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Headings and sub-heads should not be underlined. Binomial specific names and other words to be printed in italics should have a dotted underline.

Tables should be limited and be typed on separate sheets of paper numbered consecutively, Table 1, Table 2, etc. Figures, including photographic prints, graphs, maps, etc. should be numbered consecutively, Fig. 1, Fig. 2, etc., 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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BULLETIN

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STUDIES ON THE MEAT PRODUCTION POTENTIAL OF THE INDIGENOUS FOWL OF NIGERIA: 1. THE EFFECT OF DIETARY PROTEIN AND ENERGY ON PERFORMANCE TO BROILER AGE.

J. A. OLUYEMI,
Department of Animal Science, University of Ibadan, Ibadan, Nigeria.

SUMMARY
Male chicks of the Nigerian indigenous fowl were fed from day old to 12 weeks of age on diets with 3200 kcal/kg metabolizable energy (ME) and 15, 20 or 25% crude protein derived partly from different dietary levels of fish meal combined with blood meal. Growth rate, feed intake and feed efficiency improved (P < 0.05) with higher levels and crude protein and fish meal plus blood meal in the diet. The highest body weight of about 840g obtained with the diet containing 25% crude protein, 6% fish meal and 4% blood meal was not affected (P > 0.05) by decreasing the dietary energy to 3000 kcal/kg (ME) but was depressed (P < 0.05) by decreasing the dietary energy to 2,800 kcal/kg (ME) or increasing it to 3400 kcal/kg (ME). However the 3400 and 3600 kcal/kg (ME) tended to improve feed efficiency and reduce mortality of the birds.

INTRODUCTION
Meat production potential of the indigenous fowl in different parts of the world have been reported (Campos, 1954 and Desai, 1962). In Nigeria, it has been estimated that a substantial contribution of poultry meat may be derived from the indigenous fowl to increase the intake of poultry meat by Nigerians (FAO 1966). However, the potentialities of these birds appear largely obscure and their evaluation as table birds should consider their dietary requirements.

It is not known whether the birds are adapted to poor diets under which they are traditionally raised. Furthermore, the dietary requirement of chicks for energy in the humid tropics is unknown even though Scott (1974) indicated a lower dietary energy requirement under the tropics than in the temperate regions. However, the requirement of broiler chickens for dietary crude protein in the humid tropics (23 – 25%) as reported by Mba et al. (1974), Babatunde and Fetuga (1976) and Valdivie et al., (1976) compare with 23% recommended by NRC (1971). The purpose of this study is to determine the effects of different dietary protein and energy levels on the performance of the Nigerian indigenous fowl to broiler age.

MATERIALS AND METHODS
Birds and their Management
At the Teaching and Research Farm of the University of Ibadan chicks of the indigenous fowl of Nigeria were hatched with forced draught incubators. The chicks originated from parents that were obtained as representative samples from a wide geographical area lying largely in the South Western part of Nigeria and had been maintained on the farm by random breeding for five generations.

The chicks were sexed by vent examination and only the males were used. These were maintained in electrically heated tier brooders for the first five
weeks and for the following seven weeks on deep litter, housing being open sided. The brooder temperatures were 32.2 – 34°C, 30 – 32°C and 27 – 29°C in the first, second and third week respectively. Floor space per bird was increased from 80 cm² at day old to 0.10 m² at 12 weeks of age of the birds while linear feeding and watering space increased at five weeks from 2.5 to 5 cm and from 1.0 to 2.5 cm respectively.

Experimental diets

In the first of two trials, the chicks were fed on nine diets that were isocaloric (3,200 kcal/kg (ME)) contained three levels of protein (15, 20 and 25%) and three levels of fishmeal plus blood meal, in an attempt to produce three levels of essential amino acids at each level of dietary protein (Table 1). In the second, the chicks were fed on five diets that were isonitrogenous but varied in metabolizable energy (Table II).

Experimental

In the first trial, 720 male chicks were randomised to nine diets and their replicate groups with 40 chicks per group. In the second, 500 chicks were randomly assigned to replicate groups of five diets making 50 chicks per group. The groups were slightly adjusted so that their initial chick mean weights were equal in each trial. Body weight, feed efficiency and mortality were recorded in both trials. Data were analysed for variance (Steele and Torrie, 1960) and the differences among means determined using Duncan multiple range test (1955).

Table 1: Composition of the diets fed in the first trial

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>15% CP</th>
<th></th>
<th>20% CP</th>
<th></th>
<th>25% CP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish meal</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Blood meal</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Maize</td>
<td>75.00</td>
<td>79.85</td>
<td>84.70</td>
<td>58.39</td>
<td>62.93</td>
<td>67.47</td>
</tr>
<tr>
<td>Groundnut cake</td>
<td>17.7</td>
<td>8.85</td>
<td>0</td>
<td>31.86</td>
<td>23.24</td>
<td>14.62</td>
</tr>
<tr>
<td>Palm oil</td>
<td>2.00</td>
<td>1.00</td>
<td>0</td>
<td>4.45</td>
<td>3.53</td>
<td>2.61</td>
</tr>
<tr>
<td>Common ingredients</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Calculated levels of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methionine</td>
<td>0.21</td>
<td>0.25</td>
<td>0.31</td>
<td>0.25</td>
<td>0.30</td>
<td>0.34</td>
</tr>
<tr>
<td>Cystine</td>
<td>0.08</td>
<td>0.13</td>
<td>0.18</td>
<td>0.23</td>
<td>0.24</td>
<td>0.25</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.49</td>
<td>0.65</td>
<td>0.81</td>
<td>0.74</td>
<td>0.90</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>0.28</td>
<td>0.33</td>
<td>0.37</td>
<td>0.30</td>
<td>0.31</td>
<td>0.32</td>
</tr>
<tr>
<td>Metabolizable energy in all diets 3200 kcal/kg ME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Common ingredients are rice bran, 2%, oyster shell, 2%, dicalcium phosphate, 0.5%, salt, 0.3%, and feed supplements, 0.5%.

Feed supplement supplied the following per kg of diet: (a) Vitamins — Vit, A, 5500 IU; Vit D3, 3,120 IU; riboflavin, 4.4 mg; niacin, 22 gm; Ca pantothenate, 8.8 mg; choline, 440 mg; vit B12, 5 mcg; and (b) Minerals — Mn, 52.4 mg; Fe, 20.2 mg; Cu, 8 mg; Zn, 50 mg and Co, 0.5 mg.
### Table 2: Composition of the diets fed in the second trial

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Percentage in diet:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Maize</td>
<td>49.46</td>
</tr>
<tr>
<td>Palm oil</td>
<td>-</td>
</tr>
<tr>
<td>Rice bran</td>
<td>10.88</td>
</tr>
<tr>
<td>Groundnut cake</td>
<td>26.39</td>
</tr>
</tbody>
</table>

Calculated composition:
(a) Crude protein (%)  
(b) Metabolizable energy (kcal/kg)  
(c) Amino acids

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>2,800</td>
<td>3,00</td>
<td>3,200</td>
<td>3,400</td>
<td>3,600</td>
<td></td>
</tr>
<tr>
<td>0.39</td>
<td>0.38</td>
<td>0.37</td>
<td>0.37</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>0.30</td>
<td>0.30</td>
<td>0.31</td>
<td>0.31</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>1.29</td>
<td>1.29</td>
<td>1.29</td>
<td>1.30</td>
<td>1.30</td>
<td></td>
</tr>
</tbody>
</table>

*Common ingredients include fish meal, 6.0%; blood meal, 4.0%; oyster shell 2.0%, bone meal, 0.5%; salt, 0.3%; and feed supplement, 0.5%. Composition of feed supplement is as for Table 1.

### RESULTS AND DISCUSSION

The performance of the birds in relation to dietary crude protein and fish meal plus blood meal is presented in Table III. Up to 8 and 12 weeks of age, liveweight, feed intake and feed efficiency improved with increases in the dietary protein and fish meal plus blood meal.

There were no significant (P > 0.05) interactions between dietary protein level and fish meal plus blood meal levels. With each level of protein, performance improved with increased level of fish meal plus blood meal. An interaction might have arisen from the ratio of essential amino acids, contained in greater quantities in fish meal and blood meal, and the remaining amino acids (Lewis, 1966).

The pattern of response at both ages to dietary protein and fish meal and blood meal can be attributed to the extent of the availability of amino acids for tissue growth. Even though the indigenous fowl has existed for generations under rural conditions without regular feeding (Hill, 1954), the birds appear capable of benefitting from a dietary protein similar to that for broilers. By contrast, preliminary studies at the University of Ibadan indicated that the indigenous pig of Nigeria appeared adapted to a low dietary protein (Fetuga, 1978). Unlike the indigenous pig, the indigenous fowl has a history of upgrading with improved breeds (Ademosun, 1979); although, since the effect of this crossbreeding was not determined, it is uncertain whether it contributed to the response of the birds to high protein levels.

With each level of dietary protein, fish meal and blood meal increased the dietary levels of methionine, cystine and lysine close to or slightly above the levels recommended by NRC (1971) and the closer the faster appeared to be the growth of the birds. Although other sources of protein contributed to the
Table 3: Performance of the indigenous fowl of Nigeria fed from 0–12 week on isocaloric diets differing in levels of crude protein, fish meal and blood meal.

<table>
<thead>
<tr>
<th>Age(wk)</th>
<th>Traits</th>
<th>Crude protein (%)</th>
<th>Levels of fish plus blood meal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>Liveweight (g)</td>
<td>256.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>341.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Feed intake (g)</td>
<td>585.3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>772.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Feed efficiency</td>
<td>2.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.4&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(Feed/gain)</td>
<td>6.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.3&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>12</td>
<td>Liveweight (g)</td>
<td>488.3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>546.9&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Feed intake (g)</td>
<td>1215.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1314.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Feed efficiency</td>
<td>2.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.5&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(Feed/gain)</td>
<td>6.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.5&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Figures under either dietary crude protein or levels of fish meal plus blood meal and in the same row that are differently superscripted are different (P < 0.05).

1 No fishmeal plus no blood meal
2 3% fishmeal plus 2% blood meal
3 6% fishmeal plus 4% blood meal

Essential amino acids, the attainment of NRC (1971) standard in the dietary concentrations of the essential amino acids with a probable improvement in growth would require higher levels of fish meal and of blood meal in the diet or the use of synthetic amino acids. Either of these would increase the cost of rearing the birds to broiler age. Probably, more of blood meal which is locally processed and is cheaper might be included although blood meal is low in isoleucine (NRC, 1971).

Feed intake and feed efficiency largely followed the trend of growth rate, since additional nutrient is required to maintain the gain in body weight. The lower efficiency of feed utilization with the lower dietary protein indicated an attempt to consume enough essential amino acids.

The maximum body weight obtained in this study exceeded 391.0g reported by Oluyemi (1974) feeding lower levels of the three essential amino acids. However, the weights in this study were lower than 1.5 – 2kg at 8–10 weeks for commercial broilers even though the essential amino acids were close to NRC (1971) recommendations. This might be partly due to the low growth potential of the indigenous fowl.

With 25% dietary protein, 6% fish and 4% blood meal and 3,200 kcal/kg ME in the diet, the body weight of 836.3g attained in the second trial (Table IV) was similar to that in the first under identical dietary regime. With 3,400 – 3,600 kcal/kg ME in the diet, growth rate was depressed (P < 0.05). Growth rate was depressed (P < 0.05) also when dietary energy was lowered to 2,800 kcal/kg ME but not (P > 0.05) when it was lowered to 3000 kcal/kg ME. A dietary energy of 3000-3200 kcal/kg ME was adequate when the dietary protein was 25%.

Birds on the higher energy diets were significantly (P < 0.05) lower in feed
Table IV: Performance of the indigenous fowl of Nigeria fed from 0–12 week on diets with 25% crude protein and different levels of metabolizable energy (ME).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>ME Levels/kcal/kg</th>
<th>2,800</th>
<th>3,000</th>
<th>3,200</th>
<th>3,400</th>
<th>3,600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average 12 wk. body wt (g/bird)</td>
<td></td>
<td>700.0b</td>
<td>840.3a</td>
<td>836.3a</td>
<td>730.1b</td>
<td>745.3b</td>
</tr>
<tr>
<td>Average feed intake (g/bird)</td>
<td></td>
<td>2244.3a</td>
<td>2045.8a</td>
<td>1872.9ab</td>
<td>1555.6b</td>
<td>1593.6b</td>
</tr>
<tr>
<td>Feed efficiency</td>
<td></td>
<td>3.3a</td>
<td>2.5ab</td>
<td>2.3b</td>
<td>2.2b</td>
<td>2.2b</td>
</tr>
<tr>
<td>Mortality (%)</td>
<td></td>
<td>7.5a</td>
<td>6.4ab</td>
<td>5.2b</td>
<td>4.8b</td>
<td>5.5ab</td>
</tr>
</tbody>
</table>

Figures in the same horizontal column differently superscripted are different (P > 0.05).

intake (Table IV). According to Scott (1974), the energy required for body maintenance is lower in humid tropics than in the temperate. Depressed growth can be accompanied with reduced intake of essential nutrients. Reduced growth on the higher energy diets can be attributed to inadequate intake of energy. Although, the birds on the lowest energy diet lacked palm oil containing oleic acid and vitamin A, they had adequate vitamins and minerals in their diet.

REFERENCES

Received for publication on 1st March, 1979

SOME FACTORS AFFECTING BIRTH WEIGHTS OF CATTLE IN KIBOKO, KENYA

B.A.J. MWANDOTTO

SUMMARY

Data collected from 798 East African Shorthorn Zebu and its crosses with Sahiwal and Boran, Sahiwal, Boran and their crosses with Friesian born from 1971 through 1976 in Kiboko, Kenya, were analysed by least squares method to identify main factors affecting birth weights.

The corrected mean birth weight was 21.60 ± 4.62 kg. Genotype, year of birth and year and month of birth interaction had a highly significant effect on birth weight (P > 0.01) whereas sex of calf and age of dam also affected (P > 0.05) birth weight.

Crosses of Sahiwal and Boran with the East African Shorthorn Zebu were 1.02 kg. (5%) and 1.85 kg. (10%) heavier respectively than pure East African Shorthorn Zebu while the Friesian crosses of Sahiwal and Boran were only 1% heavier than pure Sahiwal and Boran respectively. Bull calves were 1.28 kg. (6%) heavier than heifer calves. There was a weight difference of 1.66 kg. (8%) between the 1971 (highest weights) and 1975 — 76 (lowest weights). Calves from mature dams, 6 — 7 year old, were 1.52 kg. (7%) heavier than those from 2 to 3 and 8 year and older dams.

INTRODUCTION

Growth rate of beef animals affects the economic returns to commercial ranchers. A genetic correlation of 0.65 between birth weight and weaning weight was reported by Tonn (1976).

Singh, Schalles, Smith and Kessler (1970) found a significant influence of birth weight on pre-weaning growth rate and weaning weight. Similar results were reported by Christian, Hauser and Chapman (1965), Gregory, Blunn and Baker (1950). Tonn (1976) found a heritability estimate of 0.44 in birth weight using Borans in Kenya ranches.

This shows that birth weights, if consistently taken, can be used as an early indicator of potentially superior animals for beef production. Though this improvement may be limited by dystocia (Young, 1970), the present relatively low birth weights in our herds show that this trait can still be improved until an upper limit is reached (Tonn, 1976).

In this study, data were analysed with an aim of identifying some of the factors causing variation in birth weights so that they can be corrected for when evaluating animals on their birth weight basis in range areas.

MATERIALS AND METHODS

Birth weight data of 798 calves born from 1971 through 1976 were collected at Kiboko National Range Research Station.

Climate and Vegetation

The station is in a semi-arid zone V (Pratt, Greenway and Gwynne, 1966). It is about 2.3°S and 37.8°E and 1000 metres above the sea level with average annual rainfall of 615 mm. Rainfall is bimodally distributed. Long rains usually fall from March to May and the short ones from October to early December.
Long dry spells from June to September, sometimes even longer, are characteristic of the zone.

The main grass species in the area: *Chloris roxburghiana*, *Cenchrus ciliaris*, *Themeda triandra*, *Digitaria milanjiana*, *Eragrostis superba* and *Panicum maximum*. *Commiphora*, *Acacia* and *Palengetis* are the dominant tree genera.

**Animals**

In 1971, a three breed rotational cross-breeding programme was started on a foundation of East African Shorthorn Zebu, Boran and Sahiwal from Buchuma Government Research Station. Boran and Sahiwal females were crossed to Friesian and the F1 crossed to Charolais. East African Shorthorn Zebu females were crossed to Boran and Sahiwal for upgrading. East African Shorthorn Zebu, Boran and Sahiwal pure-bred groups were also kept. This long-term breeding programme is shown on Figure 1. Artificial insemination and natural service were used on the herds.

**Management**

Before 1974, all year round breeding was practised, which was later reduced to 3 months from January to March following tentative recommendations by Allen (1973). After calving, the date of birth was noted for every calf. Calves were identified by serial numbers. Birth weights were taken using a weighbridge.

Animals were grazed for about ten hours and were kept in kraals at night to minimize losses by predators and theft. All animals were raised entirely on natural pasture without any supplementary feeding except for mineral licks given *ad libitum* at night. Animal performance, therefore, reflected changes in natural environment. Water was also provided in the kraals only. Normal practices of tick control and regular inoculations against Trypanosomiasis, Foot and Mouth, Anthrax, Blackquarter and Rinderpest were done on the herds.

**Data Classification and Analysis**

Seven genotypes so far accruing from the breeding programmes were used. These were the East African Shorthorn Zebu (EASZ), Sahiwal (S), Boran (B), Sahiwal -- East African Shorthorn Zebu (S x EASZ), Boran — East African Shorthorn Zebu cross (B x EASZ), Friesian — Sahiwal cross (F x S) and Friesian — Boran cross (F x B). Charolais crosses were not used. Preliminary results showed that 1975 and 76 had a similar effect on the weights. Since 1976 had relatively fewer calves than 1975, these years were therefore combined. The two sexes were analysed separately. Season of birth was divided into dry and wet months. Monthly rainfall of 35 mm. was used as the dividing line. Age of dam at calving was classified into 2 to 5, 6 to 7 and 8 and older years of age. This classification and the number of calves per cell is shown in Table 1. Cross tabulation for age of dam effect was not included.

The data were analysed using the method of least-squares for fitting constants (Harvey, 1960). This included a non-orthogonal analysis of variance and covariance. Mean squares computed for individual effects were tested against that of the residual. Constants for the levels within main effects together with respective standard errors except for the first levels were computed. Standard errors of contrasts between the constants for the levels of each treatment were also generated. The difference between the constants divided by the standard error of the contrasts gives a value distributed as ‘t’ for the residual degrees of freedom. Those contrasts given for
interactions were incorrect and statistical comparison between levels in this case was not done.

The following fixed model was used in the analysis:—

\[ Y_{ijklmn} = \mu + a_i + b_j + c_k + d_l + f_m + (ab)_{ij} + (bc)_{jk} + (cd)_{kl} + (bf)_{jm} + (bd)_{jl} + e_{ijklmn}, \]

where

- \( Y_{ijklmn} \) = birth weight of the calf
- \( \mu \) = effect common to all calves
- \( a_i \) = effect of the \( i \)th. genotype of the calf
- \( b_j \) = effect of the \( j \)th. sex of the calf
- \( c_k \) = effect of the \( k \)th. year of birth
- \( d_l \) = effect of the \( l \)th. month of birth
- \( f_m \) = effect of the \( m \)th. age of dam at calving
- \( (ab)_{ij} \) = effect of the \( i \)th. genotype \( \times \) \( j \)th. sex interaction
- \( (bc)_{jk} \) = effect of the \( j \)th. sex \( \times \) \( k \)th. year of birth interaction
- \( (cd)_{kl} \) = effect of the \( k \)th. year \( \times \) \( l \)th. month of birth interaction
- \( (bf)_{jm} \) = effect of the \( j \)th. sex \( \times \) \( m \)th. age of dam interaction
- \( (bd)_{jl} \) = effect of the \( j \)th. sex \( \times \) \( l \)th. month of birth interaction
- \( e_{ijklmn} \) = effect peculiar to an individual calf.

**RESULTS**

Results of the variance analysis for birth weights showed the corrected mean birth weight to be 21.60 ± 4.62 kg. The \( R^2 \) of 0.3036 for the regression model used was found. Genotype and year of birth had highly significant (\( P < 0.01 \)) influence on birth weights. Sex of calf and age of dam at birth were also significant (\( P < 0.05 \)). Month of birth had no effect (\( P > 0.05 \)) on birth weights. Of the interactions tested, only year \( \times \) month of birth interaction was significant (\( P < 0.01 \)).

Coefficients for the main effects \( \pm \) their standard errors are given on figures 2, 3 and 4. LSQ-constants for genotype effect are given on Figure 2. Genotype 't' comparisons are shown in Table 2. Crossbreeding the small East African Shorthorn Zebu with Sahiwal and Boran had an improvement in birth weight of 1.02 kg. (5%) and 1.85 kg. (10%) respectively. This improvement was highly significant (\( P < 0.001 \)) in the Boran East African Shorthorn Zebu cross which had similar birth weight to pure Boran. Crossbreeding pure Sahiwal and Boran with Friesian had an improvement of only 1% in birth weight which was not significant (\( P < 0.05 \)). Crosses of Boran and Sahiwal with East African Shorthorn Zebu had similar weights as were pure Boran, Sahiwal and their crosses with Friesian.

Age of dam effect is illustrated on Figure 3. Calves from 2 to 3 and 8 years and older dams were lightest at birth while those from 6 to 7 year old dams were heaviest. This gave a difference of 1.52 kg. (7%) between these two classes. Comparison between different ages is shown in Table 3. The increase in birth weight from the youngest group of dams to those from 4 to 5 and 6 to 7 dams was significant (\( P < 0.05 \)). The decline in weights from the 4 to 7 year age group to the older dams was also significant (\( P < 0.05 \)).

Year influence on birth weight is shown on Figure 4 and comparison between years depicted in Table 4. 1971
had the highest birth weight and 1975 – 6 the lowest weight. There was a significant (P < 0.05) while that from 71 and 72 to 73 was significant (P < 0.05). The rise in weights from 73 to 74 was not significant (P < 0.05) while the fall in the weights from 74 to 75 and 76 was significant (P < 0.05).

Bull calves were significantly (P < 0.05) heavier than heifer calves by 1.28 kg. (6%).

In 1971 and 74 calves born in wet months were heavier than those born in dry months. The greatest difference of 2.38 kg. (11%) between the wet and dry month weights occurred in 1972. In 1973, 75 and 76 the calves born in dry months were heavier than their wet month counterparts, the greatest difference being them of 1.50 kg. (7%) occurring in 1976. These interaction effects are shown on Figure 5. In the analysis, it was indicated that there were other interactions between the main effects which had significant influence on birth weights but which were not included, as the analysis for non-orthogonality was significant (P < 0.05).

Table 1: Classification of the data and the No. of calves per cell

<table>
<thead>
<tr>
<th></th>
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<tbody>
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<td></td>
<td>D W</td>
<td>D W</td>
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<tr>
<td>F x s</td>
<td>M</td>
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<td>3</td>
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<td>6</td>
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<td>4</td>
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<td>2</td>
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<td>2</td>
<td>10</td>
<td>6</td>
<td>9</td>
<td>4</td>
</tr>
</tbody>
</table>

| Total    |     | 48   | 30   | 89   | 42   | 147   | 86    | 104   | 58   | 132   | 62   | 798   |

D = Dry, W = Wet, M = Males, H = Females, F = Friesian, S = Sahiwal, B = Boran and EASZ = East African Shorthorn Zebu.
Figure 1: Crossbreeding Programme at Kiboko

BULLS
- Boran

FEMALES
1st Step
- Sahiwal

2nd Step
- Boran
- Sahiwal
- Friesian

3rd Step
- Charolais

4th Step
- Charolais

CONTROL
- EASZ

EASZ = The Small East African Shorthorn Zebu.
X = Crosses
Fig. 2: Influence of genotype on birth weight (Kg)

Fig. 3: Influence of age of dam on birth weight (Kg)
<table>
<thead>
<tr>
<th>Genotypes x EASZ</th>
<th>B</th>
<th>B x EASZ</th>
<th>B x EASZ</th>
<th>S x EASZ</th>
<th>B</th>
<th>S</th>
<th>S x EASZ</th>
</tr>
</thead>
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<tr>
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</tbody>
</table>

Table 2: The difference (x) standard error (between 15Q-constands for levels between individual genotypes (kg).
L.S. CONSTANTS

![Graph showing L.S. Constants for different years](image)

**Fig. 4:** Influence of year of birth on birth weight (Kg)

**Table 3:** The difference (± standard error) between LSQ-constants for levels between individual ages of dam (Kg.)

<table>
<thead>
<tr>
<th>Age group in years</th>
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<th>6 – 7</th>
<th>≥ 8</th>
</tr>
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<tr>
<td>2 – 3</td>
<td>1.29 ± 0.61*</td>
<td>1.53 ± 0.74*</td>
<td>0.00 ± 0.56</td>
</tr>
<tr>
<td>4 – 5</td>
<td>0.24 ± 0.69</td>
<td></td>
<td>1.30 ± 0.53*</td>
</tr>
<tr>
<td>6 – 7</td>
<td></td>
<td>1.53 ± 0.67*</td>
<td></td>
</tr>
</tbody>
</table>

*P < 0.05

**Table 4:** The difference (± standard error) between LSQ-constants for levels between individual years (Kg.)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>0.43 ± 0.63</td>
<td>1.55 ± 0.59**</td>
<td>0.80 ± 0.64</td>
<td>1.86 ± 0.64***</td>
</tr>
<tr>
<td>1972</td>
<td>1.13 ± 0.47*</td>
<td>0.37 ± 0.54</td>
<td></td>
<td>1.43 ± 0.51***</td>
</tr>
<tr>
<td>1973</td>
<td></td>
<td>0.76 ± 0.44</td>
<td></td>
<td>0.30 ± 0.43</td>
</tr>
<tr>
<td>1974</td>
<td></td>
<td></td>
<td></td>
<td>1.06 ± 0.45*</td>
</tr>
</tbody>
</table>

*P < 0.05  
**P < 0.01  
***P < 0.005
Fig. 5: Birth weight least square constants for year of birth computed between months of birth (Kg)
DISCUSSION AND CONCLUSIONS

The low $R^2$ value indicates that other important factors affecting birth weight might have been left out of the model of analysis. It is likely also that the error component is overestimated by exclusion of the time factor in the taking of the birth weights. The time varied from one day after birth up to about two weeks and this difference was not recorded.

The mean birth weight of $21.60 \pm 4.62$ kg was lower than the one of $28.0 \pm 3.69$ kg reported by Tonn (1974). Rainfall was higher than the one of the years covered by this study, and animals also grazed throughout the day, which was not the case with Kiboko animals and these could have contributed to the low weights.

Significant breed effects on birth weight were reported by Sacker, Trail and Fisher (1971), Kennedy and Chirchir (1971) and Frisch (1973). In the latter studies, the ranking order of superiority of Zebu crosses and Shorthorn x Hereford calves varied due to drought. In this study, Friesian cross, pure Boran and Sahiwal calves were significantly heavier than the East African Shorthorn Zebu and Sahiwal cross calves. Ranchers may benefit from upgrading their indigenous stock to either Boran or Sahiwal and crossing those to Friesian. To confirm this productivity of various genotypes has to be compared based on post-weaning weight, fertility and mortality.

Several workers have reported the effect of sex on birth weight. Sacker et al. (1971) reported male calves to be heavier than females by 0.5 and 1.4 kg. Tonn (1974) reported a difference of 1.6 kg between the birth weight of the two sexes. Thorpe, Cruickshank and Thompson (1980) found male calves to be heavier by 2.0 kg than female calves in Zambia while overseas studies by Holland, Mullaney and Hopkins (1971) also got a high figure of 1.86 kg difference in the trait between the sexes. That male calves were heavier by 1.28 kg than females in this study is consistent with findings of previous studies, small differences being due to materials used and environment of study.

Birth weight is significantly influenced by years (Seifert and Kennedy, 1966, Holland et al., 1977, Singh et al. 1970 and Tonn, 1974). In the first case, variation in birth weight of up to 5 kg was due to year effects. In this study a figure of 1.86 kg was found. Rainfall is a big contributing factor in the year effects. This affects the quantity and quality of pasture available to cows and hence available nutrients to foetus in the uterus. All the years covered by this study had rainfall figures below average. The highest was in 1971 (583.4 mm) and the lowest was in 1975 — 76 (343.4 mm). These years had the highest and the lowest birth weights respectively. The drought effect which started in Kiboko in 1973 — 74 had a peak effect in 1976 on birth weights.

Significant age of dam effects on birth weights have widely been reported (Koch and Clark, 1955, Sacker et al., 1971 and Holland et al., 1977). Contrary results have, however, been reported by Singh et al. (1970) and Tonn (1974). In the latter case, this was attributed to the unfavourable ecological conditions of the ranch which was studied. It seems that the degree of influence of age of dam on progeny weights depends on local conditions of production. In this study effects of dam’s age on birth weight were small. It showed that 2 to 3 and 8 year and older dams had the
lightest calves while 6 to 7 year old dams had the heaviest calves. This is consistent with similar studies in Southern Africa (Thorpe et al., 1980) which also indicate that the influence of age of dam is associated with increasing weight of cow (Richardson, Oliver and Clarke, 1979).

There was a tendency for calves born in wet months to be heavier than those born in dry months, though this was not true in 1973 and 1975-76. This is in agreement with the common practice in semi-arid and arid zones to have calves born in rising plane of nutrition. A biological explanation underlying the results of 1973 and 1975-76 cannot be advanced. The classification of calving season into dry and wet months based on 35 mm. monthly rainfall may not have been the best classification. This is an area requiring more research. The results however indicate that there may be two or more suitable breeding seasons in range areas. The results also indicate that more interactions between main effects which were not included in the analysis had a significant influence on birth weight. Year x breed is one of the possible interactions. This interaction was shown to affect birth weight by Seifert and Kennedy (1966). It was not tested in this analysis because of limited capacity of the computer programme used. A possibility exists also of higher order interactions or interactions involving covariates which were not tested.

It can be concluded from this study that selection programmes for beef cattle under ranching conditions can be improved if calf birth weights are corrected for sex, age of dam, year of birth and some interactions of these main effects. Variation in birth weight would also be reduced if birth weights were taken at a uniform time or the time they were recorded after birth was corrected.

ACKNOWLEDGEMENTS
My thanks go to all research colleagues at the National Animal Husbandry Research Station for their constructive criticisms. I am also indebted to Messrs. P. Kibet, H. Ochung’ and C. Konde for their valuable assistance in the initial preparation of the data, to R. Njenga for drawing the diagrams and to Pascaleina Nyambura for typing the work. This study was sponsored by the Research Division of the Ministry of Agriculture, Kenya.

REFERENCES

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EFFECT OF FEEDING CASSAVA PEEL MEAL TO GROWING PULLETS ON THEIR SUBSEQUENT LAYING PERFORMANCE

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SUMMARY
In an experiment designed to determine the effect of quantitatively substituting cassava peel meal (CPM) for maize in the growing diets of pullets on their subsequent laying performance, 120 eight-week old B-Hyline commercial hybrid pullets were fed three isonitrogenous diets containing 0, 10% or 20% CPM for twelve weeks. At 20 weeks of age all the birds were transferred to a standard layer mash containing no CPM. Laying house records were kept for eight, 28-day periods.
The results obtained showed that during the growing stage, birds receiving the control diet, consumed less feed (P < 0.01) and were more efficient (P < 0.01) in their feed utilization than the other birds. There was no difference between the other two treatments in their efficiency of feed conversion and feed intake. The rate of body weight gain was similar in all treatments. During the laying stage, the attainment of sexual maturity, feed consumption, egg production, efficiency of feed conversion and egg weight were not significantly (P > 0.05) affected by the level of CPM fed during the growing stage. The carcass quality of the birds, sacrificed at the termination of the study, was similar for all the treatments. It is concluded that the replacement of as much as 20% maize with CPM in growing pullets’ diet did not influence the laying house performance of the birds.

INTRODUCTION
Cassava peel is a low energy waste obtained during the processing of cassava root for human and animal feeding. It contains five to ten times more hydrocyanic acid than the cassava pulp (Oyenuga and Amazigo, 1957; Wood, 1965). This might, in part, explain why cassava peel has not found much use in animal feeding. Oyenuga (1968), however, observed that goats and sheep are fed the waste in village back-yard husbandry system. Cassava peel meal (CPM) is a low energy, bulky feed ingredient containing 2,030 kcal metabolizable energy per kg of dry matter. It is therefore possible that it might find use in pullet developer diets.

Energy restriction has been shown to delay sexual maturity in growing pullets and improve their subsequent laying house performance (Holland and Gowie, 1961; Waldroup and Harms, 1962; Balnave, 1973). It has also been observed that energy restriction can be achieved by replacing maize with fibrous low energy feeding-stuff (Hill and Dansky, 1954).

This study was therefore undertaken to determine the effect of quantitatively replacing maize with the fibrous, low energy CPM in growing pullets’ diets on their subsequent laying house performance.

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MATERIALS AND METHODS

The cassava peel meal used in this trial was obtained from a composite of local Nigerian varieties. Tubers were harvested from 12–15 months old cassava and peeled with knives. The peeling process removed with the outer rind about 0.25 cm of the pulp. The peel was then sun-dried on concrete floors until the moisture was reduced to between 10 and 15% and then milled. The chemical composition of the CPM was determined (A.O.A.C., 1975). The hydrocyanic acid content of the CPM was determined by the method of Wood (1965).

Two hundred and fifty day-old B-Hyline pullets were reared in kerosine-heated battery brooders on standard starter diet to eight weeks of age, when 120 birds were selected and randomly allocated to three experimental diets. Each treatment consisted of four replicates of 10 birds each. The randomized complete block design was used.

The experimental diets contained 0, 10 or 20% CPM that quantitatively replaced maize (Table 1). The diets were isonitrogenous but not isocaloric. Feed and water were available ad libitum and standard management practice on the University of Ife farm was adopted. Individual body weights were taken fortnightly while the feed consumption was recorded weekly. The birds were fed these diets till they were 140 days old.

At 141 days of age the birds were transferred to the laying quarters and fed a standard layer mash containing no CPM. Due to high mortality recorded during the growing phase, the number of birds used during this phase of the study was reduced. Each treatment, therefore, had six laying birds replicated four times.

Feeding and watering were done ad libitum. No artificial lighting was employed. Individual body weight and group feed consumption were recorded every 28 days. Egg production was recorded daily and all eggs laid by each hen during the last seven days of each 28-day period were pooled and weighed. At the end of the experimental period, three birds were randomly chosen from each treatment and sacrificed. Liver, heart, spleen, visceral fat and pancreas were collected, dried with filter paper and weighed fresh. The lengths of the intestine and ceaca were also determined.

All data were subjected to two-way analysis of variance as outlined by Steel and Torrie (1960). Significant differences were further subjected to the Multiple Range Test.

RESULT

The chemical composition of the cassava peel meal used is presented in Table 2. The result obtained during the growing phase is summarized in Table 3. There was a high mortality amongst the birds. The mortality was least for birds fed the control diet (diet I) and highest for the 10% CPM diet (diet II). The differences between treatments were not significant (P > 0.05). Similarly birds fed the control diets grew non-significantly (P > 0.05) faster than those fed either of the two CPM diets. There was a significant increase (P < 0.01) in the amount of feed consumed significantly (P > 0.05) more than diet II. The control diet was more efficiently utilized (P < 0.01) than the other two CPM diets.

The results obtained during the laying phase are summarised in Table 4. The rate of body weight gain promoted by the experimental diets did not differ
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<th>Feed ingredients</th>
<th>Diets (level of CPM)</th>
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<tbody>
<tr>
<td></td>
<td>I (0%)</td>
<td>II (10%)</td>
<td>III (20%)</td>
</tr>
<tr>
<td>Maize (Yellow)</td>
<td>58.95</td>
<td>48.95</td>
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<tr>
<td>Groundnut cake</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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<tr>
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</table>

**Calculated analysis**

| Metabolizable Energy (kcal/kg) | 2,882 | 2,740 | 2,595 |
| Calcium (%)                   | 0.82  | 0.84  | 0.85  |
| Available Phosphorus (%)      | 0.40  | 0.41  | 0.41  |
| Lysine (%)                    | 0.72  | 0.69  | 0.69  |
| Methionine + cystine (%)      | 0.61  | 0.57  | 0.55  |

**Determined analysis**

| Crude protein (%)             | 16.77 | 16.30 | 16.80 |
| Ether extract (%)             | 4.87  | 8.85  | 9.25  |
| Crude fibre (%)               | 8.30  | 9.07  | 9.85  |

1 Stabilized vitamin-mineral premix for growing and laying chicks supplying the following per kg of ration: Vitamin A, 8.00 I.U.; vitamin D₃, 2.00 I.U.; Vitamin E, 2.5 I.U.; Vitamin K, 2.0 mg; riboflavin, 4.20 mg; Vitamin B₁₂, 0.01 mg; panthothenic acid, 5.0 mg; nicotinic acid 20.0 mg; choline, 300 mg; folic acid, 0.5 mg; methionine, 225.0 mg; manganese, 56.0 mg; iodine, 1.0 mg; iron 20.0 mg; copper, 10.0 mg; zinc, 50.0 mg; and cobalt, 1.25 mg.

2 A commercial coccidiostat.

| Table 2: Analysis of the cassava peel meal  
(As fed basis) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>11.20</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>5.98</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
<td>9.30</td>
</tr>
<tr>
<td>Ether extract (%)</td>
<td>0.65</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>7.00</td>
</tr>
<tr>
<td>Nitrogen free extracts (%)</td>
<td>65.87</td>
</tr>
<tr>
<td>Gross energy (Kcal/kg)</td>
<td>4,001.2</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>0.07</td>
</tr>
<tr>
<td>Phosphorous (%)</td>
<td>0.11</td>
</tr>
<tr>
<td>Free HCN (mg/kg)</td>
<td>47.65</td>
</tr>
</tbody>
</table>
Table 3: The effect of feeding cassava peel meal on the performance of pullets from 8 – 20 weeks of age

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Treatments (level of CRM)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I  (0%)</td>
<td>II  (10%)</td>
<td>III  (20%)</td>
<td></td>
</tr>
<tr>
<td>Average daily gain (g/bird/day)</td>
<td>10.86</td>
<td>10.29</td>
<td>10.45</td>
<td></td>
</tr>
<tr>
<td>Average feed intake g/bird/day</td>
<td>62.26&lt;sup&gt;A&lt;/sup&gt;</td>
<td>69.17&lt;sup&gt;B&lt;/sup&gt;</td>
<td>72.74&lt;sup&gt;B&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Feed/gain</td>
<td>5.74&lt;sup&gt;A&lt;/sup&gt;</td>
<td>6.72&lt;sup&gt;B&lt;/sup&gt;</td>
<td>6.97&lt;sup&gt;B&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Mortality (%)</td>
<td>22.50</td>
<td>32.50</td>
<td>30.00</td>
<td></td>
</tr>
</tbody>
</table>

AB Row means bearing different letter superscripts are significantly different (P<0.01).

Table 4: The effect of feeding cassava peel meal to growing pullets on their subsequent laying performance

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Egg production (% hen-day)</td>
<td>51.30</td>
</tr>
<tr>
<td>Average feed intake (g/bird/day)</td>
<td>92.52</td>
</tr>
<tr>
<td>Feed efficiency (kg feed/dozen egg)</td>
<td>2.27</td>
</tr>
<tr>
<td>Egg weight (g)</td>
<td>57.39</td>
</tr>
<tr>
<td>Days to 1st egg</td>
<td>161.00</td>
</tr>
<tr>
<td>Body weight change</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Table 5: The effect of feeding cassava peel meal to growing pullets on their subsequent carcass characteristics<sup>1</sup>

<table>
<thead>
<tr>
<th>Carcass parameter</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>Dressing percent</td>
<td>63.35</td>
</tr>
<tr>
<td>Gizzard (g/100g live wt)</td>
<td>1.78</td>
</tr>
<tr>
<td>Heart (g/100g live wt)</td>
<td>0.53</td>
</tr>
<tr>
<td>Liver (g/100g live wt)</td>
<td>1.75</td>
</tr>
<tr>
<td>Spleen (g/100g live wt)</td>
<td>0.19</td>
</tr>
<tr>
<td>Length of intestine (cm)</td>
<td>142.92</td>
</tr>
<tr>
<td>Length of Cecum (cm)</td>
<td>18.00</td>
</tr>
<tr>
<td>Visceral fat (G/100 live wt)</td>
<td>3.05</td>
</tr>
</tbody>
</table>

<sup>1</sup>None of the differences between means was significant (P > 0.05)
significantly (P > 0.95). The attainment of sexual maturity, taken as days to first egg, was not affected (P > 0.05) by the level of CPM fed during the growing phase, although there were a few days delay in coming to lay by birds fed the CPM diets. The average feed consumption, feed efficiency, egg production and egg weight were not significantly (P > 0.05) affected by the level of CPM fed during the growing stage. Similarly the carcass characteristics were not affected (P > 0.05) by the treatments (Table 5).

**DISCUSSION**

The specific cause of the high mortality experienced during the growing stage of this experiment was not known, even though post mortem examinations were carried out on the dead birds. The veterinarian suspected that it might have been connected with the impure water given to the birds due to the acute shortage of potable water on the farm during that period. The high mortality was not limited to the chickens on this experiment alone but was widespread throughout the poultry unit.

The substitution of CPM for maize in the growing diet for the pullets consistently lowered the metabolizable energy concentration of the diets. It is known that, to a certain extent, birds fed ad libitum eat to satisfy their energy requirements. Replacing maize or wheat with low energy oat-hulls in chick diets and feeding increasing levels of brewers’ dried grains to growing pullets resulted in increasing feed consumption and lowered feed efficiency (Hill and Dansky, 1954; Ademosun, 1973). Similarly, the significantly increased feed consumption and poor feed efficiency observed in pullets fed diets containing cassava peel meal, in this study, may be attributed to the energy diluting effect of relatively fibrous and low energy CPM.

There is evidence that the energy diluting effect and hence the effect on performance and sexual maturity depends largely on the inclusion rate of the diluent. Hill and Dansky (1954) observed that by replacing maize or wheat with low energy oat hull in a 20% crude protein basal diet in increments of 10% up to a maximum of 50%, both growth and energy consumption were depressed. However, this depressing effect was only observed when oat hulls were fed in excess of 10%. Similarly, Rand et al. (1956) observed that increasing the fibre content of purified diets, of varying protein levels, up to 10% had no significant effect on weight gains. It is, therefore, likely that the levels of CPM used were too low to appreciably depress the growth rate and influence sexual maturity.

The slight non-significant delay in sexual maturity observed when CPM was incorporated in the growers’ diets of pullets did not significantly affect the laying house performance of the birds. The metabolizable energy intake of pullets fed 0, 10 and 20% CPM diets were 179.43, 189.52 and 188.76 kcal per hen per day, respectively. It might be argued, therefore, that the dilution of growers’ diet with up to 20% CPM did not restrict energy consumption of the birds, since they increased their feed intake to compensate for the lower energy content of the CPM diets.

It may also be inferred from the result of this study that the inclusion of up to 20% CPM per se in growing diets for pullets had no carry-over toxic effect that would affect the subsequent laying performance of the birds. In an experiment using cassava root meal (CRM),
Enriquez and Ross (1972), fed up to 50% CRM to growing White Leghorn pullets from 6 to 20 weeks of age, transferred all the birds to a common laying diet and observed no significant effect on egg production, feed efficiency and mortality during the laying stage.

REFERENCES

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LABORATORY DIAGNOSIS OF INFECTIOUS BURSAL DISEASE (IBD) IN NORTHERN NIGERIA (1975 – 1979)

O. ONUNKWO and M.A. MOMOH,
National Veterinary Research Institute, Vom, via Jos, Nigeria.

SUMMARY
The distribution of IBD in northern Nigeria is described based on cases confirmed by laboratory diagnosis between 1975 and 1979. Out of 1,325 specimens examined from a total of 45 suspected outbreaks, 1,292 representing samples from 36 of the outbreaks, were found positive. There is apparently no significant seasonal variation in the occurrence of IBD in the northern states, but more outbreaks are seen in May and June, and it appears that the poultry population is at the highest risk during this period, especially in the month of May. The mortality associated with outbreaks was initially high but has declined considerably following the introduction of effective control measures in the endemic areas.

INTRODUCTION
Infectious bursal disease is a viral infection of chickens causing morbidity and mortality. In addition, it results in depression of growth rate and poor response to vaccination against other poultry infections. With few exceptions, IBD is widespread throughout the world (Faragher, 1972). From the African continent, it has been recorded in Ghana (Gyening and Corkish, 1977), Mauritania (Ba and Chamoiseau, 1977), Nigeria (Ojo et al, 1973; Onunkwo, 1975), Senegal (Sagna, 1977), South Africa (Coetzee, 1970) and Zambia (Sharma et al, 1977). The disease is now recognised as a cause of substantial economic losses in commercial poultry production in Nigeria, a common sequella in most outbreaks being an increased susceptibility to mycoplasma and Escherichia coli infections in the survivors.

The history of IBD in Nigeria dates back to 1969; however, it was not until 1975 that definite control measures were introduced against the disease, using a live vaccine imported from West Germany (TAD Gumboro vac, Cuxhaven). In the same year, diagnostic examinations for IBD were initiated on a routine basis at this Institute. Initially, laboratory confirmation of field outbreaks was by virus isolation and identification by serum – neutralisation test. In 1976, the agar gel precipitation technique (AGPT) was adopted as the standard diagnostic test, using histological examinations and occasionally, chicken pathogenicity tests to check and confirm AGPT results.

This paper presents findings on specimens examined at this Institute during a five year period (1975 – 1979).

MATERIALS AND METHODS
Submission of Specimen.
From a suspected outbreak, samples of the bursa of Fabricius are collected aseptically and preserved in a thermos flask filled with ice blocks. The container is labelled properly and submitted to the laboratory with a form showing details of the outbreak and its clinical history. Alternatively, typically affected chicks are submitted live to the laboratory. On receipt at the laboratory, the specimens are divided into two halves, one half is preserved in 10%
formol-saline for histology and the other in a deep-freezer at 25°C for other tests.

Agar gel precipitation test. Bursal samples are pooled and homogenised and examined for evidence of virus antigen on solidified agar. Nigerian antigen and antisera, obtained from IBD-infected chickens, are routinely used in the tests, the specificity of these reagents being regularly confirmed using standard antigen and antisera supplied by Weybridge, U.K. and Sterwin Laboratories, U.S.A.

The agar plates used for the test are prepared by dissolving 1 g of Oxoid in 100 ml of 8 per cent normal saline in sterile distilled water. Ten ml of the dissolved molten agar are layered over a petri dish measuring 8 cm in diameter. A circular row of six wells, and one central well, each 7 mm in diameter, are punched 1 cm apart in the solidified agar gel. The centre well is filled with a known positive IBD antiserum and the peripheral wells with bursa homogenate. Subsequently, the plates are placed in humid chamber kept at room temperature and the precipitin reaction read at 24-48 hours. Normal controls are incorporated using a known positive IBD antigen and antiserum and a negative serum.

Chicken pathogenicity test

Portions of bursae, prepared in PBS-antibiotic solution, are inoculated intramuscularly into ten 3 - 6 week old susceptible chicks at the rate of 0.1 ml per bird. Another group of 5 birds is injected with the diluent alone as controls, both groups of birds being housed separately.

At 24 hourly intervals, beginning on the 3rd day of inoculation two chicks from the infected group and one from the controls, are sacrificed and examined grossly for lesions of IBD. Samples of bursae are collected and examined by histology and AGPT.

Histology

A piece of tissue about 3 x 3 x 2 mm is excised and fixed in three changes of 10% formalin for 24 hours. Subsequently, the tissue is embedded in paraffin wax, sectioned 6 microns thick and stained with H & E.

Virus isolation

Samples are ground in pools and suspended in 5 ml of phosphate-buffered saline (PBS), PH. 7.2, containing 800 in penicillin and 2 mg streptomycin per ml. Following centrifugation of the mixture at 2000 g for 5 minutes, the supernatant fluid is inoculated onto the chorio-allantoic membrane (CAM) of six 10-day-old embryonated hen eggs at the rate of 0.1 ml per embryo. Three embryos are injected with the diluent alone and serve as controls. As a check for Newcastle disease virus, a portion of the supernatant fluid is passaged in 0.1 ml amounts into four 10-day-old embryos via the allantoic fluid route.

All the eggs are incubated at 37°C and candled at 24 hourly intervals for six days. Death patterns as well as the distribution and severity of the lesions are observed. The CAMs from dead embryos showing typical lesions of IBD are processed and examined for IBD virus by serum-neutralisation test following essentially the technique described by El-Zein and others (1974). The immune serum used in the S.N. tests was obtained from 3 - 5 week old White Leghorn pullets at 3 weeks following inoculation with a commercial live IBD vaccine virus. A standard immune serum and a known IBD virus are included in the tests.
No confirmed IBD Outbreak to date

Northern States of Nigeria Showing Year IBD First Confirmed
RESULTS

Over the 5 year period under consideration (1975 – 1979), a total of 1,325 diagnostic and survey specimens were examined at this Institute for IBD. These specimens emanated from a total of 45 suspected outbreaks. Out of the total number examined, 1,292 (97%), representing samples from 36 of the outbreaks, were found positive for IBD. One of these 36 IBD-positive outbreaks was positive also for Newcastle disease. Of the positive specimens, 135 were diagnosed by a combination of AGPT, chicken pathogenicity tests, histology and virus isolation, while 1,157 (i.e. 92%) were diagnosed largely by AGPT and histology.

Generally the AGPT positive precipitin lines were clearly visible at 24 hours or less; a few appeared at 48 hours and persisted at room temperature for up to four days. In the chicken pathogenicity tests, inoculation of positive specimens produced gross lesions characteristic of IBD in three days, with most birds dead by the 6th day.

Histologically, the common lesions seen were hyperaemia, haemorrhage, necrosis and mixed cellular infiltration. The IBD virus isolated by CAM inoculation and S.N. test was further confirmed by negative stain electron microscopy, the virus particle diameter being 57 – 62 nm.

DISCUSSION

The number of specimens examined varies from year to year and from State to State. In all cases, final diagnosis was made on the basis of clinical history, the age affected and post-mortem findings supported by the results of laboratory examination. It will be observed that more than half of the positive cases (Table I) were from Plateau State. The Institute is located in that State and this has a very strong bearing on the number of specimens received. Comparatively fewer samples were examined from the other six States, the common practice here being that collection of samples for confirmation of new outbreaks is not considered necessary once the clinical syndrome of IBD has been clearly recognised in a previous outbreak. Moreover, some large commercial farmers are reluctant to report outbreaks in their flocks for fear of losing public patronage. No specimens were received from three northern States namely Benue, Niger and Sokoto (see map). This should not be construed as indicating definitely the absence of IBD in the poultry population of these States. The incidence of the disease in these areas may not be known until their veterinary services are fully intensified.

The age of greatest incidence recorded over the five year period was 4 – 7 weeks; in a few cases, the disease was seen as early as 9 days of age and as late as 16 weeks. The average morbidity was 85 per cent, and mortality which was high initially with a range of 34.8 to 52.7 per cent later dropped to 8.7 per cent. This drop in mortality appeared to have followed the introduction of effective control measures in the endemic areas. There is no significant seasonal variation in the occurrence of IBD in northern Nigeria (Table II), but more cases are seen in the months of May and June (Figure 1). The disease is consistently seen yearly only in May throughout the five year period and it seems that this is the month of highest risk for poultry in Northern Nigeria.

Confirmation of IBD by virus isolation was found time-consuming and costly in terms of the reagents required.
Table 1: Sources and number of IBD-positive specimens 1975—1979.

<table>
<thead>
<tr>
<th>State</th>
<th>1975</th>
<th>1976</th>
<th>1977</th>
<th>1978</th>
<th>1979</th>
<th>State total</th>
<th>State Total as % of all cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bauchi</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>—</td>
<td>3</td>
<td>0.2</td>
</tr>
<tr>
<td>Borno</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>7</td>
<td>—</td>
<td>8</td>
<td>0.6</td>
</tr>
<tr>
<td>Gongola</td>
<td>—</td>
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<td>—</td>
<td>2</td>
<td>2</td>
<td>4</td>
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<td>Kaduna</td>
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<td>—</td>
<td>6</td>
<td>0.4</td>
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<td>Kano</td>
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<td>—</td>
<td>—</td>
<td>3</td>
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<td>1</td>
<td>6</td>
<td>1</td>
<td>8</td>
<td>0.6</td>
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<tr>
<td>Plateau</td>
<td>135</td>
<td>961</td>
<td>—</td>
<td>114</td>
<td>50</td>
<td>1260</td>
<td>97.7</td>
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<tr>
<td>Total</td>
<td>135</td>
<td>969</td>
<td>3</td>
<td>132</td>
<td>53</td>
<td>1292</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Monthly distribution of IBD-positive outbreaks 1975—1979

<table>
<thead>
<tr>
<th>Month</th>
<th>Monthly number of confirmed outbreaks for each year</th>
<th>Total</th>
<th>Monthly Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>—</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>February</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>March</td>
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</tr>
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<td>April</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td>May</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>June</td>
<td>—</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>July</td>
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</tr>
<tr>
<td>August</td>
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<td>September</td>
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<td>December</td>
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</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>
Fig. 1: Total IBD outbreaks in Northern Nigeria (1975-1979) shown on a monthly basis.

- Total Number Examined
- No. Positive
As experience was gained, it became clear that AGPT and virus isolation were equally sensitive, the main advantage of AGPT being that it is fast and simple to perform and occasionally much more sensitive and reliable especially if conventional eggs are being used as substrates for the growth of the virus. In our experience, histology and AGPT and occasionally chicken pathogenicity tests, are sufficient to confirm a field diagnosis, using virus isolation techniques for specialised studies such as assessing the degree of virulence of the virus in a biological host system.

There has been no confirmed case of IBD in the indigenous Nigerian chicken (Kaza). It is not possible to say whether this is as a result of inherent resistance or tolerance, but it would appear that their susceptibility to IBD virus infection is extremely low. Among exotic breeds and their crosses, the disease has been diagnosed only in intensively kept commercial flocks, especially those on deep litter, suggesting that the system of management may be an important predisposing factor. It was observed in one outbreak, for instance, that clinical signs and death occurred five days earlier in deep-litter chicks than in those on elevated tier brooders even though both groups of birds were on the same farm and close to each other. The mechanics of IBD virus spread in Nigeria are not clear, but diagnostic investigations of field outbreaks indicate that the virus is shed in the droppings and expressed firmly into the organic component of the litter. The virus attaches there and so is less liable to spread in that state, but results in cyclical outbreaks on the same farm under favourable conditions. It is felt that the infection spreads to other farms especially those on battery system via wind-borne viral aerosols generated from infected deep-litter houses.

ACKNOWLEDGEMENT

We wish to thank Mr. J. W. Harkness, Central Veterinary Laboratory, Weybridge, U.K. for electron microscopy and the Director of Veterinary Research, Vom, for permission to publish.

REFERENCES


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DISCROCOELIASIS IN OVINE HEPATOPATHY: A CASE REPORT

STEPHEN M. NJIRO,
Lecturer, Department of Veterinary Pathology, University of Nairobi, P. O. Box 29053, Kabete.

SUMMARY
A sheep was brought in for a post mortem examination. It had marked ascites and a severely necrotised liver. The liver was grayish yellow in colour with haemorrhagic foci scattered throughout the organ. It was small and rubbery in consistency. Although no liver flukes were seen grossly, small flukes of the genus Dicrocoelium were seen under the microscope. It is suggested that many cases of dicrocoeliasis pass unnoticed because the extremely small size of the fluke does not allow for detection when examining gross lesions.

INTRODUCTION
In his discussion of Liver Fluke Disease, Jensen (1974) cited four species of flukes that cause the condition. These are Fasciola hepatica, Fasciola gigantica, Fasciola magna and Dicrocoelium dendriticum. He also gave the dimensions of the adult stages of these flukes as 20-30mm. x 8-15mm., 25-75mm. x 5-12mm., 23-100mm. x 11-26mm., and 6-10mm. x 1.5-2.5mm. respectively. These figures illustrate the diminutive size of Dicrocoelium dendriticum. These figures are for the adult stages and younger flukes are even smaller. Since Dicrocoelium dendriticum is usually not detectable by the naked eye, many cases are noted only as liver damage but are not properly diagnosed as being caused by the fluke Dicrocoelium dendriticum. This paper deals with a case in which severe hepatic damage was observed. At gross examination no flukes were seen but two Dicrocoelium flukes were seen under the microscope.

MATERIALS AND METHODS
The case was a female adult sheep which was approximately two months pregnant. It was brought to our post mortem room from the field by our ambulatory clinic. Prior to death a mucoid discharge from the nostrils and diarrhoea had been noted. There was also considerable dyspnoea. A post mortem examination was carried out and appropriate samples was fixed in 10% formalin for histology.

RESULTS
Gross lesions
There was approximately six litres of blood-coloured fluid in the abdominal cavity. There was also considerable fibrin deposition on peritoneal surfaces. A marked quantity of fibrin was also found surrounding the liver which was severely necrotised. It was small and rubbery in consistency, grayish yellow in colour with haemorrhagic foci scattered throughout the organ. No flukes were detected grossly. The carcass was also jaundiced especially in the omental fat and intestinal mucosa. There was a foetus approximately two months old.

Microscopic findings
Most of the hepatic parenchyma was damaged. Viable tissue that remained was in small scattered islands. Liver damage included large haemorrhages, large areas of necrotic debris while still other large areas had organising
fibrous tissue. There was no particular arrangement of the damage in respect to the hepatic lobule, but hepatic triads tended to be surrounded by the fibrous tissue. The fibrosis was widespread. Scattered among the fibroblasts and collagen fibres were macrophages which appeared in large numbers, as well as lymphocytes and plasma cells. There was also a fair degree of bile duct proliferation.

This case was negative for Rift Valley Fever. Two parasites were encountered in one section. One was coiled into a ball of approximately 1mm. diameter. The other was sectioned along its entire length. It was approximately 3mm. long and 0.75mm. wide, with one end being wider than the other.

Fig. 1: Dicrocelium hospes in liver parenchyma. The entire fluke is pictured coiled into a ball.

Fig. 2: Dicrocelium hospes in liver parenchyma. Only a small length of the fluke to the right is left onto of the picture.
DISCUSSION

In Kenya the fluke usually associated with ovine hepatopathy is Fasciola hepatica. When this fluke causes hepatopathy it is usually grossly evident and recognizable, and there is no difficulty in establishing a proper diagnosis. However, there have been cases examined in our post mortem room in the last ten years where there has been clear hepatopathy in sheep, with all the characteristics of a parasitic condition, where flukes have not been seen.

This paper asserts that such cases are due to liver flukes of the genus Dicrocoelium, which, due to their diminutive size, go undetected. In 1970, a sheep farmer at Kijabe had a problem with condemnation of the livers of his sheep at slaughter. Two of his sheep were examined in our post mortem room. Regarding one case the pathologist reported that “although no parasites have been detected, the changes are definitely of parasitic origin; possibly liver flukes.” He also reported an infiltration with eosinophils and mononuclear cells for the same case. For the other case he reported that the liver damage “resembles reaction to liver fluke, but no flukes were seen.” Another case in 1977 showed hyperplasia of bile ducts, multiple foci of necrosis and infiltration with eosinophils. The diagnosis given was merely hepatitis. (Department of Veterinary Pathology, University of Nairobi, unpublished reports).

All these are most likely cases of dicrocoeliasis. With the diagnosis so uncertain the prescription of the proper medication may be overlooked and more losses incurred. It is for this reason that there needs to be greater awareness of Dicrocoelium among veterinarians. Incidence of dicrocoeliasis of sheep seems to be on the increase in many countries of the world. As Corba et al. (1978) noted, “...in the last decade the dicrocoeliasis of sheep has become more actual in some countries......... when compared with fascioliasis.” They also found Cambendazole efficacious in the treatment of dicrocoeliasis.

Whereas Dicrocoelium dendriticum is prevalent in temperate climates, Kajubiri and Hohorst (1977) have pointed out that a different species, Dicrocoelium hospes is the one that occurs in tropical Africa. Hence the case discussed was a case of Dicrocoelium hospes. Kajubiri and Hohorst also reported an increasing incidence of Dicrocoelium hospes in Uganda.

REFERENCES


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BOVINE LEUKOSIS IN NIGERIA — A PRELIMINARY STUDY

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SUMMARY
A total of 1,055 cattle from 14 ranches and 2 abattoirs in 8 of the 19 states of Nigeria were tested for the presence of specific antibodies against bovine leukemia virus (BLV) using antigen containing BLV glycoproteins in immunodiffusion (ID) tests. Between 0.16% of the sera samples from the 14 ranches were positive.

Sixteen of 18 serologically positive animals had increased circulating lymphocytes indicating a relationship between BLV infection and lymphocytosis among Nigerian cattle.

A scattered distribution of BLV infection among the Nigerian native breeds of cattle has been established.

INTRODUCTION
Enzootic bovine leukemia and BLV infection has been reported in many European countries, North and South America and Japan (Levy et al., 1977; Mammerickx et al., 1976; Marin et al., 1978; Olson et al., 1973, Onuma et al., 1978). This disease has been practically unknown in Nigeria with no previous study to establish its presence or absence among Nigerian cattle. Similarly, little has been reported about the disease or BLV infection in tropical Africa. This may be due to either lack of attention given to the disease or to the fact that the disease has been confused with other clinically similar diseases in the field. Clinical symptoms of the disease include enlargement of the superficial lymph nodes with emaciation, unthriftness, and loss in milk production.

This study reports the preliminary finding of BLV infection among groups of Nigerian cattle.

MATERIALS AND METHODS
Serum samples were collected from a total of 1,055 animals in 14 ranches and 2 abattoirs covering 8 of the 19 states of Nigeria.

The ID tests with BLV antigen containing glycoprotein were done as previously described (Forschner et al., 1978; Onuma et al., 1977). Blood for hematological examination was obtained two weeks after the first serum samples from 18 reactors and 7 normal animals which were used as controls. Both groups were again tested for the presence or absence of BLV antibodies. It was not possible to do hematological examination on all the positive animals because the ranches were too far apart.

Peripheral leukocyte counts were performed by the visual method. The differential lymphocyte counts were done on blood smears stained with May-Grunwald and Giemsa solutions. The absolute peripheral lymphocyte value was obtained from the peripheral leukocyte count and the differential lymphocyte count. Results were evaluated against the findings of Oduye and Okunaiya (1977) for the normal lymphocyte count for Zebu cattle in Nigeria and the Japanese index for classification of lymphocytosis in cattle as described in 1979 (Ishihara et al., 1979).

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Ranch Style
All but one of the ranches are located in the northern states of Nigeria which have more than 95% of the cattle population of Nigeria (Blair, 1978). Most of the ranches are Government-owned Livestock Investigation and Breeding Centres (LIBC) and Dairy Farms with cattle populations ranging between as low as 45 animals in the Dairy Farms and 2,000 in the LIBCs. In the LIBCs, animals are kept in free-range conditions while in the Dairy Farms, they are more confined and in closer contact. In both cases the animals are allowed to roam the pasture throughout the year.

RESULTS
(1) ID result
BLV antibodies were detected in 45 of 1,055 (4.2%) cattle examined. The breakdown per ranch is shown in Table I. There were differences in ID positive rates according to age and breed. Young cattle of 2 years and below were generally negative (Table II) while the native breeds showed a higher percentage than the exotic breeds. The highest percentage of ID positive was among the Wada-ra. No serum from the abattoirs was positive. Three types of positive specific lines were generally noticed — (a) sharp extending line, (b) faint extending line and (c) short line as described by Forschner et al. (1978).

(2) Relationship between serological and hematological tests
Of the 18 serologically positive animals tested for lymphocyte count 16 (88.8%) were found to have high lymphocyte count and therefore considered as having lymphocytosis (Table III). The result was based on the findings of Oduye and Okunaiya (1971), using the Japanese index as reference (Ishihara et al., 1979).

<table>
<thead>
<tr>
<th>Ranch</th>
<th>No. positive</th>
<th>% positive</th>
<th>Breed of cattle in ranches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kachia LIBC</td>
<td>6/101</td>
<td>6.1</td>
<td>White Fulani</td>
</tr>
<tr>
<td>Dogon Daji LIBC</td>
<td>2/50</td>
<td>4.0</td>
<td>Sokoto Gudali</td>
</tr>
<tr>
<td>Talata Mafara LIBC</td>
<td>2/54</td>
<td>3.7</td>
<td>Rahaji</td>
</tr>
<tr>
<td>Bunkure LIBC</td>
<td>3/68</td>
<td>4.4</td>
<td>Bunaji</td>
</tr>
<tr>
<td>Dalori Dairy Farm</td>
<td>3/49</td>
<td>6.1</td>
<td>Friesian and Gudali</td>
</tr>
<tr>
<td>Mubi Dairy Farm</td>
<td>10/63</td>
<td>15.8</td>
<td>Wada-ra</td>
</tr>
<tr>
<td>Gobole LIBC</td>
<td>9/61</td>
<td>14.7</td>
<td>Wada-ra</td>
</tr>
<tr>
<td>Kukuri LIBC</td>
<td>1/34</td>
<td>2.9</td>
<td>Adamawa Gudali</td>
</tr>
<tr>
<td>Gujba LIBC</td>
<td>4/52</td>
<td>7.6</td>
<td>Wada-ra</td>
</tr>
<tr>
<td>Gembuh LIBC</td>
<td>1/42</td>
<td>2.3</td>
<td>Rahaji</td>
</tr>
<tr>
<td>Gembuh Dairy</td>
<td>0/43</td>
<td>0</td>
<td>Brown Swiss</td>
</tr>
<tr>
<td>Ngugoroje Dairy Farm</td>
<td>1/58</td>
<td>1.7</td>
<td>Friesian and Gudali</td>
</tr>
<tr>
<td>Echaka Farm</td>
<td>0/53</td>
<td>0</td>
<td>Adamawa Gudali</td>
</tr>
<tr>
<td>Vom LIC</td>
<td>3/196</td>
<td>1.5</td>
<td>Friesian and White Fulani</td>
</tr>
<tr>
<td>Jos Abattoir</td>
<td>0/104</td>
<td>0</td>
<td>Mixed Native Breeds</td>
</tr>
<tr>
<td>Owerri Abattoir</td>
<td>0/20</td>
<td>0</td>
<td>Mixed Native Breeds</td>
</tr>
</tbody>
</table>
Table II. Age group of 45 ID-positive animals.

<table>
<thead>
<tr>
<th>Age group</th>
<th>No. positive</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 year</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-2 years</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2-4 years</td>
<td>3</td>
<td>6.6</td>
</tr>
<tr>
<td>4-6 years</td>
<td>8</td>
<td>17.7</td>
</tr>
<tr>
<td>6-8 years</td>
<td>11</td>
<td>24.4</td>
</tr>
<tr>
<td>over 8 years</td>
<td>23</td>
<td>51.1</td>
</tr>
</tbody>
</table>

DISCUSSION

The presence of specific antibodies in cattle of 12 of the 14 ranches examined indicates widespread distribution of BLV infection among Nigerian cattle. In those ranches where both the exotic and native breeds come in contact through grazing, the percentage of ID positive was slightly higher in the native breeds than in the exotic breeds. An explanation that can be given for this is that the exotic breeds may probably not be the source of infection or native breeds are more susceptible. Both breeds may have been equally exposed to the source of the infection. The presence of antibodies in ranches consisting only of native breeds and the absence of antibodies in a ranch with exotic breeds alone further strengthens this.

There was, however, no clear difference in the percentage of ID-positive cattle of the Dairy Farm and Breeding Centres. This may have been due to the similarity in the ranch style of the two groups. Both the free-range animals and the more confined animals roam the pastures all the year round, thus there are good chances for exposure to a source of infection. Onuma et al. (1979) reported the difference in the rate of reactors between animals put together in the same pastures and those confined to a single herd. This is probably responsible for the lack of reactors in the Gembu Dairy Farm where all the 45 animals were in a single herd, and there was no possibility of mingling with other animals.

The number of BLV reactors have been shown to increase with the age of animals (Ishihara et al., 1979; Olson et al., 1978). In this study, no reactor was found among the young animals while the number of reactors increased with the age of the animals (Table II).

The differences in the rate of reactors among the different breeds suggest no breed predisposition to susceptibility. No reactor was found among the animals from the abattoirs. Animals coming to the abattoir are usually transit animals.

Table III: Relationship between immunodiffusion (ID) test and lymphocytosis.

<table>
<thead>
<tr>
<th>Age group</th>
<th>No. of animals</th>
<th>ID test</th>
<th>Lymphosytosis</th>
<th>Absolute Lymphocyte value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 7 years</td>
<td>16</td>
<td>+</td>
<td>+*</td>
<td>9583.1 ± 2706</td>
</tr>
<tr>
<td>Over 7 years</td>
<td>2</td>
<td>+</td>
<td>-</td>
<td>4218.5 ± 1940</td>
</tr>
<tr>
<td>Over 7 years</td>
<td>7**</td>
<td>-</td>
<td>-</td>
<td>4952.4 ± 904</td>
</tr>
</tbody>
</table>

*Based on Japanese Index classification (Ishihara, 1979).
**Normal control animals.
+ = positive
- = negative
from individual owners and are usually sent to the abattoir in small numbers. This suggests that the abattoir is not the best place to conduct such a survey. The differences in the precipitin lines probably indicate the stage of infection, sharp extending lines corresponding to late infection while the faint and short lines correspond to recent or early infection.

Levy et al. (1977) and Mammerickx et al. (1976) had earlier shown that there was a relationship between BLV infection and the absolute lymphocyte values. 88.8% of those animals that gave positive reaction in the ID test showed high lymphocyte count in the hematological examination.

This preliminary study established, for the first time, evidence of BLV infection among the Nigerian native cattle. The findings in this report suggest further studies to establish a trend and criteria for the diagnosis of the disease among the Nigerian native breeds. Bovine leukemia is a lymphoproliferative disease caused by BLV infection. It may therefore be necessary to pay attention to its public health significance by studying the possibility of the infection spreading to that part of our human population that uses bovine blood for food.

ACKNOWLEDGEMENTS

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REFERENCES


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THE INFESTATION OF SHEEP AND GOATS WITH LICE IN IBADAN, NIGERIA

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SUMMARY
An investigation into infestation of sheep with the sucking louse *Linognathus ovillus* and goats with *Linognathus stenopsis* showed that light to heavy degrees of infestation occurred in both sheep and goats. In both species a light to medium louse infestation had no marked effect on the packed cell volume (P.C.V) and haemoglobin concentrations (Hb). A heavy degree of infestation resulted in a significant lowering of the PCV and Hb of the affected sheep and goats. *Linognathus ovillus* infestation of sheep is described here, for the first time in Nigeria.

INTRODUCTION
Lice are responsible for serious disorders on host animals (Schilhorn Van Veen and Mohammed, 1975). They have also been incriminated as probable vectors of *Eperythrozoon* species (Jansen, 1952). In January 1980, a complaint of widespread restlessness among a flock of small ruminants kept in two adjacent pens in the Teaching and Research farm of the University of Ibadan was lodged at the Large animal clinic of the University Veterinary School.

This paper gives an account of the subsequent investigations and the species of lice encountered among the flock of small ruminants.

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MATERIALS AND METHODS
The breeds of animals involved were the West African Dwarf and the long-legged types from the Northern parts of the Country. They were housed in two adjacent pens and fed on cut grass/legumes supplemented with concentrates consisting of ground maize mineral mixtures when available. Prior to the outbreak, the animals had been on a declining plane of nutrition due to the sparse pastures at the time of the year and the irregularity in the provision of the concentrate supplement.

An estimate of the louse population on each animal was obtained by sampling areas 2.5 x 5.0cm (12.5cm²) on the shoulder, ribs, flank and gluteal region on the right side. Specimens of lice collected on the animals were cleared in 10 per cent caustic potash for 24 to 48 hours, and mounted using Depex. The lice were then identified and counted. Three degrees of louse infestation were determined based on the number of lice per cm² and on visual inspection:

(a) Light infestation — when no lice were seen on examination of hair coat (0.1 — 0.65 per cm²).

(b) Medium infestation — when no lice were seen from a distance but many are detected on examination of the haircoat (1.5 — 2.9 per cm²).

(c) Heavy infestation — when many lice could be seen on the animal as dark blotches showing through the hairs from several feet away (6.8 — 9.7 per cm²).
Each animal was bled from the jugular vein and about 5 ml of blood was collected into Greyward K E 5 specimen tubes containing ethylene—diaminetetra-acetic acid (EDTA). The PCV was determined by the microhaematocrit method while the haemoglobin concentration was determined by the cyanmethaemoglobin method. Blood smears were made fixed with absolute methyl alcohol and stained with Giemsa. These were examined for blood parasites under the microscope.

Faecal samples were collected per rectum into dry and clean universal bottles from all the affected animals. Each faecal sample was examined using a modification of the McMaster salt floatation technique (Anon, 1977) for the recovery and estimation of helminth eggs and coccidial oocysts.

RESULTS

All the sheep and goats had various degrees of louse infestation. The clinical picture included restlessness, rubbing of the body against walls, scratching and licking of the body. The heavily infested animals evinced signs of anaemia including palor of the mucous membranes and weakness. This group also had ragged hair coats with patches of alopecia and were emaciated.

All the lice collected from sheep were identified as *Linognathus ovilus* (Neumann, 1907) and those from goats were identified as *Linognathus stenopsis* (Burmeister, 1838). Lice of all stages were encountered. Identification was based on suitable morphological and morphometric characteristics (Lapage, 1968; Soulsby, 1968; Anon, 1977).

Light and medium lice infestations had no marked effect on the PCV and Hb values of the affected animals. A marked lowering of these values resulted from heavy infestation of both sheep and goats (Table 1). In both species the differences in mean PCV and Hb between the first two groups and the heavily infested group were highly significant (P < 0.05). The stained blood smears were negative for blood protozoan parasites.

Faecal examination for gastro-intestinal helminth and coccidial parasites showed no significant findings.

<table>
<thead>
<tr>
<th>Degree of Infestation</th>
<th>Light</th>
<th>Medium</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Sheep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean PCV</td>
<td>12</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Mean Hb</td>
<td>29.3 ± 0.9</td>
<td>27.6 ± 0.52</td>
<td>16.2 ± 0.68</td>
</tr>
<tr>
<td></td>
<td>9.2 ± 0.43</td>
<td>7.9 ± 0.51</td>
<td>6.5 ± 0.52</td>
</tr>
<tr>
<td>Number of Goats</td>
<td>14</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Mean PCV</td>
<td>28.9 ± 0.62</td>
<td>27.3 ± 0.57</td>
<td>15.0 ± 0.63</td>
</tr>
<tr>
<td>Mean Hb</td>
<td>9.0 ± 0.34</td>
<td>8.1 ± 0.46</td>
<td>5.2 ± 0.51</td>
</tr>
</tbody>
</table>

± = Standard deviation
DISCUSSION

Linognathus stenopsis of goats recorded in this investigation has been described on sheep in the Northern parts of Nigeria (Schillhorn Van Veen and Mohammed, 1975). However, the occurrence of Linognathus ovisulus on sheep had not been previously described in this country. Hitherto, this parasite had frequently been simply referred to as lice.

Sucking lice feed continuously on blood and produce severe discomfort because of their numerous bites and toxic secretions (Turk and Besch, 1968). They have been incriminated as cause of clinical anaemias in cattle (Collins and Dewhirst, 1965) and in sheep (Schillhorn Van Veen and Mohammed, 1975). High temperature and relative humidity are favourable to ectoparasites than temperate conditions (Beaton, 1968). Crowding of animals in pens would create slightly higher humidities in such pens. These facts, coupled with the low plane of nutrition could explain the rapid build-up of lice burden and the subsequent clinical anaemia observed.

The PCV (%) in clinical normal West African dwarf sheep is 27.4 ± 4.5 and the Hb (g%) is 8.42 ± 1.5. The corresponding values for goats are:— 26.1 ± 4.1 and 8.59 ± 1.31 (Oduye, 1976). From this investigation, animals suffering from heavy lice infestation have significantly low Hb and PCV values (Table 1), while these similar values in those suffering from light and medium infestations were not significantly different from the values obtained for those free of infestation (Oduye, 1976). Thus heavy infestation with sucking lice should be considered as a cause of anaemia in small ruminants in Nigeria. There is a need for a prompt and efficient control of ectoparasites in the tropics to avoid serious health disorders and economic losses in hides and skins.

ACKNOWLEDGEMENT

The authors are grateful to Professor O.O. Dipeolu of the Department of Veterinary Microbiology and Parasitology for his help in confirming the identification of the species of lice encountered in this investigation.

REFERENCES


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Each animal was bred from the progeny of 50 males and 50 females of the West African strain. The group was selected for morphological and behavioral characteristics. The group was housed in separate cages and fed ad libitum. The animals were observed daily for any signs of illness or abnormal behavior. The data was recorded and analyzed to determine any differences between the groups.

The results showed that there were no significant differences in the behavior or morphology of the animals. The data was then used to further refine the selection criteria for future studies.

In conclusion, the results of this study suggest that the selection of animals for research purposes should take into consideration both morphological and behavioral characteristics. Further studies are needed to confirm these findings.
FATAL TOXOPLASmosIS IN A TREE HYrax (Dendrohyrax arboreus)

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SUMMARY
Gross and microscopic lesions are described in a tree hyrax (Dendrohyrax arboreus) which died with toxoplasmosis. Significant pathological changes were observed in the liver, lung, spleen, pancreas, duodenum, brain and kidney. The changes included areas of focal necrosis and the presence of Toxoplasma tachyzoites and cysts in the tissues affected. Serum taken at the time of death had a high antibody titre against Toxoplasma gondii.

INTRODUCTION
Toxoplasmosis in wildlife has been recognized in many parts of the world. Among species native to Africa, the disease has been reported in colobus monkey (Colobus abyssinicus) (Olubayo and Mwongela, 1978), rock hyrax (Procavia capensis) (Ratcliffe and Worth, 1951), hunting dog (Lycaon pictus) (Hofmeyr, 1956) and baboon (Papio ursinus) (McConnell, et al. 1973). The importance of toxoplasmosis to man and domestic animals has prompted studies of its possible reservoir hosts in nature.

This case report describes the first diagnosis of toxoplasmosis in a tree hyrax in Kenya. Terminology used for the various forms of Toxoplasma is that outlined by Dubey (1977).

Case History
A young female tree hyrax was presented for post mortem examination. Prior to death the animal had been sick for 10 days with intermittent bleeding from the nose and mouth. In spite of antibiotic treatment the animal eventually died.

MATERIALS AND METHODS
Tissues from liver, lung, brain, kidney, stomach, pancreas, intestine, spleen, tongue and diaphragm were fixed in 10% buffered formalin, embedded in paraffin wax, sectioned at 6 μm and stained with hematoxylin and eosin. Sections from liver, spleen, lung and intestine were cultured on blood agar and McConkey's agar at 37°C for 48 hours.

Gross Pathological Findings
At necropsy the animal was found to have fair amounts of fat in the normal storage depots. The eyes were sunken and the animal was slightly dehydrated. The peridontal oral mucosa of the left premolar teeth was blood-stained and ulcerated. The liver was moderately congested and had pin-point white foci randomly distributed. The mucosal surfaces of the stomach and caecum were blood-stained. A small superficial ulcer 8-10 mm in diameter was found in the duodenum.

Histopathological changes
Focal areas of necrosis were present in the liver, heart, spleen and pancreas. There was proliferative pneumonitis in the lung, with oval nucleated parasites, typical of the tachyzoites of Toxoplasma gondii. These parasites were found in the cytoplasm of alveolar macrophages and in some cases free in the tissues. Tachyzoites of Toxoplasma were observed free and in the cytoplasm of cells and also in the pancreas, liver, spleen and lung. Toxoplasma tachyzoites were found also in epithelial cells of the convoluted tubules of the kidney and in Brunner's glands in the submucosa of the duodenum.
There was a superficial erosion in the squamous epithelium of the stomach and focal necrosis of myocardial fibres with toxoplasma cysts in many of the fibres. Cysts were found also in striated muscle fibres in the tongue and diaphragm.

Areas of haemorrhage with associated necrosis were present in the brain, spleen and liver. In the brain, apart from areas of haemorrhage, there were small foci of glial cell proliferation associated with Toxoplasma tachyzoites. In the spleen there was a general loss of white pulp, with disappearance of splenic follicles, apparently by necrosis.

Laboratory tests
Examination of the faecal material did not reveal any significant parasites. No significant pathogens were recovered after incubating bacterial cultures for 72 hours.

Serology
Serum obtained from the hyrax at the time of death was tested for the presence of toxoplasma antibodies using the Sabin-Feldman Test. An antibody titre of 1:1024 was reported, compatible with a diagnosis of active toxoplasmosis.

DISCUSSION
Demonstration of tachyzoites and tissue cysts typical of T. gondii, associated with widespread necrosis in the liver, pancreas and spleen, and with foci of haemorrhage and glial cell proliferation in the brain, leads us to consider toxoplasmosis the probable cause of death. Supporting evidence is the relatively high serum antibody titre detected by the Sabin-Feldman test. The period of illness, 10 days, correlates with the presence in tissues of both the tachyzoite and cyst forms of the parasite, since cysts begin to appear in the third week of Toxoplasma infections (Dubey, 1977).

This is the second case of Toxoplasma infection in wild mammals encountered in Kenya (Olubayo and Mwongela, 1978). These cases, together with a high prevalence of Toxoplasma antibodies found in captive and free-ranging wild animals in Kenya (Mas Bakal et al., 1980, unpublished manuscript) should alert us to the possible occurrence of clinical toxoplasmosis also in domestic animals and humans. Mas Bakal and collaborators (1968) have demonstrated Toxoplasma antibody in 59 of 106 women in Kenya, some of whom had undiagnosed clinical illnesses.

ACKNOWLEDGEMENT
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REFERENCES

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HEALTH STATUS OF BIRDS ON COMMERCIAL POULTRY FARMS IN NIGERIA

D. R. NAWATHE, B.N.C. NWAJE, O. OGBOGU, A. O. SHOKALE and K. A. MAJIYAGBE, National Veterinary Research Institute, Vom, Nigeria.

SUMMARY

The health status of birds on large commercial poultry farms in Nigeria was investigated. Serological evidence of the presence of Marek’s disease, infectious bursal disease, pullorum disease, chronic respiratory disease and infectious synovitis was found in high proportions. Suggestions for improvement in the health status are made.

INTRODUCTION

Nigeria has the largest poultry population in whole of West Africa but most of it is raised as free roaming backyard poultry. Only a fifth belongs to the exotic breed found on commercial farms around big towns and cities. Occurrence of poultry diseases as reported from time to time in Nigeria is either from imported breeds as day-old chicks or a reflection of the infection in free roaming local chicken (Adene 1975, Adene & Ojo 1976. Adene et al. 1976; Ojo et al. 1973; Onunkwo 1975; Osijimi 1976). For control and eradication of a disease, proper diagnosis and accurate survey are essential. So far surveys had been carried out in local chicken coming to Jos market and small farms around the institute (Nawathe et al 1978a, b; Nawathe and Abegunde 1980; Onunkwo and Onoviran 1978). Herein we report prevalence of Marek’s disease (MD), infectious bursal disease (IBD), pullorum disease (PD) due to Salmonella pullorum/gallinarum; chronic respiratory disease (CRD) due to Mycoplasma gallisepticum and infectious synovitis (IS) due Mycoplasma synoviae in layers from big commercial poultry farms in Nigeria where giant hatcheries are also located.

MATERIALS AND METHODS

Serum samples were collected from layers 30 weeks of age and older from the major flocks of individual commercial poultry farms. They were kept frozen at -20°C and inactivated at 56°C for 1/2 hour before use. The antigens were obtained from commercial sources (Intervet Lab; Wellcome Lab; Institute Merieux) and procedures followed were detailed elsewhere (Anon 1973; Nawathe et al 1980 a, b). Agar gel precipitation test (AGPT) was performed for MD and IBD and results read after 48 hours, while for PD, CRD & IS serum (preserved) plate agglutination test (SPAT) was performed and results read after 2 minutes.

RESULTS

The results of serological tests are detailed in Table 1. It is evident that these layers have either survived from past infections or recently been exposed. The high prevalence rate of various disease examined was not unexpected. However, this gives an indication of the health status of the birds on these farms and possible source for dissemination to others by sale of day-old chicks. IBD and IS were rampant as indicated by their high score in the survey.
# Table 1: Results of Serum Antibody Survey for Marek's Disease, Infection Bursal Disease, Pullorum Disease, and Mycoplasmosis in Layers at Commercial Poultry Farms in Nigeria

<table>
<thead>
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**DISCUSSION**

Cullen and Pattison (1980) rightly put it that poultry disease is like an onion; one skin peels away to reveal another. In developing countries, diseases like Newcastle disease, pullorum disease etc. are endemic and moreover there is the constant danger of new ones being imported with day-old chicks from overseas. MD and IBD have gained entrance (Ojo et al. 1973) Onunkwo 1975, Adene 1975) in to the country whereas egg drop syndrome is yet another example (Nawathe and Abegunde 1980).

Outbreaks of IBD in Nigeria are too frequent in chicks between 4–8 weeks age and are often confused with Newcastle disease. Outbreaks of infectious bursal disease are diagnosed by clinical and post-mortem signs and by agar gel diffusion test with bursal tissue against known positive serum. A few isolations
have been made in eggs and cell cultures. It is estimated to be responsible for 30% mortality in growers. MD outbreaks are less frequent but they are mostly in the form of range paralysis. CRD & IS are both rampant in the southern states where climate is hot and humid most part of the year. In one instance on a farm we saw 60,000 broilers gasping for breath with subsequent heavy mortality. In some northern state CRD outbreaks coincided with those of Newcastle disease causing very heavy mortality and severe economical losses. So far, there are no publications on the isolation of M. gallsisicucom M. cynoviae in Nigeria. Although antibody to PD was seen both by us and reported by Onunkwo and Onoviran (1978) fewer isolation of S. pullorum have been made. Most isolations were of S. gallinarum and indicate increase in the incidence of fowl-typhoid. These farms are presumed to have adopted the test and elimination programme since they operate hatcheries also.

The infections surveyed in this report are among the important poultry diseases in Nigeria and call for strict hygiene and sanitation as well as a planned vaccination programme for diseases whose vaccines are currently available.

ACKNOWLEDGEMENT

Authors are grateful to Miss Victoria Ezenewa and Mr. B. Yacim for technical help and to the Director, National Veterinary Research Institute, Vom for providing facilities to work and permission to publish the results.

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DISCUSSION

Coli and Patterson (1973) rightly point out that poultry diseases take an enormous toll of poultry. The toll is far more important in developing countries than in the developed world. It is clear that isolation of disease agents and their control are in the best interest of the poultry industry.

The economic significance of IBD in Nigeria is yet another example (Nwosu and Akinwude 1980).

Outbreaks of IBD in Nigeria are too frequent. In chicks between 4-6 weeks of age and are often confused with Newcastle disease. Outbreaks of infectious bronchitis and other diseases diagnosed by clinical signs post-mortem findings and by a pathologic diffusion test with viral virus against sheep positive serum. A few isolations...
ENZOOTIC PNEUMONIA OF PIGS: A REVIEW

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SUMMARY
Enzootic Pneumonia of Pigs has been identified by several names, the most frequent being "virus pneumonia", "enzootic pneumonia" and "mycoplasmal pneumonia." Research by independent investigators has established that the chronic pneumonia is caused by a mycoplasma. The primary causative mycoplasma has been named Mycoplasma hyopneumoniae (M. suipneumoniae). Chronological developments on aetiology and nomenclature as well as concepts on pathogenesis and immunity are reviewed.

INTRODUCTION
Enzootic pneumonia of pigs (EPP) is an economically important disease that has been reported in almost all swine producing countries of the world. As Goodwin (1971) rightly observed, enzootic pneumonia seems to be universally present in pig populations and it is unusual to find a large herd naturally free from the disease. In Africa, Mugera (1967) had noted that 56% of pneumonia cases observed in pigs in Kenya resembled EPP. Although the disease has not been aetologically confirmed in Nigeria, owing mainly to difficulties inherent in isolation of the causative agent, some of the lesions observed in pneumatic lungs of pigs in the country are similar to those of enzootic pneumonia. While efforts at isolation and confirmation of the primary aetiological agent are continuing in parts of Africa, it is considered valuable to review chronological and sometimes controversial concepts on aetiology and nomenclature, and on pathogenesis and immunity.

AETIOLOGY AND NOMENCLATURE
In his classic description of swine influenza in 1931, Shope recognized another distinct respiratory disease marked by greater chronicity. In 1948, Pullar reported the occurrence in Australia of a chronic pneumonia which he differentiated from swine influenza, noting that the aetiology was unknown. The chronic disease was transmissible so Pullar referred to it simply as "infectious pneumonia."

In 1952 in England, Betts also demonstrated that infectious pneumonia was distinct from swine influenza. He was able to pass the causative agent through bacteria-retaining filters. Betts considered the agent to be a large virus and named the disease "virus pneumonia of pigs" (VPP). During the next decade and more, while the concept of a viral aetiology prevailed, the name VPP became widely accepted and used.

In 1963, Goodwin and Whittlestone introduced the designation, swine enzootic pneumonia (SEP). They used this name because the transmissible pneumonia was very common or "enzootic" in swine populations. They also preferred this name to VPP because they believed that viral aetiology of the disease had not been proved.

In efforts to establish the aetiology researchers in England and the United States, working independently but about the same time, successfully propagated the agent in primary tissue and
cell cultures (L’Ecuyer & Switzer, 1963; Goodwin & Whittlestone, 1964). Passages of their different cultures inoculated into pigs produced typical lesions. Goodwin and Whittlestone (1964) next propagated the Cambridge “J” strain in cell-free medium and consistently detected pleomorphic organisms. The growth in cell-free medium suggested that the agent could not be a virus; they thought the agent probably was a pleuropneumonia-like organism (PPLO) but they could not confirm this.

In 1965, Mare and Switzer grew the agent in cell-free medium. The agent was used to produce characteristic lesions in respiratory disease-free pigs and was successfully re-isolated in cell-free medium. Microscopic examination of Giesma-stained touch preparations revealed coccoid to cocco-bacillary organisms. Further characterization showed the agent to be between 110 and 220 nm in diameter, chlorotetracycline-sensitive and penicillin-resistant. Mare and Switzer concluded that the organism was a mycoplasma and they named it *Mycoplasma hyopneumoniae* (Mycoplasma of swine pneumonia).

Later in the same year, Goodwin, Pomeroy and Whittlestone (1965) propagated their “J” strain on solid medium and observed pleomorphic mycoplasma-type elements in stained touch preparations. The organism was cloned and serially passaged on solid and liquid media and the cloned cultures were used to induce typical lesions in hysterectomy-produced colostrum-deprived (HPCD) pigs. Goodwin et al. (1965) were assured that the agent was a mycoplasma and they gave it the name *Mycoplasma suipneumoniae*.

Soon after the publication of the respective names by the American and British workers, the nomenclatures generated controversy. Goodwin et al. (1967) argued that the organism named *M. hyopneumoniae* was not cloned on solid media. However, they found *M. suipneumoniae* and *M. hyopneumoniae* to be antigenically indistinguishable. In Denmark, Frilis (1969) reported isolation from swine pneumonia lungs of an agent which he found to be serologically identical to *M. hyopneumoniae* and in Japan, Takatori (1969) demonstrated a serologic relationship between *M. hyopneumoniae* and the “M” strain he isolated from enzootic pneumonia.

Earlier investigators had reproduced enzootic pneumonia in respiratory disease-free, HPCD, or specific pathogen-free (SPF) and not in gnotobiotic or germ-free pigs. Then, Hodges, Betts and Jennings (1969) produced the pneumonia in both gnotobiotic and SPF pigs with Goodwin’s “J” strain and *M. hyopneumoniae* supplied by Switzer. They also found the two organisms to be serologically indistinguishable. Their work re-confirmed that *M. hyopneumoniae* (*M. suipneumoniae*) is a primary aetiology of enzootic pneumonia.

Since Switzer’s report constituted the first published evidence that the aetiological agent is a mycoplasma, convention required that his nomenclature (*M. hyopneumoniae*) be given priority. However, Goodwin and Whittlestone insist on the use of their species name. It has, therefore, become necessary, and rather convenient, for both names to be used simultaneously in major publications.

There are conflicting reports regarding the role of other swine mycoplasmas, particularly *M. hyorhinis* in aetiology of EPP. Since *M. hyorhinis* was first isolated by Switzer (1955) from both normal and pneumatic swine lungs,
Several investigators have noted that this organisms occurs as a secondary invader in EPP (L'Ecuyer & Switzer, 1963; Goodwin et al., 1967). However, in Czechoslovakia, Gois et al. (1968) reported that they produced EPP with "cloned" cultures of TR 32 strain of *M. hyorhinis* inoculated into gnotobiotic and conventional pigs. In England, Poland et al. (1971) reported that 3 out of 9 germ-free piglets exposed to the TR 32 strain developed pneumonia. *M. hyorhinis* was isolated from lungs irrespective of presence or absence of lesions, but was isolated from serous tissues only when lesions were present. The findings tend to confirm that primary lesion produced by *M. hyorhinis* is polyserositis. In Denmark, Friis (1971b) produced pneumatic lesions in 2 of 12 HPDCD pigs inoculated with *M. hyorhinis*. The organism was recovered from both pneumatic and normal areas of lungs.

Swine mycoplasmologists have observed that *M. hyorhinis* is less fastidious than *M. hyopneumoniae* (*M. suipneumoniae*) and readily over-grows the latter. This often creates difficulties in primary isolation of the actual aetiology of EPP and frequently accounts for unsuccessful isolation of *M. hyopneumoniae* (Goodwin et al., 1967).

Regardless of the number of mycoplasma species capable of inducing EPP, the evidence has been established that the aetiology of EPP is a mycoplasma. This means that the name VPP is inappropriate, grossly misleading and has been abandoned. It has been argued that the name EPP is based solely on epidemiological characteristics of a field disease and evades the issue which had been the major concern of many investigators — the aetiology of the disease. Mare (1963) therefore preferred the designation "mycoplasmal pneumonia of swine" (MPS) because it is more aetiologically accurate and specific. While the nomenclature MPS is aetiologically suggestive, it does not differentiate between the primary and secondary nature of the mycoplasma agent (Huhn, 1970). Huhn thus favoured the use of EPP which he considers aetiologically neutral term.

Several workers, particularly in North America, have adopted the designation MPS in their publications (Lam & Switzer, 1972; Livingston et al., 1972; Switzer & Ross, 1975).

In 1971, the Committee on Nomenclature of the Colloquium of American Veterinary Medical Association recommended the adoption of the name "porcine mycoplasmal pneumonia" (Anon, 1971). Workers in Europe, on the other hand, seem satisfied with the designation EPP or SEP which they still favour.

The author recognizes that the term EPP or SEP is more consistent with such universally adopted names like Contagious Bovine Pleuropneumonia (CBPP) and Chronic Respiratory Disease (CRD). The nomenclatures of these other important mycoplasmal diseases are based on clinical manifestations and epizootiological characteristics and not on aetiology. However, as Jericho (1968) has shown, the clinical, epidemiological and pathological manifestations of the lesions of EPP may not be diagnostic evidence specific for a disease entity. In recognition of the specificity and importance of aetiology in the definition and nomenclature of the disease, therefore, this author is more inclined to favour the designation "mycoplasmal pneumonia of pigs" (MPP).

**PATHOGENESIS**

Clinical features and gross lesions of EPP were first well described by Betts
(1952). Onset followed an incubation of 10 to 14 days. Clinical manifestations were non-productive cough, high herd morbidity, low mortality, and poor weight gain. Betts described the gross lesion as grayish coloured and clearly demarcated from normal lung tissues. The lesions occurred most frequently in the cardiac and apical lobes; the intermediate lobe was less frequently affected, and the diaphragmatic lobes are rarely involved. Several workers have reproduced identical gross lesions (Goodwin & Whittlestone, 1963; Mare & Switzer, 1965; Livingston et al., 1972; Obiohgbulam, 1973). Whittlestone (1973) described the course of infection as follows: gross lesions could be detected 7 to 10 days after intranasal inoculation, moderately extensive from 10 days up to 6 weeks, with progressive recovery after 10 weeks. According to Urman et al. (1958) the first histopathological change was recognizable 11 days post-inoculation (PI) in the form of hyperplasia of bronchial lymph node. At 13th day PI, the changes were characterized by round cell infiltration around the pulmonary blood vessels and bronchi. There was no evidence of necrosis or degeneration, but an increase in inter-alveolar connective tissue. Goodwin et al. (1965), Jericho (1968), Hodges et al. (1969) have reported similar histopathological findings. Mare and Switzer (1965) observed very pronounced peribronchial and perivascular lymphoid hyperplasia and marked infiltration and thickening of alveolar walls. In a sequential study of the pathogenesis of the disease, Livingston et al. (1972) observed by immunofluorescence that initial histopathological changes detectable on the 6th day PI consisted of small lymphoid cells in sub-mucosa of bronchial epithelium. By the 14th day PI bronchi- oles and blood vessels were completely surrounded by lymphocytic cells and inflammatory exudates were seen within bronchi and alveoli. Extensive perivascular and peribronchial lymphoid hyperplasia and alveoli involvement occurred 22 days PI. Lesions remained severe until the 37th day and by the 42nd day only mild lesions were evident. This study suggested that microscopic lesions usually regress after 5 to 6 weeks.

With the immunofluorescent technique, L'Ecuyer and Boulanger (1970) detected the mycoplasma on the surface of the bronchial and bronchiolar epithelium and in the contained exudate. Electron microscopic examination also revealed mycoplasmas adjacent to cilia and plasma membranes of epithelial cells lining the bronchi and bronchioles (Livingston et al., 1972). With these findings, the authors concluded that the significant ultrastructural lesion of MPS may be a loss of cilia over bronchial epithelial cells.

**IMMUNE RESPONSE**

Antibody to *M. hyopneumoniae* (*M. suipneumoniae*) has been demonstrated in the sera of infected animals by means of Metabolic-Inhibition test (Goodwin et al., 1967), Indirect Haemagglutination (Goodwin et al., 1969a, b; Lam & Switzer, 1971a) and Complement Fixation (Boulanger & L'Ecuyer, 1968; Goodwin et al., 1969a, b; Slavik & Switzer, 1972). Goodwin et al. (1969a) demonstrated high IHA antibody in the sera of infected pigs for as long as 60 weeks PI. Lam and Switzer (1972) also demonstrated that experimentally infected pigs developed detectable IHA antibody titres 2 to 3 weeks PI. The titres reached a maximum on 8th to 11th week and remained at the peak level until 18th week. Antibody was still detectable 47 weeks PI.
The use of CFT has been complicated by procomplimentary activity of swine serum and the apparent heat lability of antibody active in the test. These problems were circumvented by the supplementation of the complement with 1% pre-tested, fresh normal, unheated calf serum and heat-inactivation of the test sera (Boulanger & L'Ecuyer, 1968). With this modified test, Boulanger and L'Ecuyer first detected CF antibody at 2 weeks PI; maximum titre was reached 35 days and were maintained until 119 days. Antibody remained detectable 267 days PI. Slavik and Switzer (1972) developed another modified CFT by heat-treatment of the test sera to destroy the natural haemolysin and by reconstituting the lyophilized guinea-pig complement with normal swine serum. With the test, CF antibodies were detected as early as 2 weeks PI and lasted as long as 24 weeks PI.

Strong immunity is induced in pigs which had recovered from natural or experimental infection, as evidenced by failure to re-infect such recovered pigs (Lannek & Bornfors, 1957; Goodwin et al., 1969a). However, the nature of the immunity, whether serum or local antibody-mediated, T-cell-mediated, or a combination of these immune mechanisms is not definite (Adegboye, 1978a).

Goodwin et al. (1969b) and Lam and Switzer (1971b) induced little or no resistance with a formalin-killed vaccine, although high IHA and CF antibody titres developed. Resistance appeared not to be colostrum-transferable since ingestion of colostrum did not protect piglets against challenge, even when the colostrum had detectable antibody (Goodwin et al., 1969b). This suggested there is no correlation between vaccine-induced circulating antibody and protective immunity.

One report demonstrated that when the mycoplasma antigen was extracted with ether or lysed with 2% sodium lauryl sulfate and mixed with adjuvant, some protection was conferred on vaccinated pigs (Lam & Switzer, 1971b). The authors noted that piglets given serum from hyper-immunized pigs were protected against challenge. Goodwin and Whittle-stone (1973) showed that experimental vaccines containing adequate adjuvants stimulated some degree of resistance to challenge exposure.

Oboegbulem (1973, 1975) showed that a live vaccine prepared from a suspension of mycoplasma pneumatic lung failed to induce resistance. This author, however, demonstrated that heat-inactivated vaccine prepared from broth cultures of M. hyopneumoniae and mixed with adjuvant conferred significant protection. All vaccinated and protected pigs developed high CF antibody titres. The work of Lam & Switzer (1971b) and Oboegbulem (1973, 1975) suggest some correlation between vaccine-induced circulating antibody and protective immunity.

The above investigations suggest that more protective immune response is elicited by appropriate adjuvancy and proper inactivation or chemical extraction of the mycoplasma antigen.

Adegboye (1978a) investigated the role of cell-mediated immunity in EPP by responses measured by blood lymphocyte transformation and delayed-type hypersensitivity skin tests. Significant lymphocyte transformation was first obtained at 15 weeks PI and was demonstrable up to 44 weeks PI. Skin sensitivity indicated by perivascular mononuclear cell accumulation in the dermis was demonstrated between 20
and 46 weeks PI. Both responses were thus more readily demonstrated during late, recovering states, than during active pneumonic stage. In an attempt to explain the nature of the apparent non-responsiveness during the pneumonic stage, Adegoke (1978b) examined lymph nodes draining infection site for any evidence of paracortical depletion — a phenomenon associated with immunosuppressive diseases. Both thymus-independent cortical and thymus-dependent paracortical regions of the lymph nodes — which regulate humoral and cell-mediate immune responses respectively — are known to undergo hyperplasia following antigen stimulation. Adegoke observed paracortical depletion only in 2 pigs with extensive pneumonia. He, however, noted that both cortical and paracortical regions showed hyperplasia — an apparent indication that both humoral and cell-mediated immunity is activated in the course of EPP.

Whatever the nature of immune responses (humoral, cell-mediated, or both), the results of investigations cited above indicate that as with the other important mycoplasmal diseases — CBPP and CRD — it is possible to control EPP by parenteral immunization. Presently, however, no acceptable field vaccine is available.

REFERENCES


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ISOLATION OF *NOCARDIA ASTEROIDES* FROM CATTLE WITH MASTITIS IN THE SUDAN

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**SUMMARY**

*Nocardia* was isolated in pure culture and in combination with *Klebsiella pneumoniae* from three cows with mastitis. Previously reported cases of nocardial mastitis in cattle in the Sudan were due to *Nocardia farcinica*. In this investigation, the isolates were compared with reference strains of *N. asteroides* and *N. farcinica* and were identified as *N. asteroides* both immunologically and according to their physiological and biochemical characteristics.

**INTRODUCTION**

Nocardiosis of cattle is fairly common in the Sudan and occurs chiefly as an infection of the subcutis involving the lymph vessels and nodes (Mostafa, 1967). Reports of nocardial mastitis in cows are few and the causative agents in these cases were identified as *Nocardia farcinica* (Awad, 1960; Nasri, 1961). Although *N. asteroides* has been known to cause bovine mastitis in many countries (Munch-Petersen, 1954; Pier, Gray and Fossati, 1958; Ditchfield, Butas and Julian, 1959; Hillermark, 1960). It has not previously been isolated from cattle in the Sudan. However, Dafalla and Gharib (1958) and Ibrahim (1968) identified an organism from two cases of caprine mastitis as *N. asteroides*.

Distinction between *N. farcinica* and *N. asteroides* has been difficult and Gordon and Mihm (1962) considered them to be synonymous. However, Magnusson and Mariat (1968), Tsukamura (1969) and Goodfellow (1971) established reliable immunological and physiological criteria for the separation of these species. The purpose of this report is to present detailed bacteriological examination of three isolates of *Nocardia* from mastitis in cows in an attempt to determine their identity.

**MATERIALS AND METHODS**

In the course of bacteriological examination of composite quarter milk samples collected from individual cows in a dairy herd, *Nocardia* was isolated in pure culture from one animal and in combination with *Klebsiella pneumoniae* from two animals. The herd was located in El Obeid, Western Sudan and contained 90 cows which were hand milked. Infected cows showed reduced milk yield and were positive to mastitis tests, but had no signs of systemic involvement. Palpation of the udders revealed hard masses in one or more quarters in two of the cows. There were no nodules and the supramammary lymph nodes were not enlarged. On milking, the affected quarters of one cow yielded a watery secretion, whereas the milk from the other two cows appeared normal.

Cultures of *Nocardia* originally isolated on Lowenstein-Jensen's medium, were subcultured in modified Sauton's medium (Mordarska, Mordarski and Goodfellow, 1972) and on Diagnostic Sensitivity Test (DST) agar (Oxoid CM 261), 5% sheep blood agar and MacConkey's agar. Cultures were incubated aerobically at 37 and 45°C and
observed for 14 days. Modified Ziehl-Neelsen method (Gordon, 1967) was used to determine acid-fastness. *N. asteroides* NCTC 8595 and two strains of *N. farcinica* isolated from cattle with bovine farcy in the Sudan (Shigidi, Mirghani and Musa, 1980) were included as control organisms.

Fermentation of carbohydrates, hydrolysis of aesculin and reduction of nitrate were determined using the media and methods described by Cowan (1974). Hydrolysis of casein, hypoxanthine, tyrosine and xanthine was tested by the method of Gordon (1967). Utilization of benzoate and malonate as sole carbon sources, serine and acetamide as sole nitrogen and carbon sources and benzamide as sole nitrogen source was tested by the method of Tsukamure (1966). Catolase was demonstrated on DST agar cultures. Acetamidase, benzamidase, nicotinamidase and urease activity was determined by the method of Berd (1973). Lipids characteristic of nocardiae (LCN-As) were detected by thin-layer chromatography by the technique of Goodfellow (1973).

Organisms were tested against *N. farcinica* and *N. asteroides* antisera by the immunodiffusion test as described by Magnusson and Mariat (1968).

Susceptibility of isolates to antibacterial agents was determined on DST agar plates streaked with the test organisms. Commercially available paper discs containing antibacterial agents were placed onto the agar and the plates were sealed and incubated at 37° C for at least seven days. The presence of zones of inhibition around the discs was taken as indicating susceptibility.

Pathogenicity of isolates for guinea-pigs was determined using physiological saline suspensions from three-day-old blood agar cultures. A dose of 0.5 ml of these suspensions was inoculated intraperitoneally into guinea-pigs.

**RESULTS**

The isolates and reference strain of *N. asteroides* gave similar results. They grew within two days in modified Sauton’s broth and on DST and blood agar which had been incubated at 37° C. Growth was not obtained on MacConkey’s agar at 37° C or on any of the media which had been incubated at 45° C. Strains of *N. farcinica* grew within nine days on DST and blood agar at both temperatures. Colonies of isolates were non-haemolytic, dry, raised, wrinkled and white coloured. They were adherent to the media and difficult to emulsify. Aerial hyphae were not visible macroscopically. Microscopic examination of the colonies revealed filamentous margins in two isolates. Growth in fluid media was characterized by pellicle and sediment formation. Stained smears made from seven-day-old broth or agar cultures contained Gram-positive and partially acid-fast branching mycelia, short-rod and coccoid forms.

The isolates, like *N. asteroides*, produced neither acid nor gas from glucose, fructose, galactose, mannose, arabinose, xylose, rhamnose, lactose, sucrose, maltose, trehalose, raffinose, glycerola, mannitol or sorbitol. They hydrolysed aesculin, but could not hydrolyse casein, hypoxanthine, tyrosine or xanthine. They reduced nitrate to nitrite and produced catalase and urease. Nictinamidase, acetamidase and benzamidase were not produced. The organisms utilized benzamide as a sole nitrogen source, but failed to utilize benzoate and malonate as sole carbon sources or serine and acetamide as sole nitrogen and carbon sources. In contrast,
the control cultures of *N. farcinica* produced acid from glucose, fructose, galactose mannose and xylose. They produced acetamidase, but not urease. Moreover, they utilized serine and acetamide as nitrogen and carbon sources. Analysis of lipids revealed the presence of LCN-As in all cultures.

In the immunodiffusion test antigens from the isolates reacted strongly with antiserum against *N. asteroides*, while they showed faint or no reactions with antiserum of *N. farcinica*. Sensitins from all three isolates showed specificity difference of 2 mm when compared with sensitin of *N. asteroides*. The specificity difference between sensitins of the isolates and those of *N. farcinica* strains varied from 6 to 9 mm.

All isolates were susceptible *in vitro* to streptomycin (10 μg), neomycin (5 μg), gentamycin (10 μg), polymyxin B (300 units) and erythromycin (10 μg). Two isolates were susceptible to carbenicillin (100 μg), whilst one isolate was susceptible to kanamycin (30 μg) and nitrofurantoin (150 μg). None of the isolates was susceptible to penicillin (1.5 units), ampicillin (2 μg), cloxacillin (1 μg), methicillin (5 μg), tetracycline (10 μg), lincomycin (2 μg), clindamycin (2 μg), oleandomycin (5 μg), chloramphenicol (10 μg), novobiocin (10 μg), triple sulpha (150 μg), bacterim (25 μg), naladixic acid (30 μg) or mycostatin (100 units).

The Strains killed guinea-pigs within three days. At necropsy, there were multiple abscesses in the liver, visceral and parietal peritoneum. Acid-fast branching mycelia were observed in smears made from the abscesses. The organisms were recovered from the abscesses. The organisms were recovered from these lesions and from the spleen, liver, testicles and heart blood.

**DISCUSSION**

Nocardiae are considered to be soil saprophytes which may cause infection *N. asteroides* appears to be the predominant cause of nocardial mastitis in cattle and this is in line with its higher prevalence in soil compared to other *Nocardia* species (Orchard, Goodfellow and Williams, 1977; Orchard, 1979). In the Sudan, *N. asteroides* as a causal agent of mastitis has been reported in only two cases in goats (Dafalla and Gharib, 1958; Ibrahim, 1968). The organism has not been isolated from cattle. Awad (1960) and Nasri (1961) identified organisms from four cases of bovine mastitis and from lesions in nine bovine udders obtained from an abattoir as *N. farcinica*. Identification was based on morphology, staining properties and pathogenicity of the organisms to guinea-pigs. These criteria could not distinguish strains of *N. farcinica* from those of *N. asteroides* and it is possible that some of these infections might have been due to *N. asteroides*. Reliable methods are now available for differentiating these species. In the present study, isolates were quite uniform in their character. They were identified as *N. asteroides* both immunologically and according to their physiological and biochemical characteristics which resembled those described for the species (Goodfellow, 1971; Tsukamura, 1979). Similar to the observations of Johnston and Conhole (1962), Bruhl (1963) and Eales et al. (1964), the strains were resistant to most antibacterial agents *in vitro*.

Pier, Mejia and Willers (1961) reported an epizootic of bovine mastitis caused by *N. asteroides*. They regarded the organism as an opportunistic pathogen and mammary gland infections were associated with poor hygiene and the
presence of appropriate conditions in the host. Despite the poor condition under which the herd was maintained and the low level of hygiene during milking, spread through the herd was not observed in this investigation. The sporadic character of nocardial mastitis has been noted by Johnston and Connole (1962) and Eales et al. (1964). Three animals were involved and in two cases *N. asteroides* was associated with *Kl. pneumoniae*. This organism has been recovered from cases of mastitis in cattle (Bagadi, 1970). It is possible that *N. asteroides* was established as a secondary invader following infection with *Kl. pneumoniae*.

Unlike the observations of Pier, Mejia and Willers (1961), there was no correlation between virulence of isolates for guinea-pigs and the clinical disease in cattle. The organisms killed guinea-pigs within three days, but the infection was not severe in cattle. Infected cows showed no signs of systemic involvement and milk from the two cows appeared normal. Although the animals reacted positively to mastitis tests, there were no signs of diffuse fibrosis or palpable nodules in the infected quarters. Similar observations have been made by Johnston and Connole (1962) and Eales et al. (1964).

REFERENCES


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PREVENTION OF ACUTE HAEMONCHOSIS IN LAMBS IN THE RAINY SEASON IN NORTHERN NIGERIA

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SUMMARY
The efficacy of disophenol in the prevention of haemonchosis in young sheep was evaluated in two field trials in N. Nigeria.
Weaned lambs treated with disophenol at the beginning of the rainy season did not have Haemonchus eggs in their faeces for a period of 2½ months after treatment. Control groups regularly treated with short-acting anthelmintics like rafonxanide, nitroxylin and thiabendazole showed rapid rises in egg output at one to two weeks after treatment. Neither disophenol nor the other drugs prevented the establishment of arrested larvae.
Ewes were treated with disophenol two weeks before the expected lambing date. The lambs from these ewes did not show Haemonchus eggs during the first 2½ months after birth. Lambs born from ewes treated with thiophenate or from untreated ewes had egg count of over 3000 e.p.g. within 2 months of birth, and had to be treated to prevent casualties.

INTRODUCTION
Haemonchosis is considered to be one of the major diseases of sheep and goats in Nigeria (Akerejola, Schillhorn van Veen and Njoku, 1979). Losses, which may reach 40% in young lambs, are at present controlled by regular anthelmintic treatment during the wet season. In northern Nigeria the weather conditions during the dry season preclude development and survival of nematode larvae in the field (Ogunsusi, 1978) and preventive anthelmintic is generally restricted to the rainy season, during which it is recommended to treat animals at a monthly interval. The necessity of this frequent drenching is related to the rapid development of parasite larvae in the field and to the absence of a residual activity of the anthelmintics given.

Recently, however, anthelmintics with a residual efficacy have become available. Gordon (1974) reported that a single treatment with disophenol (2,6-diiodo-4-nitrophenol)1 protected sheep from clinical haemonchosis for at least two months.

Protection for such a period could be sufficient to prevent outbreaks in northern Nigerian sheep in areas with a very short rainy period like in Katsina or even in areas with a longer rainy period, like Zaria, since the manifestation of clinical disease diminishes during the second half of the wet season when most Haemonchus larvae arrest their development (Eysker and Ogunsusi, 1980).

MATERIAL AND METHODS
The trials were performed in the Katsina Mutton Improvement Centre in the Sudan vegetational zone where the rainy season generally lasts from June to October, and in the National Animal

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1 Ancylo, American Cyanamid Corp.
Production Research Institute near Zaria in the Northern Guinea zone, where the rainy season lasts from April to October.

**Trial 1:** Ewes in Katsina, expected to lamb during July 1977, were divided into three groups. During the last week of June the first group of 40 animals was treated with disophenol (DNP, 10-15 mg/kg), the second group of 32 animals was treated with thophanate\(^1\) (50 mg/kg) and the third group of 40 animals was left untreated (control). Not all ewes lambed and some lambs died during or directly after parturition of conditions unrelated to parasitic infection. Finally, there were only 18 lambs in the DNP treated group, 15 in the thiophanate group and 38 in the control group. The DNP lambs were not treated again. The thiophanate “treated” lambs were monthly drenched with the same drug, and the control lambs were treated in the middle of September with Parbendazole\(^2\), this being the normal procedure on the farm.

All animals were grazing together on an improved pasture at daytime and received a supplement of cottonseed/groundnut cake when penned up at night in a paddock. The lambs were weaned in October.

**Trial 2:** In Zaria, 100 weaned lambs born in the dry season, and worm-free, were randomly divided into five groups of 20, taking the sex, the breed and the weight into consideration.

Group 1 was grazing on a fenced improved pasture and the animals were treated with DNP (10 mg/kg).

Group 2 was grazing in a bush area under supervision (of a herdsman). The animals were treated with DNP (10 mg/kg).

Group 3 was grazing with group 2 and the animals were treated every four weeks with thiabendazole\(^3\) (66-75 mg/kg).

Group 4 was grazing with group 1 and the animals were treated every four weeks with rafloxanide\(^4\) (3-4 mg/kg).

Group 5 was grazing with groups 1 and 4 and the animals were treated with nitrooxynil\(^5\) (10 mg/kg) after three weeks and from then every four weeks with the same drug (15 mg/kg).

The first treatment was given during the first week of May 1976. The DNP animals were not treated again till the 4th of August. Then group 1 was treated with DNP (10 mg/kg), group 2 with thiabendazole (66-75 mg/kg) and the routine treatments of groups 3 and 4 were continued. Group 5 was eliminated.

**Trial 3:** The rams of trial 2 and 3 (except 14 rams which were kept for breeding) were slaughtered during March. At slaughter the complete gastro-intestinal tract was removed and sampled according to the method of Connan (1968); of each animal a 5% sample of abomasal, small intestinal and large intestinal contents was examined.

During the period between May 1976-November 1976, rectal faecal samples from all animals were collected every two weeks and trichostrongyle egg counts were performed using a modified McMaster egg counting technique (Whitlock, 1948). Larval cultures were prepared by mixing pooled faecal samples with dry and sterilized cattle faeces and incubating the sample at 26°C for 5 days. The third stage larvae were

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\(^1\) Nemafax, May and Baker
\(^2\) Vermiform, Squibb Cy.
\(^3\) Thibendazole, Merck, Sharp & Dohme.
\(^4\) Ranide, Merck, Sharp & Dohme.
\(^5\) Trodax, May & Baker.
identified according to the key of Monnig (1931).

RESULTS

Trial 1. The parasite egg counts and larval differentiations are presented in Fig. 1. The rains started during the last week of June and an increase in egg output in the ewes, except in the DNP treated group, was detectable from the second half of July and onwards. Also the lambs from the DNP treated ewes showed no detectable egg output until the end of September, approximately 3 months after treatment of the ewes. The larval cultures showed that Haemonchus was the major species involved (fig. 1). The other two groups of lambs showed a rapid increase in egg output during August and two lambs in the control group died of haemonchosis. The weight gains of the animals did not show significant differences until the end of September.

Trial 2. The egg output of the DNP treated lambs was very low until the end of August (fig. 2) and there was no detectable difference in output between the animals grazing in the bush and those on pasture. Rafoxanide and thiabendazole given every four weeks controlled the parasite output although the efficacy of the latter drug was decreasing after June. The larval cultures revealed that Haemonchus larvae were predominant till the middle of August. The efficacy of nitroxynil at 10 mg/kg was insufficient but improved when given at 15 mg/kg.

During September, Trichostrongylus and Oesophagostomum spp. became more important. The efficacy of DNP and rafoxanide against these helminths is known to be mediocre and the egg output of these groups was little affected by this drug treatment.
Table 1: Mean abomasal worm counts of rams slaughtered in March.

<table>
<thead>
<tr>
<th>Group</th>
<th>Treatment</th>
<th>Number of Animals</th>
<th>Adult</th>
<th>L-5</th>
<th>L-4</th>
<th>EL-4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DNP/TBZ</td>
<td>7</td>
<td>335</td>
<td>35</td>
<td>25</td>
<td>140</td>
<td>535</td>
</tr>
<tr>
<td>2</td>
<td>DNP (2 x)</td>
<td>5</td>
<td>155</td>
<td>55</td>
<td>10</td>
<td>175</td>
<td>395</td>
</tr>
<tr>
<td>3</td>
<td>TBZ</td>
<td>7</td>
<td>55</td>
<td>50</td>
<td>15</td>
<td>500</td>
<td>720</td>
</tr>
<tr>
<td>4</td>
<td>RAN</td>
<td>7</td>
<td>15</td>
<td>0</td>
<td>5</td>
<td>100</td>
<td>120*</td>
</tr>
</tbody>
</table>

* Statistically significant difference with other groups (P < 0.05).

Trial 3. Post mortem examination of the rams slaughtered in March revealed mainly *Haemonchus*, adults as well as larvae. Occasionally also *Trichostrongylus*, *Oesophagostomum*, *Trichuris* and some tapeworms were found (See table 1).

DISCUSSION

The establishment of worm infections with the onset of the rains demonstrates the ability of *Haemonchus* to achieve a rapid build-up of its population as soon as the circumstances in the field become favourable.

The advantage of the treatment with disophenol under such circumstances is obvious. In Katsina, with only three months of rainfall, one single treatment appeared sufficient to prevent clinical haemonchosis and may have reduced the pasture contamination as well. This pasture contamination aspect was not measurable in Katsina as the treated and control animals were all grazing together, but it may be of great importance.

A frequent dosing schedule could of course prevent such a contamination but could also interfere with the development of immunity, although Gordon (1964) did not observe a significant difference to a challenge infection when comparing monthly treated animals to animals treated only once. Frequent drenching however does not enhance the development of resistance, and the advantages of infrequent use of disophenol over frequent use of conventional anthelmintics has recently been explained by Soetedjo, Beriajaya, Henderson and Kelly (1980).

*Haemonchus* was the major helminth in sheep in Zaria during June-August, an observation which confirms earlier reports of Kuil (1973) and Ogunsusi (1978). Disophenol prevents a significant egg output during this period. The effect of a second treatment with disophenol was less obvious. However *Trichostrongylus* and *Oesophagostomum* larvae appeared in the faecal cultures in July and onwards. The increase in parasite egg output of animals treated with disophenol and rafloxanide, both claimed to act mainly against *Haemonchus* spp., showed that helminths other than *Haemonchus* became important, as can be seen in fig. 2.

In August all the Zaria lambs showed a rapid decline in egg output. Although this may have been due to the treatment as well as to the shift in worm species, it could also be related to a self-cure reaction, as reported by Van Geldorp and Schillhorn van Veen (1975).

The seasonal incidence of the trichostrongylid species in goats and sheep in the Zaria area has been reported by Kuil (1973) and Fabiyi (1973). Eysker
and Ogunsusi (1980) claim that the decline in the adult *Haemonchus* population, and subsequently in the egg output, is associated with the fact that the majority of larvae acquired from August onwards arrest their development. Inhibited larvae were indeed found in the Zaria rams slaughtered half a year later in March.

As the accumulation of inhibited larvae, at least in Zaria, may have continued until November it is difficult to evaluate the effect, directly or indirectly, of the anthelmintics used on the inhibited larvae. Only in the rafoxanide treated group was the number of *Haemonchus* larvae statistically lower (see table 1).

Nitroxynil, chemically related to diphenol, did show a good efficacy against *Haemonchus* at 15 mg/kg but showed no residual effect and the treatment had to be repeated every four weeks.

The efficacy of thiabendazole, especially during July and August seems below expectation. This low efficacy had been noticed in earlier years and the occurrence of a thiabendazole resistant strain of *Haemonchus* was suspected. The results of this trial more or less confirm this suspicion, especially since the efficacy seems to improve during September when the trichostrongylids other than *Haemonchus* are predominant.

**ACKNOWLEDGEMENT**

These trials were supported in part by a contribution of the Cyanamid Intern. Corporation. The cooperation of the Vet. Officer and Manager of the M.I.B.C. in Katsina as well as of the Director and staff of the National Animal Production Research Institute in Shika was highly appreciated. Messrs. Usman, Ishaya and Folaranmi’s technical assistance is gratefully acknowledged.

**REFERENCES**


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THE INCIDENCE OF AFRICAN HORSE SICKNESS ANTIBODIES IN ANIMALS OF VARIOUS SPECIES IN EGYPT

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SUMMARY
One thousand serum samples of different animals, other than equines were examined serologically. The incidence of African horse sickness precipitating antibodies were 8%, 6%, 2.5%, 1.5% and 1% in sera of goats, dogs, sheep, cattle, camels and buffaloes respectively, while the incidence of complement fixing antibodies were 23%, 14%, 7%, 4% and zero percent respectively in the sera of sheep, goats, dogs, camels, buffaloes and cattle. The percentage of antibodies was higher in spring, summer and autumn than in winter.

INTRODUCTION
Despite a policy of annual prophylactic mass immunization of all equine population in Egypt, sporadic cases of African horse sickness (AHS) still appear from time to time. The appearance of such cases and the fact that the disease is prevalent during summer and autumn seasons, raised the possibility of inter-seasonal survival of the virus in reservoir hosts. Theiler (1907) failed to transmit the disease to cattle and sheep but febrile reaction occurred in goats when inoculated with virulent blood. The author referred to the possibility of transmission of African horse sickness to dogs, while M’Fadyean (190) failed to produce the disease in dogs. Piercy (1951) and Haig et al. (1956) reported separate outbreaks in dogs fed on meat from horses which died from horse sickness and the causative virus was isolated and identified. McIntosh (1955), Keerti (1964) and Dardiri and Ozawa (1969) detected neutralizing antibodies against African horse sickness in dogs sera in the enzootic areas and concluded that this species probably became infected in nature. Pilo-Moran et al. (1966) reported the isolation of type 9 African horse sickness from Algerian sheep, while Aly (1980) isolated the virus from dogs in Upper Egypt. Therefore, the present work was planned to investigate the possible presence of the virus among different animal species in Upper Egypt.

MATERIALS AND METHODS
Viruses: Reference strains representing all nine AHS serotypes were used. They were, 1 (A501), 2 (OD), 3 (1), 4 (Vryhied), 5 (VH), 6 (114), 7 (Karen), 8 (18/60) and 9 (S2).

Serological tests. Serum samples were obtained according to Mackie and McCartney (1960). They were collected from different farms and markets in the localities of Edfo, Daraw, Koumombo, Wady-Abbaday and El-Arbeien road in Upper Egypt.

A total of one thousand serum samples were collected from different animals (sheep, goats, dogs, camels, cattle and buffaloes) and were subjected to precipitation and complement fixation tests (Reneaux et al., 1971) using the previously prepared type 9 reference tissue culture antigen.

RESULTS AND DISCUSSION

Tables 1 and 2 summarize the results of agar gel precipitation and complement fixation tests. The antibodies detected were AHS group antibodies and were not differentiated according to serotype. The highest incidence detected were 6 and 8 per cent respectively for dogs and goats. Results of the complement fixation test showed the highest incidence of antibodies to be 14 and 23.5 per cent respectively in goats and sheep. No detectable antibody was observed in cattle sera by this test. For both test systems the lowest incidence of antibody was winter suggesting that probably sheep, goats, dogs and camels may be exposed to AHS virus during the warm seasons. To the best of our knowledge the present communication represents the first report of AHS antibody incidence in Egyptian domestic animals other than equines.

Table 1: Incidence of AHS Precipitin antibodies in sera of non-equidae animals in Egypt.

<table>
<thead>
<tr>
<th>Season</th>
<th>Sheep</th>
<th>Goat</th>
<th>Dog</th>
<th>Camel</th>
<th>Buffalo</th>
<th>Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>1/60</td>
<td>2/30</td>
<td>3/50</td>
<td>0/20</td>
<td>0/30</td>
<td>1/50</td>
</tr>
<tr>
<td>Summer</td>
<td>2/40</td>
<td>5/40</td>
<td>5/60</td>
<td>2/50</td>
<td>1/30</td>
<td>2/60</td>
</tr>
<tr>
<td>Autumn</td>
<td>1/40</td>
<td>1/20</td>
<td>2/40</td>
<td>1/40</td>
<td>0/20</td>
<td>1/40</td>
</tr>
<tr>
<td>Winter</td>
<td>1/60</td>
<td>0/10</td>
<td>2/50</td>
<td>0/40</td>
<td>0/20</td>
<td>1/60</td>
</tr>
<tr>
<td>Total</td>
<td>5/200</td>
<td>8/100</td>
<td>12/200</td>
<td>3/200</td>
<td>1/100</td>
<td>5/200</td>
</tr>
<tr>
<td>%</td>
<td>2.5%</td>
<td>8%</td>
<td>6%</td>
<td>1.5%</td>
<td>1%</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Table 2: Incidence of AHS Complement Fixing antibodies in sera of non-equidae animals in Egypt.

<table>
<thead>
<tr>
<th>Season</th>
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<th>Dog</th>
<th>Camel</th>
<th>Buffalo</th>
<th>Cattle</th>
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<tbody>
<tr>
<td>Spring</td>
<td>15/60</td>
<td>8/30</td>
<td>6/50</td>
<td>5/70</td>
<td>2/30</td>
<td>0/50</td>
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<tr>
<td>Summer</td>
<td>12/40</td>
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<td>5/60</td>
<td>3/50</td>
<td>2/30</td>
<td>0/60</td>
</tr>
<tr>
<td>Autumn</td>
<td>10/40</td>
<td>1/20</td>
<td>2/40</td>
<td>1/40</td>
<td>0/20</td>
<td>0/40</td>
</tr>
<tr>
<td>Winter</td>
<td>10/60</td>
<td>0/10</td>
<td>1/50</td>
<td>1/40</td>
<td>0/20</td>
<td>0/60</td>
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<tr>
<td>Total</td>
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<td>14/100</td>
<td>14/200</td>
<td>10/200</td>
<td>4/100</td>
<td>0/200</td>
</tr>
<tr>
<td>%</td>
<td>23.5%</td>
<td>4%</td>
<td>7%</td>
<td>5%</td>
<td>4%</td>
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</table>
REFERENCES

Received for publication on 27th October, 1980
RESULTS AND DISCUSSION

Table 1: Incidence of anti-Complement Factor antibodies in sera of non-suspected animals in Egypt.

<table>
<thead>
<tr>
<th>Species</th>
<th>Mean</th>
<th>Std.</th>
<th>Dog</th>
<th>Cat.</th>
<th>Rabbit</th>
<th>Guinea</th>
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<tbody>
<tr>
<td>Spring</td>
<td>1.60</td>
<td>3.50</td>
<td>3.00</td>
<td>1.36</td>
<td>1.05</td>
<td>2.07</td>
</tr>
<tr>
<td>Summer</td>
<td>2.60</td>
<td>1.50</td>
<td>2.96</td>
<td>1.75</td>
<td>1.10</td>
<td>1.80</td>
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<td>Autumn</td>
<td>1.40</td>
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<td>2.46</td>
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<td>1.04</td>
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<td>Winter</td>
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<td>5.00</td>
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<td>Total</td>
<td></td>
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<td>10.00</td>
<td>5.00</td>
<td>1.00</td>
<td>3.00</td>
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</table>

Table 2: Incidence of anti-Complement Factor antibodies in sera of non-suspected animals in Egypt.

<table>
<thead>
<tr>
<th>Season</th>
<th>Sheep</th>
<th>Goat</th>
<th>Dog</th>
<th>Cat.</th>
<th>Rabbit</th>
<th>Guinea</th>
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<tbody>
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<td>Spring</td>
<td>12000</td>
<td>3.50</td>
<td>1500</td>
<td>3.50</td>
<td>1000</td>
<td>3.50</td>
</tr>
<tr>
<td>Summer</td>
<td>12000</td>
<td>9.50</td>
<td>2500</td>
<td>0.50</td>
<td>2000</td>
<td>0.50</td>
</tr>
<tr>
<td>Autumn</td>
<td>10000</td>
<td>2.50</td>
<td>2000</td>
<td>2.50</td>
<td>1000</td>
<td>2.50</td>
</tr>
<tr>
<td>Winter</td>
<td>9000</td>
<td>7.00</td>
<td>1000</td>
<td>7.00</td>
<td>500</td>
<td>7.00</td>
</tr>
<tr>
<td>Total</td>
<td>45000</td>
<td>11.00</td>
<td>6500</td>
<td>10.00</td>
<td>4000</td>
<td>10.00</td>
</tr>
</tbody>
</table>

| %     | 19.9% | 3.5% | 25%  | 10%  | 4%    | 10%    |

Short Communication

A SEROLOGICAL SURVEY OF BLUETONGUE IN MOZAMBIQUE

G.K. KANHAI1 / R. da SILVA,
National Institute for Veterinary Research Maputo — Mozambique

SUMMARY
The agar gel diffusion technique was applied in the survey of Bluetongue in the Peoples Republic of Mozambique. Although the disease had not been previously reported antibodies were found in a high percentage of cattle, sheep, goats and feral buffaloes, throughout the country.

INTRODUCTION
Bluetongue is a virus disease of sheep transmitted by insects of the genus Culicoides (Davies & Walker, 1974).

In wild bovid and indigenous cattle, the disease occurs as an inapparent infection. At present at least 20 serotypes of bluetongue viruses are known.

The existence of bluetongue has been reported in many countries and it is widespread throughout the African Continent.

In Southern Africa the presence of the disease has been reported in the Republic of South Africa, Zambia, Angola, Malawi (FAO Animal Health Yearbook, 1976). Although it seemed probable that bluetongue was present in Mozambique, no documentation could be traced.

The present study was undertaken to demonstrate whether antibodies to blue-tongue virus were present in serum samples from sheep, goats, cattle and African buffaloes (Syncerus caffer). Because of its case and economy the agar gel precipitin AGP test, which is group specific, was employed to screen the sera.

MATERIALS AND METHODS
Bluetongue virus (BTV) cell-associated antigen-BT/agP/T4(3) (M.M. Jochim, 1976) and a homologous reference positive bovine antiserum-Bees serum 2459 were kindly supplied by the Director of Onderstepoort Veterinary Research Institute, R.S.A.

BHK-21 cells also received from the Onderstepoort Laboratory were used for the production of negative control antigen. The culture medium was Eagle’s minimum essential medium with Earle’s salts (MEM) supplemented with 10% fetal calf serum and 10% tryptose phosphate broth. Penicillin, 100 units/ml and Streptomycin 100 μg/ml were added to the MEM.

It was prepared from uninfected cells grown in Roux bottles as described by Hafez & Ozawa (1973) and stored at -70° C.

A total of 644 sera were tested. These had been received at the Institute from 7 different provinces in Mozambique for various serological tests.

The animals had not been received at the Institute from 7 different provinces in Mozambique for various serological tests.

The animals had not been vaccinated nor were there any suspicion of Blue-

(1) Present address: United Nations — C.P. 4595 — Maputo, Mozambique
tongue infection in areas from which they were derived. The buffalo sera were collected from the Gorongoza and Marrromeu game parks during Buffalo cropping programmes, were extracted from clotted blood clarified by centrifugation, heat inactivated at 56°C for 30 minutes and stored in vials at -20°C until tested.

The sera were tested by the Agar Gel Diffusion test as described by Hafez & Ozawa (1973). The test was carried out in 10 cm diameter glass petri dishes containing 15 ml of 0.9% agarose in physiological saline solution and supplemented with 0.05% sodium azide as a bacteriostatic agent. Plates were used on the day of preparation. Using a plastic template 7 sets of wells 4 mm in diameter were punched in each plate. Each set consisted of one central well and 6 peripheral wells spaced at 2mm distance from each other and from the central well. These were numbered clock-wise 1-6 starting from the 12 o’clock position. Antigen was placed in the centre well, known reference BT antiserum in wells numbered 1 and 4 and 4 test sera were placed in the remainder using sterile pasteur pipettes delivering a standard drop.

The agar plates were incubated at ambient temperature in a humidified box and examined daily for precipitin lines, in a dark room. Recordings were continued for 4 days.

Fifty percent of the positive sera from each group were retested using a negative control antigen.

Table 1: Bluetongue — A.G.D. Test

<table>
<thead>
<tr>
<th>Province</th>
<th>Animal</th>
<th>Number of samples Tested</th>
<th>Number positive</th>
<th>% Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maputo</td>
<td>Sheep/Goat</td>
<td>56</td>
<td>45</td>
<td>81.8</td>
</tr>
<tr>
<td></td>
<td>Cattle</td>
<td>50</td>
<td>43</td>
<td>86.0</td>
</tr>
<tr>
<td>Gaza</td>
<td>Sheep/Goat</td>
<td>47</td>
<td>38</td>
<td>80.6</td>
</tr>
<tr>
<td></td>
<td>Cattle</td>
<td>50</td>
<td>42</td>
<td>84.0</td>
</tr>
<tr>
<td>Manica</td>
<td>Sheep/Goat</td>
<td>66</td>
<td>54</td>
<td>81.8</td>
</tr>
<tr>
<td></td>
<td>Cattle</td>
<td>30</td>
<td>30</td>
<td>100.0</td>
</tr>
<tr>
<td>Tete</td>
<td>Sheep/Goat</td>
<td>42</td>
<td>28</td>
<td>66.6</td>
</tr>
<tr>
<td>Cabo Delgado</td>
<td>Sheep/Goat</td>
<td>50</td>
<td>41</td>
<td>82.0</td>
</tr>
<tr>
<td></td>
<td>Cattle</td>
<td>50</td>
<td>45</td>
<td>90.0</td>
</tr>
<tr>
<td>Sofala</td>
<td>Buffalo (Syncerus caffer)</td>
<td>154</td>
<td>131</td>
<td>85.0</td>
</tr>
<tr>
<td>Zambezia</td>
<td>Cattle</td>
<td>50</td>
<td>41</td>
<td>82.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>644</td>
<td>538</td>
<td>83.5</td>
</tr>
</tbody>
</table>
RESULTS

The results are set out in Table 1.

The majority of the test sera produced precipitin lines which fused with those of the reference antisera placed in wells 1 and 4. The lines were of varying densities. Sera from fourteen sheep and seven cattle formed double precipitin lines while both coalesced with the lines produced by the reference antiserum. None of the buffalo sera produced double line.

None of the positive serum samples subsequently tested with a negative control antigen produced precipitin lines. Thus indicating that the lines produced by the tested sera were formed by the precipitin antibodies specific to Bluetongue or related virus.

DISCUSSION

Although the number of animals tested is small in relation to the livestock population of Mozambique the high percentage of positive reactions obtained and their widespread distribution makes it evident that the disease is endemic in the species tested although little or no clinical disease is reported.

ACKNOWLEDGEMENTS

The authors are very greatful to Dr. N.J. Fernandes for his kind assistance in the preparation of this manuscript. We also wish to thank our colleagues in the virology department who assisted in various aspects of the work.

This work was carried out in the MONAP — FAO Project LI-13 “Strengthening of the Veterinary Institute” at the National Institute for Veterinary Research, Maputo, The Peoples Republic of Mozambique.

REFERENCE

FAO, WHO, OIE: Animal Health Yearbook 1976 Published by FAO, Rome, Italy

Received for publication on 8th August, 1980
Geographical Distribution of BLACKQUARTER in Africa

OAU/STRC
INTRAFRICAN BUREAU
FOR ANIMAL RESOURCES
MAP No. 438
1980

- Foci reported
- Widescap
- Enzootic/Sporadic but no Foci reported
- No official information available

Geographical Distribution of BOVINE TUBERCULOSIS in Africa

OAU/STRC
INTRAfrican BUREAU
FOR ANIMAL RESOURCES
MAP No. 439
1980

- Foci reported
- Widespread
- Enzootic/Sporadic but no Foci reported
- No official Information available

Geographical Distribution of BOVINE PASTEURELLOSIS in Africa

OAU/STRC
INTRAAFRICAN BUREAU
FOR ANIMAL RESOURCES
MAP No. 440
1980

- Foci reported
- Widespread
- Enzootic/Sporadic but no Foci reported
- No official Information available

Geographical Distribution of AVIAN SALMONELLOSIS in Africa

OAU/STRC
INTRAFOREAN BUREAU
FOR ANIMAL RESOURCES
MAP No. 441
1980

- Foci reported
- Widespread
- Endemic/Sporadic but no Foci reported
- No official information available

Geographical Distribution of BOVINE PIROPLASMOSIS in Africa

OAU/STRC
INTRAFRICAN BUREAU
FOR ANIMAL RESOURCES
MAP No. 442
1980

■ Foci reported
X Widespread
☑ Enzootic/Sporadic but no Foci reported
☐ No official information available

Geographical Distribution of BOVINE TRYPANOSOMIASIS in Africa

OAU/STRC
INTRAfrican BUREAU
FOR ANIMAL RESOURCES
MAP No. 443
1980

- Foci reported
- Widespread
- Enzootic/Sporadic but no Foci reported
- No official Information available

ABSTRACTS

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IBAR/1981 J.E.T. JONES
58 Experimental Streptococcal Endocarditis in the Pig: The Development of Lesions 3 to 14 Days after Inoculation


AUTHOR’S SUMMARY: Endocarditis was produced in 18 of 36 pigs within 14 days of a single intravenous inoculation of a group L streptococcus; in several pigs the lesions were well established within 5 days. Valves on the left side of the heart were affected 3 times as often as those on the right. Myocardial infarction was found in 10, renal infarction in 13 and polyarthritis in all the 18 pigs that developed endocarditis. In most pigs with endocarditis there was a persistent bacteraemia but in those that did not have endocarditis, bacteraemia was of shorter duration. Possible reasons for the occurrence of endocarditis in 50 per cent of inoculated pigs are discussed and experimentally-induced and naturally occurring heart valve lesions in pigs are compared.

IBAR/1981 G. GROOTENHUIS
59 Mastitis Prevention by Selection of Sires

The Vet. Record 1981
108 (12)/ 258-260

AUTHOR’S SUMMARY: The hypothesis that milk cell counts in first lactation daughter groups can provide an indication of future mastitis susceptibility was investigated. Heifer groups with low cell counts were found to have older half-sisters (from the same sire) with lower subclinical and clinical mastitis rates. Older half-sisters of heifers with higher cell counts demonstrated a higher rate of subclinical and clinical mastitis.

IBAR/1981 B. A. SUMMERS
60 Laboratory Diagnosis of Johne’s Disease: A Potential Source of Error

The Veterinary Record, 1980, 108 (8): 166-167

AUTHOR’S SUMMARY: Gastrointestinal tract tissues from cattle with suspected clinical Johne’s disease (JD), in which acid-fast bacilli were not identified in mucosal smears, were examined histopathologically. Twenty-two per cent were positive and 4 per cent were suggestive of JD. Failure to identify mycobacteria in mucosal lesions which contained relatively few bacilli. Ten of the 22 histopathologically positive cases had complement fixation titres for JD but several false-positive titre also occurred.

IBAR/1981 K.S. GODINHO and A.J. BRAMLEY
61 The Efficacy of Teat Dips of Differing Persistence on Teat Skin in Preventing Intramammary Infection by Streptococcus uberis and Escherichia coli in dry Cows


AUTHORS’ SUMMARY: The persistence of disinfectant activity on teat skin was tested for three materials, ethanol, iodophor and chlorhexidine, using Streptococcus uberis and Escherichia coli as test organisms either 15 min or 15 h after the application of the disinfectant. All materials showed marked bactericidal activity 15 min after application but only chlorhexidine retained this activity after 15 h. The same materials were then tested in 48 cows for their ability to prevent infection in the early dry period. All teats were contaminated daily 15 h after disinfection with a mixed suspension of Streptococcus uberis and Escherichia coli. Fourteen days later 26 udder quarters became infected when the teats were dipped in ethanol as did 26 undipped quarters. Twenty two quarters treated with iodophor became infected whereas only 15 chlorhexidine-treated quarters were infected. Eighty-three percent of the infections detected were due to Streptococcus uberis. It is suggested that persistence on teat skin may be an important property for a dis-infectant to prevent Streptococcus uberis mastitis.
IBAR/1981 CHANLER, R.L., SMITH, 62 and TURFREY, B.A.
Studies on the Phagocytic Potential of Secretory Epithelial Cells in Experimental Mastitis.

J. Comp. Path., 1980, 90 (3): 385-394

AUTHORS' SUMMARY: Ultrastructural and associated studies were made on the phagocytic potential of secretory epithelial cells of the mammary gland, by means of the mouse mastitis model. Phagocytosis of viable bacteria was observed as early as 5 h after intramammary inoculation. The secretory epithelial cells of mammary glands inoculated during the involution phase also demonstrated this phagocytic potential. Glutaral dehydrate-killed streptococi, straphyloccci and E. coli were also phagocytosed by secretory cells. This phagocytic potential of cells whose primary function is secretory is of fundamental interest; it should be considered in relation to the pathogenesis of mastitis and to infections across other epithelia.

The Contamination with Salmonella of Bovine Livers in an Abattoir


AUTHORS' SUMMARY: Fifty livers from normal slaughter cattle were examined for surface contamination by Salmonella immediately after evisceration and again after inspection. Salmonella were isolated from 32% at evisceration and from 82% after inspection. Numbers of Salmonella present were low at evisceration, and rose after inspection. In only one liver was the parenchyma infected. The sources of the Salmonella were probably the contents of the gastrointestinal tract and the mesenteric lymph nodes, both of which may show high prevalence of infection in cattle which have been held before slaugh-

ter. It was concluded that edible offal should be separated from the viscera at evisceration and inspected by personnel who are not involved with the alimentary tract.

Immune Responses of Breeding Chickens to Trivalent Oil Emulsion Vaccine: Responses to Infectious Bronchitis

The Veterinary Record, 1981, 108, (5), 99-101

AUTHORS' SUMMARY: Three similar flocks of broiler breeder parent chickens that had been given live infectious bronchitis (IB) vaccines during rearing were injected at 20 weeks of age with three different oil emulsion vaccines: a commercial monovalent Newcastle disease (ND) vaccine (flock A); an experimental bivalent vaccine containing ND and infectious bursal disease (IBD) components (flock B); and an experimental trivalent vaccine containing ND, IBD and IB components (flock C). One week after vaccination 40 hens from flock A and 40 from flock C were taken to the laboratory and their egg yields individually recorded. At 37 weeks of age they were challenged by aerosol exposure to virulent IB virus. The egg production dropped significantly in the hens from flock A but not in the hens from flock C. On the farm, flock C showed a higher mean IB virus antibody titre four weeks after vaccination but titres rose in all three flocks indicating the presence of active IB virus infection. No difference in egg yields were found between the three farm flocks.

IBAR/1981 M. KALUNDA, A.H. DAR-DIRI and K.M. LEE
Malignant Catarrhal Fever I Response of American Cattle to Malignant Catarrhal Virus Isolated in Kenya


AUTHORS' SUMMARY: Fifty-three American cattle were inoculated with malignant catarrhal
fever virus isolated from a wildebeest in Kenya. Three animals showed the mild form of the disease and recovered and 47 showed the severe form of the disease. The other three did not react. Of the 47 cattle, 28 died, 16 were killed for the collection of specimens and three recovered. The incubation period for the 47 cattle ranged from 16 to 29 days and the course of the fatal disease for 28 cattle averaged three to 23 days.

Virus titration of specimens from nine infected steers yielded a mean titer of $10^4$/TCID$_{50}$ per gm for lymph nodes, $10^3$ TCID$_{50}$ per mL for buffy coats and $10^2.3$ TCID$_{50}$ per gm for spleens. Smaller amounts of virus were found in the liver, kidneys, adrenals and thyroid. Malignant catarrhal fever virus was also found in nasal secretions and saliva of viremic cattle. Viral infectivity was shown in bovine buffy coat cells stored at 4°C for two days but was immediately destroyed upon freezing even when glycerine or dimethylsulfoxide was added. Viral particles were not found in infected animal tissues by electron microscopy.

The disease was successfully transmitted in steers by intratracheal inoculation and by aerosol inhalation but not by contact.

IBAR/1981 BARTELING, S.J. 66 Developments in Foot and Mouth Disease Vaccine Production

Foot and Mouth Disease Bulletin (1980) 19 (11) 55

AUTHOR’S SUMMARY: Cattle in the Netherlands are vaccinated annually with foot and mouth disease vaccine prepared from virus grown in a Frenkel system. This system is operated under virtually the same conditions as those used by the late Dr. Frenkel when he developed the procedure. However, recent experiments have shown that the productivity of the procedure can be increased by altering some of these conditions, in particular the pH of the culture. A technique for virus production in BHK cells. This is made possible by removing antibodies from the serum used in the culture medium by pre-treatment of serum with polyethylene glycol. Virus grown in this way is partly purified and concentrated by a precipitation/filtration/elution process. The antigen is inactivated with acetylethyleneimine and absorbed on aluminium hydroxide. Vaccines produced by this process give satisfactory protection in cattle. In the case of pig vaccines, satisfactory results are obtained by using a double emulsion (water-in-oil-in-water) adjuvant. When antigen is subjected to a second precipitation/filtration/elution process, a 200-fold concentrate can be obtained and stored at $-70^\circ$C. This procedure makes possible the holding of a strategic stock of concentrated, inactivated antigen which can be used to prepare large amounts of vaccine if required in an emergency.

IBAR/1981 R.S. HEDGER, J.B. CON-67 DY and D.V. GRADWELL The response of some African Wildlife Species to Foot and Mouth Disease Vaccination

J. Wildlife Dis. 16 (3): 341-438, 1980

AUTHORS’ SUMMARY: In many countries in Africa the interests of wildlife conservationists can conflict with those of the owners of domestic livestock because of possible transmission of disease, in particular foot and mouth disease, from wild to domesticated species. The effects of foot and mouth disease vaccination in three wildlife species has been investigated. The vaccines used were a commercial, trivalent (SAT1/SAT2/SAT 3) and a similar bivalent (SAT 1/SAT 2). The standard cattle dose (3ml) was used. The pattern of serum neutralising antibody responses in buffalo (syncerus caffer), eland (Taurotragus oryx) and impala (Aepyceros melampus) was similar to that of cattle but of a lower order. In general, eland responded to both initial and booster vaccinations with higher antibody titres than buffalo or impala, but titres in buffalo persisted longer than in the other species. Antibody titres to all three virus types were low in all species after primary vaccination but were significantly improved following revaccination after 21 days. Titres then declined rapidly. Booster vaccinations at 6 months produced satisfactory secondary responses to the SAT 1 component in all species and to the SAT 3 component in cattle, eland and impala. SAT 2 responses were variable and of a low order.
AUTHORS’ SUMMARY: Counter-immunoelectrophoresis was compared with immunodiffusion for its ability to detect rinderpest virus antigens. Counter-immunoelectrophoresis detected antigens in lymph node biopsies from all of 9 infected cattle whereas immunodiffusion detected them in 8 only. Counter-immunoelectrophoresis was between 4 and 16 times more sensitive than immunodiffusion for detecting rinderpest virus antigens in the tissues of diseased animals and could detect positive reactions within 40 min. Counter-immunoelectrophoresis could offer an opportunity for rapid laboratory confirmation of rinderpest.

AUTHORS’ SUMMARY: Treatments to reduce costs, for example, extra indicus tick resistance in indicus/taurus strains, may not enhance beef profits. On the other hand, the negative correlation between productivity and adaptability to ticks can be reversed by the alternative use of ‘lean beef’ carcass characters. Results show that high indicus/lean beef genotypes are significantly (P < 0.01) heavier than the cattle without the carcass character. That the ‘right type of cattle’ for a southern hemisphere situation, that is resistant/high yield genotypes, can be produced has been made clear.

AUTHORS’ SUMMARY: An experiment in which groups of calves were repeatedly treated with thiabendazole and compared with similar untreated groups suggested that parasitic gastro-enteritis is not a problem in calves kept under traditional management during the wet season on the Jos plateau in northern Nigeria. On the other hand, as the dry season advanced, the effect of earlier treatment during the wet season showed in better weight gains, higher serum albumin concentrations and higher packed cell volumes compared to the controls. The epidemiological significance of this is discussed in relation to the nutritional stresses of the dry season.
eosinophilia was recorded. Intestinal worm burden and occurrence of white spots in the liver were related to repeated inoculations and time interval between last inoculation and post-mortem examination.

**IBAR/1981 M.T. FOX and D.E. JACS COBS**
Factors Influencing Uptake of Nematode Larvae in Adult Dairy Cattle During the Grazing Season and Sources of Pasture Contamination.


**AUTHORS' SUMMARY:** Investigations on nine well managed English dairy farms showed that 85.2 percent of 460 adult cows harboured patent nematode infections, although the worm burdens, as judged by faecal egg counts, were small. Infection took place primarily by the ingestion of grass previously contaminated either directly with bovine faeces or indirectly with slurry. Calves did not appear to contribute to the infectivity of land grazed by adults on these farms. The parasitic challenge to which cows were exposed was dependent upon the feeding regime, grassland management and the season of the year. Generally the intake of infective larvae ranged from 0 to 1500 per day but daily intakes of up to 4520 were recorded.

Experimental Immunization of calves Against *Anaplasma marginale* Infection: Observations on the Use of Living *A. centrale* and *A. marginale*


**AUTHORS' SUMMARY:** Groups of *Bos indicus* cross calves aged 6 months were immunized with *Anaplasma centrale* or *A. mar-

**IBAR/1981 U. CHETAL, S. KUMAR and U.B. SING**
Effect of Heat, Pressure and Alkali Treatment of Rice Husk on its utilization by Sheep

*Indian vet. med. J. 1980, 4* (2), 54-57

**AUTHORS' SUMMARY:** Preliminary experiments have been conducted to study the possibility of feeding rice husk in sheep as a sole roughage. The experiments show that it may not be safe to use rice husk as a sole basal roughage without treatment with either water or alkali solution under heat and pressure. The pellets of rice husk may perhaps be acceptable to animals since in the process of pellet making heat and pressure is generated.

**IBAR/1981 J.J. RUTLEDGE**
Fraternity Size and Swine Reproduction 1. Effect on Fecundity of Gilts


**AUTHOR'S SUMMARY:** Data from three generations of a selection experiment with Yorkshire swine were analyzed. Fraternity size was defined as the number of sibs at 2 weeks of age. In one line, potential replacements were reared in fraternity sizes initially set at six, while in the other two lines fraternity size was not altered. Over the period of study, gilts reared in small fraternities (mean = 5.77)
averaged 10.19 pigs born. Both of these lines had experienced two generations of selection for increased litter size. A randomly selected control line in which fraternity size (mean = 7.80) was not altered averaged 10.77 pigs born. Gilts reared in small fraternities were heavier at 21 days, but there were no significant body weight differences between lines at breeding or farrowing.

IBAR/1981 RICHARD W. MATTHEWMAN
Small Ruminant Production in the Humid Tropical Zones of Southern Nigeria


AUTHOR’S SUMMARY: A study was made of village goat and sheep production systems in the humid tropical zone of south-west Nigeria. A summary of the herd and flock population dynamics is given followed by a discussion of the importance of goat and sheep production in southern Nigeria and suggestions for methods of improvement. The problems of livestock production in areas of endemic trypanosomiasis are discussed and it is concluded that, where cattle are excluded due to this disease and where human population pressure is high, goats and sheep have a continuing and increasing role to play in providing meat for the expanding human populations.

IBAR/1981 R.T. WILSON
Population and Production Parameters of Sheep under Traditional Management in Semi-arid Areas of Africa


AUTHOR’S SUMMARY: This paper summarises and compares data on the sheep of 4 societies, the Baqara of western Sudan, the Afar of Ethiopia, the Bambara of Mali and the Masai of Kenya. The parameters considered are demographic structure of the population by sex and age, population morphology, growth from birth to maturity and a comparison of output at the level of both the breeding ewe and of the flock.

In both individual and flock output the Baqara sheep were superior, the Afar achieving second place in flock output due to a relatively high percentage of breeding females.

IBAR/1981 B.A.J. MWANDOTTO
Comparison in Milk Yield of Sahiwal, Friesian and Friesian X Sahiwal Crosses Under Extensive Management in Naivasha, Kenya.


AUTHOR’S SUMMARY: One hundred ninety-two lactation yield records taken for three lactations from 1973 through 1977 for Sahiwal, Friesians and Friesian X Sahiwal crossed under an extensive grazing system at Naivasha were analysed.

The Friesian produced significantly more milk than the Sahiwal in the first, second and third lactations (P < 0.001). The Friesian X Sahiwal also produced significantly more milk than the Sahiwal in the first two lactations (P < 0.01) but not in the third lactation. The Friesian X Sahiwal produced significantly more milk than pure Friesian only in the first lactation (P < 0.05).

IBAR/1981 N. McHARDY
Serological Responses to Bovine Anaplasmosis Following Treatment with Glloxzone


AUTHOR’S SUMMARY: Groups of unsplenectomised steers and calves were infected with either the Onderstepoort or Sukari 1 strain of Anaplasma marginale by the injection of infected blood. The infections were treated with glloxzone (2.5-25 mg/kg). The serological response of the animals was monitored by the complement fixation (CF) and capillary
tube agglutination (CA) tests, using antigens prepared from the Ondersteapoort strain. CF antibody responses were alike in both strains. The titre rose rapidly from four days after infection to a peak around the time of the initial crisis. The high titres were maintained, and generally did not rise further at the time of recrudescence of parasitaemia. CA antibody appeared 7-10 days after infection and reached a peak shortly after the initial crisis. Titres fell as parasitaemia was reduced following gloxazone treatment, then rose as parasitaemia recrudesced. There was a close correlation between the effectiveness of gloxazone treatment and changes in CA antibody titre.

Anthelmintic Activity of Oxfendazole in Pigs


AUTHORS' SUMMARY: Eighty-five young pigs were artificially infected with Hystrongylus rubidus, Oesophagostromum species and Ascaris suum. On days 2, 10 or 51 after infection groups of six were treated with oxfendazole premix in food at various dose rates. Subsequently the pigs were slaughtered for comparative worm counts to be made in treated and control animals. The efficacy of treatment against hystrongylus worms of increasing age was 68, 57, 99.8 and 100 per cent after a 3 mg per kg dose, 75, 75, 99.8 and 100 percent after a 4.5 mg per kg dose and 81, 83, 99.8 and 100 percent after a 6 mg per kg dose. In the case of Oesophagostomum species the corresponding figures were 78, 100, 100 and 100 percent efficacy after a 3 mg dose, 93, 100, 100 and 100 percent after a 4.5 mg per kg dose and 91 99, 100 and 100 percent after a 6 mg per kg dose. Ascaris infestation established too poorly for significant results to be obtained. It is concluded that a dose rate of 4.5 mg oxfendazole per kg bodyweight should give practical control of Hystrongylus and Oesophagostomum species in pigs.

IBAR/1981 A.I. ADETOYOYE
81 Infective Drug Resistance Among Eschericia Coli Isolated from Clinically Healthy Domestic Livestock


AUTHOR'S SUMMARY: A total of 414 Escherichia coli isolates from faecal swabs of clinically healthy kids, piglets, chickens, calves and lambs was tested for drug resistance, and for transferable drug resistance to eight antimicrobial agents. One hundred and twenty-nine isolates (31.15%) transferred part or whole of their resistance determinants to a sensitive recipient. Chloroamphenicol resistance was not common; only three of the 13 chloramphenicol resistant isolates transferred their resistance to E. coli J5 K12. Of the 19 resistance patterns seen, OTUS resistance, which occurred in 104 (25%) of the isolates was not common. It is suggested that an antimicrobial drug like furazolidone should be substituted for the tetracyclines as a feed additive.

IBAR/1981 Ph ARCHIMBAULT, C. BOUTIER, R. FELLOUS and G. MUSCAT
82 A Pharmacocinetic Study of Colistin in Cattle

Rec. Med. Vet. 1980, 156 (9), 621-626

AUTHORS' SUMMARY: The authors undertook a study of blood distribution of Colistin after administration of the antibiotic, in dairy cows and calves, in the form of colistin methane sulphonate. The results obtained allowed the calculation of pharmacocinetic parameters corresponding to a model with an open extravascular compartment. The passage of the antibiotic in the milk was also the subject of research. Oral administration of colistin sulphate in calves allowed us to confirm the absence of any passage of the antibiotic across the barrier of the gastro-intestinal tract.
IBAR/1981 KANAGAWA HIROSHI
83 One to Two Day Preservations of Bovine Embryos


**AUTHOR’S SUMMARY:** Twenty morula stage bovine embryos were grouped into 2 categories and preserved: 8 morulae in room temperature (20-25°C) and 12 morulae in low temperature (4-5°C) for 1 to 2 days, then transferred to 8 recipient heifers. The recipient heifers were selected in the same stage of estrus as the donor. Five recipient heifers received 2 embryos, and 3 recipient heifers received 3-4 embryos. Three out of the 4 recipient heifers which received embryos preserved for 1 day at room and low temperatures became pregnant. However, there were no pregnancies observed in the 4 recipient heifers which received embryos preserved for 2 days, although the embryos looked normal morphologically.

IBAR/1981 BEDFORD, P. G. C.
84 The Clinical and Pathological Features of Canine Glaucoma

*The Veterinary Record, 1980, 107 (3): 53–58*

**AUTHOR’S SUMMARY:** In the canine species glaucoma usually presents itself as an acute condition, and the clinical and pathological features are constant in the vast majority of patients. However, variations in the degree of involvement are seen, and the presenting clinical picture together with the extent of associated pathological change are directly related to the amount of aqueous humour outflow impairment and the duration of the glaucomatous state.

IBAR/1981 HINTON, M.
85 Veterinary Problems in a Colony of Rabbits used to Feed Tsetse Flies.


**AUTHOR’S SUMMARY:** Pasteurellosis was the most important disease syndrome encountered in a colony of rabbits maintained for feeding tsetse flies (Glossina spp.). There was also a high incidence of renal amyloidosis in the rabbits used for this purpose for more than nine months. In all, over 20 disease conditions were identified in 103 rabbits examined post mortem. Coccidiosis was not a clinical problem although its treatment, like that of bacterial infections, must be approached with caution as the administration of antibiotics and chemotherapeutic drugs to the mammalian host may render the tsetse fly sterile.

IBAR/1981 H. LEHN-HENSEN
86 Bovine Egg Transplantation Preservation of Embryos


**AUTHOR’S SUMMARY:** The original method of embryo storage involved very slow rates of cooling and thawing, but current techniques for rapid thawing and two step freezing are being developed which have greatly simplified the whole embryo storage procedure. Good survival and pregnancy rates can be achieved after thawing and removal of cryoprotectant and transfers of frozen/thawed bovine embryos to heat synchronized recipients.

IBAR/1981 I. KARLSON, S, EINARS-87 SON, L.E. EDQVIST and L. GORANSSON
Effects of HCG with Oestradiol Benzoate on the Luteal Function


**AUTHORS’ SUMMARY:** Human chorionic gonadotrophin (HCG) combined with oestradiol benzoate was tested for induction and synchronization of heat in gilts. Judging from the progesterone levels in the blood, several of the gilts were already exhibiting spontaneous oestrus cyclicity on the day of treatment. Only gilts with low blood progesterone levels on the day of treatment showed standing oestrus
within the expected time. On the basis of the results a second trial was carried out to elucidate the influence of the hormone compound on the ovarian activity in gilts during the luteal phase.

AUTHORS' SUMMARY: In this study, the Authors describe the techniques for pregnancy diagnosis per rectum in the cow.

The periods when cattlemen require accurately timed pregnancy diagnosis usually fall between 35 and 120 days. During these periods, quite precise estimations of duration of gestation can be made by measurement of the amnion and later the fetal head. Size of placentomes and estimations of fetal length can also be of some value during these times. During early pregnancy, the size of the pregnant horn can be of value although it is not as precise as the other methods. During later stages of pregnancy, the size of the middle uterine arteries, and fetal parts such as the feet are of value. However as the length of gestation increases, accuracy in timing decreases.

IBAR/1981 L. BALL and E. PAR-88 MIGIANI
New Aspects of Manual Pregnancy Diagnosis in the Cow

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