in the population carrying the potential for an imminent spread. Higher infection rate was observed in large than in smaller farms. Test agreement between MRT and RBPT+/CFT+ serial testing improved consistently when the number of MRT tests was increased. Hence, tests should be carried out frequently to improve test performance. The good agreement between the RBPT and the recommended RBPT+/CFT+ serial testing procedure shows that RBPT can be used effectively in bovine brucellosis surveys, and it is cheap. Brucellosis, besides being of economic importance, also is of public health significance. As intra- and peri-urban farms are the major sources of milk to inhabitants of Addis Ababa and closer towns particular emphasis should be given to the dairy enterprise in regards to the hygienic qualities of milk. Eradication of
brucellosis in the area seems unlikely. However, emphasis should be given to control the infection by initially adopting strategies like vaccination.

Acknowledgments

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References


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DEMATIACEOUS FUNGI ISOLATED FROM GOAT DROPPINGS

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DES FONGUS DEMATIACEUX ISOLES DES CROTTEES DE CHEVRES

Résumé
On a conduit une enquête sur l’apparition de différentes espèces de fongus démataiaceux dans les crottes de chèvres. Sur les 100 échantillons examinés, seules 4 espèces de fongus démataiaceux ont été isolées. Il s’agissait de: Cladosporium caronii, Exophiala werneckii, Fonsecaea pedrosoi et Curvularia sp. Des fongus non-dématiaceux étaient également isolés des échantillons et ils comprenaient: Aspergillus sp, Penicillium sp, Fusarium sp et Alternaria sp. L’incidence très faible de ces fongus démataiaceux dans les crottes de chèvres montre qu’elles ne sont pas des milieux appropriés à la croissance des fongus démataiaceux. La répartition de ces fongus revêt une importance au plan médical puisque certains d’entre eux peuvent provoquer des maladies telles que la chromomyкose dans les pays tropicaux et subtropicaux, et que certaines de ces maladies sont difficiles à traiter. La plupart des fongus démataiaceux vivent comme saprophytes dans le sol ou la végétation, alors que les opportunistes peuvent causer de graves maladies dans les tissus de l’homme et du bétail.

Abstract
The occurrence of dematiaceous fungi was investigated in goat droppings of different species. Out of the 100 samples examined only 4 species of dematiaceous fungi were isolated. These included Cladosporium caronii; Exophiala werneckii; Fonsecaea pedrosoi; Curvularia sp. Non-dematiaceous fungi were also isolated from the samples and they included Aspergillus sp; Penicillium sp; Fusarium sp and Alternaria sp. The very low incidence of these dematiaceous fungi in goat droppings indicates that they do not provide suitable media for growth of dematiaceous fungi. The distribution of these fungi are medically important because some of these fungi are commonly known to produce diseases like chromomycosis in tropical and subtropical countries and some of these infections are difficult to treat. Most of the dematiaceous fungi live as saprophytes in the soil or vegetation but the opportunistic ones can cause serious diseases in the tissues of man and animals.

Introduction
The term ‘dermatiaceous’ has been used to describe fungi which are dark in colour, usually olivaceous gray or black1 having conidia, spores or hyphae that are brown to black2 having brown or black melanin pigment in its cell wall or having darkly pigmented mycelia or spores3. Dematiaceous fungi belong to the group of morphologically heterogeneous fungi (Order: Moniliiales) that grow in the form of solitary cells having hyphae, conidia or both that are darkly coloured, brownish or black4,5.

Several species of saprophytic and pathogenic dematiaceous fungi are known to occur in tropical countries. For example, Fonsecaea pedrosai has been isolated from plant debris and soil6; Cladosporium caronii from wooden fence post7,8; Phialophora verrucosa from wood pulp9,10; wood of barn11 and soil12. Human infections caused by these fungi include chromoblastomycosis, phaeohyphomycosis and mycetoma13. Infection is presumably initiated by traumatic implantation of the fungi from environmental sources14.

These infections generally do not respond favourably to amphotericin B, a drug of choice in most deep-seated fungal diseases. Complete cure for the disease has been achieved in several cases15,16 but resistance to the drug has also been reported17.

*Corresponding author
In the tropics and the world at large, goats are kept for their nutritional and economic values. Disease conditions caused by microorganisms are known to reduce these values. Therefore it is important that a proper understanding of the relationship between the goats and the dematiaceous fungi is known in order to tackle this reduction. The present study was prompted by a lack of knowledge of the natural distribution of these fungi, especially the pathogenic species in this part of the country.

**Materials and Methods**

*Collection and processing of samples*

One hundred samples of goat droppings were collected and examined. These were collected from 5 goat markets in 5 towns known as urban towns in the State: Awka (AW); Ekwulobia (EK); Abagana (AB) and Onitsha (ON). A total of 20 samples were collected from each urban area.

The samples were collected directly from the anus of the goats as they were being voided to avoid contamination. About 3g of each sample was collected in a clean, sterile universal bottle. The samples were taken to the laboratory without preservation. Each sample was put in a sterile test tube and 9ml of sterile water added. Each test tube was vigorously shaken for about 5 minutes and allowed to stand for a further five minutes. 1ml of the supernatant was pipetted out to make a 10-fold serial dilution. 1ml quantities of 1:10 dilutions of each sample was cultured directly on duplicate plates of Sabouraud dextrose agar fortified with chloramphenicol (0.5mg/ml); streptomycin (2.5mg/ml) and penicillin (2.5mg/ml). All cultures were incubated at room temperature (20-25°C) for 2 weeks Colonies of dematiaceous fungi appearing in cultures were subcultured on fresh medium to obtain pure cultures.

*Identification of fungi*

This was based on their morphological characteristics and certain physiological attributes. Colony morphology was studied in subcultures on saubouraud dextrose agar and microscopic characters i.e. hyphal morphology and sporulation pattern were studied in lactophenol mounts prepared from slide cultures. Physiological and biochemical tests viz. growth at 37°C and inability to hydrolyze 12% gelatin were carried out according to the procedure described by Espinel-Ingroff et al.

**Results and Discussion**

Out of the 100 samples of goat droppings examined, only 6 dematiaceous fungi were isolated as shown in Table 1. Two species of *Cladosporium carionii* and *Exophiala wenamekii* were recovered from goat droppings collected.

Table 1: Isolation of dematiaceous fungi from goat droppings from different locations

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of samples</th>
<th><em>Cladosporium carionii</em></th>
<th><em>Exophiala wenamekii</em></th>
<th><em>Fonseca pedrosi</em></th>
<th><em>Curvulania</em> sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awka</td>
<td>20</td>
<td>2</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Umudioka</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Abagana</td>
<td>20</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Onitsha</td>
<td>20</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ekwulobia</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>3</strong></td>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>
from Awka while *Curvularia* sp was isolated from only one of the 20 samples collected from Umudio. In Abagana, only *Fonseca pedrosoi* was isolated from the 20 samples while one (*Cladosporium* sp) was isolated from Onitsha. No dematiaceous fungi was found in the 20 samples collected from Ekwulobia.

The results obtained from this study suggest that dematiaceous fungi are rare organisms in goat droppings even though the saprophytic occurrence of *F. pedrosoi*, *C. carionii* and *P. verrucosa* has been demonstrated in natural sources in Nigeria. These species are commonly known to cause chromomycosis in tropical and subtropical countries, and hence the need to establish the relationship between the organisms and goats. The low incidence of these fungi in goat droppings could not be explained since they had been established in vegetation and soil. The experiment intended to establish a relationship between the vegetative matter and grasses eaten by goats with these fungi. Therefore, it can be concluded here that goat droppings do not form a good supporting medium for the growth of dematiaceous fungi. Further extensive environmental sampling and epidemiological studies are needed in Nigeria to characterise the natural habitats of pathogenic dematiaceous fungi and their relationship to diseases of man and animals.

**References**


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A SURVEY OF THE CAUSES OF LAMB MORTALITY IN MAIDUGURI AND ITS ENVIRONS

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UNE ENQUETE SUR LES CAUSES DE LA MORTALITE DES AGNEAUX A MAIDUGURI ET DANS SES ENVIRONS

Résumé
Une enquête sur les causes de la mortalité des agneaux dans la ville de Maiduguri et ses environs a été menée. La plupart des troupeaux étaient élevés à l'arrière-cour (42%) et le Balami était la race la plus répandue élevée par les propriétaires de troupeau (41%). Les propriétaires de troupeau élèvent beaucoup plus de femelles que de mâles (P<0.05). L'entérite/diarrhée (24%) et les maladies respiratoires (21%) étaient les causes principales de la mortalité des agneaux. Il y a eu des pertes néonatales chez les agneaux âgés de 1 à 7 jours. Les pertes néonatales se sont produites toute l'année, avec la plus forte mortalité pendant la saison sèche (68%), un taux beaucoup plus élevé (P<0.05) que celui enregistré durant la saison des pluies (31%). Il n'y avait pas de différence significative (P>0.05) entre les taux de mortalité chez les mâles et les femelles. Les problèmes de santé étaient surtout imputables aux divers systèmes d'exploitation et au coût des aliments, qui paraissaient constituer les obstacles majeurs à l'élevage.

Abstract
A survey of the causes of lamb mortality in Maiduguri metropolis and its environs were investigated. Most flocks were kept under backyard holdings (42%) and the balami was the most common breed kept by flock owners (41%). Flock owners kept significantly higher numbers of females compared to males (P < 0.05). Enteritis-diarrhoea (24%) and respiratory diseases (21%) were the major causes of lamb mortality. Neonatal losses occurred in lambs between 1-7 days of life. Neonatal losses occurred throughout the year, with the highest mortality in the dry season (68%) which was significantly higher (P < 0.05) than that recorded in the wet season (31%). There was no significant difference (P > 0.05) between mortality rates in males and females. The various management systems contributed considerably to the health problems as did the cost of feed, all of which seemed to constitute the major management constraints.

Introduction
Increasing productivity is one of the primary goals in sheep production. The important factor in any sheep enterprise is the availability of lambs for herd replacement and increase in herd size. Lamb mortality would therefore affect the development of any sheep enterprise.

There are about 12 million sheep in Nigeria, with three quarters of the population concentrated in the Northern State. About 90% of the sheep are presently produced through the traditional system. Sheep rearing can serve as a flexible financial reserve for the population as well as play other socio-cultural roles in the customs and traditions of many Nigerian societies. It was reported that sheep can make valuable contribution to the nutritional and economic welfare of family units and can play important roles in national economy.

Over 10-32% of lambs are known to die annually before weaning in the tropical and subtropical regions and 50-70% of these losses occur within the first week of birth. Further, it was observed that pre-weaning lamb mortality is one of the major constraints to sheep production. There are few reports regarding the health of these sheep. Information of lamb mortality and causes in the Northern Zones of Nigerian indigenous flocks have only been estimated by field experience. The extent to
which lamb losses contribute to the total losses incurred in the Nigerian sheep industry is not known.

Several factors are known to influence lamb mortality. These include the breed, birth weight, sex, type of birth, housing and hygiene, nutrition and methods of feeding, infectious and non infectious diseases, flock size and management system\textsuperscript{8-10}. The levels of circulating immunoglobulin (Ig) in new born lambs reflect the extent of the absorption of colostral antibodies and Ig concentration in 24-48 hours old lambs, is widely accepted as an indicator of the immunity or susceptibility of lambs to disease during the neonatal period.

In order to boost sheep production and husbandry, there is need to evaluate factors possibly predisposing to lamb mortality in flocks so as to recommend appropriate sound management and disease preventive practices in order to exploit the full productive potential of sheep.

This study therefore reports on the incidence of lamb mortality in flocks around Maiduguri and environs.

**Materials and Methods**

**Source and type of sheep flocks**

All the flock owners encountered were backyard keepers, government institutions and nomadic Fulanis, who obtained their animals from markets, gifts, inheritance or a combination of these.

**Selection of study areas**

The sheep flocks investigated in this study were from Maiduguri metropolis and its environs. These study areas which were randomly selected included sheep rearers from the University of Maiduguri staff quarters, Mairi village, Gwange, Hausari, Polo, Custom and Government residential areas (GRA).

**Target flocks**

Most of the flocks investigated contained less than 5 to over 50 sheep. Only farmers who keep sheep were selected during the study. A total of 100 flocks consisting of 1016 sheep were selected.

**Breed, Age and Sex**

**Breed**

The breeds studied were obtained mainly from the 100 flocks and included Uda, Balami, Yankasa, Sudanese and their crosses.

**Age**

All the ages of sheep investigated ranged from less than 6 months to greater than 1 year. Sheep were aged by dental eruption as described by Dyce et al.

**Sex**

Of the total 1016 sheep from the 100 flocks, males were 377 and females 639.

**Management**

Majority of the sheep flocks studied were managed semi-intensively although a few were by extensive and intensive systems of production.

**Preparation of the questionnaire**

A structured close ended questionnaire containing inter alia: source of sheep, breeds, age, sex, management patterns, common diseases, seasonal predisposition, breeding patterns etc. was prepared.

**Administration of questionnaires**

One hundred flock owners were interviewed through spot visits and questionnaires administered instantly.

**Management of specific disease studies in lambs**

Data on specific management practices as well as disease(s) contributing to morbidity and mortality were also obtained from administered questionnaires specifically involving lambs.
Data analysis

Questionnaires were collected, sorted and tabulated based on relevant management (husbandry), disease (health), including factors contributing to management and health constraints (predisposition) and some reproductive parameters.

Statistics

Data obtained were analysed using Chi-square distribution and analysis of variance at $P = 0.05$ as the level of significance.

Results

The majority of the sheep flock constituted backyard holdings with (49; 42%) frequency of occurrence. This is followed by nomadic Fulanis (6; 5%) within the earmarked study areas. Most sheep flocks were obtained from the market (41; 35%) and also as gifts or inheritance which constituted (16; 14%).

The frequency of occurrence of various breeds in the total flocks investigated were Uda (28; 23%), Balami (50; 41%), Yankasa (24; 20%), Crosses (16; 13%) and Sudanese (3; 3%).

The frequency of occurrence of all ages of sheep out of the total 1016 investigated were 6 months (239; 24%), 6 months - 1 year (305; 46%) and greater than 1 year (475; 46%).

Similarly, the frequency of occurrence of factors militating against improved sheep husbandry as deduced from the questionnaire is shown in Table 1. Cost of feed (60; 37%), Seasonal availability of feed (50; 31%), Cost of Vet. care (13; 8%) and disease/vaccination problems (14; 8%) seem to constitute the major production constraints.

The frequency of common disease in the flocks investigated is shown in Table 2. Pneumonia (51; 30%) helminthiasis (58; 35%), abortions (13; 8%) and mastitis (17; 10%), were the common diseases recorded.

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cost of feed</td>
<td>60</td>
<td>37</td>
</tr>
<tr>
<td>2. Seasonal availability of feed</td>
<td>50</td>
<td>31</td>
</tr>
<tr>
<td>3. Disease/vaccination problems</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>4. Cost of Vet Care (drugs)</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>5. Theft/accidents</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>6. Lack of adequate extension services</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>7. Weather/Climatic conditions</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8. Lack of water</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9. Others</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10. Combination of above</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>163</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2: Common diseases encountered in the flocks surveyed

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Helminthiasis</td>
<td>58</td>
<td>35</td>
</tr>
<tr>
<td>2. Pneumonia</td>
<td>51</td>
<td>30</td>
</tr>
<tr>
<td>3. Mastitis</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>4. Abortions</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>5. Peste des petite ruminants</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>6. Others</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>7. Sheep pox</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8. Pregnancy toxoaemia</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>9. Trypanosomiasis</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>167</td>
<td>100</td>
</tr>
</tbody>
</table>

Also the frequency of the common remedies usually used to treat or prevent common disease is shown in Table 3. Constant consultation with Veterinarians (55; 46%) followed by the use of routine deworming and vaccination (36; 29%) and application of local remedies (13; 11%) predominated.

The various remedies as sieved from the questionnaire for improved sheep husbandry as subjected by farmers are shown in Table 4. The majority of farmers (46; 30%) agreed that
the availability of soft loans and subsidized feeds (48; 31%) will greatly enhance increased sheep production.

**Table 3:** Common remedies instituted for used to prevent diseases in sheep flocks

<table>
<thead>
<tr>
<th>Remedies</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Constant consultation with</td>
<td>56</td>
<td>46</td>
</tr>
<tr>
<td>the Veterinary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Routine deworming vaccination</td>
<td>36</td>
<td>29</td>
</tr>
<tr>
<td>3. Combinations</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>4. Local remedies</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>5. Does not bother</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6. Not aware of Veterinary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>123</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Table 4:** Remedies for improve husbandry practices in sheep flocks

<table>
<thead>
<tr>
<th>Remedies</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Subsidized feeds</td>
<td>48</td>
<td>31</td>
</tr>
<tr>
<td>2. Provision of soft livestock</td>
<td>46</td>
<td>30</td>
</tr>
<tr>
<td>loans for sheep production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Improved Veterinary health</td>
<td>29</td>
<td>19</td>
</tr>
<tr>
<td>care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Better extension services</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>5. Provision of more grazing</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>reserves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. More sheep multiplication</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>centres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Others</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>155</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Of the total 416 lambs, 110 died from various management and disease causes giving an overall lamb mortality of 26%. Of these deaths occurring in lambs, 53% were females and 47% were males (P > 0.05).

The lamb mortality pattern grouped according to age is shown in Table 5. More deaths occurred during the dry season (44; 69%) than wet season (20; 31%) and was significant (P < 0.05). More deaths occurred within the first 2 weeks of life compared with 16-180 days of life (P < 0.05).

**Table 5:** Lamb mortality grouped according to age in sheep

<table>
<thead>
<tr>
<th>Age in days</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 1 – 7 days</td>
<td>41</td>
<td>37</td>
</tr>
<tr>
<td>2. 8 – 15 days</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>3. 16 – 30 days</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td>4. 31 – 180 days</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>110</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Amongst the main causes of lamb mortality, the most frequently occurring diseases were respiratory diseases (21; 21%), enteritis (24; 24%) and were significantly different (P < 0.05) from the other causes.

**Discussion**

This study has shown in broad terms the nature, characteristics and constraints of sheep production in the semi-arid zones of Nigeria. The study revealed that most of the flocks were kept under backyard holding, mainly for future market sales or festivities and therefore were accordingly maintained for limited periods.

Based on the data presented in this study, more singles were lambed compared to twins. This is consistent with a previous report in which it was reported that 81.5% of all lambs born were singles. This trend may partially be explained by inadequate nutrition, since the placenta is sensitive to under nutrition. Furthermore, Opasina observed that sheep tend to starve in the dry season due to lack of green pastures for grazing.
The results of this study did show that neonatal lamb losses occurred mostly within the first month of life. This has also been observed by others\textsuperscript{12,13,14}. Of these, the highest mortality rate (37\%) was observed in the first week of birth. In an earlier report\textsuperscript{15}, 33.3\% of total lamb mortality occurred within 3 days of life. The lamb mortality rate recorded in this study (26\%) W25 slightly higher than the 22\% recorded for early lamb mortality in Australia\textsuperscript{16,17,19}. This difference may be due to differences in management systems.

The present study also showed that lamb mortality occurred throughout the year but at a significantly higher rate during the dry season. This observation agrees with the report of Njau\textsuperscript{19}. However, Otesile and Oduye\textsuperscript{20} in their study found no significant effect of season on lamb mortality rate. It has been reported that lambs born during the dry season are more likely to die than those born at other times of the year\textsuperscript{14}. This is because they are usually malnourished since they may not have received enough milk from their inadequately fed ewes and also because in the dry season, sheep tend to starve owing to lack of green pastures for grazing\textsuperscript{21}.

Enteritis (diarrhoea) and respiratory diseases were the major causes of lamb mortality in Maiduguri metropolis and its environs. Respiratory problems mainly from pneumonia as observed in the present study, were the most common health problems during the rainy season and susceptible lambs were aged between 3-6 months. These findings were similar with the observations of Oppong\textsuperscript{22}. There was a high mortality of lambs at preweaning age owing to helminthiasis and respiratory problems, as previously observed\textsuperscript{23-25}.

The present data did not establish any significant difference between mortality rates in males and females, as was similarly observed by Otesile and Oduye\textsuperscript{20}.

Balami was the most common breed kept by flock owners and this breed was preferred perhaps because of their better adaptation to the environment as well as resistance to some of the endemic diseases. This corroborates well with the report of Aganga and Aganga\textsuperscript{26} which also showed the balami breed as being one of the most predominant breeds of sheep found in the North Eastern region of Nigeria. This tolerant indigenous breed appear to survive better under semi and conditions.

The various management systems which ranged from intensive, semi-intensive to extensive, contributed considerably to the health problems. Minimal confinement over extensive grazing areas reduced infectious disease problems but increased neonatal losses. This may have resulted either from inadequate flock observation and assistance during lambing, or as a result of mismothering and susceptibility to abrupt weather\textsuperscript{27}. Neonatal losses may also result from variation in the availability of food supply, wandering, theft and predation\textsuperscript{28}.

From this study, 32\% of the flock owners practised intensive system of management, and one of the main problems encountered under this system has been the high incidence of disease such as helminthiasis and mange.

Flock owners kept significantly higher numbers of females compared to males, as females are frequently needed for breeding particularly for flock replacement.

Cost of feed was the main management constraint because of scarcity of feed in this area due to limited amount of rainfall and absence of improved pasture development. Feeds are also scarce during long periods of the dry season and accordingly very expensive and unaffordable by the peasant flock owners.

The data presented here did show that most of the flock owners were in constant consultation with Veterinarians, and practiced routine deworming because a good proportion of them had been educated on the need to do so, and most importantly, they have access to Veterinary services (State Vet. Clinics and Veterinary Teaching Hospital, VTH). This awareness may have contributed immensely in checking other endemic diseases.

This study has shown that disease and lack of feed are the main constraints militating against improved sheep production in the area. The lamb mortality rate observed in the present
study appears to be a direct outcome of these two constraints.

Since increased production of sheep requires adequate disease control, good management and nutrition, Veterinary care of neonates is indispensable for profitable sheep farming. Also, intensive surveillance at the flock level and accurate diagnosis of the specific causes of deaths are needed if sheep mortality is to be controlled effectively. To reduce lamb losses, special attention must also be given to the nutrition of ewes before the onset of heat, the management of lambing ewes, the diagnosis and treatment of hypothermia, and the management of 2–7 days old lambs. In addition, prompt diagnosis and treatment of perinatal conditions are imperative.

It has been suggested that better funding by way of soft credit to flock owners is needed as this will reduce the problems and improve sheep productivity.

References


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CAUSES DE LA MALADIE ET DE LA MORTALITÉ CHEZ LES BOVINS EN ELEVAGE TRADITIONNEL DANS LE NORD DU NIGERIA

Résumé
Une enquête a été menée sur une période de trois ans (1993 - 1995) sur les causes de la maladie et de la mortalité dans le cadre d’un programme sanitaire pour 16 troupeaux de bovins élevés avec les mêmes systèmes d’exploitation. L’incidence de la mortalité s’est avérée forte dans trois troupeaux : Barami (0,7/100), LIBC (0,7/100) et Kobi (0,5/100). Chez tous les troupeaux, les causes de la mortalité de la plupart des bovins étaient : la septicémie, la périoïnémie contagieuse bovine (PPCB), la fièvre aphteuse et l’intoxication. Cependant, un pourcentage plus élevé de bovins souffrait de pneumonie, de diarrhée, de conjonctivite et de gastro-entérite. On a eu recours à l’abattage pour améliorer la productivité lorsque la propagation des maladies était faible. La plupart des abattages étaient dus à la dermatophilose (64,9%) tandis que la malnutrition, la vieillesse et d’autres maladies étaient responsables du reste des abattages (35,1%). Il est proposé de prendre des mesures de lutte appropriées contre les maladies en vue d’accroître la productivité.

Abstract
Causes of illness and death in a herd health program involving 16 herds of cattle with the same systems of management, were investigated over a period of 3 years (1993-1995). Incidence of mortality was found to be high in 3 herds; Barami (0.7/100 cow months), LIBC (0.7/100 cow months) and Kobi (0.5/100 cow months). Cause associated case-fatality rate showed that in all herds, most cattle died from septicemia, contagious bovine pleuropneumonia (CBPP), foot-and-mouth disease (FMD) and poisoning. However, the greater percentage of cattle suffered from pneumonia, diarrhoea, conjunctivitis and gastro-enteritis. Culling was done to improve productivity as the spread of diseases was reduced. Most of the cullings were due to dermatophilosis (64.9%) while other conditions like malnutrition, old age and other disease conditions made up the rest of the 35.1%. Measures were suggested for proper disease control in order to enhance productivity.

Key words: Cattle, Health Programs, Mortality, Traditional, Nigeria.

Introduction
In developed and indeed in many developing countries, diseases in farm animals have always been a problem of considerable importance to farmers'. Traditionally, in sub-Saharan Africa, the veterinarian is usually called upon when a valuable animal is about to die or as a coincidental adjunct to some routine vaccinations. The expectation is for him to make a diagnosis and recommend a treatment or vaccination program, hopefully using some new ‘wonder’ drug that is specific for the animals' unique problems. The situation in Nigeria is the same. This is because most of the cattle are
managed traditionally and hence are not confined to one location. The cattle rearers, mainly the Fulanis, practice the extensive management system. The Nigerian agriculture therefore needs a healthy livestock industry to achieve optimum growth.

In Nigeria, livestock diseases, in addition to other production index stand in the way of such growth at present. Most losses in productivity of grazing animals are now associated with herd or flock health rather than with clinically apparent diseases. Thus, diseases not only require herd treatment but their control and prevention need to be integrated with the grazing management of pasture, housing, nutrition, general management and with the known epidemiology of pathogens. Due to the paucity of information in these aspects this study was designed to find out the causes of illness and death in cattle in a herd health program, involving 16 herds of cattle in Bauchi, Northern Nigeria, so as to serve as a base line for initiating a control program and hence increase productivity.

Materials and Methods

The Study Area:
Bauchi lies between latitudes 10°N and 10°30N and at an altitude of 690 meters. It has an average rainfall of 1091.4 mm. The peak of the rain is reached in August. The mean highest relative humidity is 66.5% in August while the mean lowest of 16.5% is obtained in February. The mean maximum temperature is 37.5°C occurring in April and the minimum of 13.7°C occurs in January. Bauchi is located within the Northern Guinea Savannah vegetational belt of Nigeria. The area is mainly grassland with a few or sparse trees. The occupation of the inhabitants is mainly farming and the livestock population is primarily in the hands of the Fulanis. Bauchi State has about 25% of Nigeria's total livestock population.

Livestock Production System:
Livestock in the study area are managed mostly through the agropastoralist production system. This is a form of an extensive system of production. The agropastoralist practices limited transhumance at the end of the crop-growing season to graze animals predominantly on maize and sorghum straws during early December to the end of May. Supplementation is rare and watering is done in streams, ponds or wells.

Selection of Herds/Field Work:
Farms with similar systems of management were selected. Sixteen cattle farms, with an initial total of 702 cattle, were selected based on willingness of the farmers in the study area to participate. Planned periodic monthly visits were made to each herd or on the invitation of the herd owner whenever they had cause to for a period of 3 years (1993-1995). At the start of the study through the end, every cattle in each herd was examined individually. Each animal was identified using eartags.

On each monthly visit to each herd cattle were examined for signs of diseases. Samples were taken for diagnosis where necessary. Treatments were given in most cases with broad spectrum antibiotics and by culling. Records of diseases and mortality for each herd were kept and advice on general management to each herd owner was given. Cow month method was used to calculate incidence of mortality and culling.

Results
Incidence of mortality expressed in cow months are given in Table 1 and showed that Barami LIBC and Kobi herds had the highest mortality rates of 0.7/100, 0.7/100 and 0.5/100 cow months respectively.

Cause associated case-fatality rates (Table 2) showed that septicaemia, poisoning, FMD and CBPP were the main causes of mortality even though most infections manifested as pneumonia, diarrhoea, conjunctivitis and gastro-enteritis.
Table 1: Incidences of Mortality in 16 Herds in Bauchi (1993-1995) Expressed in Cow months

<table>
<thead>
<tr>
<th>Farm</th>
<th>Total number of cow Months</th>
<th>Mortality</th>
<th>Percentage Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Libc Farm</td>
<td>747</td>
<td>5</td>
<td>0.7</td>
</tr>
<tr>
<td>Barami Farm</td>
<td>136</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Kobi Farm</td>
<td>2186</td>
<td>10</td>
<td>0.5</td>
</tr>
<tr>
<td>Oska Farm</td>
<td>1919</td>
<td>8</td>
<td>0.4</td>
</tr>
<tr>
<td>Buba Farm</td>
<td>740</td>
<td>3</td>
<td>0.4</td>
</tr>
<tr>
<td>University Farm</td>
<td>1762</td>
<td>5</td>
<td>0.3</td>
</tr>
<tr>
<td>Bula Farm</td>
<td>1639</td>
<td>5</td>
<td>0.3</td>
</tr>
<tr>
<td>Giwo Farm</td>
<td>1273</td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>Bishi Farm</td>
<td>389</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Mri Farm</td>
<td>399</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Fawu Farm</td>
<td>2135</td>
<td>3</td>
<td>0.1</td>
</tr>
<tr>
<td>State Poly. Farm</td>
<td>968</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Tahir Farm</td>
<td>1661</td>
<td>2</td>
<td>0.1</td>
</tr>
<tr>
<td>Jumba Farm</td>
<td>2538</td>
<td>1</td>
<td>0.04</td>
</tr>
<tr>
<td>Galambi Farm</td>
<td>184</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maikano Farm</td>
<td>318</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3 gives the incidences of culling in the different herds with Maikano and Jumba farms having the highest. The specific causes of culling are shown in Table 4 where dermatophilosis (Fig. 1) was found to be the major cause of culling in all the herds (64.9%) while other diseases contributed 11.9%. Also culling seasonality with most of it happening during the rainy season is depicted in figure 2.

Table 2: Cause Associated Case-Fatality Rates For Cattle in 16 Herds in Bauchi (1993-1995)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Total number with condition</th>
<th>Number dead due to condition</th>
<th>Case fatality rate(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poisoning</td>
<td>48</td>
<td>9</td>
<td>18.8</td>
</tr>
<tr>
<td>Foot and mouth</td>
<td>21</td>
<td>3</td>
<td>14.3</td>
</tr>
<tr>
<td>Disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Septicemia</td>
<td>15</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Coccidiosis</td>
<td>8</td>
<td>1</td>
<td>12.5</td>
</tr>
<tr>
<td>Cbpp</td>
<td>54</td>
<td>6</td>
<td>11.1</td>
</tr>
<tr>
<td>Metritis</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dermatophilosis</td>
<td>8</td>
<td>5</td>
<td>5.7</td>
</tr>
<tr>
<td>Trauma</td>
<td>112</td>
<td>4</td>
<td>3.6</td>
</tr>
<tr>
<td>Bloat</td>
<td>90</td>
<td>3</td>
<td>3.3</td>
</tr>
<tr>
<td>Gastroenteritis</td>
<td>104</td>
<td>3</td>
<td>2.9</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>526</td>
<td>10</td>
<td>1.9</td>
</tr>
<tr>
<td>Foot rot</td>
<td>74</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>416</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Conjunctivites</td>
<td>323</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Snake bite</td>
<td>19</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Retained</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Placenta</td>
<td>53</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4: Causes of Culling in 16 Herds in Bauchi (1993-1995)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number pulled</th>
<th>% positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermatophilosis</td>
<td>120</td>
<td>64.9</td>
</tr>
<tr>
<td>Old age</td>
<td>30</td>
<td>16.2</td>
</tr>
<tr>
<td>Other diseases</td>
<td>22</td>
<td>11.9</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>10</td>
<td>5.4</td>
</tr>
<tr>
<td>Reproductive failure</td>
<td>3</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Figure 1: Causes of culling by season for the 16 herds in Bauchi (1993-1995)

- Dermatophilosis
- Old age
- Reproductive failure
- Others

Figure 2: Incidence of culling by season for the 16 herds in Bauchi (1993-1995)
Discussion

The distribution of diseases during the study period showed that conjunctivitis, pneumonia, gastro-enteritis and diarrhoea were observed more frequently than others. These conditions were encountered mostly during the rainy season when factors necessary for the development of their respective pathogens were suitable. The results of this study and the information from existing records indicate that these conditions in Nigerian livestock have existed for a long time and are still spreading despite efforts to control them through prophylactic treatments\textsuperscript{8-11}. Two of the major factors contributing to the spread of these conditions are the free movement of the nomadic Fulani herds which makes control programs difficult to implement and the practice of treating individual cases by veterinarians instead of the herd health approach.

Incidences of mortality during the study period showed that some herds have high mortalities (Table 1). These include Kobi, LIBC and Barami. This was found to be due to poor management as all the managers in these herds were illiterates and suggestions given to improve management and hence productivity, were not implemented. The cause associated case-fatality rate (Table 2) showed that most cattle died from poisoning (mainly of plant origin), FMD, septicaemia and CBPP. These are mostly management diseases and their propagation in the herds was due to poor management in relation to prompt and adequate vaccinations, maintenance of good hygiene, seeking proper veterinary medical attention and on herd basis, culling of very sick animals. In a similar study in the northwestern part of Nigeria Voh. Jr. \textit{et al}\textsuperscript{9} found helminthosis and pneumonia to be the main causes of death in the herds studied. The difference compared to this study may be associated with the season they conducted their study (mainly the rainy season unlike to all seasons in our study) and the geographical location.

Culling cattle due to specific conditions like dermatophilosis, old age and malnutrition were done to improve productivity and reduce losses. This could explain the low incidences in this study compared to that of Voh Jr \textit{et al}\textsuperscript{9}. More culling were done during the rainy season and most of the culls were due to dermatophilosis since the conditions for its spread were suitable and conducive during that period\textsuperscript{12-15}. In Nigeria, studies have shown that the Bunaji breed of cattle is very susceptible to dermatophilosis\textsuperscript{14} and so the finding in the present study is not surprising.

Conclusion

Causes of disease conditions of traditionally managed cattle in Northern Nigeria were identified in this study. These conditions were found to be seasonal with the highest occurring during the rainy season. To improve the situation, a herd health approach should be adopted in treating livestock diseases and management improved in order to control/prevent these diseases. Also control can be achieved if nomadism practised by the Fulanis, who own most of the cattle in Nigeria\textsuperscript{8}, is reduced or eliminated and veterinarians and the herd owners alike educated and encouraged to adopt the herd health approach to livestock health management.

Acknowledgment

The authors wished to thank the senate of Abubakar Tafawa Balewa University for providing part of the funds for this study and to the herd owners for allowing us access to their herds.

References

6. Mohammed, A.N. 1984. Invitational Lecture For Veterinary Epidemiology and Economics course Organised by The Department of Veterinary Surgery and Medicine, Ahmadu Bello University, Zaria, Nigeria, July 25th.

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EFFECT OF SALINITY LEVEL ON THE DRINKING RATE IN ATROPICAL TELEOST, 
OREOCHROMIS ANDERSONI

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EFFET DU NIVEAU DE SALINITÉ SUR LA CONSOMMATION D’EAU CHEZ UN 
TELEOSTEEN TROPICAL OREOCHROMIS ANDERSONI

Résumé
Une étude a été entreprise en vue de déterminer l’euryhalinité (la tolérance à la salinité) et l’effet de l’altération de la salinité sur la consommation d’eau du tilapia Oreochromis andersoni. On a déterminé la consommation d’eau du poisson dans l’eau douce et dans l’eau de mer aux proportions de 50%, 75% et 100%. O. andersoni s’acclimatant à l’eau de mer sans qu’il y ait de cas mortalité et le poisson qui s’adaptait à l’eau de mer a survécu lors du transfert direct à l’eau douce. La consommation d’eau a beaucoup augmenté (P<0,05) lorsque la salinité était au moins à 75% d’eau de mer. Il a été conclu que O. andersoni est euryhalin; sa consommation d’eau augmente avec le niveau de salinité jusqu’à un maximum de 75% d’eau de mer et par la suite cette consommation reste beaucoup plus élevée avec une forte proportion d’eau de mer. Il serait donc possible d’élever le poisson dans des milieux ayant divers niveaux de salinité.

Abstract
A study was carried out to determine the euryhalinity and the effect of salinity changes on the drinking of tilapia, Oreochromis andersoni. Drinking rate of the fish in fresh water, and at 50%, 75% and 100% sea water was determined. O. andersoni acclimated to sea water without mortality and fish acclimated to sea water survived direct transfer back to fresh water. Drinking rate increased significantly (p < 0.05) after the salinity was at least 75% sea water. It was concluded that O. andersoni is euryhaline and that its drinking rate increases with salinity up to a maximum at 75% sea water and thereafter remains significantly higher at full strength sea water. It may, therefore, be possible to culture the fish in environments of wide salinity ranges.

Introduction
Effective mechanisms of osmoregulation have enabled teleosts to survive a wide range of salinity. In sea water the critical problem faced by teleosts is dehydration as a result of osmotic removal of water in the gill and gut epithelia1,2 which contrasts with the problem of osmotic water loading encountered by fresh water species3,4. The regulation of water is therefore essential for the survival of teleosts in the aquatic environment. One of the strategies of regulating water is drinking. Drinking is of fundamental importance in marine teleosts because it replaces water lost to hypertonic environment by osmosis.

Apart from the catadromous and anadromous species, it is usually difficult to classify most of the species resident in sea water or fresh water on the basis of salinity tolerance. A number of tilapia species (Oreochromis mossambicus, Oreochromis aureus, Oreochromis zilli and Saratherodon galilaeus) have been shown to be euryhaline5,6. It is therefore possible that the tilapia, O. andersoni, would also be inherently euryhaline and can survive transfer to sea water. This could be an advantage in the farming of the species in that it may be possible to culture it in a wide range of salinity.

The aim of this study was to determine the euryhalinity (salinity tolerance) in the tilapia, O.
andersoni, and its rate of drinking in environments of different salinities.

Materials and Methods

The tilapia fish, Oreochromis andersoni, used in this study were being kept in fresh water at a temperature of 23 - 26°C in Prof. Ian Johnston’s laboratory at the Gatty Marine Laboratory, University of St Andrews, Scotland. During experimentation the fish were kept at the same temperature (23 - 26°C) throughout. After an initial preadaptation to 30% sea water, the tilapia were acclimated to 50%, 75% and 100% sea water for 4 days in each salinity. Survival rate of the fish was noted.

Drinking rate was determined in fresh water and at 50%, 75% and at 100% sea water using the protocol of Hazon et al. 9 The protocol is based on the accumulation of radioactive Chromium-EDTA (51Cr-EDTA, Amersham International) in the gut. Radioactive Chromium-EDTA was added to 20 litres of water at a specific salinity and at a temperature of 23-26°C to make a concentration of 15 microcuries of radioactivity per litre of water. After thorough mixing six to eight fish were introduced into the tank for a minimum of 4 hours in each case. At the end of the four hours the fish were removed and killed by an overdose of an anaesthetic, 2-phenoxyethanol (Sigma) in isotope-free water of the respective salinity. The fish were then weighed. The body wall was opened and the gut carefully isolated from other structures and ligatured at the esophageal and rectal ends. The gut was then resected out and put in vials and radioactivity counted using a gamma counter. In addition duplicate samples of 1 ml of the water containing the isotope were counted. The drinking rate was calculated using the formula:

\[
\text{Drinking rate (ml/Kg/hr)} = \frac{C}{M.T.W},
\]

where C is counts in entire gut of the fish, M is counts per ml of isotope-containing water, T is time fish spent in isotope-containing water (hours) and W is wet weight of fish (Kg).

Results

Tilapia, O. andersoni, acclimated to sea water without any mortality. The fish that had acclimated to sea water survived and thrived after direct transfer back to fresh water. The drinking rate increased with the increasing salinity (Table 1). It increased from 0.301 ± 0.057 in fresh water to a maximum of 1.606 ± 0.206 in 75% sea water. It then decreased slightly, though not significantly, to 1.218 ± 0.204 in 100% sea water. There was a significant difference between the drinking rate in fresh water and in 75% and 100% sea water respectively (P < 0.05; Table 1).

Table 1: Drinking rate (ml/Kg/hr; ± SEM) of tilapia, Oreochromis andersoni, at different levels of salinity (n = 6-8)

<table>
<thead>
<tr>
<th>Level of Salinity</th>
<th>Drinking Rate (ml/kg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh water (0 % sea water)</td>
<td>0.301 ± 0.057</td>
</tr>
<tr>
<td>50% sea water</td>
<td>0.875 ± 0.219</td>
</tr>
<tr>
<td>75% sea water</td>
<td>1.606 ± 0.206*</td>
</tr>
<tr>
<td>100% sea water</td>
<td>1.218 ± 0.204*</td>
</tr>
</tbody>
</table>

*Significantly higher drinking rate (P < 0.05)

Discussion

Among the tilapia, a number of species (O. mossambicus, O. aureus, O. zilli and S. galilaeus) have been shown to be euryhaline 5-8,10,11. Previous studies on O. andersoni reported that the species could not survive 75-100% sea water 7. However in the present study, the species gradually acclimated to sea water without mortality. Preadaptation at 20-30% sea water has been shown to be necessary in acclimating O. mossambicus to full strength sea water 12. This preadaptation at 30% sea water may be an important step in inducing or stimulating the mechanisms of salt extrusion and water conservation during adaptation of tilapia to sea water. In the present study, the tilapia,
O. andersoni, which is a naturally fresh water fish acclimated relatively fast to sea water. This may imply that the fish already has sea water osmoregulatory mechanisms in place.

With the exception of a study by Potts et al. on O. mossambicus there is apparently no other report on the drinking rate in tilapia. The drinking rate results in the present study compare well with those of O. mossambicus. The drinking rate in this tilapia, O. andersoni, in fresh water was relatively higher than in other fresh water fish species studied. This may be due to the influence of the higher preferred temperature (23-26°C) of O. andersoni. Moreover, it has been shown that drinking increases with the increase in temperature in a species dependent manner.

In the present study the critical salinity that caused a significant change in drinking in O. andersoni was more than 50% sea water. In addition, it appeared that at 75% sea water O. andersoni had stimulated the sea water osmoregulatory mechanisms to such an extent that at 100% sea water no further significant increase in drinking was elicited. It may, therefore, be concluded that O. andersoni is euryhaline and that its drinking rate increases significantly as the salinity is increased to 75% and 100% sea water. Furthermore, the results obtained in this study suggest that aquaculture of O. andersoni may be performed in fresh, brackish and sea waters. However, studies on the growth rates of the fish after adapting to brackish and marine environments need to be carried out to establish whether it would be economical to culture the fish in these environments.

Acknowledgments

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References


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RESPONSE OF THE MALAWI LOCAL CHICKEN TO COMMERCIAL FEED UP TO EIGHT WEEKS OF AGE

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REACTION DES POULETS LOCAUX DU MALAWI AUX ALIMENTS COMMERCIAUX JUSQU’A L’ÂGE DE HUIT SEMAINES

Résumé

Une expérience a été conduite pour comparer la croissance, l’efficience alimentaire et les caractéristiques de la carcasse des poulets locaux du Malawi (MLC), des Starbro Broilers (SB) et des Black Australorp (BA) nourris d’aliments commerciaux équilibrés à l’âge de un jour à huit semaines. Chaque traitement a été répété huit fois avec 15 poulets selon un système complètement randomisé. A l’âge de huit semaines, le poids vif des MLC (630 g) était beaucoup plus faible (P<0,05) que celui des BA (710 g) et des SB (2.192 g). Les poids de la carcasse pour les poulets MLC et BA étaient similaires, mais ces paramètres étaient beaucoup plus petits (P<0,05) par rapport à ceux des poulets SB.

La consommation alimentaire des poulets MLC (1,623 g) était fortement plus réduite (P<0,05) que celle des BA (1,776 g) et des SB (4,448 g). Cependant, la transformation des aliments des poulets SB (2.08) était nettement meilleure que celles des MLC (2.71) et des BA (2.62). Le taux de mortalité était beaucoup plus faible (P<0,05) chez les MLC comparé aux autres génotypes. Ces résultats montrent que les poulets MLC et BA sont presque similaires en ce qui concerne le poids à l’abattage et le rendement en carcasse; en revanche, ces génotypes sont inférieurs à SB pendant la période de croissance de huit semaines. Il faudrait une période de croissance de plus de huit semaines aux MLC pour avoir un poids de la carcasse acceptable. Par conséquent, il n’est pas recommandé d’utiliser les MLC comme poulets de gril dans un élevage intensif.

Abstract

An experiment was conducted to compare the growth, feed efficiency and carcass characteristics of Malawi Local Chickens (MLC), Starbro Broilers (SB) and Black Australorp (BA) when fed commercial balanced diets from day old to 8 weeks of age. Each treatment had eight replicates of 15 birds arranged in a Completely Randomised Block Design. At eight weeks of age, body weight for MLC (630g) was significantly (P < 0.05) lower than that of BA (710g) and SB birds (2.192g). Absolute dressed and carcass parts weights for MLC and BA birds were similar but these parameters were significantly (P < 0.05) inferior to those of SB birds.

Feed intake for MLC birds (1,623g) was significantly (P<0.05) lower than that of BA (1,776g) and SB birds (4,448g). However, feed conversion of SB birds (2.08) was significantly better than that of MLC (2.71) and BA birds (2.62). Mortality rate was significantly (P < 0.05) lower in MLC than the other genotypes. These results suggest that MLC and BA birds are almost similar in terms of dressed weight and carcass yields but these genotypes are inferior to SB birds within an eight-week growing period. A growing period longer than eight weeks would be required for the MLC to attain acceptable slaughter weights. The use of the MLC as a broiler breed under intensive conditions is therefore not recommended.

Introduction

The Malawi Local Chicken (MLC) is the most prevalent type of poultry kept by the majority of farmers in Malawi. Chicken meat obtained from the MLC is considered to be tastier than that from modern breeds such as the Black Australorp (BA) and Starbro (SB) broilers. Eggs from scavenging MLC are also preferred to other eggs due to the deep yellow colour of the egg yolk that probably arises from scavenging on green plants. Despite these advantages, the productivity of the MLC is inherently low resulting in low supply and availability of MLC meat and eggs. The low productivity of the MLC has been attributed to the low-input free range management conditions that prevail in a scavenging environment. Poor nutrition and below standard husbandry systems are two of the major constraints that hamper productivity.
of the MLC\textsuperscript{1,2}. Recently, it was reported that the MLC, BA and their crosses could attain weights of 2,000g when grown to twenty weeks of age under intensive conditions\textsuperscript{3}. Yet it only takes about six weeks for modern broiler breeds to attain a similar weight. In Nigeria, it was reported that the growth pattern of the indigenous fowl is different from that of improved breeds\textsuperscript{4}. Apart from the data available on growth of MLC birds from 8-20 weeks of age\textsuperscript{3}, no empirically collected data exist regarding the growth performance and carcass characteristics of MLC from 0 to 8 weeks of age. Additionally, as is practiced in other developing countries, MLC birds are never fed on commercially compounded balanced diets in Malawi. Without such empirical information, no proper evaluation can be made regarding the potential productivity of the MLC when fed balanced diets.

This experiment was therefore conducted to evaluate the growth performance and carcass characteristics of MLC birds when fed commercial balanced diets in comparison to BA and SB birds. The BA and SB breeds were chosen because they are the other two breeds commonly raised in Malawi under semi-intensive and intensive conditions respectively\textsuperscript{3}.

**Materials and Methods**

**Breed Type, Incubation and Housing**

Hatching eggs for the BA, MLC and SB birds were obtained from Bwemba Poultry Breeding Centre, University of Malawi's Bunda College Farm and a commercial breeding farm respectively. All eggs were incubated at a commercial hatchery on the same day. Upon hatching, all chicks were vaccinated against New Castle Disease, Infectious Bronchitis and Marek's Disease.

Chicks were housed in an open sided deep litter house covered with pine wood shavings. Birds underwent normal brooding procedures where the temperature was gradually reduced from 32°C at day old to 22°C at day 21. During the first two weeks of brooding, birds were subjected to a 23 hour light and 1 hour darkness regime. Birds were thereafter raised under natural daylight until the experiment was terminated.

**Feeding and Data Collection**

Feed and water were provided *ad libitum*. Birds were fed on a commercial broiler starter mash containing 22.5% crude protein (CP) and 3150 kcal ME/kg from 1-21 days of age. Broiler finisher mash containing 19% CP and 3215 kcal ME/kg was provided from 21 to 56 days of age. The feed was purchased from Bwemba Poultry Feed Mill. Micro-nutrients (vitamins, trace minerals and amino acids) were included in the diet to meet National Research Council\textsuperscript{5} recommendations meant for broilers.

The experiment was arranged as a Completely Randomised Block Design with breed types as treatments. The poultry house was divided into two parts of twelve pens each by a hallway. Each group of twelve pens constituted a block. Each treatment had one hundred and twenty birds randomly allocated to eight replicates of fifteen birds per pen (2m x 1m).

Body weight and feed intake measurements were determined at weekly intervals while morbidity and mortality were monitored on a daily basis. At eight weeks of age, sixteen birds were randomly selected from each treatment (two per pen) for determination of carcass parts yields. Before slaughter, birds were starved overnight in order to empty the intestines of any feed residues. This was done to prevent any confounding effects on body weight. Birds were killed by cervical dislocation. Birds were then bled for two minutes and scalded in hot water at 50°C for 30 seconds. Feather plucking was done manually. Carcass yield and parts yields (breast, leg plus thigh, wing) and abdominal fat were cut as reported in earlier studies. Carcass parts were cut by one person in order to maintain consistency.

**Statistical Analysis**

Data were evaluated by a One Way Analysis of Variance for the response variables using the General Linear Models (GLM) procedure of
SAS® software®. Means of the response variables between treatments resulting in a significant F test were further analysed using the Duncan’s Multiple Range Test. Unless otherwise stated, all statements of statistical significance were based on P < 0.05.

**Results**

**Body Weight, Weight Gain, Feed Utilisation and Mortality**

There were significant differences in live body weight, weight gain and mortality at the end of the experimental period (Table 1). Starbro birds had significantly (P < 0.05) higher weight gain than the other two genotypes. On the other hand, the body weight of BA birds was significantly (P < 0.05) higher than that of MLC birds. When compared on a daily basis, the weight gain for BA and MLC were similar. The percentage mortality rate of MLC birds was significantly (P < 0.05) lower than that of SB and BA birds. No differences were observed in the percentage mortality rate between SB and BA birds. The attained body weight by the different genotypes was also reflected in the amount of feed consumed. Starbro birds consumed a significantly (P < 0.05) higher amount of feed than BA and MLC birds. The cumulative feed intake (FI) of BA birds was statistically different (P < 0.05) from that of MLC birds. Starbro birds registered the best efficiency of feed utilisation (feed: gain ratio) among the three genotypes. The feed: gain ratio of BA birds was better than that of MLC birds but the difference was not significant.

**Carcass and Parts Yield**

Data on dressed weight and carcass parts yields are, presented in Table 2. Dressed weight followed a trend almost similar to body weight and weight gain for all the three genotypes. Starbro birds had significantly (P < 0.05) heavier dressed, wing, leg plus thigh, breast and abdominal fat pad weights than those of BA and MLC birds on both absolute and percent basis. Abdominal fat pad weight of BA birds was significantly (P < 0.05) higher than that of MLC birds when taken as a proportion of body weight.

### Table 1: Mean live weight, weight gain and feed utilisation of different chicken genotypes at eight weeks of age

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SB</th>
<th>BA</th>
<th>MLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live weight, g</td>
<td>2192 ± 30b</td>
<td>710 ± 15b</td>
<td>630 ± 20b</td>
</tr>
<tr>
<td>Weight gain, g</td>
<td>2142 ± 27b</td>
<td>677 ± 11b</td>
<td>599 ± 12b</td>
</tr>
<tr>
<td>Gain/day, g</td>
<td>38.25 ± 5a</td>
<td>12.09 ± 2b</td>
<td>10.70 ± 1b</td>
</tr>
<tr>
<td>Feed intake, g</td>
<td>4.448 ± 35a</td>
<td>1.776 ± 22c</td>
<td>1.623 ± 18c</td>
</tr>
<tr>
<td>Feed/day, g</td>
<td>79.42 ± 8.2a</td>
<td>31.71 ± 5.6a</td>
<td>28.98 ± 4.3a</td>
</tr>
<tr>
<td>Feed: gain, g/g</td>
<td>2.08b</td>
<td>2.62a</td>
<td>2.71a</td>
</tr>
<tr>
<td>Mortality, %; 1-56 days</td>
<td>8a</td>
<td>7a</td>
<td>2a</td>
</tr>
</tbody>
</table>

*Means (± SEM, n = 120) within a row with no common superscripts are significantly different (P < 0.05)  
*SB = Starbro; BA = Black Australorp; MLC = Malawi Local Chicken

### Table 2: Mean dressed weight, wing, leg plus thigh, breast yields and abdominal fat weight of different chicken genotypes

<table>
<thead>
<tr>
<th></th>
<th>SB</th>
<th>BA</th>
<th>MLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dressed wt, g</td>
<td>15241 ± 23b</td>
<td>318 ± 9b</td>
<td>303 ± 13b</td>
</tr>
<tr>
<td>%</td>
<td>69.52 ± 2.1a</td>
<td>44.79 ± 2.5a</td>
<td>48.09 ± 1.9b</td>
</tr>
<tr>
<td>Wing, g</td>
<td>172 ± 4.3a</td>
<td>19 ± 2.0b</td>
<td>18 ± 1.1b</td>
</tr>
<tr>
<td>%</td>
<td>11.28 ± 2.1a</td>
<td>5.97 ± 0.2a</td>
<td>5.94 ± 0.4a</td>
</tr>
<tr>
<td>Leg + Thigh, g</td>
<td>458+9.7a</td>
<td>91 ± 3.5b</td>
<td>90 ± 1.5b</td>
</tr>
<tr>
<td>%</td>
<td>30.05 ± 1.2</td>
<td>28.61 ± 1.8</td>
<td>29.70 ± 2.0</td>
</tr>
<tr>
<td>Breast, g</td>
<td>273 ± 8.1a</td>
<td>4013.7b</td>
<td>39 ± 2.3b</td>
</tr>
<tr>
<td>%</td>
<td>17.91 ± 2.1a</td>
<td>12.58 ± 1.0b</td>
<td>12.87±b</td>
</tr>
<tr>
<td>Abdominal fat pad, g</td>
<td>20 ± 2a</td>
<td>5.8 ± 0.4b</td>
<td>3.9 ± 0.1b</td>
</tr>
<tr>
<td>%</td>
<td>1.31 ± 0.1a</td>
<td>1.82 ± 5b</td>
<td>1.29 ± 0.1a</td>
</tr>
</tbody>
</table>

*Means (± SEM, n = 120) within a row with no common superscripts are significantly different (P < 0.05)  
*SB = Starbro; CB = Cobb x Cobb; BA = Black Australorp; MLC = Malawi Local Chicken
Although not significantly (P < 0.05) different, BA birds had generally higher carcass parts values than MLC birds. Only the leg plus thigh weights were similar for all the three genotypes when calculated as percent of body weight.

Discussion
The SB birds exhibited the best performance when compared to the other genotypes. This is probably due to the fact that modern broiler breeds such as SB, unlike the MLC, have been selected for fast growth and improved feed efficiency through planned selection and genetic improvement. The MLC, like many indigenous poultry breeds in the developing world, has never undergone any planned selection and genetic improvement, hence the low performance as revealed in this study. The low productivity of the MLC may be attributed to the slow growth rate and poor feed efficiency typical of unimproved breeds such as the MLC\(^1\). In this study, the MLC was only 89% and 28% of the BA and SB live body weight respectively. The weight of BA birds was only 32% of the SB. The poor growth performance and low weights of MLC birds observed in this study are in concordance with those obtained in other studies\(^2\). Another problem mitigating against improvement of the MLC is socio-cultural; only birds with a large body size are slaughtered for meat consumption. This, therefore, means that large body sized MLC chickens are selected against\(^6\). With long term selection and carefully planned genetic improvement programmes, productivity of the MLC may be improved\(^1,3\). Selection for traits such as fast growth and improved feed efficiency without compromising the hardiness and survival characteristics of MLC would be desired.

In this study, the daily feed intake and feed: gain ratio between the BA and MLC were not significantly different. It was observed during the study that the scratching behaviour and frightful nature of the MLC occasionally resulted in some feed wastage. Though negligible, feed intake and feed conversion ratios may be affected by such feed losses and should always be closely monitored and taken into consideration.

The dressed and parts yield of the SB completely surpassed those of BA and MLC. As a broiler breed, the SB was selected for fast growth and improved feed efficiency hence the superior performance. Albeit being provided with balanced diets, the eight-week carcass weights for BA and MLC birds are too low to warrant their use as broiler breeds unless sold as "baby chickens". As reported earlier\(^3\), longer growing periods extending to up to twenty weeks would be required for the MLC to attain acceptable carcass weights. However, extended growing periods imply an increase in feed costs and reduced number of batches grown per year which would adversely affect profit margins. Although BA birds had significantly (P < 0.05) higher body weight and weight gain than MLC, the absolute carcass, wing, leg plus thigh, breast and abdominal fat pad weights were similar. The differences in body weight obtained in this study may, therefore, be attributed to weights of parts such as feathers, the neck, feet and lost blood that were not determined. In an earlier study, it was shown that BA birds had significantly higher carcass and parts yields than the MLC at twenty weeks of age\(^3\). The similar carcass parts yields observed here, therefore, suggest that the growth pattern of some body parts of BA and MLC birds are similar at an early age only.

The mortality rate of the MLC was the least among the genotypes. This is further evidence of the fact that the MLC, like other indigenous chickens of the world, are harder and more resistant to the harsh environment than imported breeds such as BA and SB. This is an aspect of MLC that should be conserved.

The present results suggest that despite their adaptability to the local environment, the MLC and BA birds cannot be grown as broilers within an eight-week period. Longer growing periods of up to twenty weeks would be required for the birds to attain weights of more than 1 kg\(^1,3,9\). Improvements in BW and carcass yields of the MLC can be obtained if a rigorous
genetic selection and improvement programme can be implemented. An economic analysis of feeding balanced diets to the MLC should be conducted to evaluate whether such an undertaking would be economically viable or not. For intensive broiler production, the modern broiler breeds such as the Strabro is recommended.

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References
The growth of BA and MLC chicks was studied and the results indicated that
the MLC was more efficient than the BA in terms of weight gain per unit of feed consumed. However, the MLC chicks exhibited increased mortality, which may have contributed to the lower overall growth rate. Further studies are needed to investigate the reasons behind this observation.

In this study, the MLC chicks were found to have a significantly lower mortality rate compared to the BA chicks. This result is consistent with previous studies indicating that MLCs may be more resistant to certain diseases and environmental stressors. However, the higher mortality rate observed in the BA group highlights the need for improved management practices to minimize losses and optimize growth performance.

The nutritional requirements of BA and MLC chicks were also evaluated. The MLC chicks were found to have a higher crude protein content in their diet compared to the BA group. This may explain the improved growth rate observed in the MLC chicks. Further studies are needed to determine the optimal dietary requirements for each breed to optimize growth and minimize mortality.

The results of this study have important implications for the poultry industry, as they suggest that MLCs may be a more suitable option for commercial production due to their higher efficiency and lower mortality rate. However, further research is needed to fully understand the underlying mechanisms and develop effective management strategies to optimize growth in both breeds.

In conclusion, the MLC breed exhibited higher growth efficiency and lower mortality rate compared to the BA breed. This suggests that MLCs may be a more suitable option for commercial production. Further studies are needed to investigate the underlying mechanisms and develop effective management strategies to optimize growth and minimize mortality in both breeds.
Introduction

Les petits ruminants occupent une grande importance dans les activités agro-pastorales de la Guinée avec 280.000 exploitations pratiquant cet élevage; la moyenne d’ovin-caprin par exploitation est de 6.8. Ces animaux, de par leur taille et la facilité de leur conduite, représentent une spéculatrice intéressante au niveau des populations rurales. En effet, les investissements sont faibles ainsi que les frais de fonctionnement, la taille du troupeau est adaptable aux aliments disponibles, la commercialisation est facile à des prix rémunérateurs; la prolifcité élevée et le cycle court permettent une exploitation régulière.

Tous ces petits ruminants sont du type Djallonké; les ovins sont de petite taille dont le poids adulte varie de 25-30kg; ils sont rustiques et trypanotolérants. Tout comme les ovins, les caprins sont rustiques et résistent aux trypanosomiases et leur poids adulte dépasse rarement les 16-20kg.

Malgré l’importance et le potentiel de ces petits ruminants dans le contexte de la production animale en Guinée, la quasi-totalité de ce cheptel est élevée dans le système traditionnel où les éleveurs sont plutôt propriétaires qu’éleveurs et le système pratiqué est celui de la cueillette. Ainsi, ne bénéficiant que très peu de soins, ces animaux souffrent de fortes contraintes alimentaires et pathologiques. Ces dernières sont dominées par les nématodes gastro-intestinales, la peste des petits ruminants, les bactérioses etc..., et s’expriment par des taux de mortalité de plus de 30% et des retards de croissance.

Pour améliorer la situation, la Direction Nationale de l’Elevage déploie de gros efforts dans plusieurs directions notamment dans l’organisation de la filière et le suivi sanitaire pour une meilleure connaissance des contraintes pathologiques.

Le présent article s’inscrit dans cette voie et vise à identifier les principaux groupes de parasites rencontrés et leur variation saisonnière, afin de proposer un calendrier de traitement.

L’étude a été menée dans la préfecture de Kindia qui fait partie de la zone éco-pastorale Foutah Djallon Sud. Cette zone jouit d’un climat soudano-guinéen avec deux saisons bien distinctes; une saison pluvieuse qui va de mai à novembre et une saison sèche de décembre à avril.

Cent soixante dix ovins de race djallonké et quatre vingt dix caprins (chèvre naine guinéenne) de trois villages ont été identifiés avec des boucles auriculaires et suivis durant l’année 1995. Tous ces animaux ont été soumis mensuellement à un examen coproscopique quantitatif individuel sur cellule de Mac Master en employant la solution saturée de chlorure de sodium comme liquide de flottaison.

Figure 1: Graphique précipitations et humidité relative
Les moyennes mensuelles des précipitations et de l'humidité relevées à la station météorologique de Kindia durant la période d'étude apparaissent dans la figure 1.

Les examens coproscopiques réalisés de janvier à décembre montrent que la majorité des animaux (ovins et caprins) sont infestés par des strongles sensu lato, des coccidies (Eimeria sp) et des cestodes (Moniezia sp) avec une prévalence plus élevée des strongles. Les degrés moyens d'infestation pour les divers parasites rencontrés et exprimés en OPG (œufs par gramme de matières fécales) ainsi que les prévalences sont présentés dans les tableaux 1 et 2. Les degrés moyens d'infestation sont calculés en tenant compte des seuls animaux positifs pour ne pas trop diluer les résultats.

Les recherches parasitologiques effectuées révèlent un polyparasitisme à strongles sensu lato (Haemonchus, Oesophagostomum, Trichostrongylus, Cooperia, Gaigeria), à taenias (Moniezia sp) et coccidies (Eimeria sp) comme l'on constate d'autres auteurs avant nous²⁻⁵. Nous n'avons pas rencontré de trématodes.

Quant à la variation saisonnière, nous constatons une diminution de l'intensité de l'infestation pendant la saison sèche due probablement au phénomène d'hypobiose avec la présence de larves quiescentes⁶; par contre, l'élimination des œufs montre un pic de mai à novembre, période caractérisée par des...
température et humidité élevées favorisant ainsi le développement rapide des helminthes et coccidies. Ceci rejoint les constatations faites ailleurs 1,7,8; en Gambie, l'excrétion d'œufs de parasites par gramme de matières fécales (OPG) diminue fortement en fin de saison des pluies, reste basse durant l'essentiel de la saison sèche, puis augmente de nouveau avec l'arrivée des pluies, due à une réactivation des larves inhibées ou des adultes en phase hypométabolique appelée "rain rise"°.

 Aussi bien en saison sèche qu'en saison des pluies, les ovins ont une charge parasitaire plus importante que les caprins; ceci confirme les observations faites au Mali°, au Sénégal°, au Mozambique° contrairement à ce qui a été observé au Cameroun° et au Burundi° dans la province de Gitega. Les charges parasitaires plus élevées chez les ovins que chez les caprins peuvent être dues au fait que les chèvres exploitent davantage le pâturage ligneux tandis que les moutons préfèrent les herbagés et peuvent ainsi ingérer plus de larves infestantes°.

 Nous relevons trois périodes critiques: la première en fin saison sèche début hivernage (mai), la deuxième en fin hivernage début saison sèche (novembre) et la troisième en milieu d'hivernage (août); à toutes ces périodes il faudra intervenir avec un déparasitatin à large spectre. L'efficacité et la rentabilité économique de ce schéma de traitement restent à démontrer.

Remerciements

Cette étude a été réalisée grâce à une bourse de recherche octroyée par l'African Development Foundation (ADF); qu'elle trouve ici l'expression de ma très profonde gratitude.

J'adresse également mes remerciements à M. Amadou Badiane Diallo, technicien parasitologue, qui a collaboré dans le suivi parasitologique des animaux.

Bibliographie


Reçu pour publication le 20 juillet 1998
Table 2. Results of the Protein Purification by a 30 Layer TIRF

<table>
<thead>
<tr>
<th>Protein</th>
<th>Purity</th>
<th>O.D.</th>
<th>%</th>
<th>O.D.</th>
<th>%</th>
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<tr>
<td>Albumin</td>
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<td>0.5</td>
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<td>Fibrin</td>
<td>90%</td>
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<td>Myosin</td>
<td>85%</td>
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<td>0.5</td>
<td>0.7</td>
<td>0.5</td>
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<tr>
<td>Actin</td>
<td>80%</td>
<td>0.8</td>
<td>0.6</td>
<td>0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>Myoglobin</td>
<td>75%</td>
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<td>0.7</td>
<td>0.9</td>
<td>0.7</td>
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<tr>
<td>Collagen</td>
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<tr>
<td>Elastin</td>
<td>65%</td>
<td>1.1</td>
<td>0.9</td>
<td>1.1</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Note: The results are expressed as percentage purity (%).
REPRODUCTIVE PERFORMANCE OF COWS IN SETTLED CATTLE HERDS IN ZARIA, NIGERIA

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²National Animal Reproduction Research Institute, Shika, Ahmadu Bello University, Zaria, Nigeria

The productivity of Nigerian cattle under the traditional management system is low¹,². The emergence of settled cattle herds in Zaria with different management systems may have improvement the productivity of cattle. Four settled cattle herds (A, B, C and D) were studied using farm records of a 15-year period (1980-1994). The breed distribution, age at first calving (AFC), calving interval (CI), calf birth weight (CBW), reproductive problems (RP), calf mortality (CM) and effect of management were examined.

Zaria is located at latitude 11°08’N and at an altitude of 686 metres above sea level. Its annual rainfall, average temperature and mean relative humidity are 1055 millimetres, 24.55°C and 43.6% respectively. The farms had similar herd structure consisting of cows, bulls and calves. Cattle source was on-farm breeding but in farm B, bull-calves were also purchased from markets for fattening. Except for farm A where calves were separated from their dams in the first week of life and bucket-fed, weaning was by natural means. The milk from cows was sold except in farm B. The care of farms A and B was by owners and hired labour, farms C and D by hired labour only. Farms A and B had regular veterinary care (de-worming, ectoparasite control, vaccination, routine visits). Salt-licks and water were provided ad libitum. Hay or silage supplemented with 3.5kg/day mixture of undelinted cottonseed cake, maize or guinea-corn was fed to cattle in the dry season in farm A. Farm B had supplementation at no specific amount to only the needy animals. Housing in farms A and B was open-fenced, concreted floors and had regular cleaning. Culling was practiced. Farms C and D had occasional veterinary care and salt-licks. Water was provided twice daily. No supplementation was given in the dry season. Housing was open, non-concreted floor and cleaning occasional. Only sick animals were culled.

Breed differences in AFC and CI within farms and effect of management on AFC and CI among farms were tested by the one-way and two-way analysis of variance (ANOVA) respectively. Breed and farm prevalences on RP were subjected to Odds ratio test. CM among farms were subjected to Chi-square (χ²) test. Table 1 shows reproductive performance indices according to breed and farms. The breeds obtained were Bunaji, Friesian-Bunaji, Sokoto Gudali, Mixed, with the first two predominating. A slightly higher AFC (45.9 ± 5.7 months) than average of 44 months for Bos indicus in the tropics³ was recorded. This AFC is lower than figures reported for cattle under traditional management system² but higher than AFC desirable for efficient cattle production. AFC and CI differed significantly (P<0.05) among breeds agreeing with other reports⁴. The Bunaji in this study has a lower AFC (44.9 ± 0.5 Vs 62.5 months) than that reported by other workers⁵ in the same zone. The Friesian-Bunaji reported to calve earlier than Bos indicus in the tropics³ had the highest AFC. Their higher vulnerability to nutritional and management stresses than indigenous breeds may account for this. The CI obtained
Table 1: Reproductive performance indices in settled cattle herds in Zaria according to breed and farm

<table>
<thead>
<tr>
<th>Parameter</th>
<th>No. of animals</th>
<th>AFC ± S.D (m)</th>
<th>CI ± S.D (m)</th>
<th>CBW ± S.D (m)</th>
<th>Inf %</th>
<th>Abo %</th>
<th>Stb %</th>
<th>Dys %</th>
<th>Rpl %</th>
<th>TL %</th>
<th>CM %</th>
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</thead>
<tbody>
<tr>
<td>(A) Breed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friesian-Bunaji</td>
<td>350</td>
<td>46.8 ± 0.5a</td>
<td>15.3 ± 4.0b</td>
<td>20.2 ± 0.3a</td>
<td>3.7</td>
<td>1.7</td>
<td>0.6</td>
<td>0.0</td>
<td>0.0</td>
<td>6.0</td>
<td>-</td>
</tr>
<tr>
<td>Bunaji</td>
<td>358</td>
<td>44.9 ± 0.5c</td>
<td>16.1 ± 4.2a</td>
<td>17.4 ± 0.5c</td>
<td>0.8</td>
<td>2.8</td>
<td>1.4</td>
<td>0.3</td>
<td>0.0</td>
<td>5.4</td>
<td>-</td>
</tr>
<tr>
<td>Sokoto Gudali</td>
<td>48</td>
<td>43.5 ± 6.3c</td>
<td>16.4 ± 3.5c</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.1</td>
<td>2.1</td>
<td>-</td>
</tr>
<tr>
<td>Mixed</td>
<td>20</td>
<td>42.0 ± 7.8c</td>
<td>18.4 ± 0.4c</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>*45.9 ± 5.7</td>
<td>15.8 ± 0.3</td>
<td>20.2 ± 0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(B) Farm</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>A</td>
<td>408</td>
<td>47.4 ± 11.5a</td>
<td>15.5 ± 4.0a</td>
<td>20.2 ± 0.3</td>
<td>4.2</td>
<td>2.9</td>
<td>1.0</td>
<td>0.0</td>
<td>0.0</td>
<td>8.1</td>
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<tr>
<td>B</td>
<td>258</td>
<td>44.1 ± 6.8a</td>
<td>16.0 ± 3.4a</td>
<td>-</td>
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<td>0.0</td>
<td>0.4</td>
<td>0.4</td>
<td>0.0</td>
<td>1.9</td>
<td>19.3</td>
</tr>
<tr>
<td>C</td>
<td>44</td>
<td>43.0 ± 6.2a</td>
<td>16.3 ± 4.0a</td>
<td>-</td>
<td>0.0</td>
<td>2.0</td>
<td>2.3</td>
<td>0.0</td>
<td>0.0</td>
<td>4.5</td>
<td>46.7</td>
</tr>
<tr>
<td>D</td>
<td>61</td>
<td>45.2 ± 7.4a</td>
<td>16.6 ± 4.1a</td>
<td>-</td>
<td>0.0</td>
<td>1.6</td>
<td>1.6</td>
<td>0.1</td>
<td>0.1</td>
<td>3.5</td>
<td>43.7</td>
</tr>
</tbody>
</table>

S.D: Standard deviation
* Overall value of indices
a,b,c: Superscripts in a column where different indicate significant difference (P < 0.05)
Inf: Infertility
Abo: Abortion
Stb: Still birth
Dys: Dystocia
Rpl: Retained placenta
TL: Total
%: Prevalence
m: Months

(15.8 ± 0.3 months) falls within the range of 12.2-26.6 months for cattle in the tropics\textsuperscript{3,6}. This is higher than 15.3 months considered as unsatisfactory for Zebu\textsuperscript{7}. CI differed significantly (P < 0.05) among breeds as reported by others\textsuperscript{8}. The Mixed breed had the longest CI (18.4 ± 0.4 months). Crossbreeding has been reported to affect CI\textsuperscript{9}. Contrary to the report that Friesian-Bunaji has shorter CI than the Bunaji\textsuperscript{10}, there was no significant difference in their CI. A lower CI for Bunaji than reported by others\textsuperscript{6} was obtained in this study (16.1 ± 4.2 Vs 22.5 months). This may reflect differences in management practices. Only farm A had information on CBW. CBW obtained (20.2 ± 0.3 kg) is lower than figures for temperate countries. Friesian-Bunaji calves had a slightly higher CBW than Bunaji calves (20.2 Vs 17.4). Management did not have significant effect on AFC and CI among farms studied. This may be because, nutrition, the most important factor which affects reproductive performance of indigenous cattle\textsuperscript{11} did not differ significantly among farms.

The RP recorded were infertility, abortion, stillbirth, dystocia and retained placenta. A low prevalence (5.5%) compared with figures reported elsewhere\textsuperscript{12} is recorded. The highest prevalence of RP in Friesian-Bunaji (6.0%) may be associated with breed factor\textsuperscript{13}. A high CM (33.3%) recorded in this study no doubt constitutes a substantial economic loss. A lower
figure (4.5%) has been reported for Fulani herds\textsuperscript{14}. CM greater than 15% is to attract serious attention for intervention\textsuperscript{15}.

The results of this study indicate a limited potential of cattle in settled herds towards improved cattle productivity in Nigeria.

Acknowledgments
We are grateful to Drs. E.I. Amber and A.K. Sackey for their contributions and to Ahmadu Bello University, Zaria for supporting this work with grant.

References

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(19.8 ± 4.5 months) falls within the range of 12-26 months for cattle in the tropics. This is higher than 15.3 months considered as unsatisfactory for Zebu. Cl differed significantly (P < 0.01) among breeds as reported by others (2). The Maasai breed had the longest Cl (44.4 ± 4.4 months). Crossbreeding has been reported to affect Cl. Contrary to the report that Friesian--Bunala had shorter Cl than the Bunala (7), there was no significant difference in their Cl. A lower Cl for Buna--Beja--Sawu reported by others was obtained in the study (6.5 ± 2.2 wks 20.8 months). This may reflect differences in management practices. Data from A had no information on CBW. CBW observed (80.2 ± 0.3 kg) is lower than figures for temperate countries. Friesian--Bunala, slaves, had a significantly higher CBW than Bunala calves (20.2 kg; 17.3). Management did not have significant effect on AFC and CI among breeds studied. This may be because, nutrition, the most important factor which affects reproductive performance of indigenous cattle, did not differ significantly among breeds.

The RF recorded were infertility, abortion, stillbirth, dystocia, and retained placenta. A low prevalence (5.5%) compared with figures reported elsewhere (10) is recorded. The highest prevalence of RF in Friesian--Bunala (10.0%) may be associated with breed factors (10). A high CM (68.5%) recorded in the study is doubtless due to substantial occurrences. A lower
SHORT COMMUNICATION

PATHOGENICITY OF SALMONELLA ENTERITIDIS ISOLATES ISOLATED FROM TABLE EGGS AND CHICKEN CARCASSES IN ZAMBIA

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²Norwegian College of Veterinary Medicine, Department of Pharmacology, Microbiology and Food Hygiene, P.O. Box 8146, N-0033 Oslo, Norway

Salmonella enteritidis is an important human pathogen, which has been isolated in Zambia from table eggs and chicken carcasses for human consumption¹. It predominates in human salmonellosis in countries found both in the northern and southern hemispheres³.

Even though Salmonella enteritidis is an important pathogen, considerable variations have been observed on how it causes infections in different animal models. Differences have been observed in virulence comparative studies⁴. The present paper reports the result of pathogenicity studies conducted on Salmonella enteritidis isolates from table eggs and chicken carcasses in Zambia.

Twenty-seven Salmonella enteritidis isolates isolated from table eggs and chicken carcasses were subjected to pathogenicity tests using mice and seven days old Arbo acre chicks. Of these 27 isolates, 18 were obtained from chicken carcasses while 9 were from the egg yolk of table eggs.

The Minimum lethal dose was first determined before proceeding with the mice and chick inoculations.

5 weeks old mice weighing approximately 20 g were used. The mice were inoculated intraperitoneally with 0.1ml broth culture (5.6 x 10⁷ colony forming units/ml, c.f.u). Five mice were used for each isolate. These were caged accordingly and were fed on an autoclaved feed. Food and water were supplied ad libitum. All mice were observed daily for death. Specimens of liver, spleen and blood were taken from dead mice using aseptic techniques and cultured for Salmonella using standard pre-enrichment, enrichment and plating techniques. The experiment was terminated after 3 weeks when all the mice remaining alive were euthanised with chloroform and incinerated.

Seven days old specific pathogen free Arbo acre chicks from the Central veterinary research Institute, Lusaka were used. Chicks were divided at random into groups of 5. The birds were inoculated intraperitoneally with 0.2ml of the culture broth containing 10⁶ c.f.u./ml. Each group of chicks was housed in separate compartments after inoculation. Autoclaved feed and water were provided ad libitum. The chicks were observed twice a day for clinical signs and mortality. Bacteriological cultures of liver, spleen, heart, caeca and blood were made from dead chicks and examined as described in the mice experiment. All birds remaining viable two weeks after infection were euthanised using carbon dioxide and then incinerated.

The Salmonella status of mice and chicks was tested, by direct culturing of faecal samples in selenite broth followed by selective plating before proceeding with the experiment. Only Salmonella free animals were used for this test.

The enteritidis isolates were remarkably different in the virulence pattern. In the whole experiment, mice inoculated with Salmonella enteritidis isolates from table eggs caused significant mortalities as compared to isolates from chicken carcasses. The mean percent mortality with Salmonella enteritidis in mice from table eggs and chicken carcasses was 64.4 and 7.78 respectively. All the 9 isolates
from the egg yolk of table eggs caused mortalities, compared to only 3 isolates out of 18 from chicken carcasses.

**Table 1:** Virulence of *Salmonella enteritidis* isolated from chicken carcasses in mice and chicks respectively

<table>
<thead>
<tr>
<th><em>Salmonella enteritidis</em> Ref No.</th>
<th>Mice</th>
<th>Chickes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of Deaths</td>
<td>Mortality (%)</td>
<td>No of Deaths</td>
</tr>
<tr>
<td>10 (RT)</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>17 (PT4)</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>18 (PT4)</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>

Note: 5 mice were inoculated for each isolate.

All the 18 isolates from chicken carcasses numbered 1 to 18 were used, but only Isolate 10, 17 and 18 caused mortalities in mice but none in chicks (Table 1).

The mice that died were culture positive for *Salmonella enteritidis*.

**Table 2:** Virulence pattern of *Salmonella enteritidis* PT4 isolated from table eggs in mice and chicks respectively

<table>
<thead>
<tr>
<th><em>Salmonella enteritidis</em> Isolate No.</th>
<th>Mice</th>
<th>Chickes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of Deaths</td>
<td>Mortality (%)</td>
<td>No of Deaths</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
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<tr>
<td>3</td>
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<tr>
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<td>60</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>60</td>
</tr>
</tbody>
</table>

Note: 5 mice and chicks were inoculated for each isolate

*Salmonella enteritidis* isolates from the chicken carcasses did not cause mortality, while *Salmonella enteritidis* phage type 4 isolates from the table eggs caused mortalities in seven-day-old chicks. The mean per cent mortality was 15.56% in chicks for isolates from table eggs. The results are shown in Table 2. All chicks that died following inoculation of table egg isolates were culture positive for *Salmonella enteritidis*.

Significant differences in virulence of *Salmonella enteritidis* for mice and chicks were observed. *Salmonella enteritidis* isolates from the table eggs were more virulent than isolates from chicken carcasses. Three isolates from chicken carcasses (two *Salmonella enteritidis* phage type 4 and one rough type isolate) caused mortalities, though with variable results. The mean mortality was 64.4% and 7.78% in mice respectively for isolates from table eggs and chicken carcasses. Field reports have often linked *Salmonella enteritidis* phage type 4 with high levels of morbidity and mortality in British broiler flocks5,6, whereas many experimental evaluations of *Salmonella enteritidis* phage type 4 isolates have failed to reveal evidence of significant pathogenicity7. These observations suggest that there may be variations in the virulence of *Salmonella enteritidis* isolates both between and within phage types. Our study confirms findings of other workers7-9. Considerable range of virulence capabilities can exist within a particular phage type.

Under the present experimental work, variation in the pathogenicity of *Salmonella enteritidis* phage type 4 isolates from chicken carcasses and table eggs can not be well explained.

**Acknowledgments**

We are grateful to the Norwegian University Fund (NUFU) for the financial support of the research project. Thanks are also due to Mr. Don Mule, Microbiology laboratory for the technical assistance.
Pathogenicity of salmonella enteritidis isolates isolated from table eggs and chicken carcasses in Zambia

References


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<table>
<thead>
<tr>
<th>Year</th>
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<th>Source</th>
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<th>No. of Resistant</th>
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</tr>
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<td>Amana</td>
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All the 14 isolates tested showed lysis to temperate 1 in 14 strains. All strains isolated from egg and chicken embryos were tested against standard Salmonella enteritidis. The results showed that 80% of the strains were resistant to gentamicin. The strain that died were cultured positive for Salmonella enteritidis.

Table 3: Virulence pattern of Salmonella enteritidis NT4, isolated from table eggs, in vivo and in vitro respectively.

The flies from infected eggs were cultured positive for Salmonella enteritidis. The flies isolated from chicken eggs were cultured positive for Salmonella enteritidis.

Acknowledgments
We are grateful to the Norwegian University Hand (NUFU) for the financial support of the research project. Thanks are also due to Mr. Ole Ståle, Microbiology laboratory for his technical assistance.
SHORT COMMUNICATION

ESCHERICHIA COLI 053: K+ EXTRAINTESTINAL OUTBREAKS IN LAYING FLOCKS IN NSUKKA, SOUTH-EAST NIGERIA

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Department of Veterinary Pathology and Microbiology
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Escherichia coli are gram-negative bacilli considered part of normal flora of man and animals. Although most strains are non-pathogenic, few serogroups are known to be associated with extraintestinal infections in avian species\textsuperscript{1,2}. These extraintestinal colibacillosis in chickens include pericarditis, perirehepatitis, air sacculitis, egg peritonitis and sappingilitis\textsuperscript{2,3}. These infections often cause great economic losses due to high morbidity and mortality especially in chicks and reduction in egg production in laying birds. Escherichia coli serogroups frequently isolated from cases of extraintestinal colibacillosis in chickens include 01, 02, 035, 036 and 078\textsuperscript{2,4}. Strains of E. coli belonging to Serogroup 053 were first isolated from cases of colisepcticaemia in chicken in Britain\textsuperscript{4}. Recently strains of E. coli belonging to this serogroup were recovered in Spain from chickens with colisepcticaemia and these E. coli strains were shown to be highly pathogenic for chickens\textsuperscript{5}. This paper reports, probably for the first time, on E. coli 053:K\textsuperscript{+} associated with outbreak incidents of extraintestinal infections in laying flocks in Nigeria.

Between 1995 and 1997, five major outbreak incidents of extraintestinal infections were recorded in five different farms inNsukka, South-East Nigeria. All the outbreaks occurred in laying flocks (Lohmann Brown or Harco Breeds) and were characterized by a 10-35 % drop in egg production, 5-20% mortality, cough and drop in feed consumption. The birds were reported to have received all the approved vaccinations. Dead as well as moribund birds were submitted to the Department of Vet Path/ microb. (University of Nigeria, Nsukka) for pathobacteriological examination. Postmortem examination of the birds revealed hydropericardium, enlarged liver, with necrotic foci, air sacculitis, enlarged oviducts with shelled eggs covered by caseous exudate and the peritoneal fluid was mixed with yolk. Samples were taken from the pericardium, liver, air sacs, peritoneal exudate and the oviducts and cultured on blood agar and MacConkey agar plates. Isolates obtained were biochemically identified in our laboratory. Antibiogram of the isolates was determined by the disc diffusion method\textsuperscript{6}. Full serotyping of strains from five of the outbreaks was done at the Central Veterinary Laboratory, England.

Pure cultures of lactose fermenting organisms were obtained from all cultured organs in each of the five major outbreaks. These isolates were biochemically identified as E. coli and they all belonged to E. coli 053: K\textsuperscript{+} serotype. All the strains of this serotype were sensitive only to furazolidone (100mg) but resistant to streptomycin (10mg), tetracycline (100mg), chloramphenicol (30mg) and sulfamethoxazole-trimethoprim (25mg). Treatment of affected flocks with furazolidone alone or with combination of erythromycin, oxytetracycline and furaltadone alleviated the disease condition in only two of the five farms.

This is probably the first time E. coli 053:K\textsuperscript{+} is reported from chickens in Nigeria. Since strains of E. coli belonging to this serogroup have recently been reported from cases of colisepcticaemia in chickens\textsuperscript{5} it is possible that this is an emerging pathogenic E. coli serogroup for chickens.

However, this speculation needs to be supported by results of experimental infection of chickens with this E. coli serotype.
Primary respiratory infection with viruses such as Newcastle disease virus and infectious Bronchitis virus and bacterial pathogen like Mycoplasma gallisepticum have been reported to predispose chickens to secondary infections with E. coli. Since medication of diseased flocks with furazolidone alone or in combination with other antimicrobial agents was ineffective in three of the outbreaks, a possibility exists that the outbreak incidents were secondary to primary respiratory infections.

Considering the fact that antimicrobial agents especially tetracycline are used routinely and extensively in the poultry industry in Nigeria, both therapeutically and as feed additive, it is probable that E. coli 053:K+ is a survival strain that acquired drug resistance. These multiple drug resistant strains of E. coli may be capable of transferring their resistances to other bacterial organisms such as Salmonella species. Hence the prevalence of this multiple drug resistant E. coli serotype in poultry farms is of great epidemiological, economic and public health significance. We are not certain of the sources and mode of spread of the outbreaks since affected farms obtained day-old chicks and feed from different local producers.

This present report and that of Blanco et al.1 call for further investigations on the role of E. coli 053:K+ in avian colibacillosis.

Acknowledgments
We thank the Central Veterinary Laboratory (CVL), England for serotyping the E. coli isolates. We are grateful to the Director and Mr. Henry Mather of the Scottish Salmonella reference Laboratory, Stobhill, Glasgow for submitting the cultures to on our behalf. We also thank Prof. I.U Asuzu of the Department of Veterinary Physiology and Pharmacology, University of Nigeria, Nsukka for carrying the packaged cultures to Glasgow.

References

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SHORT COMMUNICATION

COMPARATIVE EFFICACIES OF LEVAMISOLE, IVERMECTIN, RAFOXANLDE AND BENZIMIDAZOLES AGAINST NATURAL NEMATODE INFECTIONS OF SMALL RUMINANTS IN CENTRAL KENYA

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Gastrointestinal (GI) nematode parasitism is the major animal health problem facing the sheep and goat industry in Kenya1. The industry is based predominantly on a year round grazing of pastures on which infective nematode larvae are always potentially available, albeit with seasonal fluctuations dependent mainly on rainfall.

*Haemonchus contortus* is regarded as the most economically important nematode parasite of small ruminants in Kenya2.3. The species causes the death of large numbers of animals, reduction in weight gain and increased susceptibility to other illnesses. Owing to favourable climatic conditions and because grazing management involving "clean" pastures is usually not practical, control of nematode infections in Kenya is solely based on the frequent use of anthelmintics at short intervals. The high frequency of treatment is attended by a high risk of rapid selection for anthelmintic resistance (AR), especially in *H. contortus* 4.5.

The present study was planned to evaluate the comparative efficacies of four groups of anthelmintics against naturally acquired nematode infections of sheep and goats in central Kenya.

The investigation was carried out using mainly indigenous mixed breeds of sheep and goats reared and kept on privately managed farms in Lari Division, Kiambu District and Kipipiri Division, Nyandarua District over the period between September to November 1996. The animals had been treated with thiabendazole, fenbendazole, albendazole (ALB) and levamisole (LEV) plus oxydiazon combination at one time or another during the previous 5 years.

Five sheep and 4 goat farms were identified. On each farm the animals selected for the trials (those not drenched during the previous 6 weeks) were identified by ear tags and weighed before being randomly assigned to treatment and control groups of 10-20 animals of both sexes and age ranging from 6 to 18 months. They were treated according to the manufacturer's recommendations except goats which were treated with LEV received twice the sheep dose. All animals in a given group received a constant dose based on the heaviest animal in the group. The following anthelmintics were used. LEV1 (NilvermR-Cooper Kenya Ltd., Nairobi), 7.5 mg kg⁻¹; ALB (ValbazenR-Smithkline, Beecham, UK), 5 mg kg⁻¹; rafoxanine (RAF) (RanoxR-Smithkline, Beecham, UK), 7.5 mg kg⁻¹; LEV2 (DeworminR-Pharma and Horticultural inputs Ltd. Nairobi, Kenya), 7.5 mg kg⁻¹; IVM (OramecR-Merrick and Co. inc., NJ), 0.2 mg kg⁻¹; mebendazole (MBZ) and LEV (Nematuff-PR-Pharmaceuticals Ltd., Nairobi, Kenya), 3ml 10 kg⁻¹ (15 mg kg⁻¹ MBZ, 7.5 mg kg⁻¹ LEV). RAF and LEV (MultidoseR-Univet Ltd., Tullyvin, Cavan, Ireland), 5 ml 15 kg⁻¹ (11.25 mg

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kg\(^1\) plus 7.5 mg kg\(^1\)). All the drugs were administered orally using separate calibrated syringes.

Faecal samples were collected per rectum at the time of treatment (Day 0) and again 14 days post-treatment. Faecal egg counts (FEC's) were done by the modified McMaster technique\(^6\) sensitive to 100 eggs gram\(^1\) of faeces (epg). Larval cultures were undertaken on bulked faecal samples from each group at days 0 and 14 and third stage infective larvae (L3) extracted following the Baermann method\(^7\). A minimum of 100 L3 were differentiated in each culture according to morphological features\(^8\). Arithmetic mean pre- and post-treatment FEC's of control and treatment groups were used to calculate the percentage efficacy\(^9\). Resistance was deemed to be present when less than 95 % reduction of the mean egg counts of the treated group compared with the untreated occurred and the lower 95 % confidence limit was less than or equal to 90%\(^{10,11}\).

The faecal egg count reductions (FECR's) for the sheep and goat farms are summarized in Tables 1 and 2, respectively. The mean pre-treatment epg on different sheep farms varied between 233 and 3267 and 500 and 3233 for goat farms. The results indicated that oral IVM was 100% effective against GI nematodes of sheep and goat examined.

A FECR of > 95% was observed with ALB, LEVI, MBZ/LEV and RAF/LEV combinations on all sheep and 3 goat farms. At OM farm, there were 88.6%, 92.2%, 94.8% and 90.4% reductions in the mean FEC's of goats treated with ALB, LEVI, MBZ/LEV and RAF/LEV combinations, respectively (Table 2).

The reduction of FEC's of sheep treated with RAF varied from 90.8% to 98.5% and 77.5% to 95.9% for goats when compared with the untreated groups. The FECR's by LEV2 varied within and between the sheep and goat farms. In most cases, the post-treatment epg was higher than the pre-treatment epg indicating the lack of efficacy of this compound.

Faecal cultures showed that L3 were composed of three types of nematodes, namely H. contortus, Trichostrongylus spp. and Oesophagostomum spp. In both sheep and goats the predominant nematode parasite L3 encountered were H. contortus, with the average proportion of H. contortus on Day 0 being around 74% with a range of 53 to 91% for both sheep and goats.

The observed high efficacy of LEVI, ALB, RAF plus LEV and MBZ plus LEV against GI nematodes have been reported by others\(^{12,13}\). However, the highest efficacy was observed with IVM as the faeces of IVM treated groups of sheep and goats did not reveal any parasite eggs on Day 14 post-treatment. These results are broadly in agreement with Helle\(^{14}\), Doganay\(^{15}\) and Ponikarov\(^{16}\). IVM is one of the most expensive anthelmintic on the market and in a recent survey in Kenya, not a single farmer was found to be using IVM\(^{17}\). Thus, the reported high efficacy (100%) in all sheep and goat farms is not surprising.

Levamisole (LEV) is at present the most widely used anthelmintic in Kenya, and it is sold under at least 12 trade names by different manufacturers. Some of the cheap brands (e.g. LEV2) are substandard products which have been shown to have no anthelmintic efficacy\(^{17}\). While such products have no impact on AR, farmers will lose faith in chemotherapy and at worst, face disastrous stock losses\(^{18}\).

Resistance was observed with RAF in one sheep (WM) and 3 goat farms (KK, MM, OM). It is a narrow spectrum antelmintic effective against blood sucking (H. contortus) nematodes\(^{19,20}\). This resistance may be attributed to the use of LEV or benzimidazoles (BZs) in a combination product with a flucliclide (salicylanilide) such as RAF over the previous years.

The mean epg counts in goats at OM farm, treated with LEVI, ALB, RAF plus LEV and MBZ plus LEV were reduced by <95% on Day 14 post-treatment. The use of MBZ plus LEV combination resulted in a relative increase in FECR to 94.8 % which was encouraging but still did not exceed the 95 % reduction. This was consistent with published evidence for improved
### Table 1: Sheep farm survey in central Kenya: results of FCR tests with hemimidazoles and noo henzimidazole anthelmintics

<table>
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*ALB, albendazole; RAF, rafoxanide; IVM, oral ivermectin; LEV1, levamisole (Niverm®); LEV2, levamisole (Dewormin®); MBZ & LEV, mebendazole & levamisole; RAF & LEV, rafoxanide & levamisole.

*H. Haemonchus contortus; T. Trichostrongylus spp.; O. Oesophagostomum spp.

*PR% (FCR%) = \(1 - \frac{T(E_{13,10} + C)}{E_{13} + C}\) X 100 where T is treated, C is control, 1 is pre- and 2 is post-treatment arithmetic mean of epg(15). DLower 95% Confidence Limit. *No Larvae.
Table 2: Goat farm survey in central Kenya: results of FECR tests with benzimidazoles and non-benzimidazole anthelmintics

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<td></td>
<td>MBZ &amp; LEV</td>
<td>1900 70 20 10</td>
<td>77 100 0 0</td>
<td>94.8 76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAF &amp; LEV</td>
<td>1125 72 16 12</td>
<td>85 78 22 0</td>
<td>90.4 70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CONTROL</td>
<td>2260 69 19 12</td>
<td>1775 72 17 11</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

*ALB, albendazole; RAF, rafoxanide; IVM, oral ivermectin; LEVI, levamisole (Nileverm<sup>b</sup>); LEV2, levamisole (Dewormin<sup>b</sup>); MBZ & LEV, mebendazole & levamisole; RAF & LEV, rafoxanide & levamisole.

<sup>a</sup>H, Haemonchus contortus; T, Trichostrongylus spp.; O, Oesophagostomum spp.

<sup>b</sup>PR% (FECR%) = 1 - (T<sub>T</sub>/T<sub>T</sub> + C<sub>C</sub> X 100 where T is treated, C is control, 1 is pre- and 2 is post-treatment arithmetic mean of epg(15). DLower 95% Confidence Limit. *No Larvae.
efficacy of combinations of BZs, LEV and IVM against sheep nematodes resistant to either or both of these anthelmintic groups. Where there is no resistant to combinations, the incorporation of this type of anthelmintic into treatment programmes, rather than simply a BZ or LEV, should be encouraged.

There appear to be several reasons for the high prevalence of resistant nematodes in goats at OM farm. First, the prevailing climatic conditions maintain a virtually continuous cycle of infection between the host and the pasture. In addition, goats have a poor ability to regulate GI nematode infections and this ability is largely unaffected by age or previous experience. Thus, goats of all ages require frequent anthelmintic treatments during the whole year to reduce losses. However, this may lead to the rapid development of resistance as shown at OM farm.

Selection for resistant worms may also be enhanced by using a sub-therapeutic level of an anthelmintic. The most frequent cause of underdosing is probably incorrect guessing of the weights of animals, such guessing being the usual practice in Kenya. In addition, the limited bioavailability of BZs and LEV in goats may result in ineffective levels if they are administered at the doses recommended for sheep. It has therefore been suggested that goats should be treated at one and a half or twice the dose rates recommended for sheep.

Acknowledgments
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References


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SHORT COMMUNICATION

EVALUATION OF THREE BREEDS OF RABBITS FOR LITTER CHARACTERISTICS IN SOUTH-WEST NIGERIA

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In recent years, there has been a growing awareness of the advantages of rabbit meat production in developing countries as a means of alleviating food shortages\(^1\). This is largely attributable to the rabbit’s high genetic selection potential, efficient feed and land space utilization and high quality nutritious meat\(^2\). Despite these promising potentials, the productivity levels of rabbit breeds is much lower in the tropics than in the temperate region\(^3\). For instance, in the humid tropics about 3 to 5 litters per doe per year have been recorded\(^4,5\). In the temperate region, it was reported that rabbit raisers wean 60 offspring from 8 litters per doe annually\(^5\).

Limited information is available on the comparative productivity levels of these rabbit breeds in the humid tropics. This study examined fertility and litter performance of three breeds of rabbits under the humid tropical conditions of South-Western Nigeria.

Data on 384 litters comprising 254 New Zealand White (NZW), 78 Chinchilla (CHS) and 52 Californian White (CAL) breeds of rabbits were used for this study. The data were collected at the Rabbit Unit, Obafemi Awolowo University Ile-Ife, over a period of 3 years. All the rabbits were housed individually in wire cages and fed pelleted concentrate rations and fresh forages ad-libitum. Routine management was followed through mating, gestation, kindling and weaning of kids at 4 weeks of age. Does were remated thereafter. Data were collected on fertility and litter traits at kindling and at weaning. Data were analysed using the GLM Procedure of SAS\(^6\). Breed group means for each variable effect were compared using the Least Squares Procedure and Duncan option of the same software\(^8\).

Results

Table 1 shows the least squares means for number of matings to conception (NMC), litter size at birth (LSB), litter birth weight (LBW), litter size at weaning (LSW), litter weaning weight (LWW) and kindling interval (KI). For NMC, the NZW breed recorded the lowest mean value (P < 0.05) while there was no difference between CAL and CHS breeds (P > 0.05). Significant seasonal variation in NMC for all three breeds was observed (P < 0.05). In terms of prolificacy, the NZW breed recorded the largest LSB (P < 0.05) while the performance of CAL and CHS were comparable (P > 0.05). Least squares means for LBW followed the same pattern as LSB. At weaning however, CAL litters were heaviest while there was no marked difference between NZW and CHS litters (P > 0.05). NZW does had the shortest mean KI (P < 0.05) while there was no difference between CAL and CHS breeds (P > 0.05). Significant seasonal variations in KI for all does was observed, with higher values recorded during the dry season (P < 0.05).

Breed differences in NMC as observed in the present study are consistent with reports in the literature\(^4,5,7\). The superior performance of the NZW breed in NMC could be attributed to a higher degree of fertility displayed by this breed. It could also be a reflection of its high adaptability to tropical conditions\(^8\). However, seasonal variation in NMC as observed in the present study shows that all does, irrespective of breed groups, were more fertile during the rainy season. This depression in fertility observed in the dry season could be attributed to high ambient temperature (> 32\(^\circ\)C) common during
Table 1: Least-squares means of number of matings to conception and litter traits for three breeds of rabbits in two seasons

<table>
<thead>
<tr>
<th>Trait</th>
<th>NZW</th>
<th>CAL</th>
<th>CHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMC</td>
<td>Overall</td>
<td>1.86 ± 0.04ab (254)</td>
<td>2.14 ± 0.10a (52)</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>2.18 ± 0.07a (88)</td>
<td>2.68 ± 0.11ab (19)</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>1.54 ± 0.05ab (166)</td>
<td>1.61 ± 0.12ab (33)</td>
</tr>
<tr>
<td>LSB</td>
<td>Overall</td>
<td>5.33 ± 0.11a (254)</td>
<td>4.70 ± 0.25a (52)</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>5.24±0.19b (23)</td>
<td>4.37 ± 0.40b (19)</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>5.42 ± 0.14ab (166)</td>
<td>5.03 ± 0.30a (33)</td>
</tr>
<tr>
<td>LBW</td>
<td>Overall</td>
<td>0.19 ± 0.01ab (254)</td>
<td>0.15 ± 0.01a (52)</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>0.18 ± 0.01ab (88)</td>
<td>0.18 ± 0.02ab (19)</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>0.19 ± 0.01ab (166)</td>
<td>0.13 ± 0.02a (33)</td>
</tr>
<tr>
<td>LSW</td>
<td>Overall</td>
<td>3.31 ± 0.10a (195)</td>
<td>3.71 ± 0.23a (39)</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>3.10 ± 0.17c (62)</td>
<td>3.50 ± 0.36c (14)</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>3.53 ± 0.12b (133)</td>
<td>3.92 ± 0.26a (25)</td>
</tr>
<tr>
<td>LWW</td>
<td>Overall</td>
<td>0.56 ± 0.03a (195)</td>
<td>0.76 ± 0.09b (39)</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>0.43 ± 0.01d (62)</td>
<td>0.76 ± 0.20b (14)</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>0.70 ± 0.04g (133)</td>
<td>0.76 ± 0.05g (25)</td>
</tr>
<tr>
<td>KL</td>
<td>Overall</td>
<td>72.45 ± 0.47b (195)</td>
<td>83.26 ± 1.02c (39)</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>79.26 ± 0.78b (62)</td>
<td>92.70 ± 1.04b (14)</td>
</tr>
<tr>
<td></td>
<td>Rain</td>
<td>65.65 ± 0.53b (133)</td>
<td>73.80 ± 1.22b (25)</td>
</tr>
</tbody>
</table>

Figures in parenthesis represent total number of observations used in computation.
Means along the same row with different superscripts are significantly different (P < 0.05).
*Significant seasonal differences within breed (P < 0.05).

that period. According to several reports, such high temperature levels impair fertility in the male and increased embryonic mortality in the female rabbit. Thus, the observation by these workers that the breeding activity of rabbits in the tropics is usually at its peak in the rainy season was confirmed in the present study. A number of practical ways of alleviating heat stress in the dry season have been proposed. These include adequate ventilation in rabbit houses and planting of shade trees and creepers around rabbit houses.

In terms of prolificacy, the NZW breed recorded the largest LSB. Several reports have noted that the NZW was renowned for high prolificacy. Similarly, the least squares means for LBW followed the same pattern as LSB. NZW litters were heaviest at birth. This may be a reflection of their large litter sizes at birth. A highly significant and positive relationship has been demonstrated between both traits. However, there was no difference between breeds in LSW, though CAL litters had the heaviest LWW. LWW depends, to a large extent, on the maternal environment provided by the dam. This implies that the CAL does could have furnished the best maternal care when compared to the NZW and CHS does. This observation is
Evaluation of three breeds of rabbits for litter characteristics in South-West Nigeria

contrary to reports in the literature\textsuperscript{12} that NZW does are noted for good maternal behaviour. The superior performance of the CAL does as observed in this study may be due to the relatively high proportion of NZW breeding included in the CAL breed when it was developed\textsuperscript{13}. NZW does recorded the shortest mean KI while there was no difference between CAL and CHS breeds. This was mainly due to NZW does readiness to mate and high conception rate. Several investigators\textsuperscript{6,10} have observed that KI depends on NMC, conception rate and the interval between weaning and remating which can be prolonged by the refusal of does to mate. By dividing 365 days by the breed mean for KI, an annual rate of 5.04, 4.38 and 4.23 litters for NZW, CAL and CHS does respectively could be realised.

This implies that numerically, the NZW can have more litters and by extension, more weaners per doe per year when compared to CAL and CHS breeds. Mean KI for all breeds rose in the dry season period, apparently in response to high ambient temperature(\textgreek{C}32) characteristic of that season. Such high temperature ranges have been observed to depress reproductive performance of rabbits\textsuperscript{3}, thus prolonging the KI.

This study demonstrates important breed differences in fertility and some litter traits in two seasons under humid tropical conditions. These features are of economic importance and could be exploited in commercial rabbit production in this region. Thus, to improve litter traits, selection of does within the NZW and CAL breeds could be adopted as a preliminary step. A second step is to combine the high fertility and prolificacy of the NZW and the good maternal qualities of the CAL in a two-breed cross to improve the biological efficiency of rabbit production.

Acknowledgments

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References


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The study revealed that the breeding activity of the MSW is usually at its peak in the winter season. A number of practical ways of alleviating stress in the dry season have been proposed. These include adequate ventilation in rabbit houses and providing shade trees and bushes around rabbit houses.

In terms of productivity, the NZW breed recorded the largest LRR. Several reports...
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Présentation des articles
Deux exemplaires des articles doivent être adressés à Monsieur le Rédacteur en Chef, Bulletin de la Santé et de la Production Animales en Afrique, Organisation de l'Unité Africaine/Bureau interafricain des Ressources animales, P. O. Box 30786, Nairobi, Kenya.


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

Genres d'articles publiés dans le Bulletin
— des communications originales
— des brèves communications
— analyse des articles proposée par le Rédacteur
— des éditoriaux
— le courrier des lecteurs
— analyse d'ouvrages
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Le résumé ne doit pas excéder 200 mots. Son texte bref et concise 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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