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Whenever possible articles should take the following structure: (1) title (2) name(s) and address(es) of author(s) (3) Summary (4) Introduction (5) Material(s) and Method(s) (6) Results (7) Discussion (8) Acknowledgement (9) References.

Papers should be typewritten on one side of the paper only in English or French. Double line spacing and adequate margins are desirable. The original and one carbon copy are required.

Papers are accepted on the understanding that they are subject to minor editorial revision to conform with the general principles of format adopted by the Bureau.

The title should be concise. The initials and name of author(s) without professional qualifications should be followed by the title of his post and the organisation and country in which the work described was carried out.

Papers should contain a summary, which should be factual, should convey the contents of the paper and should draw attention to new information and to the main conclusions.

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.

Bibliographical references should be listed in alphabetical order of first author or country (if annual report) at the end of the paper, and not numbered. Only those cited in the text should be included. References cited in the text should be inserted, as e.g. (Richards 1950) or "Richards (1950) showed".

If the same author is cited more than once, his publications should be arranged in chronological order in the list of references, and if more than one publication of the same author in the same year of publication is included, the letters "a, b, c" should be added after the date in both the list of references and in the text.

References should include, in the following order, surname, initials of author(s), year of publication (in parentheses), World List abbreviation of title of periodical (dotted underline), volume number (arabic numerals underlined), first page number. The title of the article should not be included.

References to books should include name and initials of author(s), year of publication (in parentheses), the exact title (underlined), town of publication, page number (if page number specifically cited).

References to annual reports should state the country, year of reference, followed by the name of the department or organisation, e.g. Kenya (1955) An. Rep. Dept. Vet. Services, p. 50 (if specific page cited).

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COMPARATIVE STUDIES OF MILK YIELD OF IMPORTED HOLSTEIN AND INDIGENOUS WHITE FULANI (BUNAJI) ZEBU CATTLE IN THE TROPICS

J.A. IBEAWUCHI,
National Veterinary Research Institute, Vom, Nigeria.

Summary: One hundred and sixty completed lactations of 30 imported purebred Holstein and 120 lactation records of 27 White Fulani cows were analysed. Both breeds were maintained on the National Veterinary Research Institute Farm, Vom from 1950 through 1964.

Holstein heifers calved at a mean age of 28.3 months while the Zebu were 42.3 months old at first freshening. Average milk production from 1st through 5th lactation for Holstein were 2672 ± 103.1, 2542 ± 104.9, 2779 ± 108.7, 2740 ± 110.4 and 2821 ± 142 kg, respectively. The White Fulani averaged 809.4 ± 80.3, 868.8 ± 96.6, 1701.4 ± 128.7, 864.4 ± 65.7, and 1632 ± 125.7 kg in the same order. Holstein and White Fulani cows attained peak milk production in the 4th and 3rd lactations respectively. The 1st lactation of Holstein and the 5th lactation of Zebu were longer (P<0.05) than the other lactations. First calving interval extended to 484.9 and 352.7 days in the Holstein and Zebu, respectively which were longer (P<0.05) than subsequent lactations. Both breeds had longer first dry period which, in the Holstein, was significantly (P<0.05) longer than the subsequent dry periods. Sixteen or 53.3% of the Holstein attained an average of 5 lactations as against 77.8% of the local breed.

Good feeding and management were suggested as measures that could reduce age at first calving.

Introduction

Holstein and other cattle of European origin with high production potential have been imported into the tropics and used either to upgrade the local breeds or maintained as pure breeds. Production performance of Holstein cattle in tropical and sub-tropical regions has been documented. Age at first calving varied from 27.4 to 39.6 months (Verde, 1972; Bhat et al., 1978; Adeneye and Adebajo, 1978). Milk yield also showed considerable variation from 2nd through 4th lactation (Adeneye and Adebajo, 1978). Bhat et al., (1978) reported an average of 4,500 kg milk yield in a 305-days lactation while less than 3,000 kg was recorded by Ragab and Asker (1959). First calving intervals in Holstein and other breeds were longer than the subsequent ones (Traill and Marples, 1968; Phipps, 1974; Wilson and Willis, 1974).

There is very little attempt (Knudsen and Sohael, 1970) made to ascertain the lactational performances of the Holstein heifers imported into Vom over the years. The aim of this paper is therefore to compare the lactational ability of both the Holstein and White Fulani cows in the tropics.

Materials and Methods

The materials used in this study were obtained from records of a herd of Holstein cows imported as heifers from Britain between 1950 and 1964. These cows were maintained at the National Veterinary Research Institute, (NVRI), Vom. One hundred and sixty completed lactations from this exotic breed were studied along with 120 lactation records of White Fulani (Bunaji) Zebu cattle maintained under similar conditions.

The climate and geographical location of Vom has been described (Knudsen and Sohael, 1970). Vom is located at 8° 45' East and 9° 43' North at an altitude of 128 m. The area is tsetse fly free. The average rainfall ranges from 1300—1500 mm and extends from late March to early October. The high altitude provides a climate suitable for dairy cattle production. The animals were reared out-doors in paddocks. During the wet season (April – September), the animals were rotationally
grazed in paddocks sown mainly to *Cynodon nlemfuensis* var *robustus*. In addition, milking animals received dairy concentrate supplement in two equal instalments during the morning (06.00 hours) and afternoon (15.00 hours) machine milkings. The allowances fed were adjusted weekly on the basis of the average daily fat-corrected milk yield of each cow recorded in the proceeding week. In the dry season (October—March), maize silage and hay mainly *Digitaria exilis* stapf. were offered free-choice. All the animals were sprayed against exoparasites and inoculated against rinderpest, anthrax, blackquarter haemorrhagic septicaemia, and foot and mouth disease. Breeding was by natural service with pure-bred Holstein bulls.

Analysis of variance of the data was done (Steel and Torrie, 1960). Means were compared by Duncan’s Multiple Range Test (Duncan, 1955). Lactations that were less than 50 days were excluded from the analysis.

### Results

**Season of calving**

Calving in both breeds occurred throughout the year. However, it was most frequent in the months of February (18.3%) and October (13.8%) for Holstein and Zebu, respectively. In the months of January—March, April—June, July—September and October—December of 1950-64 period, 41.4, 21.2, 16.9 and 20.4% of the calving, respectively occurred in the Holstein herd. The corresponding figures of 42.4, 18.8, 13.8, 25% were obtained for White Fulani. The two breeds freshened more in the dry season than in the wet season.

**Age at first calving**

The average age at first parturition was 28.3 and 42.3 months in Holstein and Zebu, respectively.

**Milk Production**

Sixteen or 53.3% of the 30 imported animals and 77.9% of the Zebu attained an average of 5 lactations. Mean lactation milk yields are presented in Tables and 2. Peak production was reached in the 4th lactation in Holstein and the 3rd lactation in local cattle. Differences in lactation lengths were not significant (P > 0.05) in the Zebu. They were different (P < 0.05) across lactations in the Holstein. The 2nd and 4th lactation milk yields were similar in the Zebu.

**Calving Interval and Dry Period**

Calving intervals of both breeds of cattle are shown in Tables 1 and 2. The first calving intervals of 484.9 days in Holstein and 352.7 days in the Zebu were longer (P < 0.05) than the subsequent ones in both breeds. Similarly, the first lactation dry period was longer (P < 0.05) than those of later lactations in the Holstein. In the Zebu, the dry periods were not different (P > 0.05).

**Discussion**

The Holstein cattle in the present study were much younger at 1st, 2nd, 3rd, 4th and 5th parturitions than those reported by Adeneye and Adebajo (1978) and Bhat *et al.*, (1978) for the same breed in Western Nigeria and India, respectively. However, the figure of 28.3 months at first calving was higher than 27.4 months reported by Verde (1972) in Florida, but close to the figure of 28.7 months obtained by Knudsen and Sohael (1970) in Nigeria. When temperate cattle are transferred to the tropics, there is an increase in age at first calving. This was observed by Lahouse (1962) with Friesian cows in Zaire. Age at first calving is not heritable (Sayer, 1936; Mahadevan, 1953; Larson *et al.*, 1951). It is much influenced by the environment, especially nutrition and management which are lacking in most of the tropics. The White Fulani herd calved at a much older age than the Holstein herd. The figure of 42.3 months at first calving in this study was lower than 51.3 and 51.7 months for Ankole and Zebu cattle in Uganda, respectively (Sacker and Trail, 1966) and 49.4 months for the same breed in Nigeria (Knudsen and Sohael, 1970).
<table>
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<sup>n</sup> = Number of observations,  
<sup>x</sup> = Mean,  
<sup>SE</sup> = Standard Error  
<sup>abcde</sup> Means on the same line with unlike superscripts are different (P < 0.05).
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n = number of observations,

x = Mean,

SE = Standard Error

<sup>a</sup><sup>b</sup><sup>c</sup><sup>d</sup><sup>e</sup> Means on the same line with unlike superscripts are different (P < 0.05)
Average milk yields from 1st through 5th lactation were higher for the Holstein than for the Zebu. Milk yield by the Holstein (2,672–2,821 kg) was similar to the figures obtained by Ragab and Asker (1959), but higher than the figures reported by Knudsen and Sohael (1970) and Adeneye and Adebakjon (1978). The longer lactation length (291.4 days) might partly be responsible for the higher milk production.

Peak production was reached in the 4th lactation by the exotic breed and in the 3rd lactation by the Zebu. Adeneye and Adebakjon (1978) also recorded peak production in the 4th lactation in the Holstein.

However, earlier reports indicated that Holstein attained peak yield in the 3rd lactation (Shaheffer and Henderson, 1972; Bhat et al., 1978). The prevailing conditions of food supply within a year could influence peak yield. Rainy season is characterised by availability of good quality forage unlike the dry season. Also during the period under review, streptothricosis was prevalent. The Zebu exhibited greater resistance than the Holstein. Reduction in milk depends to a large extent on the length and severity of attack. The disease condition could have affected peak milk yield. In this country, no reliable and adequate measures so far have been found for streptothricosis. The attack which is normally common in the rainy season has caused losses of many exotic animals of all ages.

The first lactation was longer than the later ones in the Holstein. Differences in lactation lengths were significant (P < 0.05) in the Holstein. The Holstein cows were milked for shorter period than those reported in Uganda by Trail and Marples (1968). Differences in lactation lengths in Zebu were not significant (P > 0.05). However, the 5th lactation was relatively longer than the others.

Heat stress, especially in the dry season could have affected milk production. Feed intake could be reduced and this might probably cause a decrease in nutrient supply and consequently lower-
Received for publication on 22nd August, 1983

HEMATOLOGIC PARAMETERS OF ZEBU CATTLE ON DIFFERENT PROTEIN LEVELS AND THEIR RELATION TO RATE OF GAIN

E.O. OYEDIFE, D. SAROR*, D.I.K. OSORI* and O. AKEREJOLA*,

Summary: Sixty Zebu heifers aged between 10-12 months and weighing approximately 150 kg each were divided into three equal groups and fed for 12 months isocaloric diets containing different levels of protein. The protein levels were 19.2 per cent (high), 13.4 per cent (medium-NRC recommendations) and 8.3 per cent (low). Body weights and blood samples were taken at monthly intervals. The average daily gains were 0.47 and 0.36 kg for the high and medium protein groups which differed significantly (P < 0.01) from the low protein group (0.14 kg). Packed cell volume and hemoglobin values showed consistent differences between treatment groups at the different sampling times; the values for the low protein group were lower (P<0.05) than the high protein group at all sampling times. Total plasma protein levels were not consistently different between the high and low protein groups. The level of protein intake had no significant effect on white blood cell counts. Average daily gain in weight within treatment groups did not correlate (P > 0.05) with each of the hematologic parameters, indicating that the latter were not useful indicators of weight gains in this breed off cattle. The results confirm previous observations that hematologic values obtained for Zebu cattle are influenced by nutritional and management factors.

Introduction

Monitoring of hematologic parameters of animals can provide useful information on their current health status. The metabolic systems involved in the physiology of growth and reproduction are also dependent on some of the blood components (Roubicek et al., 1968).

Nutritional influences on hematologic parameters have been reported by Greig and Boyne (1956) and Hewett (1974). Observations by Schultz (1955), McDonald et al., (1956), Luitingh (1962) and Stufflebeam et al., (1969) have shown correlations between certain blood components and rate of weight gain. Contradictory results have also been published (Arthaud et al., 1959, Roubicek et al., 1968). Saror and Coles (1975) attributed lower packed cell volume and hemoglobin values in Zebu cattle to lower nutritional status.

The present studies were undertaken to evaluate the influence of different levels of nutrition on the hematologic parameters of Zebu cattle indigenous to Nigeria, and to monitor the changes in these parameters in relation to rate of weight gain.

Materials and Methods

Sixty Zebu heifers between ten and twelve months of age and weighing approximately 150 kg each were involved in the study. Prior to the experiment, heifers were reared under range conditions and were given small amounts of supplementary concentrates while availability of water was scanty.

The heifers were divided equally into three nutritional groups and fed isocaloric rations (Table 1) varying in protein levels viz High protein (HP), Medium protein (MP) and Low protein (LP). The medium protein ration was formulated based on National Research Council requirements designed to gain 0.5 kg/head/day. In relation to the MP ration (100%), the HP and LP rations contained 150% and 40.9% crude protein, respectively. All animals were fed individually in single pens throughout the duration of the study. Daily dry matter consumption averaged 3.5 kg/head/day. Drinking water was

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provided ad libitum. Planned routine deworming and vaccination programs were carried out before and during the study. The experimental animals were weighed individually at monthly intervals. Average daily gain (ADG) for liveweight was calculated.

Blood samples were collected from individual animals one month before commencement of study, at the beginning of the study and at monthly intervals thereafter for 13 months. The blood samples were collected via jugular venipuncture into vacutainer tubes containing an anticoagulant, disodium salt of ethylene diaminetetraacetic acid (EDTA).

Hemoglobin (Hb), packed cell volume (PCV), red blood cells (RBC), white blood cells (WBC) and total protein (TP) were determined using routine laboratory procedures (Coles, 1967, Saror and Coles, 1973).

A statistical package (Nie et al., 1975) comprising an analysis of variance (ANOVA), Duncan's multiple range test and least significant differences was used in the analysis of data obtained in this study. Multiple correlation analyses (Steel and Torrie, 1960) were done within groups to check the relationship between different parameters.

Results

The average (± standard error) daily gain in weight were 0.49 ± 0.06, 0.36 ± 0.02 and 0.14 ± 0.06 kg for the high, medium and low protein groups, respectively. Differences in the average daily gain for the high and medium protein groups were not significant (P > 0.05). However, average daily gains for the high and medium protein groups were higher (P<0.01) than for the low protein group.

Packed cell volume (PCV) and hemoglobin (Hb) values (Figures 1 and 2) for all the groups declined initially and then increased beginning from 2 months after commencement of the study. Packed cell volume and Hb values showed consistent differences between treatment groups (Table 2) at the different sampling dates; the values for the low protein group were lower (P<0.05) than for the high protein group at all sampling dates while values for the medium protein group were intermediate (Figures 1 and 2). There were generally no significant differences (P>0.05) in the PCV and Hb values for the high and medium protein groups.

There were no significant differences (P>0.05) in the white blood cell counts between the three nutritional groups except at one sampling date only.

Table 1: Composition of rations used in the study

<table>
<thead>
<tr>
<th>Components (%)</th>
<th>Protein level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Maize Silage</td>
<td>66</td>
</tr>
<tr>
<td>Maize gain</td>
<td></td>
</tr>
<tr>
<td>Undelinted Cotton Seed</td>
<td>32</td>
</tr>
<tr>
<td>Supplements</td>
<td>2</td>
</tr>
<tr>
<td>Metabolisable energy (Mcal/kg)</td>
<td>2.61</td>
</tr>
<tr>
<td>Crude Protein %</td>
<td>19.17</td>
</tr>
</tbody>
</table>

X Vitamin and trace mineral premix, Zoodry VM 701, F. Hoffman — La Roche and Co. Ltd., Basle, Switzerland, and Pfizer mineral block
|     | Group (g) | Number of animals
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>with each group = 20</td>
</tr>
</tbody>
</table>

*Means with different superscript(s) within each row differ (p < 0.05).

**Hematological Parameters of Zebu Calves on Different Protein Levels**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Low (g/m³)</th>
<th>Medium (g/m³)</th>
<th>High (g/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hb (g/dl)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCV (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of trial (months)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

- **Low** refers to the lowest protein level.
- **Medium** refers to the medium protein level.
- **High** refers to the highest protein level.
- **Hb** is the hemoglobin level.
- **PCV** is the packed cell volume.
- **Time of trial** indicates the time at which the measurements were taken.

**Table 2:** Means and standard deviations for packed cell volume (PCV), hemoglobin (Hb), and total protein (TP) of Zebu heifers.

*On various levels of protein intake.*
Fig. 1: Mean packed cell volume of Zebu heifers on different levels of dietary protein intake

Fig. 2: Mean haemoglobin values of Zebu heifers on different levels of dietary protein intake
Total plasma protein concentrations (Table 2) for the high and medium protein groups were higher (P <0.05) than for the low protein group only at 2, 3, 7 and 13 months after commencement of the study.

Correlations between ADG with PCV, Hb and total protein (Table 3) were generally non-significant. By the 13th month however, the correlation coefficients of ADG with PCV, Hb and TP were 0.58, 0.53 and 0.56 respectively, for the low protein group, and were highly significant (P<0.01).

Correlations between plasma total protein with PCV and Hb (Table 4) were positive but not consistently significant for the high and medium protein group up to 9 months after commencement of the study. Thereafter, correlations between plasma total protein with PCV and Hb were positive and highly significant (P<0.01) for the medium protein group till the end of the experimental period. Positive and significant correlations of total plasma protein with PCV and Hb for the low protein group were observed at approximately 3 month intervals (Table 4).

**Discussion**

Data obtained in the present study show that a reduction in the protein level in the feed results in reduced haemoglobin, packed cell volume and serum protein values of Zebu heifers. The differences in values for the hematologic parameters for the treatment groups generally followed that of the protein content in the feed. The latter might confirm a nutritional effect on the hematologic values. These observations are in agreement with those of Bedrak *et al.*, (1956, 1957), Hewett (1974) and Manston *et al.*, (1975) who reported that Hb and PCV were influenced by feeding levels and by protein content in particular. In studies by Nomani and Evans (1972), PCV was raised in growing steers by increasing nitrogen intake.

The cause of the sudden decline in the hematologic parameters for all the treatment groups following the introduction of the diets, is not known. This might be due to hemoconcentration when animals were under range conditions prior to the start of the experiment.

There were also occasional slight fluctuations in the hematologic values occurring usually at the same sampling dates for all the groups. The reason for the latter is unclear but might be due to other environmental factors which influence hematologic parameters.

Results on the white blood cell counts are in agreement with those of Bedrak *et al.* (1957) who observed no consistent association between level of protein intake and variations in leucocyte counts. In studies by Stufflebeam *et al.* (1969) varying energy intake, however, significantly affected total leucocytes, neutrophil and lymphocyte counts.

Significant differences between total plasma protein values for the groups were observed at only 3 sampling dates and seem to have occurred at intervals. The latter is in close agreement with reports by Madden and Whipple (1940) and Wright *et al.* (1962) who showed that during times of severe dietary inadequacy, body tissue protein may be mobilised. Thus, there may be a loss in the body conditions of heifers even with normal levels of circulating plasma protein.

Correlations between average daily gain in body weight and hematologic parameters were generally low and non-significant for the high and medium protein groups. By the 13th month of the experimental period, correlations of average daily gain with PCV, Hb and TP were high and significant for the low protein group. This would indicate that PCV and Hb may be used as indirect indices of liveweight gain under conditions of prolonged low protein intake. More consistent and significant correlations existed between plasma total protein with Hb and PCV for the three nutritional groups. This latter observation tends to confirm that level of protein intake is closely associated with PCV and Hb (Saror and Coles, 1975). Values for PCV and
| High     | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Medium | Low | Maximum of 4 months)

**Table 3:** Correlations (r) of ADC with PCV, HB and TP at different time for varying levels of protein intake.
Table 4: Correlation (r) of total protein with PCV and HB at different times for varying levels of protein intake.

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>Hematological Parameters of Zebu Cattle on different protein levels</th>
<th>135</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Medium High Low Medium High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TFP VS HP</td>
<td>TFP VS PCV</td>
<td></td>
</tr>
</tbody>
</table>

Correlation coefficients within each treatment group (n = 20)

* xx Significant (p > 0.01)

x Significant (p > 0.05)
Hb obtained under field conditions may therefore be good indicators of the nutritional status of Zebu herbs.

Acknowledgement

We are grateful to Mr. O. Ogundare, Department of Animal Reproduction, N.A.P.R.I., Zaria, Nigeria for his technical assistance and Prof. V. Buvanendran, Breeding Section, Department of cattle production, N.A.P.R.I., Zaria, for the statistical analyses.

References


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NUTRITIONAL OSTEODYSTROPHIA FIBROSA IN RACE HORSES IN THE SUDAN

M.H. Tageldin, E.Y. Shadda* and T.T. Yasin
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Summary: Osteodystrophia fibrosa was reported in three brood mares and two foals which had been maintained on a mixture of sorghum and bran for 1-2 years. A complete haemogram and blood chemical changes associated with the condition, including alkaline phosphatase, calcium and phosphorous had little diagnostic value. The condition was confirmed by feed analyses and histopathological findings.

Introduction

Osteodystrophia fibrosa is principally a disease of horses and other equidae. It is nutritional, occurring either in animals fed on a ration containing a relative excess of phosphorous in proportion to the amount of calcium (Joyce et al., 1971), or grazing on pastures that contain grasses with high oxalates (Walthall and McKenzie, 1976).

In this report, we record the first cases of osteodystrophia fibrosa in race horses in the Sudan. The clinical, biochemical and pathological findings were discussed.

Clinical findings

This condition was encountered on the outskirts of Khartoum. In this farm three groups of horses were raised. The first group consisted of 20 under-training horses which was fed on sorghum (15 lbs per animal). The second group (12 yearlings) was kept in a yard and maintained on sorghum and bran in separate containers for a period of 1-2 years, but only two showed the symptoms. While the third group (three brood mares) had been given a mixture of sorghum and bran (15 lbs per animal) and all of them exhibited the clinical manifestation of the condition. Alfalfa was supplied to all animals in the farm in undetermined quantities.

Case 1

A four years old, cross-bred female that was kept with other foals in pool in a yard. Since October 1978 she had been maintained on grain and bran separate containers. The exact amount of this supplement was unavailable. In November 1979 it showed radial paralysis in the right forelimb, general weakness and poor physical condition which rendered it unable to fight for the grain (sorghum) and concentrated on the bran. In January 1980, she manifested an insidious shifting lameness. A few months later, the rib cage lacked the normal curvature and appeared to be unusually flat-sided. Swelling of the bones of the head was first observed as enlargement of the nasal bone above the facial crest (Fig. 1). The horizontal borders of the ramus of the mandibles were thickened and irregular. No thickening of the bone was seen elsewhere. The thickened bone was firm but unlike bone and digital pressure elicited pain. A serious nasal discharge was observed. The filly was recumbent for two months and died in August 1980.

Case 2

A nine years old, Sudan-bred mare (Western Sudan). She won two races and in December, 1977 delivered a filly (case 1) from one service. She was fed on a mixture of sorghum and bran

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Fig. 1: Shows lack of normal curvature of the rib cage and swelling of the maxilla and nasal bones

(15 lbs daily). In June 1980, the mare showed severe lameness in the right hind limb; slight swelling was detected immediately above and below the fetlock and pastern joints. She delivered a normal foal in August 1980, but remained recumbent with decreased milk yield, she was treated with calcium glucose and vitamins for 4 days and she returned to normal milk yield. Later she developed swelling of the jaws and reduction of the intermandibular space. Bilateral swelling of the nasal and frontal bones was very pronounced. She died in October 1980.

Case 3 and 4

Cross-bred, brood mares 6 and 7 years old. They were fed on a mixture of sorghum and bran (15 lbs per animal daily) for two years. During April 1980, both of them showed severe lameness, incoordination and bilateral swelling of the frontal and maxillary bones. They were weak and cachectic. Both of them died during October 1980.

Case 5

A two and a half years old cross-bred female, was kept with the group fed on sorghum and bran separately for 18 months. The feed was changed to a ration with balanced calcium and phosphorous. Two months later, the animal developed severe lameness, bilateral swelling of the nasal and frontal bones, respiratory distress, recumbency, severe emaciation and anaemia. It died two months after the onset of these clinical manifestations.

Biochemical Findings

A blood sample in EDTA and another for serum were collected from the jugular veins of healthy (5 animals) and affected horses.

For haematological investigation, haemoglobin values (Hb), packed cell volume (PCV), red blood cells (RBC) and white blood cells (WBC) were determined according to Schalm et al. (1975). There were no significant differences between the healthy and affected horses.

Serum alkaline phosphatase (SAP) was measured by the method of Kind and King (1954). No significant differences could be detected between the healthy and affected ones.
Inorganic phosphorus was determined by the method of Varley (1969) while the calcium and magnesium were measured by Atomic Absorption Spectrophotometer (Sp. 190 and 2900 Series, Cambridge, England). The calcium and phosphorus displayed no significant differences between the two groups.

The feed samples were collected at random from the manger of two affected animals. The ratio of bran to sorghum was unavailable. Atomic Absorption Spectrophotometer (Pye Unicam 191 Series, 1972) was used for the analysis of the feeds. Calcium and magnesium absorbence were read in the same instrument after dilution and chelation with lanthanum chloride. Phosphorus concentration was read in a UV Spectrophotometer. Phosphorus content was 5 times that of calcium in both feeds (Table 1).

**Pathological Findings**

Only two heads of dead affected brood mares were submitted for examination. Both of them showed bilateral swelling of the frontal and nasal bones (Fig. 2). The intermandibular space was reduced because of the thickening of the alveolar margins of the mandibles. The heads were sectioned longitudinally into two halves. The swollen bones yielded to pressure. The nasal passages were reduced as a result of the swelling of the palate. Some of the teeth were loose and partially buried.

Representative portions of the swollen bones were fixed in 10% formal saline, embedded in paraffin wax, sectioned (without decalcification) and stained with haematoxylin-eosin (H & E), Van Kossa and Massons trichrome stains.

Histopathologically, the osseous tissue was reduced to small fragments (Fig. 3) surrounded by extensive proliferating fibrous connective tissues. Numerous osteoclasts were seen (Fig. 4). Haemorrhages were observed in some areas while other areas were highly vascular. Collagenous fibrous tissue was seen in many areas.

**Table 1. Result of analysis of two feed samples on dry matter bases**

<table>
<thead>
<tr>
<th>Feed No.</th>
<th>Ash %</th>
<th>Protein %</th>
<th>Oil %</th>
<th>Mg Mg%</th>
<th>Ca mg%</th>
<th>P04 mg%</th>
<th>CaP04 Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box 1</td>
<td>4.97</td>
<td>16.35</td>
<td>3.46</td>
<td>0.35</td>
<td>0.14</td>
<td>0.72</td>
<td>1:5</td>
</tr>
<tr>
<td>Box 2</td>
<td>5.22</td>
<td>13.12</td>
<td>3.44</td>
<td>0.35</td>
<td>0.14</td>
<td>0.72</td>
<td>1:5</td>
</tr>
</tbody>
</table>
Fig. 3: Note fragments of osseous tissue surrounded by extensive proliferative fibrous tissue. H & E x 100.

Fig. 4: Shows several osteoclasts and haemorrhage surrounded by connective tissue. H & E x 400.
Discussion

The brood mares and foals as idle animals had been fed on a ration comprising mainly bran which had high phosphorus and low calcium, in an attempt to reduce the cost. Besides they did not receive proper calcium supplementation. Hence, nutritional secondary hyperparathyroidism was induced that led to osteodystrophia fibrosa. The high demand of these animals for calcium appears to be a major predisposing factor.

In the pregnant mare, the foetus had not been affected by this imbalance because of the compensatory effect of the dam's parathyroid hormone. One foal developed the condition two months after the unbalanced ration was stopped. It is difficult to understand why this animal showed evidence of the clinical symptoms. It is possible, however, that the poor state of this particular animal had contributed to the development of this condition.

Osseus resorption and accumulation of soft tissue was exaggerated in the skull because of the great mechanical stress. The condition was irreversible, since all affected animals did not show significant progress after the feed was stopped and finally they died as a result of suffocation and/or inability to eat.

Our results support the previous findings (Joyce et al., 1971 and Watt-}

hall and McKenzie, 1976) that laboratory analysis of serum calcium, inorganic phosphates and alkaline phosphatase activity have limited value in confirming the diagnosis of this condition in horses. Diagnosis off the osteodystrophia fibrosa was based on feed analysis, clinical signs and pathological findings. Haematological analysis proved to have no diagnostic value in such cases.

Acknowledgements

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References


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POULTRY MANURE AS A FEEDSTUFF FOR RUMINANTS: I. EFFECT OF AIR-DRYING, OVEN-HEATING AND AUTOCLAVING ON ODOUR, PATHOGENS AND NUTRIENT LOSSES

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Department of Animal Science, University of Ghana, Legon, Ghana.

Summary: In a study comparing sun-drying, shade-drying, oven-heating (at 90°C) and autoclaving (at 121°C and 1.05kg/cm²) of caged layer manure, bacterial control was best with autoclaving, followed by oven-heating, sun-drying for 30 days and shade-drying for 30 days. *Staphylococcus* and *E. coli* were readily eliminated by all treatments. *Salmonella* and *Klebsiella* species were killed by all treatments, except shade-drying. *Streptococcus*, *Proteus*, *Lactobacillus*, and *Corynebacterium* species were killed by oven-heating and autoclaving, but not by air-drying. *Bacillus* was the most resistant bacterium. None of the treatments was satisfactory however for the control of odour, but autoclaving conserved all the nitrogen in the manure, whilst oven-heating resulted in a decline in crude protein (from 28% to 24%) and air-drying in sun or shade led to 50% loss in N content after 30 days of drying.

Introduction

Poultry manure (PM) has received little attention as a feedstuff in Africa, although it has been reported widely as such elsewhere (Bhattacharya and Fontenot 1965; Anthony, 1971; Gihad, 1976). Poultry manure contains 30% CP and has as much as 70% of its nitrogen content in the form of uric acid which is a superior form of non-protein nitrogen (NPN) for livestock feeding since it generates rumen ammonia (NH₃) more slowly than urea does. It is thus less likely to cause NH₃-toxicity in the animal (Oltjen et al., 1968). The rest of the nitrogen in PM is in the form of preformed protein, and NPN utilisation is known to be enhanced by the presence of preformed protein (Gohl, 1975). Thus, PM is more efficiently utilised by ruminants than other sources of NPN. Furthermore, it contains considerable levels of undigested carbohydrates which can furnish part of the energy requirements of ruminants (Gohl, 1975). However, PM is awkward to handle as a feedstuff on account of its odour, rapid loss of nitrogen (Caswell et al., 1972) and potential pathogen content (Flippot et al., 1975).

In this study conducted during the dry season in this Department, fresh caged-layer chicken droppings were subjected to drying and sterilization by oven-heating, autoclaving and open-air-drying in sunlight and shade in order to determine effect on odour, pathogens and nitrogen losses.

Materials and Methods

Fresh caged-layer excreta, collected from chickens fed on a ration made up of Protein-Mineral-Vitamin Concentrate (25%), Wheatbran (10%), Maize (57%) and Limestone (8%), was either open air-dried, in the sun or shade, spread out on clean polythene sheets on plywood to a depth of 0.5–1.0 cm; or oven-heated at 90°C for 5, 10 and 15 minutes, respectively, in aluminium trays measuring 5 cm x 10 cm x 30 cm with a depth of 4 cm; or autoclaved at 1.05 kg/cm² and 121°C for 10, 20 and 30 minutes respectively.

Pre- and post-treatment samples of the manure were cultured for microbial content (Collins and Lyne, 1970, and Difco, 1965); and similar manure samples were analysed for proximate composition using AOAC (1970). Odour was subjectively assessed by sniffing, before and after the various treatments.
Results

Composition of Fresh Manure: Fresh poultry manure averaged 28.8% dry matter, 27.8% crude protein, 1.1% ether extractives 29.3% nitrogen-free extractives and 28.5% ash (Table 1).

Table 1: Proximate, Calcium, Phosphorus and copper composition of fresh poultry manure (Averages)

<table>
<thead>
<tr>
<th>Component</th>
<th>% Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximate composition</td>
<td></td>
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<tr>
<td>Dry matter</td>
<td>28.8</td>
</tr>
<tr>
<td>Crude protein</td>
<td>27.8</td>
</tr>
<tr>
<td>Ether extractives</td>
<td>1.1</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>13.4</td>
</tr>
<tr>
<td>Nitrogen-free extractives</td>
<td>29.3</td>
</tr>
<tr>
<td>Ash</td>
<td>28.5</td>
</tr>
<tr>
<td>Mineral composition</td>
<td></td>
</tr>
<tr>
<td>Calcium, %</td>
<td>7.0</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>2.5</td>
</tr>
<tr>
<td>Copper, ppm</td>
<td>30.1</td>
</tr>
</tbody>
</table>

Nutrient Losses During Treatment: After 30 days of shade- and sun-drying, per cent dry matter (DM) rose to 90 and 95 respectively. Autoclaving caused no change in DM content while oven-drying raised the DM from 29% to 48% in 30 minutes (Fig. 1, Table 2 and 3). Nitrogen losses occurred during all treatments except autoclaving but other proximate components were stable during all treatments. Sun-drying reduced N content by 50% within 5 days and shade-drying did likewise in 10 days.

Bacterial Counts: Fresh manure contained Bacillus, Corynebacterium, E. coli, Klebsiella, Proteus, Lactobacillus, Salmonella, Staphylococcus and Streptococcus (Table 4). Bacillus was decreased, though not eliminated, after 30 days open air-drying either in the sun or in the shade, while E. coli and Staphylococcus were eliminated. Similarly, sun-drying killed Klebsiella and Salmonella whose counts were reduced but not eliminated by shade-drying. In oven-heating, all bacteria were eliminated after 30 minutes. Traces of Bacillus persisted up to 20 minutes of over-heating. Autoclaving for 10 minutes destroyed all bacteria.

Odour: All the treatments were accompanied by offensive odour during processing. However, malodour was barely discernible after ten days of

<table>
<thead>
<tr>
<th>Table 2: Changes in percent (%) proximate composition of caged layer manure during open air drying</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Fresh manure</td>
</tr>
<tr>
<td>Sun-drying: (days dried)</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>Shade-Drying: (days dried)</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
</tbody>
</table>
Table 3: Changes in percent (%) proximate composition of caged layer manure Autoclaved at 121°C and 1.05kg/cm² pressure or Ovenheated at 90°C

<table>
<thead>
<tr>
<th></th>
<th>DM</th>
<th>CP</th>
<th>EE</th>
<th>CF</th>
<th>NFE</th>
<th>ASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh manure</td>
<td>29.0</td>
<td>28.1</td>
<td>1.07</td>
<td>13.4</td>
<td>28.4</td>
<td>29.1</td>
</tr>
<tr>
<td>Time Autoclaved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 mins.</td>
<td>29.0</td>
<td>28.1</td>
<td>1.07</td>
<td>13.4</td>
<td>28.4</td>
<td>29.1</td>
</tr>
<tr>
<td>10 mins.</td>
<td>28.1</td>
<td>28.1</td>
<td>1.07</td>
<td>13.4</td>
<td>28.4</td>
<td>29.1</td>
</tr>
<tr>
<td>15 mins.</td>
<td>28.0</td>
<td>28.0</td>
<td>1.05</td>
<td>13.4</td>
<td>28.5</td>
<td>29.0</td>
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<tr>
<td>Time Ovenheated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 mins.</td>
<td>29.0</td>
<td>28.1</td>
<td>1.07</td>
<td>13.4</td>
<td>28.4</td>
<td>29.1</td>
</tr>
<tr>
<td>10 mins.</td>
<td>31.2</td>
<td>26.9</td>
<td>1.07</td>
<td>13.4</td>
<td>29.5</td>
<td>29.1</td>
</tr>
<tr>
<td>20 mins.</td>
<td>35.5</td>
<td>25.6</td>
<td>1.08</td>
<td>13.4</td>
<td>30.5</td>
<td>29.4</td>
</tr>
<tr>
<td>30 mins.</td>
<td>48.2</td>
<td>24.0</td>
<td>1.09</td>
<td>13.4</td>
<td>31.8</td>
<td>29.7</td>
</tr>
</tbody>
</table>

Fig. 1: Changes in Dry Matter (DM) and Crude Protein (CP) during open Air drying of caged-layer manure
Table 4: Effect of treatments on Bacterial count

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Bacillus</th>
<th>Corynebacteria</th>
<th>E. coli</th>
<th>Klebsiella</th>
<th>Lactobacillus</th>
<th>Proteus</th>
<th>Salmonella</th>
<th>Staphylococcus</th>
<th>Streptococcus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Manure</td>
<td>++++</td>
<td>+++</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
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<td>+++</td>
</tr>
<tr>
<td>Sodrying for 30 days</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Shadedrying for 30 days</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Overheating 10 mins.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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</tr>
<tr>
<td>Overheating 20 mins.</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Overheating 30 mins.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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</tr>
<tr>
<td>Autoclaving 5 mins.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Autoclaving 10 mins.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Autoclaving 15 mins.</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
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<tr>
<td>Autoclaving NIL</td>
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<td>+</td>
<td>+</td>
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<td>+</td>
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</tr>
</tbody>
</table>
shadedrying and seven days of sun-drying, while being persistent after all periods of oven-heating and autoclaving.

Discussion

The composition was typical of analysis reported in the literature (Bhattacharya and Taylor, 1975; Smith et al., 1978; Smith et al., 1979). However, CP was slightly lower (30%) CP than the 37% reported by Bull and Reid (1971) and 42% by Fontenot et al., (1971). Copper levels were also lower than those reported by Smith and Lindahl (1977) and Bhattacharya and Taylor (1975).

The heat-stability of proximate components other than nitrogen has been reported by Caswell et al., (1972) who oven-heated caged-layer manure at 150°C for twenty minutes at a depth of 0.63 cm. On the other hand, N-losses have been widely reported for various treatments (Surbrook et al., 1971; Gohl, 1975; Pos, et al., 1971; Bhattacharya and Taylor, 1975). These high losses were due to the rapid generation of ammonia from uric acid which constitutes 60-70 percent of the total N in poultry manure (Bhattacharya and Taylor, 1975). Sun-drying resulted in 60% loss of N in 5 days, but shadedrying took 10 days to reach 48% N-loss. This difference may be due to more rapid volatilization of ammonia by the heating effect of sunlight. In contrast with air-drying, autoclaving resulted in no change in N content as ammonia could not easily escape, while in oven-heating some ammonia escaped, thus reducing N levels by 4 points in 10 minutes, 9 points in 20 minutes and 14 points in 30 minutes.

Odour in PM is largely the result of the formation of ammonia, amines, H₂S, indole and skatole compounds by anaerobic bacteria. On the other hand, under aerobic conditions, odourless substances such as CO₂, NO₃ and SO₄ are generated instead (McCalla and Elliot, 1971; Bressler and White, et al., 1971). Thus, open-air drying which permitted free aeration of PM raised few odour problems. In the light of this, the fact that autoclaving and oven-heating had no effect on odour may have been because aeration could not take place to effect oxidation.

Open-air drying killed the bacteria probably mainly by dehydration. Thus, organisms such as Staphylococcus and E. coli which are most susceptible to dehydration were readily eliminated even by shade-drying. In addition to gradual dehydration, Salmonella and Klebsiella needed ultraviolet radiation in solar radiation to be killed and thus were not eliminated under shade-drying. The effectiveness of ultraviolet rays as germicide are well documented (Wheeler and Volk, 1964).

The absolute effectiveness of autoclaving at 121°C and 1.05 kg/cm² pressure in eliminating all bacteria confirms the results of Caswell et al., (1972). This is primarily by denaturation of the bacterial body proteins. Oven-heating to 90°C was a milder heat that Bacillus could survive for 10-20 minutes but not for 30 minutes. The heat resistance of Bacillus has been attributed to sporulation (Wheeler and Volk, 1964). However, sporulation in this experiment was not investigated.

The results confirm the limitations in the use of autoclaving, oven-heating, sun-drying and shade-drying for treating PM for use as a feedstuff. Although nearly all the methods tested were quite effective for bacterial control, only the air-drying methods were suitable and reasonably effective in controlling odour; and in spite of the fact that air-drying gives excessive N-losses, this seems to be the most practical to most farmers, among the methods tested. However, of the other treatment
options with low capital inputs not tested in the present study, ensilage of diets formulated from poultry manure may also offer an alternative convenient method of treating PM for use as a livestock feedstuff. The second part of this study had this as the main objective.

Acknowledgement

The authors are grateful to Merypol Commercial Farms, Achimota, Ghana, for the supply of poultry manure; to Messrs. S.K. Qurrantey, Mama Junah and Abubakar Yacubu for help with the laboratory work and to Mr. James K. Madakena for typing the manuscript.

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References


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ISOLATION, IDENTIFICATION AND CHARACTERIZATION OF STAPHYLOCOCCUS AUREUS FROM CAPRINE PNEUMONIC LUNGS IN NSUKKA AND ENUGU AREAS OF ANAMBRA STATE, NIGERIA.

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Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria

Summary: A total of 200 caprine pneumatic lung specimens obtained from Enugu Veterinary Clinic, Nsukka abattoir and Faculty of Veterinary Medicines, University of Nigeria post mortem room were sampled using standard bacteriological techniques for the presence of staphylococcus aureus. Twenty one coagulase — positive staphylococcus aureus isolates were recovered. Further identification and characterization of the isolates were carried out by physiological and biochemical tests. Histopathological examination of the pneumatic lung samples from which Staphylococcus aureus was isolated showed slight congestion of the blood vessels, interstitial oedema and cellular infiltration of neutrophils and lymphocytes. In conclusion, the possible role of coagulase-positive staphylococcus aureus in the pathogenesis of caprine pneumonia is discussed.

Introduction

It has been established beyond reasonable doubt that pneumonia is an important disease in small ruminants in Nigeria (Ojo, 1971; Ikede, 1977). Not only is it one of the limiting factors in the improvement of goat industry in Nigeria (Akerejola, Schillhorn van Veen and Njoku, 1979) but also it is the cause of great economic loss especially in southern Nigeria. A number of pathogenic bacteria, organisms like Staphylococcus, Pasteurella, Streptococcus and Klebsiella have been associated with caprine pneumonia (Falade, Ojo and Ogunnariwo, 1977; Ikede, 1977) in Northern and Western States of Nigeria.

Although caprine pneumonia is a relatively common condition affecting goats, little research has been conducted to indicate the range and frequency of pathogenic organisms involved in Eastern States of Nigeria. In this study, the isolation, identification and characterization of 21 isolates of Staphylococcus aureus from pneumatic lungs of goats in Nsukka and Enugu areas of Anambra state of Nigeria are presented as a preliminary step in understanding the possible role that this potentially pathogenic organism plays in the pathogenesis of bacterial pneumonia in goats.

Materials and Methods

Collection of specimens: A total of 200 pneumatic lung samples were aseptically collected from carcasses of goats slaughtered at Nsukka abattoir and Enugu areas of Anambra State of Nigeria. The specimens were transported to the laboratory on ice.

Isolation Procedure: Using a sterile wire loop, the different pneumatic lung samples were inoculated into blood agar plates (oxoid). The plates were incubated for 24 hours at 37°C aerobically and examined for typical Staphylococcus colonies based on cultural morphology. Incubation was continued for a further 24 hours on plates which failed to show such colonies. Stock cultures of pure isolates were maintained on Nutrient agar slants in bijou bottles at 4°C

Physiological and Biochemical characteristics: Gram reaction. Smears were prepared from pure cultures of the isolates, stained by Gram stain technique and examined under oil immersion.

Catalase Test. This test was performed by mixing one drop of 3% hydrogen peroxide (H₂O₂) solution with a drop of culture suspension.

Pigment formation. This test was conducted after 48 hours of incubation
at room temperature on milk agar.

Coagulase Test: The coagulation of fresh rabbit plasma was tested in tubes according to the recommendations of the subcommittee on Taxonomy of Staphylococcus and Micrococcus (1965).

Hemolysis: Ability of the isolates to hemolyze sheep red blood cells was determined by plating out pure culture of the isolates on blood agar plates containing 5% sheep blood and incubating for 24 hours at 37°C aerobically.

Phosphatase Test: Phenolphthalein phosphatase agar was slightly inoculated and incubated for 24 hours at 37°C to obtain discrete colonies. One millimetre of ammonia solution was placed on the lids off the petri dishes containing the Staphylococcus like isolates.

Oxidase Test: A freshly prepared 1 per cent solution of tetramethyl-P. Phenyle nediamine hydrochloride in distilled water was added to a portion of 24 hour old plate culture of Staphylococcus-like colonies.

Motility Test: This test was conducted with slight modification of hanging drop preparation.

Growth under anaerobic condition: The Staphylococcus — like isolates were streaked individually on blood agar plates placed in special anaerobic jars with gas paks* and incubated for 48 hours at 37°C.

Urease production: Urease activity was tested in Christensens urea media. The bijou bottles with screw caps containing urea media were heavily inoculated with Staphylococcus — like organisms aerobically at 37°C ffor 24 hours.

Oxidation-Fermentation Test: To determine whether the organisms attacked carbohydrate oxidatively for fermentatively, the oxidation — Fermentation test was carried out by inoculating the Staphylococcus-like isolates in two universal bottles of Hugh and Leifson’s medium containing different sugars like glucose, maltose, lactose and mannitol.

Histopathology: Sections of pneumonic lung tissue immediately adjacent to the area sampled bacteriologically were fixed in 10% formalin, embedded in paraffin, cut and then stained with haematoxylin-eosin. Detailed histopathological examination of lung specimens from which successful isolation of Staphylococcus aureus was conducted.

Results

All the isolates were Gram-positive cocci in grape-like clusters. The physiological and biochemical criteria used for the identification and characterization of Staphylococcus-like organisms isolated are shown in Table 1.

Of a total of 200 caprine pneumonic lung specimens sampled, 25 (12.5%) fielded Staphylococcus spp. Twenty-one (10.50%) of the isolates confirmed to the physiological and biochemical characteristics of Staphylococcus epidermidis. Histopathological observations of the pneumonic lung samples from which coagulase-positive Staphylococcus aureus was isolated showed congested blood vessels. In addition, interstitial oedema and cellular infiltration involving principally lymphocytes and neutrophils were evident.

Discussion

The incidence of respiratory tract infections, either as frank pneumonia or as pneumonic complied with enteritis in goats is quite high and has reached alarming proportions in Nigeria (Ikede, 1977; Falade, Ojo and Ogunnarwo, 1976; Schillhorn van Veen, 1973; Ikede, 1978).

*Cockeyville, Maryland 21030, USA
A diversity of organisms like Pasteurella multocida, Pasteurella hemolytica, Staphylococcus aureus, beta-hemolytic Streptococcus species and Klebsiella species have been associated with outbreaks of caprine pneumonia in Western and Northern states of the country (Ojo, 1971; Ikede, 1977).

Our microbiological findings in this investigation confirmed previous observations in Northern and Western parts of the country (Ojo, 1971; Ikede, 1977).

Staphylococcus aureus is recognized as the cause of a wide range of different kinds of major and minor pyogenic infections and inspite of numerous antibiotics deployed against it, it has continued to remain a serious clinical problem because of its genetic versatility as demonstrated by its ability to acquire resistance (Emeruwa, 1979; Duguid, Mamion and Swain, 1978).

Although Staphylococcus aureus has been known for many years as a pathogenic agent (Carter, 1975), its aetiologic role in caprine pneumonia is not yet established.

Occurring in nature as a commensal parasite in the anterior nares and on moist areas off the skin (Duguid, Mamion and Swain, 1978), Staphylococcus aureus is regarded by some workers as a mere secondary invader in bacterial pneumonia complicating already pre-existing condition (Carter, 1975).

Recent experimental infection of sheep and goats with Staphylococcus aureus and other organisms has successfully caused bacterial pneumonia (Abubakr, El Faki, Abdall and Kamal, 1981), histopathologically similar to the observations in this work.

In the past, Staphylococcus epidermidis was generally considered as non-pathogenic but today this bacterium is recognized as a common cause of disease in man and animals (Andriole and Lyons, 1970). The precise etiologic role of Staphylococcus epidermidis isolated in this study is not known.

The relatively low frequency of occurrence of Staphylococcus aureus in caprine pneumonic lungs as observed in this investigation suggest that other pathogens may be involved either in

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Table 1: Physiological and biochemical attributes of Staphylococcus isolated from pneumonic lungs of goats.

<table>
<thead>
<tr>
<th>No</th>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Catalase</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Pigment formation</td>
<td>++</td>
</tr>
<tr>
<td>3</td>
<td>Coagulase</td>
<td>+++</td>
</tr>
<tr>
<td>4</td>
<td>Hemolysis</td>
<td>+++</td>
</tr>
<tr>
<td>5</td>
<td>Phosphatase</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>Oxidase</td>
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</tr>
<tr>
<td>7</td>
<td>Motility</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Growth under anaerobic condition</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>Urease production</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>Oxidation-Fermentation</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>Carbohydrates attacked acid from glucose</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Maltose</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Mannitol</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Mannitol (anaerobic)</td>
<td>+</td>
</tr>
</tbody>
</table>

* 21 strains were positive; **21 strains were coagulase positive while ***23 strains were hemolytic.
association with or as a separate entity in the aetiology of bacterial pneumonia. Nonetheless, using the binomial distribution with a frequency of occurrence of *Staphylococcus aureus* in caprine pneumonic lungs of 10.5% the probability of isolation of this pathogen is fairly high.

Acknowledgement

The author wishes to express his gratitude to Dr. K.S. Mohan and Dr. S.I. Oboegbulem for their guidance and useful criticisms. Thanks are due to Mr. E. Erojikwe and Mr. C. Ezimoha for their skilled technical assistance. The excellent secretarial work of Mr. E. U. Asadu is gratefully appreciated.

Finally, the love and encouragement received from my wife is also acknowledged.

References


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CLINICO-PATHOLOGICAL STUDIES AND TREATMENT TRIALS OF CONTAGIOUS CAPRINE PLEUROPNEUMONIA (CCPP) IN SUDANESE GOATS.

M.I. ABUBAKR; S.M. ELHASSAN; and M.S.M.A. HARBI.
Veterinary Research Administration, P.O. Box 8067, Alamarat, Khartoum, Sudan.

Summary: A mycoplasma (F38 type) designated strain SGP1 was recently isolated in the Sudan. It was found to cause acute pleuropneumonia in intratracheally infected goats. The disease was readily transmissible to healthy goats in-contact. Clinically the disease was characterised by rise in body temperature, frequent coughing and dyspnea. The macroscopic and microscopic pathological lesions were confined to the thoracic cavity. The main histopathological lesions were in the alveoli, interalveolar septa and the pleura.

Chemotherapy was found effective in reducing the severity of the disease. Mycoplasma identical with F38 was isolated.

Introduction

Contagious caprine pleuropneumonia (CCPP) is one of the most important diseases causing heavy losses in goat populations. The morbidity rate is very high and mortality rates exceeding 50% have been reported. The disease is of wide geographic distribution and of great importance in Asia, African and Southern Europe (Jubb & Kennedy, 1970). The pathology of this disease has been studied by Baumann, (1938) Longley, (1940) Shirlaw, (1949).

Cottew (1979) mentioned the important lung changes of CCPP as extensive edema, hepatization, enlargement of the interlobular septa and fibrinous pleurisy.

Several mycoplasma strains have been implicated in aetiology of CCPP but successful experimental transmission has been obtained only recently (MacOwan and Minette 1977b; Rurangirwa et al., 1981; Harbi, et al.,1983 a & b).

In the Sudan, CCPP has been associated with different mycoplasmas (Pillai 1965, Abdulla and Lindley 1967). Recently an F 38 type of mycoplasma strain SGP1) was isolated in the Sudan from classical acute CCPP and was proved to be true aetiologic agent of the disease (Harbi 1982, Harbi et al. 1981, 1983 a, 1983 b).

Sharma and Bhalla (1982) reported that terramycin at a concentration of 50 μ gram/ml of serumised broth was lethal to mycoplasma mycoides subs. caprae. In 1978 Dixit and Sadana reported that treatment of naturally affected goats, in early stages of the disease, with terramycin (Pfizer) in the doses of 2 to 5 ml for 3.5 days, gave encouraging results and the animals recovered (Dixit & Sadana 1978). Nasri (1964) reported that chemotherapy, if begun early in the course of the disease, can be effective in reducing its severity. Recently Rurangirwa et al., (1981), reported the successful treatment of CCPP with streptomycin.

Materials and Methods

Experimental animals

Indigenous goats, 2 to 2½ years old, were purchased from farms known to be free from CCPP. The goats were kept under observation for one month prior to the experiment and confirmed free from blood parasites, helminth and coccidial infections. Sera collected from these experimental animals were tested for the presence of antibodies to mycoplasma F 38 strain using the growth inhibition test described by Black (1973) in which wells were punched in the agar.

Inoculum

Infective inoculum used for experimental infection was a three-day old
culture of SGP1 in its 4th passage. It contained $10^8$ cfu/ml and was confirmed free from contaminating bacteria.

**Experimental design**

A total of 25 experimental male goats were divided randomly into five equal groups. Animals in group I, II, III, and IV received 10 ml of the inoculum intra-tracheally while those in group V were left as a non-inoculated in-contact group. Animals in group I were treated by intramuscular injection of oxytetracycline at a dose of 3 ml (10 mg/kg b.w.) for six successive days. Animals in group II were treated by intramuscular injection of long acting terramycin at a single dose of 3 ml (20 mg/kg b.w.). Animals in group III were treated by intramuscular injection of 20% tyloject at a dose of 3 ml (20 mg/kg b.w.) for six days. The treatment of infected animals (groups I, II, III) started when the first clinical sign of the disease, i.e. rise in body temperature, was observed. An infected goat was considered febrile when the body temperature reached 40°C or higher. The rectal temperature of all animals was taken daily. The clinical signs and the postmortem findings in dead animals were recorded. The experiment was terminated after 32 days when all the surviving treated, untreated and in-contact animals were killed.

At postmortem examination specimens from lung lesions, pleural and pericardial fluids were taken and cultured for the isolation of Mycoplasma strain SGP1 in Mycoplasma (Oxoid) and Brucella (Albimi) media. The cultural technique used for reisolation of the inoculated Mycoplasma was that described by Erno and Stipkovits (1973). The re-isolated Mycoplasmas were then identified by growth inhibition test as described by Black (1973). Specimens of lung, trachea, bronchial lymph nodes, liver, spleen, heart and kidneys taken for histopathological examination were preserved in 10% buffered formalin. These tissues were trimmed, embedded in paraffin, sectioned at 5-6 μm, and stained with haematoxylin and eosin (H&E) stain. Specimens of lung, trachea, pleural and pericardial fluids were also collected for bacterial examination. Specimens were cultured on 5% horse blood agar. Cultures were considered negative if no growth was observed after 3 days of incubation at 37°C.

**Results**

The incubation period was 2-5 days in the inoculated groups (gr. I, II, III and IV) and 4-12 days in the in-contact group (gr. V).

The first clinical sign in the affected goats was the onset of fever. On the first day of fever the body temperature was 40.3°C and continued above 40°C up to 6 days. Sick goats were depressed and developed abdominal respiration. Frequent coughing was a constant feature. There was slight bilateral serous nasal discharge in most of the affected goats. Affected goats were reluctant to move and stood apart from other animals. Appetite was reduced only during the febrile stage.

Out of the five inoculated goats in group I, one goat was sacrificed in a moribund state 26 days after inoculation. The remaining four animals were slaughtered at the termination of the experiment. In group II one goat died after 18 days after inoculation. The remaining four goats were slaughtered at termination of the experiment. In group III all the goats were slaughtered at termination of the experiment. In group IV one goat was slaughtered in a moribund state 6 days after inoculation, two goats died one on day 7 and the other on 25th day after inoculation. The remaining two goats were slaughtered at the termination of the experiment. All goats in group V were slaughtered at the termination of the experiment.
In 60% of the inoculated then treated groups, I, II and III, no gross or microscopic pathological lesions indicative for CCPP were observed. In the remaining 40% very mild gross pathological changes in the form of slight lung oedema, hydro-thorax and slight accumulation of pleural fluid were observed.

Necropsy examination of the infected, untreated control animals (group IV) and in-contact animals (group V) revealed that the gross pathological lesions were confined to the lung, pleura and pericardium. No changes of pathological importance were seen in other organs. The pathological changes in these animals, whether dead or sacrificed in-extremis or at the termination of the experiment, were almost similar, differing only in the extent of lung involvement. Usually the right lung, but occasionally both lungs were affected. The affected lung was enlarged, oedematous and in section showed reddish, brown, or different coloured lobules. In few cases there were various degrees of hepatization (Fig. 1). In some cases the parietal pleura was adherent to the chest wall. In others the interlobular septa were thickened. The pleural cavity contained considerable pleural fluid. The pleural membrane adjacent to the affected portions of lung was congested and oedematous or covered with fibrinous exudate that formed a thick layer with adhesions to the pleura and some times, to the pericardium.

In few cases the pericardial sac was filled with 30 to 50 ml of serous fluid.

The histopathological examination of the lung tissue of the affected goats revealed changes in the alveolar septa. The walls of the alveoli were thickened as a result of their infiltration with mononuclear cells, neutrophils and fibrin (Fig. 2). In some cases the alveolar lumen contained a proteinous exudate (Fig. 2). The bronchioles were filled with degenerating neutrophils and cellular debris (Fig. 3) besides the mild peribronchial lymphocytic infiltration.

Fig. 1: Lung showing various areas of hepatization

Fig. 2: Lung: Note thickening of the alveolar walls and proteinaceous exudate in the alveolar lumen. H & E staining (x 100)

Fig. 3: Lung bronchiole: filled with degenerating neutrophils and cellular debris. H & E stain (x 400).
The interlobular septa were thickened (Fig. 4) due to the presence of fibrinous exudate. The lymphatics in the interalveolar septa were dilated, contained fibrin, lymphocytes, and mononuclear cells. The blood vessels were dilated. The thickening of the pleura was due to the presence of fibrinocellular exudate (Fig. 5). The subpleural tissue was infiltrated with macrophages, lymphocytes and neutrophils. Red and grey hepatization was encountered in few lung sections (Fig. 6).

No consistent pathological alterations could be found in tissues taken from trachea, pericardium and heart. At the site of inoculation of the trachea no gross or histopathological lesions were detected.

Mycoplasma confirmed to be strain F 38 was re-isolated from 80% (4 cases) of the infected untreated group (group IV), from 60% (3 cases) of the in-contact group (group V) and from 26.6% (4 cases) of the treated groups (group I, II, III).

Out of the 25 samples examined for the presence of bacteria, the following bacteria were isolated: Pseudomonas sp. 18%, Proteus sp. 16%, Staphylococcus sp. 12% Streptococcus sp. 4%.

Discussion

Mycoplasma strain F 38 caused experimental CCPP in goats following intratracheal-endobronchial inoculation and that the disease spread readily to healthy goats in-contact (MacOwan & Minette 1977 a & b; Rurangirwa et al., 1981, Harbi et al. 1983 a & b). Such findings have been confirmed in the present study using the intratracheal route alone. The clinical data obtained in this study supported the earlier observations of Mattam (1929), MacOwan and Minette (1976), 1977).
McMartin et al., (1980) and Moulton (1980). The gross pathological lesions observed did not differ from those observed by MacOwan (1976), Dixit and Sadana (1978), Sharma and Jatkar (1978), Cottew (1979), McMartin et al. (1980), and Ojo and Ozoya (1980). The histopathological lesions were identical with those obtained by Dixit and Sadana (1978) Sharma (1978) and Ojo Ozoya (1980).

Mycoplasma strain F 38 was reisolated from 80% of the infected untreated group (group IV), from 60% of the in-contact group (group V) and from 26.6% of the infected and then treated groups (I, II, III). Harbi et al., (1983 a, b) easily reisolated Mycoplasma F 38 from goats experimentally infected or those which were infected by contact. Failure to reisolate Mycoplasma from 20% of the infected untreated animals and 40% of the in-contact animals that contracted the disease is difficult to explain. But this could have been due to individual resistance to the infection because of immunity or natural resistance. The authors are less inclined to the assumption made by Mattam (1929) and Longley (1951) that the infective agent was present in the lungs and thorax only at the beginning of the disease. The bacteria which were isolated from a number of pneumonic lung lesions were similar to those isolated by MacOwan (1976), 1977 a & b), Abubakr et al., (1980).

Chemotherapy, which has been attempted early in the course of the disease was found to be effective. In the infected then treated groups (group I, II, III), 60% of the treated goats recovered and no gross or microscopic lesions indicative of CCPP were observed in these animals. Similar results, concerning treatment, were obtained by Sharma and Balla (1962), Nasri (1964). Dixit & Sadana (1978), Rurangirwa et al. (1981).

In the remaining 40% of these groups there was partial recovery and the pathological lesions encountered were mild in nature. While the re-isolation of the inoculated Mycoplasma (strain SGP1) was from 80% of the infected untreated group (group IV) and from 60% of the in-contact group, the re-isolation of this organism from the treated groups (groups I, II, III) was from 26.6% only.

In conformity with previous reports (Harbi et al., 1983 a, b), it could be concluded that inoculation of strain SGP1 (F 38) type) causes CCPP which is easily transmitted to healthy goats in-contact. However, the route recommended for infection, in the present study was the intratracheal route. The authors are of the opinion that treatment would have been more effective if the use of tyloject and oxytetracyclin continued for 2-3 days more, and that two doses of the long acting terramycin given instead of only one dose.

Acknowledgement

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References


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BOVINE TUBERCULOSIS IN UGANDA

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Summary: The epidemiologic findings for bovine tuberculosis are reviewed and a model that may fit most of the facts is proposed for further testing. The major features of the model for bovine tuberculosis are:

(a) The incidence of bovine tuberculosis is highest in those places where man and animals live under the same roof.
(b) Bovine tuberculosis is more common in indigenous (Zebu) cattle than in exotic cattle.
(c) The incidence of the disease is also associated with socio-economic status of the farmer and the soil type. A general upward trend in reported cases of tuberculosis is indicated. The comparison of generalized and localised tuberculosis shows that localised tuberculosis is more common than generalized tuberculosis. Amongst generalised tuberculosis, miliary tuberculosis involving both lungs was more common than any other forms of generalized tuberculosis. For the control of tuberculosis in Uganda more strict measures are needed, and the part played by wildlife in the maintenance and dissemination of tuberculosis should be urgently investigated.

Introduction

Tuberculosis occurs in every District of Uganda and is of major importance in dairy cattle. (Masaba, personal communication, 1982). The disease can occur in all species including men and is of importance for Public Health reasons as well as for its detrimental effects on animal production. All species and age groups are susceptible to *Mycobacterium bovis* (*M. bovis*) with cattle, goats and pigs being most susceptible and sheep and horses showing a high natural resistance. (Luke, 1958).

*M. bovis* is the commonest cause of tuberculosis in these animals. (Luke, 1958). Spontaneous disease in cattle due to the human type is rare, but has been recorded several times especially from sanatorium sewage or from tuberculosis attendants. Natural infection with the human type tubercule bacillus does not produce progressive disease in cattle but infection which quickly heals, the lesions in cattle sensitized by the human bacillus being small and confined to the bronchial and mediastinal lymph nodes. At times no lesions may be found. (Ivanow, Belehev, Buchavareva, 1981). No case of generalised tuberculosis in cattle due to human type bacillus has been recorded. (Glover and Ritchie, 1953).

Infection of cattle by the avian bacillus has been frequently recorded, though its virulence for these animals is low. (Towar, et al., 1965). Lesions are usually localised and non-progressive, being generally found in the mesenteric lymph nodes and occasionally in the retropharyngeal lymph nodes. (Stuart, 1982). Goats and sheep are susceptible to the *M. bovis* and if they are maintained in association with infected herds of cattle the incidence may be as high as 28 per cent. (Klein, 1959), Cordes, Pulliams, Lukes and Carter, 1981).

This paper reports the incidence of carcasses found to have tuberculosis during the routine meat inspection at the Uganda Meat Packers and at the City Council abattoirs during the period of 12 months.

Materials and Methods

A total of 27198 head of cattle were slaughtered at the Uganda Meat Packers and at the City Council abattoir during the period of one year. During the same period, 1910 goats and 81 sheep were
slaughtered in the two mentioned abattoirs. The animals were shipped from the field to the slaughter-houses by either railway, lorries or on hoof. On arrival at the slaughter-houses, the animals were given a 24 hour rest before slaughter.

Kampala, the capital city of Uganda, has two state-owned slaughter-houses which receive animals for slaughter from all corners of Uganda. Cattle of European breeds, zebu and cross-breeds were slaughtered in those two abattoirs. Both young and adult animals were slaughtered.

The diagnosis of tuberculosis was based on the finding of gross lesions of tuberculosis granulomas in any part of the carcass.

In order to confirm the presence of tuberculous lesions in the carcass or organs of slaughtered animals a careful search for the disease was carried out, and once detected, a further examination of the lesions to assess their character and nature was carried out. Carcasses with tuberculous lesions were divided into two major categories according to distribution of the lesions. Carcasses were categorized as having generalized tuberculosis, if during routine inspection they showed evidence of any of the following condition:

(a) Miliary tuberculous lesions of both lungs and other organs.
(b) Multiple and actively progressive lesions of tuberculosis.
(c) Widespread tuberculosis infection of the lymphatic glands of the carcass.
(d) Diffuse and acute lesions of tuberculosis of both the pleura and peritoneum, associated with enlarged or tuberculous lymph nodes of the carcass.
(e) Active or recent lesions present in the substance of any two of the following:— Spleen, kidney, uterus, ovary or testicle, in addition to tuberculous lesions in the respiratory digestive tract.
(f) Congenital tuberculosis in calves.

Those carcasses which did not have the evidence of generalized tuberculosis were categorised as having localised tuberculosis. Uganda has been divided into 9 (nine) zoo-geographic regions (see table 1) based on soil type and the socio-economic status of the farmers in those regions. The data obtained from the two abattoirs were used to determine whether the distribution of recorded tuberculosis cases in Uganda was equal in the nine (9) different zoo-geographic regions. The data was also used to determine whether there was an upward trend in the reported cases of tuberculosis in Uganda.

The number of reported cases of tuberculosis in cattle was compared with the number of reported cases of tuberculosis in goats to see if there was any correlation between the two species.

Results

The results in Table 11 show the different species of animals slaughtered at the Uganda Meat Packers and at the City Council abattoirs during the period of 12 months (January 1st through to February 1982). The records available through the Ministry of Animal Resources and Fisheries indicate that more cattle were slaughtered than small ruminants at these abattoirs.

Table III presents the districts which supply cattle to Uganda Meat Packers and the City Council abattoirs. Mbarara District alone supplied a total of 10455 head of cattle. This was followed by Luwero district with a total of 4685 head of cattle. Kampala supplied a total of 129 head of cattle.

These tables also show the number of positive tuberculous cases and the percentage of cases in each district.
<table>
<thead>
<tr>
<th>REGION NAME</th>
<th>SOIL PRODUCTIVITY</th>
<th>POTENTIAL VEGETATION</th>
<th>CATTLE POPULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVARA</td>
<td>FAIR</td>
<td>MOIST THICKET</td>
<td>ABUNDANT</td>
</tr>
<tr>
<td>MASAKA</td>
<td>HIGH</td>
<td>MOIST THICKET</td>
<td>MODERATE</td>
</tr>
<tr>
<td>KAMPAL</td>
<td>HIGH</td>
<td>SEMI-DECIDUOUS FORST</td>
<td>MODERATE</td>
</tr>
<tr>
<td>W. BUGANDA</td>
<td>FAIR</td>
<td>SEMI-DECIDUOUS FORST</td>
<td>ABUNDANT</td>
</tr>
<tr>
<td>N. BUGANDA</td>
<td>FAIR</td>
<td>MOIST THICKET</td>
<td>ABUNDANT</td>
</tr>
<tr>
<td>WESTERN</td>
<td>FAIR</td>
<td>SAVANA</td>
<td>SCANT</td>
</tr>
<tr>
<td>LANGO</td>
<td>LOW</td>
<td>DRY SAVANNA</td>
<td>MODERATE</td>
</tr>
<tr>
<td>ACHOLI</td>
<td>FAIR</td>
<td>BUTYROPERMUM SAVANNA</td>
<td>POOR</td>
</tr>
<tr>
<td>W. N.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Characteristics of Zoographic Regions of Uganda
Table 1: Number of animals slaughtered in 1982

<table>
<thead>
<tr>
<th>MONTH</th>
<th>CATTLE</th>
<th>GOATS</th>
<th>SHEEP</th>
<th>CATTLE</th>
<th>GOATS</th>
<th>SHEEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>JANUARY</td>
<td>1221</td>
<td>42</td>
<td>—</td>
<td>1394</td>
<td>92</td>
<td>3</td>
</tr>
<tr>
<td>FEBRUARY</td>
<td>1022</td>
<td>47</td>
<td>—</td>
<td>828</td>
<td>58</td>
<td>3</td>
</tr>
<tr>
<td>MARCH</td>
<td>988</td>
<td>28</td>
<td>—</td>
<td>947</td>
<td>63</td>
<td>3</td>
</tr>
<tr>
<td>APRIL</td>
<td>1195</td>
<td>30</td>
<td>—</td>
<td>802</td>
<td>44</td>
<td>1</td>
</tr>
<tr>
<td>MAY</td>
<td>1209</td>
<td>73</td>
<td>—</td>
<td>884</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td>JUNE</td>
<td>1275</td>
<td>72</td>
<td>1</td>
<td>856</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>JULY</td>
<td>1404</td>
<td>100</td>
<td>—</td>
<td>959</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>AUGUST</td>
<td>1166</td>
<td>113</td>
<td>—</td>
<td>963</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td>SEPTEMBER</td>
<td>1132</td>
<td>137</td>
<td>1</td>
<td>1067</td>
<td>29</td>
<td>14</td>
</tr>
<tr>
<td>OCTOBER</td>
<td>1129</td>
<td>202</td>
<td>3</td>
<td>1182</td>
<td>26</td>
<td>4</td>
</tr>
<tr>
<td>NOVEMBER</td>
<td>1171</td>
<td>286</td>
<td>1</td>
<td>1462</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>DECEMBER</td>
<td>1414</td>
<td>260</td>
<td>—</td>
<td>1528</td>
<td>107</td>
<td>9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14326</td>
<td>1390</td>
<td>6</td>
<td>12872</td>
<td>520</td>
<td>75</td>
</tr>
</tbody>
</table>

Mpigi, Masaka and Mbarara had the highest incidence of the disease. Tuberculosis was not observed in goats and sheep that were examined during the routine meat inspection.

The results in Table IV present the percentage of monthly reporting of tuberculosis in cattle. The monthly reporting of tuberculosis fluctuated. When the Hotelling Pabest statistical test (Hotelling and Pabest, 1936) was applied to those data, the null hypothesis (ho) of identical distribution of tuberculous carcases at the Uganda Meat Packers and City Council abattoirs was rejected (1 < .01). This confirmed the fact that there is an upward trend in reported cases of tuberculosis.

These tables also show that the disease occurred throughout the year with the highest incidences occurring towards the end of the year. The highest incidences coincided with the months when Rwandese refugees returned to their motherland. A very large portion of the animals that were slaughtered at the two abattoirs came from West Central part of Uganda.

Of 27198 cattle slaughtered 2197 (8.1%) were found with tuberculous lesions during the routing post-mortem inspection. The prevalence of tuberculosis in cattle supplied from the 9 regions ranged from 0.9% to 13.9%, with the highest rate occurring in the West Central Zone.

Of 2197 positive tuberculosis cases 645 (29.5%) were generalised tuberculosis. Thoracic lesions involving both lungs with evidence of tuberculosis elsewhere occurred in 574 of the 645 cases (89%). In the majority of these cases the lesions were characterised by the presence of a very large number of miliary tuberculosis, apparently, all of the same stage of development.

The lesions were distributed throughout both lungs together with miliary lesions in the visceral organs, particularly the kidneys and spleen. In the thoracic cavity, lesions occurred most frequently in the mediastinal and bronchial lymph nodes. In the lungs, miliary abscesses at times were so extensive as to cause a supplicative broncho-pneumonia. The pus had a characteristic cream to orange colour and varied in consistency from thick cream to thick crumbly cheese.

Abdominal lesions with widespread tuberculous infection occurred in 58 off the 645 cases (9%). In the abdominal
Table III: Number of reported cases of Tuberculosis by district

<table>
<thead>
<tr>
<th>DISTRICT</th>
<th>ANIMALS SLAUGHTERED</th>
<th>UGANDA MEAT PACKERS</th>
<th>CITY COUNCIL ABATTOIR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>POSITIVE</td>
<td>PERCENTAGE</td>
<td>ANIMALS SLAUGHTERED</td>
</tr>
<tr>
<td>MBARARA</td>
<td>5190</td>
<td>634</td>
<td>12.2%</td>
</tr>
<tr>
<td>MASAKA</td>
<td>2054</td>
<td>274</td>
<td>13.4%</td>
</tr>
<tr>
<td>LUWERO</td>
<td>2315</td>
<td>5</td>
<td>23%</td>
</tr>
<tr>
<td>APAC</td>
<td>363</td>
<td>3</td>
<td>0.8%</td>
</tr>
<tr>
<td>MASINDI</td>
<td>579</td>
<td>11</td>
<td>1.1%</td>
</tr>
<tr>
<td>MUBENDE</td>
<td>667</td>
<td>8</td>
<td>1.2%</td>
</tr>
<tr>
<td>MPIGI</td>
<td>955</td>
<td>134</td>
<td>14.0%</td>
</tr>
<tr>
<td>MUKONO</td>
<td>604</td>
<td>7</td>
<td>1.2%</td>
</tr>
<tr>
<td>LIRA</td>
<td>184</td>
<td>2</td>
<td>1.1%</td>
</tr>
<tr>
<td>GULU</td>
<td>292</td>
<td>3</td>
<td>1.0%</td>
</tr>
<tr>
<td>KAMPALA</td>
<td>85</td>
<td>1</td>
<td>1.2%</td>
</tr>
<tr>
<td>ACHOLI</td>
<td>246</td>
<td>2</td>
<td>0.6%</td>
</tr>
<tr>
<td>MITYANA</td>
<td>278</td>
<td>6</td>
<td>2.6%</td>
</tr>
<tr>
<td>LANGO</td>
<td>168</td>
<td>1</td>
<td>0.6%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14326</td>
<td>1091</td>
<td>7.6%</td>
</tr>
<tr>
<td>MONTH</td>
<td>TOTAL NO. SLAUGHTERED</td>
<td>UGANDA MEAT PACKERS</td>
<td>POSITIVE PERCENTAGE</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>January</td>
<td>1221</td>
<td>77</td>
<td>6.3%</td>
</tr>
<tr>
<td>February</td>
<td>1022</td>
<td>66</td>
<td>6.4%</td>
</tr>
<tr>
<td>March</td>
<td>988</td>
<td>58</td>
<td>5.6%</td>
</tr>
<tr>
<td>April</td>
<td>1,195</td>
<td>83</td>
<td>6.9%</td>
</tr>
<tr>
<td>May</td>
<td>1,209</td>
<td>86</td>
<td>7.1%</td>
</tr>
<tr>
<td>June</td>
<td>1,275</td>
<td>94</td>
<td>7.6%</td>
</tr>
<tr>
<td>July</td>
<td>1,404</td>
<td>94</td>
<td>6.7%</td>
</tr>
<tr>
<td>August</td>
<td>1,166</td>
<td>79</td>
<td>6.8%</td>
</tr>
<tr>
<td>September</td>
<td>1,132</td>
<td>85</td>
<td>7.5%</td>
</tr>
<tr>
<td>October</td>
<td>1,129</td>
<td>104</td>
<td>9.2%</td>
</tr>
<tr>
<td>November</td>
<td>1,171</td>
<td>128</td>
<td>10.9%</td>
</tr>
<tr>
<td>December</td>
<td>1,414</td>
<td>138</td>
<td>9.4%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14,326</td>
<td>1,091</td>
<td>7.6%</td>
</tr>
</tbody>
</table>
cavity, it was the liver and the associated lymph nodes most frequently infected. Congenital tuberculosis in calves occurred in 13 of the 645 cases (2%). Tuberculosis in calves occurred in 13 of the 645 cases (2%). Tuberculosis in calves was characterised by the predominance of the infection of the lymph nodes of the lungs and by the frequency of lesions in the abdominal cavity. Head lesions occurred in 786 of the 1554 (50.6%) cases of localized tuberculosis. The commonest finding was localization in one or two of the following organs and/or lymph nodes, tonsils, submaxillary and retropharyngeal lymph nodes.

Infection of one or both prescapular lymph nodes occurred in 529 of the 1554 (16.7%) cases of the localized tuberculosis.

Infection of superficial inguinal lymph nodes was mainly in bullocks. Infection of this nature was probably acquired by way of castration wounds. Infection of parotid lymph node occurred in 74 of the 1554 (4.8%) cases of the localized tuberculosis. Probably, infection of this nature was acquired by way of dehorning.

Genital tuberculosis occurred in 96 of 1554 (6.2%) cases of localized tuberculosis. This occurred in the sexual organs of both male and female. The majority of localized tuberculosis cases were characterized by discrete nodules containing thick, yellow to orange caseous material, often calcified and surrounded by a thick, fibrous capsule.

In Uganda, the bovine animal is by far the most important source of tuberculosis infection to both man and animals. (Masaba, personal communication, 1982).

Unlike cattle, the incidence of tuberculosis in goats and sheep is extremely low and this is related to the ‘open air’ life of the sheep and goats. This relative lack of exposure to tuberculosis infection has led some people to believe that goats and sheep are resistant to tuberculosis. While working at the Veterinary Training Institute, Entebbe, the author observed that the susceptibility of goats to tuberculosis increased if they are housed for more intensive milk production. In Uganda goats are not an important source of tuberculosis infection.

The distribution of tuberculosis in Uganda seems to depend on the traditional methods of keeping animals in each particular zoo-geographic region. The question that has not been fully resolved by this study is what traditional methods are responsible for facilitating the spread of tuberculosis. A functional model of the ecology of traditional animal husbandry in those areas where bovine tuberculosis is abundant is needed before that question can be answered. It appears however, that wild animals, as yet unidentified, may be responsible for the spread of the disease. Experimental work demonstrated that mycobacterium bovis could be transmitted from badges (Meles-meles) to badges and from badges to cattle. (Evans and Thompson, 1981).

The potential for interspecies transmission of tuberculosis, especially to cattle, is possible and is created when cattle and wild ruminants graze together. Once the disease has become established in a herd the following necessary measures may be adopted to prevent its spread:

1. Any procedure which brings animals together should be avoided if possible, especially if in the herd there is any animal showing clinical signs of tuberculosis such as chronic coughing and emaciation. Procedures which bring animals together include such things as passage through the milking shed, housing at night, dipping, collection of animals for inspection, bleeding and vaccination. All these procedures facilitate the spread of tuberculosis. Droplet infection is more likely to occur in hot and humid environment such as that which prevails in Uganda.
2. Infected animals should be removed from the herd as soon as possible. Single intradermal injection is adequate to identify the infected animals and if possible it should be carried out in conjunction with clinical examination. The main disadvantage of single intradermal injection include failure to detect cases of minimal sensitivity such as may occur in cows which have recently calved, early or late stages of the disease and in old cows. (Blood and Henderson 1981). The available test devised to overcome this deficiency is enzyme linked immunosorbent assay (ELISA) testing, (Mann, Bush, Janssen, Frank an Montali, 1981).

3. All positive and suspicious reactors and clinical cases should be transported under close control to the abattoirs which have facilities for heat treatment. Animals which are eventually to go to the abattoirs should be kept under quarantine until slaughter, irrespective of their status. Where this cannot be done without a chance of spread to other animals along the route, destruction of the animals on the property is necessary. The incarceration of such animals should be carried out under official supervision. The state should pay half of the value of the animal to the farmer in order to encourage them to eliminate such animals.

4. Calves being reared, especially those which are being reared as herd replacement, should be fed on tuberculosis free milk either from known free animals or pasteurised.

5. The practice of vaccinating cattle against tuberculosis should be discouraged. In cattle, the use of BCG vaccine has no protective effect against infection with mycobacterium bovis. (Berggre, 1980, Oliveria and Ranes, 1981).

6. State-owned abattoirs should have facilities for histopathological and bacteriological examination in order to avoid unnecessary condemnation of carcasses which otherwise have no tuberculosis. Kantor, Vega, Cabellor and Pinares, (1981), confirmed that 53.9% of total or partial condemnation were false. Hence, the need for a laboratory to support normal meat inspection. In addition, cold storage facilities should be available at the abattoir.

Acknowledgement
The technical assistance of the staff of the Uganda Meat Packers and the City Council abattoirs is very much appreciated.

References
PREVALENCE OF CAMEL TICKS IN THE NGURUNIT AREA OF MARSABIT DISTRICT, NORTHERN KENYA

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Summary: Between May 1981 and June 1982, the prevalence of ticks on camels were studied in an arid region of Northern Kenya. A total of 5,546 ticks were collected from 120 camels aged between 1 month and about 20 years. Six species of ticks, 3 of Hyalomma, 2 of Rhipicephalus and 1 of Amblyomma were identified. Hyalomma species accounted for 96% of the total ticks, Rhipicephalus species 2.4% and Amblyomma species 1.6%.

Of the total tick population, Hyalomma dromedarii accounted for 68.7%, Hyalomma rufipes 21.7%, Hyalomma truncatum 5.6%, Rhipicephalus pulchellus 2.2%, Rhipicephalus pravus 0.2% and Amblyomma gemma 1.6%. On predilection sites, Hyalomma dromedarii was found all over the body with a predilection of the nostrils and ears. Rhipicephalus pravus was found in low numbers in the ears and nostrils. Other tick species were prevalent in the inguinal area and tail switch.

Introduction

Although ticks are common on camels in Kenya, (Wilson, Dolan and Olaha, 1981, Rutagwenda, 1982), no tick-borne diseases have been reported (Wilson et al. 1981). However, tick-borne diseases do appear in the literature elsewhere (Gatt-Rutter 1967, Richards 1979). Ticks nevertheless, are important pests which apart from disease transmission, have indirect effects on livestock like irritation, tick worry, anaemia and severe weight loss.

The objective of this paper is to show the prevalence of tick species on camels in an arid region of Northern Kenya. The work was carried out as part of an investigation on a disease control of camels.

Materials and Methods

The investigations were carried out in Ngurunit, which is in Marsabit District, the largest district in Kenya. Ngurunit (1° 50' N and 37° 13'E) receives an annual rainfall of 400-600 mm and stands at an altitude of 740 metres above sea level. The rains in the area occur in two seasons April and May (Long rains, and November and December short rains) Lusigi, (1981). The remaining months receive trace or no rain at all. The vegetation of the area is dwarf shrubland with scattered woodlands which have been described by Herlocker (1979).

A total of 5,546 ticks were collected from 120 camels aged between one month and about 20 years, between May 1981 and June 1982. The collection of ticks was done once every month from known tick predilection sites viz. ear, nose, tail, udder and testes (inguinal area). The ticks were kept in labelled universal bottles containing 70% Methanol until identification which was done using a key prepared by Hoogstral (1956).

Results

Table 1 gives the tick species identified on the dromedary and their relative abundance.

The results indicate that Hyalomma dromedarii is the most common tick prevalent on camels in the area. The next was Hyalomma rufipes, and Hyalomma truncatum, Rhipicephalus pulchellus, Amblyomma gemma, Rhipicephalus pravus in that order.

Hyalomma species alone accounted for 96% of the total ticks. Rhipicepha-
Table 1: Tick species and their relative abundance

<table>
<thead>
<tr>
<th>Tick species</th>
<th>(Expressed as percentage of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hyalomma dromedarii</em></td>
<td>68.7</td>
</tr>
<tr>
<td><em>Hyalomma rufipes</em></td>
<td>21.7</td>
</tr>
<tr>
<td><em>Hyalomma truncatum</em></td>
<td>5.6</td>
</tr>
<tr>
<td><em>Rhipicephalus pulchellus</em></td>
<td>2.2</td>
</tr>
<tr>
<td><em>Rhipicephalus pravus</em></td>
<td>0.2</td>
</tr>
<tr>
<td><em>Amblyomma gemma</em></td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Table II: Tick predilection sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Tick species (Number of ticks samples in brackets)</th>
<th>Expressed as percentage of total</th>
<th>Rate of male to female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nose</td>
<td><em>Hyalomma dromedarii</em></td>
<td>99.5</td>
<td>2:1</td>
</tr>
<tr>
<td></td>
<td><em>Rhipicephalus pravus</em> (1781)</td>
<td>0.5</td>
<td>3:1</td>
</tr>
<tr>
<td>Ear</td>
<td><em>Hyalomma dromedarii</em></td>
<td>99.0</td>
<td>2:1</td>
</tr>
<tr>
<td></td>
<td><em>Rhipicephalus pulchellus</em></td>
<td>0.6</td>
<td>3:2</td>
</tr>
<tr>
<td></td>
<td><em>Rhipicephalus pravus</em></td>
<td>0.2</td>
<td>1:1</td>
</tr>
<tr>
<td></td>
<td><em>Hyalomma rufipes</em> (1621)</td>
<td>0.2</td>
<td>3:1</td>
</tr>
<tr>
<td>Tail switch</td>
<td><em>Hyalomma dromedarii</em></td>
<td>18.7</td>
<td>3:2</td>
</tr>
<tr>
<td></td>
<td><em>Hyalomma rufipes</em></td>
<td>62.8</td>
<td>3:2</td>
</tr>
<tr>
<td></td>
<td><em>Hyalomma truncatum</em></td>
<td>11.0</td>
<td>1:1</td>
</tr>
<tr>
<td></td>
<td><em>Rhipicephalus pulchellus</em></td>
<td>4.2</td>
<td>2:1</td>
</tr>
<tr>
<td></td>
<td><em>Amblyomma gemma</em> (1740)</td>
<td>3.3</td>
<td>2:1</td>
</tr>
<tr>
<td>Inguinal area</td>
<td><em>Hyalomma dromedarii</em></td>
<td>27.3</td>
<td>3:2</td>
</tr>
<tr>
<td>(Udder and testis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Hyalomma rufipes</em></td>
<td>26.5</td>
<td>2:1</td>
</tr>
<tr>
<td></td>
<td><em>Hyalomma truncatum</em></td>
<td>29.0</td>
<td>3:1</td>
</tr>
<tr>
<td></td>
<td><em>Rhipicephalus pulchellus</em></td>
<td>9.1</td>
<td>2:1</td>
</tr>
<tr>
<td></td>
<td><em>Amblyomma gemma</em> (404)</td>
<td>8.1</td>
<td>4:1</td>
</tr>
</tbody>
</table>

lus species 2.4% and Amblyomma species 1.6%.

These results of identification of ticks according to their predilection sites indicate that *Hyalomma dromedarii* was found all over the body with predilection of nostrils and ears. *Rhipicephalus pravus* was found in very low numbers in the nose and ear. *Rhipicephalus pulchellus* was found in the tail switch and inguinal area. *Amblyomma gemma* was found in the inguinal area and tail switch. *Hyalomma rufipes* was found in the tail switch and inguinal area. *Hyalomma truncatum* was found mostly in inguinal area. The ratio of male ticks to female was higher for most of the ticks.
Discussion

These results, although based on a small sample of animals and for a short period of study agree with those obtained earlier (Wilson et al. 1981). The three species of Hyalomma accounted for 96% of the total ticks and this record agrees with the report of Steward (1950) in the Sudan. These results may not be typical of the whole of Marsabit district but they do show that ticks, especially those of Hyalomma which are desert aclimatized, are present in this area which is on the fringe of a desert.

Hyalomma dromedarii was the most common tick and those findings confirm those reported elsewhere (Steward 1950), and Rhipicephalus pravus was found in the nostrils and ears of the dromedary.

The ratio of males to females indicates that males were greater in number than females. Probably indicating that males remain much longer on the hosts while the females drop down to lay eggs and continue the life cycles (Lapage, 1965).

References

STUDIES ON TICKS OF VETERINARY IMPORTANCE IN NIGERIA

IX. The size changes of adult ticks during engorgement and Oviposition

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Department of Veterinary Microbiology and Parasitology, University of Ibadan, Ibadan, Nigeria.

Summary: The measurements of length, breadth and height of engorged Amblyomma variegatum, Boophilus decoloratus, Boophilus geiyyi, Hyalomma rufipes, Hyalomma truncatum, Hyalomma impressum and Hyalomma impeltatum showed that their values and those of the volumes increased with the degree of engorgement. Daily measurements of these values in ovipositing ticks also showed that they fluctuated around initial values generally after detachment until a number of days, which is characteristic for each species, when appreciable decreases could be detected. These were 26 days for A. variegatum, 21 days for Boophilus species and 15 days for Hyalomma species. The decreases progressed gradually until death. It was also found that while there was correlation between the peaks in weight loss of ovipositing ticks and the number of eggs oviposited, no such correlation was detected between the size changes, especially the volumes of the ovipositing ticks and the number of eggs oviposited. The decrease in volume accompanying each oviposition was insignificant.

Introduction

Arthur (1962) stated that the engorged blood in ticks is primarily used for the metabolic processes accompanying oviposition. We further demonstrated that the state of engorgement of A. variegatum was not only an important factor in the number of eggs oviposited but also that peaks of oviposition corresponded with peaks in loss of weight of the ovipositing females (Dipeolu and Ogunji, 1980). In the course of investigations into the bionomics of some ticks, it was observed that during oviposition, there were changes in the sizes of the female ticks until the end of oviposition when the cuticle hardened and the ticks shrivelled and died. In this paper, therefore, changes in the length, breadth, height, area and volume of ovipositing adult female ticks are reported.

Materials and Methods

Adult female A. variegatum, B. decoloratus, B. geiyyi, H. rufipes, H. truncatum, H. impressum, and H. impeltatum were collected on various occasions from cattle stationed at the veterinary control post in Ibadan. They were collected individually by forcible detachment with pairs of forceps and were immediately conveyed to the insectary in dual purpose Kilner jars. Only fully engorged ticks were detached, except during studies on the relationship between length, breadth, height, volume and weight of engorgement when ticks in various categories of engorgement were detached. In the insectary, the individual weights of the ticks were determined and recorded immediately on arrival using a sensitive chemical balance. They were kept, throughout the experiments, in the insectary maintained at 24°C and 85% relative humidity. Each tick was kept in a universal bottle tightly corked with cotton wool. For the experiments in which volume changes were observed, 300 ticks of each species were used. When different weights of each species were needed, 200 ticks of each weight group were used. In experiments in which the relationship between engorged weight, length, breadth, height and volume were studies, 100 ticks of each weight group were also studied.
The measurements of length, breadth and height of each engorged tick were measured everyday from the day of arrival in the insectary till death was observed. The same technique of measurement was used for all the tick species. In order to measure the length, a straight line was drawn on a clean white paper. The tick was placed on the white paper such that its posterior end lays on the same line with the straight line. By applying a gentle pressure through a dissecting pin placed on an area of the cuticle close to the posterior end, the tick’s posterior end was held on the line and with another dissecting pin, the anterior end of the tick was fixed. The anterior end was normally taken as the anterior tip of the two palps which usually fell into a straight line. The distance between the posterior and anterior ends was then measured in millimetres. The breadth was measured similarly by measuring the distance in millimetre between one lateral side of the tick to the other. In order to standardise the measurement of breadth of all tick species, measurement was taken from exactly half the length on the left lateral side to the right lateral side. To measure the height, the highest contour on the dorsal cuticle was chosen. The tick was placed on the white paper and a ruler was placed in a standing position by the tick’s side such that the zero mark (mm.) on the ruler was on the paper. A dissecting pin was then placed on the highest contour on the dorsal cuticle from the opposite side to the ruler and was moved slowly forward until it reached the ruler and the height read. Areas and volumes were calculated from multiplication of length and breadth and length, breadth and height respectively.

Results

Tables 1 and 2 show that the length, breadth, height and volume of *A. variegatum*, *B. decoloratus* and *H. rufipes* increased with their weights of engorgement. *B. geigyi* had similar measurements as *B. decoloratus* while the measurements for *H. truncatum*, *H. impressum* and *H. impeltatum* were similar to those of *H. rufipes*.

Table 1 The relationship of weight of engorged *A. variegatum* and their length, width, height and volume.

<table>
<thead>
<tr>
<th>Wt. of Tick in gram</th>
<th>Measurements in millimetres (mm.)</th>
<th>Volume (cu. mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Breadth</td>
</tr>
<tr>
<td>&lt;0.5</td>
<td>12.5</td>
<td>10.5</td>
</tr>
<tr>
<td>1.5 - 0.99</td>
<td>15</td>
<td>11.8</td>
</tr>
<tr>
<td>1 - 1.49</td>
<td>16.5</td>
<td>12.8</td>
</tr>
<tr>
<td>1.5 - 1.99</td>
<td>18.5</td>
<td>15</td>
</tr>
<tr>
<td>2 - 2.49</td>
<td>20.2</td>
<td>16.2</td>
</tr>
<tr>
<td>2.5 - 2.99</td>
<td>21.3</td>
<td>17.4</td>
</tr>
<tr>
<td>3 - 3.49</td>
<td>21.3</td>
<td>18.0</td>
</tr>
<tr>
<td>3.5 - 3.99</td>
<td>23.8</td>
<td>18.9</td>
</tr>
<tr>
<td>&gt;4</td>
<td>25.1</td>
<td>20.2</td>
</tr>
</tbody>
</table>
### Table 2: The relationship of weights of engorged *B. decoloratus* and *H. rufipes* and their length, width, height and volume.

<table>
<thead>
<tr>
<th>Wt. of Ticks (gram)</th>
<th>Measurements in mm.</th>
<th>Volume (Cu.mm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Breadth</td>
</tr>
<tr>
<td>0.05 – 0.099</td>
<td>9.8</td>
<td>5.6</td>
</tr>
<tr>
<td>0.1 – 0.149</td>
<td>10.8 <em>(9.6)</em></td>
<td>5.9 (5.0)</td>
</tr>
<tr>
<td>0.15 – 0.199</td>
<td>11.2 (11)</td>
<td>7.4 (6.1)</td>
</tr>
<tr>
<td>0.2 – 0.249</td>
<td>12 (11.1)</td>
<td>8.9 (6.5)</td>
</tr>
<tr>
<td>0.25 – 0.299</td>
<td>13.1</td>
<td>9.2</td>
</tr>
<tr>
<td>0.3 – 0.349</td>
<td>13.6</td>
<td>9.5</td>
</tr>
<tr>
<td>0.35 – 0.399</td>
<td>14.8</td>
<td>9.0</td>
</tr>
<tr>
<td>0.4 – 0.449</td>
<td>15.1</td>
<td>9.8</td>
</tr>
<tr>
<td>0.45 – 0.499</td>
<td>14.9</td>
<td>10.0</td>
</tr>
<tr>
<td>0.5 – 0.549</td>
<td>15.6</td>
<td>10.8</td>
</tr>
<tr>
<td>0.55 – 0.599</td>
<td>16</td>
<td>11.0</td>
</tr>
<tr>
<td>0.6 – 0.649</td>
<td>16.1</td>
<td>10.8</td>
</tr>
<tr>
<td>0.65 – 0.699</td>
<td>16.8</td>
<td>10.8</td>
</tr>
<tr>
<td>0.7 – 0.749</td>
<td>17.0</td>
<td>10.8</td>
</tr>
<tr>
<td>0.75 – 0.799</td>
<td>17.7</td>
<td>11.0</td>
</tr>
<tr>
<td>0.8 – 0.849</td>
<td>18.3</td>
<td>11.4</td>
</tr>
<tr>
<td>0.85 – 0.899</td>
<td>18.5</td>
<td>11.9</td>
</tr>
<tr>
<td>0.9 – 0.945</td>
<td>19.1</td>
<td>12.5</td>
</tr>
</tbody>
</table>

* Figures in bracket represent data for *B. decoloratus*.

Both length and breadth (Fig. 1) fluctuated above and below the measurements of day 0 (16mm and 14mm) and showed small peaks until around 25th-28th day when both measurements were almost equal, thence the length and breadth decreased progressively by almost equal amounts till death around 40 days post-detachment. The height also fluctuated above and below that of day 0 (9mm) until around the 20th day when it began to decrease progressively until death. At death, around day 40 post-detachment, the length breadth and height were the same. The areas and volumes fluctuated also until around day 25-30 when they decreased gradually until death.

As for *B. decoloratus* and *B. geigy* (Figs 2 and 3 respectively), the length and breadth never increased more than those of day 0 (10mm and 8mm;
10.5mm and 9mm respectively). They showed only slight decreases until death around day 30. The height showed some increase from day 6 to 10 (B. decoloratus) and from day 5 to 8 (B. geigy) after which there was definite decrease lasting 7 and 5 days respectively. The area fluctuated widely initially until about day 12 when it decreased gradually until death.

The changes in measurements of Hyalomma species were similar to one another; hence only those of H. impressum are presented in Fig. 4. It was observed that it was easier to measure the length, breadth and height of fully engorged ones with weight 0.6-1gm. Within this weight group, the length and breadth fluctuated initially and progressively decreased from day 13 until death on day 32. The height also showed fluctuations but around day 26 it rose above day 0 readings (7mm) until death. This increase in height during the last days of life was also observed in the partially engorged ticks.

Figs. 5-9 show that there was no correlation between the peaks of oviposition and decrease in volume of A. variegatum, B. decoloratus, B. geigy, H. rufipes and H. impeltatum respectively unlike the clear correlation between peaks of oviposition and weight loss. In all cases, each oviposition was only accompanied by insignificant decreases in volume.

![Graph showing oviposition and volume changes](image-url)

**Fig. 1.** The daily fluctuations in length, breadth, height area and volume of different engorgement weights of A. variegatum.
Fig. 2. The daily fluctuations in length, breadth, height, area and volume of *B. decoloratus*.

Fig. 3. The daily fluctuations in length, breadth, height, area and volume of *B. geigyi*.
Fig. 4. The daily fluctuations in the length, breadth, height, area and volume of different engorged weight of *H. impressum*.

Fig. 5. The relationship between the volume of *A. variegatum*, its loss in weight and number of eggs laid during oviposition period of the female.
Fig. 6. The relationship between the volume of *B. decoloratus*, its loss in weight and number of eggs laid during oviposition period of the female.

Fig. 7. The relationship between the volume of *B. geigyii*, its loss in weight and number of eggs laid during oviposition period of the female.
Fig. 8. The relationship between the volume of *H. rufipes*, its loss in weight and number of eggs laid during oviposition period of the female.

Fig. 9. The relationship between the volume of *H. impeltatum*, its loss in weight and number of eggs laid during oviposition period of the female.
Discussion

The results of this study show that length, breadth, height and volume of *A. variegatum*, *B. decoloratus*, *B. geigyi*, *H. rufipes*, *H. impressum*, *H. truncatum* and *H. impeltatum* increase with degree of engorgement. This would suggest that the extension of the cuticle takes place anteriorly, posteriorly and laterally during engorgement. Dipeolu and Ogunji (1980) observed that adult females of *A. variegatum* which engorged up to 4 gm died before ovipositing or after ovipositing a few eggs. This is an indication that the elastic limit of the cuticle of this tick species is reached as soon as it is engorged to that weight. Our current observation in the laboratory is that the elastic limit of the cuticle of the *Hyalomma* species is around the engorged weight of 1.00 gm while that of *B. decoloratus* and *B. geigyi* is around the engorged weight of 0.20 gm. Because the more extensible the cuticle is, the more blood that is engorged, ticks such as *A. variegatum* whose cuticle could accommodate large volumes of blood lay greater number of eggs than *Hyalomma* or *Boophilus* species. For the same reason, *Hyalomma* species lay more eggs than *Boophilus* species.

This work also shows that after engorgement, oviposition is accompanied by decrease in size of the ticks and the decrease is mostly manifested in the volumes although there was no correlation between oviposition and decrease in volume as observed with loss of weight during oviposition (Dipeolu and Ogunji, 1980). Our observation during this investigation was that the values of length, breadth, height and volume of the engorged ticks remained relatively constant even up to the onset of oviposition of eggs and decreases became appreciable only towards the latter stages of egg-laying. This is an indication that although the engorged blood is used for the metabolic changes accompanying oviposition, the tick retains its shape until the later period of oviposition when it begins to decrease in size and shrivel, preparatory to dying.

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PATHOGENICITY OF MYCOPLASMA BOVIGENITALIUM ISOLATED FROM IMPORTED BOVINE SEMEN TO SUDANESE BULLS.

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Summary: The pathogenicity of M. bovigenitalium, isolated from imported bovine semen, to Sudanese bulls was studied. The organism was recovered from the inoculated testes, head and tail of the epididymis, seminal vesicles, preputial mucous, and regional lymph nodes. The infected testes, epididymis and seminal vesicles showed gross and histopathological changes. The authors recommended regular examination of imported semen and further studies into the infertility of Sudanese cattle associated with Mycoplasmas.

Introduction

Mycoplasma bovigenitalium was recovered for the first time from the male genital tract Edward et al. 1947). The organism was isolated in various countries from prepuce and semen of bulls (Albertson 1955; Barber and Fabricant, 1962; Erno, Plastridge and Tourtellotte,1967; Blom and Erno, 1970; Kapoor and Pathak, 1975; Gourlay and Howard, 1979; Jasper et al. 1974; Rae, 1982). Erno and Blom (1972) found that experimental and spontaneous infection of the genital tract of bulls with M. bovigenitalium is possible. Al-Aubaidi et al., (1972) succeeded in producing bovine seminal vesiculies and epididymitis using a strain of M. bovigenitalium similar to that encountered in field cases. Experimental and spontaneous infection of bulls showed that M. bovigenitalium may cause seminal vesiculitis, ampulitis, epididymitis, orchitis, urethritis and adenitis of the bulbourethral gland (Blom and Erno, 1967; Al-Audaiede et al., 1972, Erno and Blom, 1972; Parsonson et al., 1974).

In the Sudan M. bovigenitalium has been isolated from the genital tract of bulls (Nasri et al., 1979; El Hassan, 1980). Some of these isolates were shown to be pathogenic. They produced experimental seminal vesiculitis, epididymitis and orchitis (El Hassan, 1980). Recently M. bovigenitalium was isolated from imported semen (Harbi et al., 1983). The purpose of this study is to examine the pathogenicity of this strain for the genitalia of bulls.

Material and Methods

Experimental Animals

Four Zebu bulls, 2-3 years old, were used for experimental infection with M. bovigenitalium. They were kept under close observation for 2 weeks before the experiment and were confirmed free from parasitic infection. Sera collected from the four bulls were found negative for antibodies against M. bovigenitalium, using the growth inhibition test (Black, 1973).

Inoculum

Three days old, 3rd-passage-broth-culture of M. bovigenitalium, containing 10^6 C.F.U./ml was used. The inoculum was confirmed free from contaminating bacterial.

Media

The medium used for propagation of inoculum was Brucella broth (Albimi) supplemented with 20% sterile horse serum, yeast extract, fresh yeast and D.N.A. Benzyl pencillin and thallium acetate were added as bacterial inhibitors.

Site and technique of inoculation

Proximal and caudal portion of the left testis were inoculated with orga-
nism. Each testis was cleaned and thoroughly disinfected. Three ml of inoculum was injected at the caudal portion of the testis and another 3 ml at the proximal end.

Clinical observations

The bulls were regularly observed after inoculation for clinical manifestations. Their body temperatures were recorded daily throughout the experiment. Testes were examined and palpated from time to time to detect any change in size or induration. Animals were slaughtered after 40 to 60 days of clinical observation. Postmortem changes were recorded for each bull. Tissue samples from the genital organs, kidneys, heart, liver, lung, spleen and regional lymph nodes were collected in 10% formalin for histopathology. Sections were prepared using the paraffin block method, cut at 5-6 microns and stained with Haematoxylin and Eosin (H & E).

Cultural examinations

Seven days before inoculation, preputial swabs, nasal and blood were collected and cultured for Mycoplasmas. During the period of clinical observations, preputial swabs were collected every week from each bull and examined for the presence of Mycoplasmas. At postmortem examination pieces from genital organs, lung, kidneys, spleen, heart, liver, heart blood and regional lymph nodes were removed aseptically, collected in sterile containers and cultured for the inoculum of Mycoplasmas.

Tissue samples and swabs were cultured into Brucella (Albimi) and Mycoplasmas broth and agar (Oxoid). Both media were supplemented with additives as described for the propagation of inoculum. All cultures were incubated at 37°C in a humid environment, and were checked for growth for a maximum period of two weeks.

Results

Clinical observations: One month after inoculation, all bulls showed obvious enlargement of the inoculated testes. The left testes of two bulls out of four were indurated and very hard on palpation. Those of the remaining two bulls showed slight small indurations. The body temperature remained normal in all bulls.

Post-mortem findings: The P.M. examination of bull No. 655, slaughtered after 40 days of clinical observations, and bull No. 496, slaughtered after 60 days of clinical observations, revealed enlargement of the left testes. The cut surface was oedematous and there was no adhesion between the two layers of tunica vaginalis (Fig. 1).

The P.M. examination of bull No. 635, slaughtered after 51 days of clinical observations, and bull No. 639 slaughtered after 59 days of clinical observations showed that the left testes were larger than the right ones. The cut surfaces were dry and seemed fibrosed. The two layers of tunica vaginalis were adhered together (Fig. 2).

Fig. 1: Testis: Note enlargement of the left testis
The right testis, other genital organs and internal organs were histopathologically normal.

Cultural examination: No Mycoplasma was isolated from nasal swabs, preputial swabs or blood, collected and cultured 7 days before inoculation.

The inoculated M. bovigenitalium was not recovered from preputial mucous collected during the period of clinical observations, until after 36 days, when inoculated Mycoplasma was recovered from bull No. 655 and 4 days later from bull No. 496 and then from the other two bulls.

Following slaughter, M. bovigenitalium was reisolated from the left testis, head, body and tail of epididymis and from regional lymph nodes of bull No. 496.

Discussion

Harbi et al., (1983) searched for Mycoplasmas in imported semen of bulls, because bovine semen is now regularly imported for Artificial Insemination in the Sudan with the purpose of improving the characters of the local breeds of cattle. A single strain (B.S. 6) of M. bovigenitalium was isolated from a sample of imported semen.

The results of experimental inoculation into the testes showed clinical findings which confirmed those observed by Erno and Blom (1972); and El Hassan (1980). The inoculated testes evinced marked enlargement, induration and adhesion of the two layers of tunica vaginalis. The histopathological findings of the testes, epididymis and other organs were similar to those described earlier (Erno and Blom 1972; El Hassan, 1980). The recovery of M. bovigenitalium from the testes, epididymis, seminal vesicle confirmed the previous findings of Erno and Blom, (1972) and El Hassan (1980). It was shown in this study that M. bovigenitalium did not only survive in frozen semen (Hirth et al.,

**Fig. 2: Testis: Note adherence of the two layers of tunica vaginalis**

The right testis, other genital organs and internal organs of all bulls appeared normal.

Microscopic examination revealed histopathological changes in the left testis, head, body and tail of epididymis of the four infected bulls.

The inoculated testis showed focal and diffuse mononuclear cells infiltration in the interstitial tissue connective tissue hyperplasia (Fig. 3) and also severe necrosis of seminiferous tubules (Fig. 4).

The epididymis showed hyperplasia of connective tissue and diffuse interstitial cellular infiltration (Fig. 5). Some areas showed focal interstitial cellular infiltration, hyperplasia of epithelial wall and its infiltration with mononuclear cells (Fig. 6). Degeneration and desquamation of the epithelial wall, and accumulation of debris, mononuclear and polymorphonuclear cells in the lumen of the ductus were seen (Fig. 7, Fig. 8).

The left seminal vesicle showed slight diffuse cellular infiltration of interstitial tissue.
Fig. 3: Testis showing mononuclear cellular infiltration in the interstitial tissue. (H & E Stain, x 100)

Fig. 4: Testis: Showing severe necrosis of the seminiferous tubules. (H & E Stain, x 400)
Fig. 5: Epididymis: Showing hyperplasia of connective tissue and diffuse interstitial cellular infiltration. (H & E Stain, × 100)

Fig. 6: Epididymis: Focal interstitial cellular infiltration, hyperplasia of epithelial wall and its infiltration with mononuclear cells. (H & E Stain, × 400)
Fig. 7: Note degeneration and desquamation of epithelial wall, accumulation of debris, mononuclear and polymorph cells in the lumen of ductus (H & E Stain, x 100)

Fig. 8: Magnification of figure 7 (H & E Stain, x 400)
1967) but also retained its pathogenicity for the bovine genital tract. It was once reported that contaminated semen could be one of the means of spreading genital mycoplasmal infection in cattle (Hirth et al., 1967). Taylor-Robinson and Manchee (1967) found that M. bovigenitalium could adsorb spermatozoa, which lowered the semen quality. It is interesting to note that cows inseminated with the imported semen from which B.S. 6 strain was isolated, experienced lower conception rate (Ahmed, 1983). Afshar (1968) has already reported the association of M. bovigenitalium with experimental and natural infection of the genital tract of cows.

The authors recommend that semen should not be distributed to cattle owners before its examination for pathogens. Further studies into infertility of Sudanese cattle associated with Mycoplasmas are also recommended.

Acknowledgement

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- Abs’ No’


- Abs. No. 2745.


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OCCURRENCE OF CONTAGIOUS BOVINE PLEUROPNEUMONIA IN KINGDOM OF SAUDI ARABIA.

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SUMMARY: Contagious Bovine Pleurupneumonia (C.B.P.P.) is reported for the first time in the Kingdom of Saudi Arabia. *M. mycoides* subsp. mycoides was identified from the lungs, mediastinal lymph nodes, fibrin as well as from tracheal and bronchial swabs of two buffaloes and a cow infected with the disease. The buffaloes were imported from India for slaughter purpose while the cow was for a native breed.

The danger of importation of such infectious disease, control and conclusions are discussed.

Introduction

Contagious Bovine Pleurupneumonia (C.B.P.P.) is a highly infectious septicaemia characterized by localization in the lungs and pleura. It is one of the major plagues in cattle causing heavy losses in many parts of the world (Blood et al., 1981). The disease is caused by *M. mycoides* subsp. It was widespread in Europe in the early part of the nineteenth century and there after spread throughout the world as a result of movements of cattle. It was eradicated from the U.K. in 1898 by a slaughter policy and has similarly been eradicated from the USSR, USA and other countries (Turner, 1959). In Australia the disease has been brought under control by a combined slaughter and vaccination policy (Whittlestone, 1975). The disease recurred in France and was eradicated in 1967, but persisted in Spain and Portugal at least until 1968. Parts of Africa and Asia are still infected (Hudson, 1971).

Anon (1959-1965) reported that water buffaloes (Babalus bubalis) were susceptible to C.B.P.P. Shifrine et al. (1970) isolated *M. mycoides* from the lungs of buffalo inoculated experimentally with organism. Hudson (1971) reported that natural C.B.P.P. cases occurred among buffaloes in Assam.

In areas where the disease enzootic there is slow spread by droplet infection and the mortality is about 10%, in some outbreaks the disease is severe, with marked pleural effusion and with mortality rising up to 90%. An important feature of the disease is long persistence of the causal agent in the lungs of recovered cases. These apparently normal carriers may initiate fresh outbreaks of the disease (Whittlestone, 1975).

There is no record in the literature about the incidence of the disease in Saudi Arabia. The aim of this investigation was therefore to report the occurrence of C.B.P.P. in Saudi Arabia and to identify the causative agent.

Materials and Methods

In September 1981 and February 1982 two Indian buffaloes, imported from India for slaughter purpose, suffered from a disease which was clinically diagnosed at Riyadh Abbatoir as C.B.P.P. In November 1981, just before the pilgrimage period, a native breed cow was clinically diagnosed to be infected with the disease at Rea-Zakher (Makkah) Abbatoir.

Samples: Samples from these infected animals including lungs, mediastinal lymph nodes, fibrin (one buffalo) as

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well as tracheal and bronchial swabs were collected for mycoplasma isolation.

**Isolation and Identification of Mycoplasmas:**

1— *Culture medium:* Heart infusion broth and agar base (Difco)* enriched with mycoplasma supplement S (Difco)* were used for the isolation of mycoplasma.

2— *Culture procedure:* It was performed as described previously by Sabry and Ahmed (1975).

3— *Biochemical Characterization of isolates:* This was carried out using the digitonin test (Freundt *et al.*, 1973), glucose fermentation arginine deamination and film & Spots formation test (Erno and Stipkovits, 1973).

4— *Serological indentation:* The isolates were identified using three serological tests viz., growth-inhibition (Clyde, 1964, & Sabry *et al.*, 1971) growth-precipitation (Krösggaard-Jensen, 1972) and metabolic-inhibition (Taylor-Robinson *et al.*, 1966).

*M. mycoides* subsp. *mycoides* (PG-1) and *M. mycoides* subsp. *capri* (PG-3) reference reagents were kindly supplied by Prof. Dr. E.A. Freundt (Denmark) and Prof. Dr. M.Z. Sabry (Egypt) for sero-identification purpose.

**Results**

The primary isolation data was based on the use of one medium and both direct and indirect culturing scheme for optimal recovery rates.

*Primary isolation of mycoplasma:* Typical mycoplasma colonies were isolated from all specimens including lungs, mediastinal lymph nodes, fibrin (one buffalo) as well as tracheal and bronchial swabs.

**Identification of isolates:** Based on the cultural characteristics, biochemical properties and colonial morphology of the isolates, only one type of Mycoplasmas was recognized which showed a large colony with raised nipple and rapid growth. Eleven isolates were tested firstly for genus differentiation using the digitonin test. All the isolates were related to the genus *Mycoplasma*. There strains were also tested biochemically, and the pattern of the results was suggestive of *M. mycoides* subsp. *mycoides* or *M. mycoides* subsp. *capri* (Table 1).

<table>
<thead>
<tr>
<th>TEST</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digitonin sensitivity</td>
<td>Positive</td>
</tr>
<tr>
<td>Glucose fermentation</td>
<td>Positive</td>
</tr>
<tr>
<td>Arginine deamination</td>
<td>Negative</td>
</tr>
<tr>
<td>Film and spots formation</td>
<td>Negative</td>
</tr>
</tbody>
</table>

Using reference antisera against both strains of *M. mycoides* subsp. *mycoides* and *M. mycoides* subsp. *capri* (PG-1 & PG-3 respectively), all the tested strains revealed cross-reaction to both antisera by using the growth-precipitation test. On using growth-inhibition test, all isolates gave 1mm. or more inhibition zone against *M. mycoides* discs, while by metabolic-inhibition test gave a reciprocal titre of (1:160 - 1:320) against *M. mycoides* subsp. *mycoides* antiserum.

**Discussion**

Contagious bovine pleuropneumonia is an acute lobar pneumonia and pleurisy developing by localization from an initial septicaem. Death results from anoxia and presumably from toxaemia. The di-
sease is still enzootic in areas of eastern Europe, Asia, Africa and the Iberian Peninsula (Blood et al., 1981).

The disease was firstly described by Nocard et al. (1898) who isolated in artificial media an organism of the Mycoplasma group, now known as M. mycoides from exudate obtained from the thoracic cavity from C.B.P.P. The disease has been produced experimentally in cattle and captive African buffaloes (Shifrine et al., 1970 & Hudson, 1971).

The isolation and identification of the causative organism, M. mycoides subsp. mycoides, from the examined tissues including lungs, mediastinal lymph fibrin as well as tracheal and bronchial swabs were not surprising since the necropsy findings revealed typical marbling appearance characteristics of the diseased lungs.

The cross-reactions observed during growth-precipitation and growth-inhibition tests by using both M. mycoides subsp. mycoides and M. mycoides subsp. capri antisera confirmed previous findings of Provost et al. (1964) and Lemeck (1965).

The infection of the native breed cow with C.B.P.P. probably occurred from other infected animals. It is well known that about one month before the pilgrimage period, about one million farm animals (Anon, 1982) are moved from different towns in the kingdom toward Holy Makkah and Mena for sacrifice purpose according to Muslim religion beliefs (Quran). Most of the animals sacrificed at the pilgrimage period are imported from different countries. Imported cattle and buffaloes were estimated at 108000 & 11400, respectively (Anon, 1980). Buffaloes are usually imported from India while cows from USA, Canada, Holland, Australia, Jordan, Turkey, Sudan, Somalia and Ethiopia.

Further work is still needed to explore the prevalence of the disease throughout the Kingdom as many monthly records indicate the occurrence of the disease in Jeddah, Taif and Dammam. The control and prevention of transmission of the disease seem possible, since there are a limited number of animals as well as the greater distances involved. Generally, these can be achieved through strict hygienic measures as well as eradication by testing and slaughtering of reactors.

Windsor and Masiga (1977) failed to transmit CBPP from 22 animals recovered from artificial infection to healthy animals. It was concluded that sequestrum do not break down easily and that it is difficult to reinfect recovered animals. They suggested that in field outbreak of obscure origin, investigation should be thorough before it is concluded that an animal with old sequestrum was responsible. On the contrary, Blood et al., (1981) mentioned that the focus of infection is often provided by recovered "carrier" animal in which a pulmonary sequestrum preserves a potential source of organism for periods as long as three years. Under conditions of stress due to starvation, exhaustion or intercurrent disease, the sequestrum breaks down and the animal becomes an active case.

The prevention of entry of such contagious disease into the kingdom includes: (1) prevention of importation of buffaloes or cattle from India, (2) strict quarantine measures on the imported animals, and (3) permission of entry of cattle going to immediate slaughter after a clinical examination and a period of at least one month in a free area or in case accompanied with certificate indicating negative reaction to complement fixation test on two occasions within the preceding two months or have not been in contact with infected animals during this period.

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INFECTIOUS BURSAL DISEASE IN VACCINATED FLOCKS IN NIGERIA

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Summary: A flock of 200 broilers was vaccinated against infectious bursal disease (IBD) at the age of 26 days. But 20 days later a natural outbreak of IBD occurred in the flock and mortality rate was 24 per cent. Another flock of 102 broilers vaccinated against IBD on the 36th day off age suffered clinical IBD 14 days post vaccination. Mortality rate in this flock was 9 per cent. Main clinical signs were severe depression, trembling and diarrhoea. At necropsy the bursa fabricius of affected birds was swollen and histopathological examinations showed that the bursal follicles were depleted of lymphocytes, contained cystic cavities, hyperplastic reticular cells, necrotic lymphocytes and tissue debris. Infectious bursal disease virus (IBDV) was identified in the suspensions of the affected bursae by agar gel diffusion precipitation test (AGDT). IBDV antibodies were detected in the sera of survivors by AGDT. These vaccine failures might be due to inactivation by maternal antibodies in the vaccines. It could also be due to overcome of vaccinal immunity by a highly pathogenic field strain of IBDV.

Introduction

An IBD-like disease was first described in Nigeria by Ojo, Oduye, Noibi and Idowu (1973). Onunkwo (1975) provided the first laboratory confirmation of infectious bursal disease. Since then the control of the disease has been mainly by vaccination with any of the three IBD vaccines commercially available in Nigeria. Two are imported and the third is a new and locally made product. Nevertheless there are reports from the field of unconfirmed outbreaks of IBD among chickens previously vaccinated with some of these vaccines. This paper describes two separate confirmed cases of IBD in flocks vaccinated either on 26th or 36th day of age with local or imported IBD vaccines respectively.

Materials and Methods

Flock history

The flock of 200 broilers was vaccinated against IBD 26 days post hatch using a locally produced commercial vaccine but clinical signs of IBD appeared 20 days later. The second flock of 102 broilers was vaccinated with an imported European IBD vaccine at the age of 36 days and signs of IBD appeared 14 days later. The two flocks were Star Cross breed and were hatched from IBD-vaccinated parent breeding stock at this University. They were reared by deep litter system in some of the faculty poultry houses.

There was marked drop in feed and water consumption by the affected birds. Some of the birds were lying down and trembling; their feathers were ruffled and wings droopy. Faeces were watery, greenish or yellowish in colour. Some birds were prostrated before death. Survivors recovered within 7 days after the appearance of clinical signs. The mortality rate was 24 per cent in the 200-bird flock and 9 per cent in 102-bird flock. Morbidity was over 60 per cent in both cases.

Necropsy and histopathology

The dead birds were examined for gross pathological lesions. Samples of the bursa fabricius were fixed in 10% formal saline for a maximum of 24 hours. They were processed and embedded in paraffin wax. Sections 5μ thickness were cut, stained with haematoxylin and eosin (H & E) and examined under the light microscope.

Virus identification

The bursae of dead birds were accepti-
cally collected and homogenised in phosphate buffered saline (PBS). The suspension was centrifuged at 3000 rpm for 30 minutes and the supernatant fluid was collected for IBDV antigen identification in the agar gel diffusion test (AGDT) previously described (Oko-ye and Uzoukwu, 1981). The positive control antigen was a suspension of infected bursa while the negative control antigen was a suspension of normal bursa. The antiserum used was supplied by the National Veterinary Research Institute, Vom, Nigeria.

**Antibody detection in serum**

Serum samples were collected from survivors 12 days after the appearance of clinical signs. They were inactivated at 56°C for 30 minutes and tested for the presence of IBDV specific precipitins by AGDT. The antigen used was a 50% suspension of infected bursa. The positive control was a known antiserum while the negative control was a normal serum.

**Bacteriological and parasitological examinations**

The spleen, kidney, liver and bursa were cultured for bacterial growth while the intestine was examined for coccidiosis.

**Results**

**Necropsy**

The bursa in most cases was enlarged and showed a striated serosal surface which was covered by a jelatinous exudate. The mucosal surface was congested or haemorrhagic and the cavity contained yellow slimy or bloody fluid. Atrophy of the bursa was seen in some cases. The spleen was enlarged and contained some grey lesions in the serosa. The kidneys were enlarged, congested and haemorrhagic. The tubules were conspicuously distended. Haemorrhages were found in the muscles of the thigh, chest and on the mucosal surface of the proventriculus gizzard junction. Haemorrhagic enteritis was found mainly in the duodenum.

**Histopathology**

There was hyperplasia of the bursal epithelium. The interfollicular spaces were oedematous, fibroblastic, contained reticular cells and heterophils (Fig. 1). The follicles were severely depleted of lymphocytes but there was hyperplasia of reticular cells and follicular epithelium. Some of the follicles had cystic cavities containing eosinophilic fluid, necrotic cells and tissue debris (Fig. 1). The follicles were also infiltrated with heterophiles.

**Virus identification**

Precipitation lines appeared between the antiserum and the test bursal suspensions and the positive control antigen within 48 hours. Negative control antigen produced no line.

**Detection of IBD antibody**

The test serum samples and the positive control antiserum also produced precipitation lines within 48 hours. The negative control serum produced no line.

**Bacteriological and parasitological examinations**

Results of the examinations were negative.

**Discussion**

The clinical and pathological manifestations described in these outbreaks are similar to those previously described in these outbreaks are similar to those previously described for IBD by other workers (Cosgrove, 1962; Helmboldt and Garner, 1964; Cho and Edgar, 1972; Okoye and Uzoukwu, 1982a & 1982b). The present report, however,
seems to be the first description in Nigeria of trembling in chickens infected by IBDV in Nigeria.

The different vaccines used were obtained directly from the accredited distributors and stored frozen for a short time before use. Administration was through drinking water and according to the directions of the manufacturers. Therefore there is no evidence that the vaccines might have been inactivated by bad storage, handling or administration.

It is possible that these cases of IBD vaccines failure might be due to inactivation of the vaccinal virus by maternal antibody as described by Winterfield and Tacker (1978). Rinaldi, Cessi, Cervio and Lodetti (1974) reported that maternal antibody interfered with immunological response of chickens vaccinated before they were 21 days old. Wyeth and Cullen (1976), Wyeth and Cullen (1978) observed complete susceptibility of maternally immune chicks to IBD vaccination to occur at 17 and 27 or 31 days of age respectively.

Ide, Schulte-Nordholt, Dewitt and Smith (1978) found neutralizing IBD antibodies in 86, 72, 30 and 22 per cent of 36 chickens sampled at intervals of 4, 11, 19 and 26 days respectively post hatch. Although the immune status of the flocks in this study was not ascertained before the vaccinations, it is possible that some of the chickens were still carrying neutralizing maternal antibodies at the periods of vaccination. The higher mortality rate among the birds inoculated on day 26 age could be due to the fact that more birds were resistant to IBD vaccination at that time than on the 36th day post hatch.

However, it might be that the vaccinal immunity was overcome by highly virulent field strain of IBDV in Nigeria. The high pathogenicity of Nigeria wild strains of IBDV was reported by Okoye and Uzoukwu (1982b) when the recorded an average mortality of 26.2 per cent in 10 different natural outbreaks. Onunkwo (1975) reported 43.8 per cent mortality. It is possible that a vaccine produced with a local isolate will pro-
duce stronger protection against IBD in Nigeria. Such a vaccine does not exist at the moment because even the IBD vaccine being produced in Nigeria now is an imported IBDV vaccine strain.

IDB often causes high mortality of up to 33.5 and 43.8 per cent in Nigeria (Okoye and Uzoukwu, 1982b and Onunkwo, 1975). The lower mortality rates on these outbreaks might have been due to some vaccinal or maternal immunity or both. The IBDV precipitins detected in the survivors by AGDT could be produced by both the vaccination and the IBD outbreak.

The vaccine failure might conceivably be due to infection by IBDV strains antigenically different from the vaccine virus. But this appears unlikely because antigenic variation has not been found in IBDV strains so far known.

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TRYPANOSOMA CONGOLENSE IN CALVES: PARASITE CONCENTRATION DURING TREATMENT AND ITS RELATION TO THE EFFICACY OF TRYPANOCIDES.

ARUNSI U. KALU and AYO AINA

Summary: Sixteen Zebu cross N'Dama calves experimentally infected with Trypanosoma congoense were treated via the intravenous route and the height of the first parasitaemic wave with seven trypanocides.

Administration of the diaminides increased parasite concentration by a maximum of 7.7 (Pentamidine) and 16.2 (Berenil) time initial values within thirty minutes. Though the quinaldine and the phenanthridine trypanocides resulted in increases as high as 5.2 (Samorin), 8.1 (Novidium) and 8.2 (Antricyde) times zero-time concentration, maximum effects were not observed till the 60th minute post-treatment. There was no significant difference in the parasitaemia of Suramin (Antrypol) - treated and control animals. Changes in the trypanosome concentration in the ear vein were similar to those in the jugular vein, significantly higher at zero-time and during treatment with Penramidine, Samorin and Antricyde but less with Berenil and Novidium.

The higher the maximum parasitaemia attained in the jugular vein, the earlier the onset of, and mean time required for, clearing of parasites. The therapeutic efficacy of the trypanocides in rats was highly correlated with increases in parasite concentration over initial values when drugs were administered via the intramuscular, but not the subcutaneous or intraperitoneal, routes.

Introduction

Trypanosoma congoense is an obligate plasma parasite (Ssenyonga and Adams, 1975) which localises in clusters within the micrvasculature of the hosts' tissues (Banks, 1978) preferring those of the brain, heart and skeletal muscles to others (Kaliner, 1974). More of the parasites have been detected in small blood vessels than in larger central ones (Bugner and Miller, 1976). Therefore, unlike Trypanosoma vivax another strict plasma parasite, cardiac and jugular parasitaemia are poor indicators of the degree of infection for most strains of Trypanosoma congoense.

Maxie and Losos (1977) reported the release of Trypanosoma congoense into general circulation following intravenous injection of Berenil (Diminazine aceturate, Farbweke Hoechst) and suggested that the drug does not kill the trypanosomes but make them accessible to the hosts' defence mechanisms. Earlier, Hall (1927) and Hornby and Bailey (1931) had made similar observations on the ear vein caused by administration of Halarsine and Antimosan, respectively, and were of the opinion that the drugs, had a 'disturbing' effect on the parasite.

The parasite concentration in the jugular and ear veins of Zebu cross N'Dama calves have been quantified before and after treatment with seven trypanocides in order to elucidate if increases in jugular trypanosomes is specific for Berenil, the diaminides and or, trypanocides in general. Furthermore the time for clearing of parasites from infected rats treated through various perenteral routes was monitored and the relationship between therapeutic efficacy and the parasitologic action of the trypanocides assessed.

Materials and Methods

Calves;

Sixteen Zebu cross N'Dama calves, born and raised in the Nigerian Institute
for Trypanosomiasis Research (N.I.T.R.) farm in Vom, a tsetse-free area of Nigeria, were used. The animals aged between 6 and 12 months and weighing 93.60±2.75 (se) kg. were divided into eight groups (one male and one female per group) and fed cut grass/legume with concentrate supplement. Salt licks and water were provided ad libitum. Prior to infection, the animals were iron dextran (Myofer 100; Farbweke Hoechst), sprayed with an acaricide (diazinon; Neocidol, Ciba Geigy) and dewormed (thiophanate; Nemafax, May and Baker).

Rats.

Adult albino rats of mean weight 143.96±12.67g were obtained from the Laboratory Animal Unit, Parasitology Division, N.I.T.R., separated into three groups and fed mice cubes and rabbit pellets.

Trypanosome infection

A stablate off cloned Trypanosoma congoense strain 58/98 (N.I.T.R. Laboratories) was passaged several times in donor rats. Each calf was infected intravenously (right jugular) with approximately 1x10^8 trypanosomes contained in 5 to 10 ml. infected rat blood. Rats were infected via the intraperitoneal (i.p.) route with 1x10^5 trypanosomes per animal.

Haemomotology and parasite concentration.

From the day of infection, 0.5ml. blood was collected from the jugular and ear veins of calves, preserved in EDTA and used for total leucocyte counts. Differential leucocyte counts were made on Giemsa-stained thin blood films. Wet films were prepared and twenty fields (x 400 magnification) of each was screened for trypanosomes. Low parasitaemias were estimate by the rapid ‘matching’ (Herbert and Lumsden, 1976) and the trypanosome-leucocyte ratio (Maxie and Losos, 1977) methods. In addition to these methods, high trypanosome concentration was estimated by physical counts in an improved Neubauer haemocytometer as described by Brown Losos (1977).

Trypanocidal drugs

The composition and doses of trypanocides used were:

- Diminazene aceturate (Berenil\(^{(R)}\); Farbweke Hoechst AG, Frankfurt) 7% w/v; 3.5 mg. kg\(^{-1}\).
- Pentamidine isethionate (Pentamidine\(^{(R)}\); May and Baker, Dagenham) 10% w/v; 4.0 mg. kg\(^{-1}\).
- Homidium chloride (Novidium; May and Baker, Dagenham) 2.5% w/v; 1.0 mg. kg\(^{-1}\).
- Homidium bromide (Ethidium\(^{(R)}\); The Boots Co. Ltd., Nottingham) 2.5% w/v; 1.0 mg. kg\(^{-1}\).
- Isometamidium chloride (Samorin\(^{(R)}\); May and Baker, Dagenham) 2% w/v; 0.5 mg. kg\(^{-1}\).
- Quinapyramine methylsulphate (Antrycid\(^{(R)}\); ICI England) 10% w/v; 4.4 mg. kg\(^{-1}\).
- Suramin sodium (Antrypol\(^{(R)}\); ICI; England) 10% w/v; 10.0 mg. kg\(^{-1}\).

Treatment

At the height of the first parasitaemic wave each calf was treated by intravenous (i.v.; right jugular) injection of one of the trypanocides. Control animals were given 5 ml. sterile normal saline while animals in groups 2 to 8 received the therapeutic doses (outlined above) of Berenil, Pentamidine, Novidium, Ethidium, Samorin, Antrycid and Antrypol respectively. On treatment days, multiple blood samples were collected from the left jugular and ear veins at the time of drug administration (9.00 a.m.) and at 5-10,15,20, 25,30,45,60,75,90,120, and 150 minutes post treatment and used for parasite estimation.
Each of the three batches of rats was divided into eight groups. Control animals were injected with 0.1 ml. sterile normal saline while the other groups were treated with trypanocides using the same schedule used for calves. However, the drug solutions were prepared in such a way that each dose for a 200g rat was contained in approximately 0.2 ml. sterile distilled water, while the first batch of rats were treated by the intramuscular (i.m.) route, the second and third batches were injected subcutaneously (s.c.) and intraperitoneally (i.p.) respectively.

**Efficacy of trypanocides**

After treatment, tail blood was collected from each rat three times daily between 9 a.m. and 9 p.m. and at six hours interval. Wet smears and thin and thick films were prepared from the blood and stained with Giemsa. Absence of trypansomes from sixty fields of the wet preparation and one hundred oil immersion fields (X 1,000 magnification) in each of the Giemsa-stained films was regarded as evidence of clearing - the criterion used to measure the efficacy of the drugs. Clearing was regarded as having started at the first time during which no trypansome was detected in the wet and stained films from one or more rats in a group and to have been completed when all rats in the group were negative for trypansomes by the detection methods used.

**Statistical analyses.**

Trypanosome concentration at different times were compared by the paired 't' test and the correlation coefficient calculated according to Snedecor and Cochran (1957).

**Results**

Effects of trypanocides on parasitaemia.

In calves, prepatent periods ranged from seven to nine days and the height of the first parasitaemic wave occurred 13.12±0.45 days after infection.

Within ten minutes of the administration of Berenil, Pentamidine, Novidium and Antrycide, jugular parasite concentration had doubled. Berenil resulted in two peaks of parasitaemia at the seventh and tenth minutes after injection. At these times, parasite concentrations were 16.2 and 7.7 times the pre-treatment value, respectively. Increases recorded with Pentamidine were maximal at the 7th and 45th minutes post-treatment and were 7.7 and 6.2 times the zero-time concentration of 1.03x10³ trypanosomes per ul. The diamidines exhibited maximum effect within thirty minutes of administration (Fig. 1); parasitaemia had returned to initial values within 30 and 60 minutes of Berenil and Pentamidine treatment respectively. The former (Berenil) and eliminated 93.8% of the trypanosomes from jugular circulation two hours after injection.

Among the phenanthridine trypanocides jugular parasite counts resulting from administration of Novidium and Samorin were similar. Both drugs increased jugular parasite concentration significantly (P < 0.001) at the 25th minute, exhibited rising parasitaemia between the 90th and 150th minute and resulted in peak parasite concentration 45 to 60 minutes post treatment (Fig. 2). Despite these similarities, Novidium was more effective in releasing marginated trypanosomes from the microvasculature and increasing jugular parasitaemia. Maximum parasite concentration was higher than initial values in calves treated with Novidium (8.1 times) than in those treated with either Samorin (5.2 times) or Ethidium (4.5 times). There was no significant difference (P > 0.05) in the parasitaemia of Ethidium-treated and control calves till the 75th minute. Mean parasitaemia resulting from treat-
ment with the drug at this time showed an increase of 2.2 times over original concentration.

Although Antrycid doubled parasite concentration at the 10th and 20th minutes after treatment maximum effect of the drug, an increase of 8.2 times zero-time concentration, was not recorded till the 90th minute after administration. However, mean increases ranging from 4.0 to 4.4 times original trypanosome numbers occurred between the 45th and 75th minutes (Fig. 3). Like the diamidines, the parasitaemia in Antrycid-treated calves returned to initial values within the test period of 2½ hours. There was no significant difference (P > 0.05) in the jugular trypanosome concentration of Antrypol-treated and control calves (Fig. 3). Besides, the drug was the only trypanocide which did not increase trypanosome numbers. Increased parasite counts were accompanied by double peaks of parasitaemia in which the first peak was usually lower than the second.

Trypanocides did not show any general trend in the relationship between jugular and ear vein concentrations. However, the higher a trypanocide increased jugular counts the less the parasitaemia resulting from its action on the ear vein. There were more parasites in the ear at zero-time and during treatment with Pentamidine, Samorin and Antrycid but less with Berenil and Novidium.

**Trypanocides which increased jugular parasite concentration in calves cleared trypanosomes from infected rats within 78 hours (Table 1). Post-treatment, the course of parasitaemia in rats showed an initial increase within 12 to 24 hours followed by progressive decline except with Antrycid therapy. The higher the maximum parasitaemia attained and the more the increase in parasite numbers over initial values in calves, the earlier the beginning of clearing and the shorter the mean time required for clearing of parasites in rats. However, increases in parasitaemia over zero-time concentration was better correlated with the onset (r = -0.75) and mean time of clearing (r = -0.60) than was maximum parasitaemia reached (r = -0.68 and r = -0.59 respectively) when the drugs were given via the intramuscular route. This correlation was lost if any of the other routes was used. Subcutaneous and intraperitoneal injection significantly (P < 0.05) increased the beginning and mean time required for clearing (Table 1) except with Antrycid. Unlike other trypanocides Antrycid was more efficacious when given subcutaneously: within 12 hours all treated rats exhibited parasitologic cure of the infection.

**Discussion**

Flushing of *Trypanosoma congoense* from the microvasculature into larger vessels is not specific for any group of trypanocides but is a phenomenon common to all trypanocidal drugs which are therapeutically effective against infections caused by the parasite. The effect of the diamidines is spontaneous; those of the phanathridines and quinaldines are usually delayed while Suramin preparations are usually ineffective. In rats the effect of the drugs as measured by time of onset of, and mean time for, clearing showed a gradation similar to that observed in calves. These findings
Fig. 1: Parasite concentration in Zebu cross N'Dama calves experimentally infected with Trypanosoma congoense and treated, at the height of the first parasitaemic wave, with diamidine trypanocides
Fig. 2: Effect of the phenanthridines on jugular parasite concentration in T. congolense infected Zebu cross N'Dama calves.
Fig. 3: Changes in jugular parasitaemia of *T. congolense* — infected Zebu cross N'Dama calves after treatment with Antrycide (○—○) and antrypol (●—●).
Table 1. Clearing potential of trypanocides for *Trypanosoma congoense* in infected rats treated, via different routes, on the day of maximum (3-4x10⁵ ut⁻¹) parasitaemia.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Route</th>
<th>No of rats</th>
<th>Onset</th>
<th>End</th>
<th>Mean (±se)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diminazene aceturate (Berenil)p.3</td>
<td>i.m. 2</td>
<td>20</td>
<td>12</td>
<td>36</td>
<td>24.0±0.38</td>
</tr>
<tr>
<td></td>
<td>s.c.</td>
<td>10</td>
<td>36</td>
<td>60</td>
<td>52.0±4.4</td>
</tr>
<tr>
<td></td>
<td>i.p.</td>
<td>10</td>
<td>36</td>
<td>60</td>
<td>44.0±6.3</td>
</tr>
<tr>
<td>Pentamidine isethionate</td>
<td>i.m.</td>
<td>20</td>
<td>30</td>
<td>72</td>
<td>52.5±3.9</td>
</tr>
<tr>
<td></td>
<td>s.c.</td>
<td>10</td>
<td>48</td>
<td>66</td>
<td>55.2±2.2</td>
</tr>
<tr>
<td></td>
<td>i.p.</td>
<td>10</td>
<td>60</td>
<td>72</td>
<td>66.4±3.3</td>
</tr>
<tr>
<td>Homidium chloride (Novidium)</td>
<td>i.m.</td>
<td>20</td>
<td>24</td>
<td>36</td>
<td>27.0±0.6</td>
</tr>
<tr>
<td></td>
<td>s.c.</td>
<td>10</td>
<td>36</td>
<td>60</td>
<td>50.4±2.9</td>
</tr>
<tr>
<td></td>
<td>i.p.</td>
<td>10</td>
<td>36</td>
<td>42</td>
<td>40.0±2.1</td>
</tr>
<tr>
<td>Homidium bromide (Ethidium)</td>
<td>i.m.</td>
<td>20</td>
<td>30</td>
<td>72</td>
<td>54.4±4.8</td>
</tr>
<tr>
<td></td>
<td>s.c.</td>
<td>10</td>
<td>48</td>
<td>72</td>
<td>56.0±3.0</td>
</tr>
<tr>
<td></td>
<td>i.p.</td>
<td>10</td>
<td>42</td>
<td>54</td>
<td>50.2±2.2</td>
</tr>
<tr>
<td>Isomeramidium Chloride (Samorin)</td>
<td>i.m.</td>
<td>20</td>
<td>36</td>
<td>54</td>
<td>40.8±1.4</td>
</tr>
<tr>
<td></td>
<td>s.c.</td>
<td>10</td>
<td>36</td>
<td>78</td>
<td>54.0±4.6</td>
</tr>
<tr>
<td></td>
<td>i.p.</td>
<td>10</td>
<td>54</td>
<td>72</td>
<td>62.0±2.8</td>
</tr>
<tr>
<td>Quinapyramine methylsulphate (Antrycide)</td>
<td>i.m.</td>
<td>20</td>
<td>12</td>
<td>24</td>
<td>19.2±1.3</td>
</tr>
<tr>
<td></td>
<td>s.c.</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>12.0±0.0</td>
</tr>
<tr>
<td></td>
<td>i.p.</td>
<td>10</td>
<td>36</td>
<td>36</td>
<td>36.0±0.0</td>
</tr>
<tr>
<td>Suramin Sodium (Antrypol)</td>
<td>i.m.</td>
<td>20</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>s.c.</td>
<td>10</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>i.p.</td>
<td>10</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

1. i.m. = intramuscular
2. s.c. = subcutaneous
3. i.p. = intraperitoneal
— indicates lack of clearance (i.e. infection terminated in death).

were not affected by diurnal variation (Hornby and Bailey, 1931): trypanosome numbers were estimated using samples collected at similar times in the morning and from housed animals. Besides, it is known that calves tolerate infections better than adults (Finnes, 1950) and most strains of the parasite produce low jugular parasitaemia (Maxie and Losos, 1977). Furthermore the trypanosome concentration in control and Suramin-treated calves did not exhibit the progressive peaks found with effective trypanocides.

The delay in the onset of clearing by Samorin despite its effect on jugular parasitaemia may be due to its prophylactic status and the reported complexing with proteins (Williamson, 1970) when administered by routes other than intravenous. Similarly Pentamideine increased parasite concentration relative to other trypanocides better than it effected clearance of the parasite in rats. This might have been due to the facts that (1) for *T. congoense* the effective dose of the drug is equivalent to its Maximum Tolerated dose (50 mg/kg, s.c.; Hawking, 1963) and (2) the duration of treatment is a critical factor in therapeutic results with the drug (Minelli et al, 1981). The efficacy of Berenil and
Antrycide were comparable if the intramuscular route is employed but the higher efficacy of the latter when the subcutaneous route was used is contrary to the report of continued multiplication of trypanosomes in mice after quinapyramine therapy (Hawking, 1963) but is not surprising. Not only is Antrycide normally injected by the s.c. route, but the dose employed might have been too high. Doses as low as 0.1 mg/kg (Curd and Davey, 1949) 0.35 mg/kg (Minelli et al., 1981) and 2.2 mg/kg (Anon, 1975) have been found effective against different strains of *T. congolense*. Moreover the drug arrests multiplication of trypanosomes by inhibiting division of the cytoplasm (Bhattacharya, et al, 1962) and is highly soluble and may therefore be absorbed fast.

Increase in parasitaemia correlated well with the efficacy of the trypanocides if drugs were injected intramuscularly. *Trypanosoma congolense* is a haematic organism (Losos and Ikede, 1972) and drugs would have to get into the vascular system to have any effect on the parasite. Differences in absorption rates from the site of parenteral injections and thereby attainment of adequate blood levels would be responsible for delays in onset of clearing and lack of correlation by the s.c. and i.p. routes. The observation on mean time of clearing cleanly indicate that the route of administration is of major importance in the therapeutic efficacy of trypanocides.

The ineffectiveness of Suramin on *T. congolense* in calves and mice agree with reported *in vivo* and *in vitro* effects on the parasite (Williamson, 1970). Of the two Homidium compounds used, Novidium was more efficacious. The difference may be accounted for by the higher solubility of Novidium (Stephen, 1970) and, or the prophylactic tendencies of Ethidium (Leach et al., 1955). Resistance to Ethidium by the strain of *T. congolense* used would however be the major factor: nineteen to twenty five days after therapy all animals treated with the drug relapsed on matter the route of injection. Besides widespread resistance to Ethidium is common with laboratory and field strains of *T. congolense* (Williamson, 1970; Gray and Roberts, 1971; Scott and Pengram, 1974).

Maxie and Losos (1977) and Mills and associates (1980) had reported increases in jugular trypanosome concentration following Berenil injection. Earlier, Hornby and Bailey (1931) had made similar observations in the ox’s ear. The latter were of the opinion that all trypanocides should have ‘disturbing’ action on *T. congolense* similar to that of Antimosan. These studies report gradation in increases in parasite concentration in the ear and jugular veins of cattle by Berenil and other effective trypanocides. Furthermore the degree to which a trypanocide is able to bring about this increase in the jugular parasite concentration of *T. congolense* reflects its efficacy in the treatment of infections caused by the parasite.

Acknowledgements

The authors are grateful to Dr. J. Williamson, Institute for Medical Research, London for the supply of Antrycide (Quinapyramine methylsulphate), Messrs M.M. Baah and F. Doro for technical assistance and Mr. C.O. Adomoke for typing the script. Our thanks are also due to the Director. N.I.T.R., (Alhaji Y. Magaji) for permission to publish.

References


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GENITAL ACHOLEPLASMAS IN FEMALE CAMELS (Camelus dromedorus)

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Early observation have proved that mycoplasmas may at least act as facultative pathogens for the reproductive tract (Freundt, 1976). In Egypt Mycoplasmas were isolated from the lower genitalia of female buffaloes (Sabry et al., 1976, a; Ahmed and Sabry, 1982), cow and ewes (Ahmed et al., 1981) and Camel (Sabry and Ahmed, 1975 and Sabry et al., 1976, b). The present study is aimed to identifying the acholeplasma species in the vagina of female camel.

On hundred and fifteen vaginal mucous swabs were collected from she-camel (Camelus deomedorus) brought for slaughter at Cairo abattoir, ranging in age from 7—12 years old. The swabs were collected on HN-transport medium and further cultured as described previously by Sabry and Ahmed (1975). Biochemical characterization and serological identification of isolated strains were performed as described by Ahmed and Sabry (1982).

Mollicutes isolation were recovered from 64 out of 115 (55.65%). Forty-eight representative isolates were biochemically characterized; all these isolates were biochemically identical to family Acholeplasma ataceae. Serological identification revealed that 37 (32.17%) were identified as A. laidlawii, 3 (2.61%) as A. granularum, 3 (2.61%) as A. oculi and the remaining strains could not be typed.

A. laidlawii was isolated from the vagina of cattle in Egypt in a higher rate from unmated heifers (67.74%) and to a lesser extent from endometritis animals (1.08%) Ahmed, 1979). In buffaloes, the highest incidence was shown to exist in apparently normal animals (43.00%) and its low recovery was obtained from animals affected with endometritis (5.00%) (Ahmed and Sabry, 1982). Also Acholeplasma laidlawii had been previously recovered in a comparable percentage from the genitalia of apparently normal and diseased cattle (Edward, 1954; Al-Aubaidi and Fabricant, 1968; Al-Aubaidi, 1970; Pan and Ogata, 1969; Savav and Buchvotova, 1976; Langford, 1975; Hoare, 1969 and Ahmed and Sabry, 1979).

A. oculi was originally recovered by Al-Aubaidi et al., (1973) from goat suffering from keratoconjunctivitis, from horse (Allam and Lemcke, 1975), camel nasal cavity (Al-Aubaidi, et al., 1978) and recently from buffalo genitalia (Ahmed and Sabry, 1982). A. granularum was identified originally from porcine nasal cavity (Switzer, 1957; Edward and Freundt, 1970) and equine conjunctiva (Ogata et al., 1974) and recently in Egypt from buffalo genitalia (Ahmed and Sabry, 1982).

References
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PARATYPHOID INFECTION IN A BABY BULBUL: A CASE REPORT

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Summary: A baby bulbul (Pyenonotus spp.) was found dead in the compound of the Veterinary Investigation Centre (V.I.C.) Arusha. Postmortem, histopathological and bacteriological examinations of the carcass confirmed a case of Paratyphoid (Salmonella group B) infection.

Introduction

Salmonellosis has been reported in a number of wild birds by various workers. Such birds have included pigeons, canaries, quails, seagulls, mallards, patri- dge, magpie, tawny owl, jackdaw, goldfinch, curlew, gannet, rook, starling, sparrow, brown headed cowbird, coot and wild pheasant (Davis et al., 1971), kite and sparrow hawk (Khan, 1970).

The bulbul is a small black capped tropical wild bird. This paper reports a case of Paratyphoid infection in a baby bulbul found dead in Arusha, Tanzania.

Materials and Methods

Postmortem was carried out according to conventional methods (Coffin, 1953). Portions of heart, liver, lung, spleen and intestines were aseptically collected and were subjected to pathological and microbiological studies. Sections from heart, liver and intestines for microscopic examination were fixed in 10% buffered formalin, embedded in paraffin wax, sectional at 6 microns and stained with Haematoxylin and Eosin. Culturing for bacteria was carried out on blood agar and McConkey agar medium using sections from lung, heart, spleen and liver and incubated at 37°C for 18 hours.

Results

The carcass showed marked dehydra- tion. Vent feathers were soiled and pasted with faecal material. The lungs and heart were moderately congested. The liver was enlarged and bronze coloured with numerous miliary greyish white necrotic foci. The spleen and kidneys were moderately congested. The intestinal mucosa was markedly inflamed with yellowish grey catarrhal contents.

Histological examination revealed focal and diffuse necrosis of liver cells with infiltration of mononuclear cells, congestion and haemorrhages. The heart showed marked interstitial oedema, haemorrhages, vascular congestion and degenerative changes of myocardial fibres. The intestinal mucosa revealed marked epithelial denudation, congestion, oedema and leucocytic infiltration.

After incubation of the plates at 37°C for 18 hours Salmonellae — like colonies were subcultured onto McCon- key Agar medium and the plates incubated at 37°C for 18 hours. Non-lactose fermenting colonies on McConkey Agar medium were subjected to Slide agglutination tests using polyvalent somatic antiserum, polyvalent specific and non-specific flagellar anti- sera**, which confirmed a case of Sal- monella group B. Non-lactose fermenters

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** Burroughs Wellcome
on McConkey Agar were tested for urease production using Christensen Urea agar. Urease negative cultures were picked up for further identification. Further tests included motility in semi solid nutrient agar, Vogue—Prauskouer reaction, sugar fermentation, indole production and methyl red reaction. The identification was done at the Animal Diseases Research Institute Dar-es-Salaam.

Discussion

Salmonellosis in the bulbul has hitherto not been described in the literature and in this respect the present investigation did reveal a new finding. Bulbuls usually feed on fruits such as guavas, pawpaws, pepper and also on insects. Such fruit plants are not uncommonly found near or around homesteads where poultry farming is a common practice. Infected bulbuls gaining access to houses and yards occupied by domestic poultry, are likely to contaminate such premises and therefore constitute a hazard to the domestic birds.

Hummel (1969) made a Salmonellosis survey in domestic animals in Tanzania. Out of 109 strains of Salmonella isolated, 38 came from the V.I.C. Arusha, which included 10 isolates of Salmonella typhi-murium, 5 isolates of Salmonella enteritidis and one isolate of Salmonella wagenia, all from chickens. The isolation of species of Salmonella other than Salmonella gallinarum in chickens originated from areas where the domestic fowl lived in close contact with other farm animals and humans. Infected Pycnonotus spp. dealt with in this paper could be a possible source of infection. Other possible sources of infection include rodents, insects and reptiles.

In wild birds the isolation of Salmonella appears to have been more frequent than that of Salmonella gallinarum pullorum. In domestic poultry the reverse appears to be the case. It has been suggested by some workers that probably wild birds possess natural resistance to Salmonella gallinarum pullorum or that they are exposed infrequently (Davis et al. 1971).

Although paratyphoid infections are more likely to be spread by infected and carrier wild birds compared to Fowl typhoid, this fact does not rule out the possibility of spreading Fowl typhoid from the few cases that do occur. Hence, the desire to keep surroundings of domestic poultry out of reach of wild birds, rodents and other vermins need not be overemphasized.

Acknowledgement

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OCCULAR SQUAMOUS CELL CARCINOMA IN A BUNAJI (WHITE FULANI) COW A CASE REPORT

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and

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Summary: Squamous cell carcinoma of the left eye of an 8-year-old Bunaji (White Fulani) cow is reported. The tumor was found on the conjunctiva and extending to adjacent portion of the adnexa. Severe necrosis and haemorrhage was observed around the lesion. The neoplastic tissue was removed and the eye enucleated. Histologic section of the tumor mass revealed irregular cords of epithelial cells invading the conjunctiva, subcutis and the dermis.

Introduction

Ocular squamous cell carcinoma is a common tumor of cattle with a prevalence of up to 50% in some region of the world (Woodward and Knapp, 1950). It is an economic disease which may also account for 82% off cattle condemned for neoplasia (Russell et al, 1956). Animals older than five years are more susceptible than younger ones (Blackwell et al 1956). Although there is no breed predisposition, Hereford cattle are believed to be most susceptible. This is attributed to a lack of pigmentation around the eyes in that breed (Cordy, 1978). There is also no sex predisposition. It has been reported that the prevalence is higher in South Western part of the United States where animals are exposed more than other regions of that country to ultraviolet radiation from the sun (Anderson and Skinner, 1961; Guilbert et al., 1948). Reports of squamous cell carcinoma in Nigeria exist only in the horse (Akerejola et al, 1978) and dog (Uzoukwu, 1970). This paper reports squamous cell carcinoma in a bunaji cow.

Case History:

An 8-year-old Bunaji cow was admitted into the Large Animal Clinic of the Faculty of Veterinary Medicine of Ahmadu Bello University, Zaria, Nigeria for an eye ailment. Examination revealed a friable bleeding mass on the left conjunctiva. The mass was partially necrotic and covered the whole eyelid so that the eye was closed (Fig. 1). There was extension of the tumor mass into adjacent skin areas. A biopsy of the mass was taken and enucleation of the eye performed when it was observed that the tumor has invaded the surrounding skin tissue and the eyeball.

Pathologic Findings

The tumor mass was solid and whitish grey. Severe necrosis and haemorrhage was observed where the tumor infiltrated into adjacent skin tissue. Histologically, the mass consisted of squamous cells arranged in whorls or cords with keratinized centres (Fig. 2). Intercellular bridges were easily distinguishable (Fig. 3) while the periphery of the neoplasm was infiltrated by mononuclear cells. Mitotic figures were common (Fig. 3).

Discussion

The Bunaji is the commonest breed of cattle in the savannah zone of Northern Nigeria. The more common name
Fig. 1: Note near total closure of eyelid due to "Cancer Eye"

Fig. 2: Squamous cell carcinoma showing Keratinized whorls and mononuclear cell infiltration. H & E x 40
"White Fulani" is given because the coat colour is predominantly white with the exception of some areas around the eye, muzzle, horn tips and tail tip which are black (Gate, 1952). Predisposition to ocular squamous cell carcinoma has been thought to be a recessively inherited character in cattle (Blackwell et al., 1956; Woodward and Knapp, 1950). In a survey by Anderson and Chambers (1957), 44.4% of the progeny of two affected cattle developed ocular squamous cell carcinoma while only 8.8% of the progeny of unaffected cattle developed the condition. Furthermore, characteristics of eyelid pigmentation are inherited in the Hereford breed, and hence breeding of animals with "heavier" pigmentation tends to reduce the incidence of ocular squamous cell carcinoma in their progenies.

Viruses have been shown to be aided by ultraviolet light in the development of this disease condition (Lytle et al., 1970). Since the Bunaji is basically white and since exposure to ultraviolet light is high all year around, there is need to study the effects of pigmentation and expose to ultraviolet light in this breed of cattle. A point to be considered is the fact that some diseases, for example tibial hemimelia, have been thought to be limited to certain breeds of cattle until encountered in the Bunaji (Salako and Abdullahi, 1982). The prevalence therefore of ocular squamous cell carcinoma is probably higher than has been encountered here, since meat inspection and disease surveillance are not carried out with the same intensity as in the more advanced parts of the world.

Reference


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Geographical Distribution of SHEEP POX in Africa

OAU/STiHC
INTERAFRICAN BUREAU
FOR ANIMAL RESOURCES
MAP No. 486
1983

■ Foci reported
X Widespread
□ Enzootic/Sporadic but no Foci reported
□ No official Information available

Geographical Distribution of NEWCASTLE DISEASE in Africa

OAU/STNC
INTERAFRICAN BUREAU
FOR ANIMAL RESOURCES
MAP No. 487
1983

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

Geographical Distribution of BOVINE PLEUROPNEUMONIA in Africa

OAU/STRC
INTERAFRICAN BUREAU
FOR ANIMAL RESOURCES
MAP No. 488
1983

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

Geographical Distribution of FOOT AND MOUTH DISEASE in Africa
Geographical Distribution of RABIES in Africa

OAU/STRC INTERRAFRICAN BUREAU FOR ANIMAL RESOURCES
MAP No. 490
1983

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

Geographical Distribution of RINDERPEST in Africa

OAU/STRC
INTERAFRICAN BUREAU
FOR ANIMAL RESOURCES
MAP No. 491
1983

■ Foci reported
X Widespread
☑ EnzOOTIC/Sporadic but no Foci reported
☑ No official Information available

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IBAR/1984  D. DAVIS
29  Infection with Dermatophilus congolensis at a Contact Hypersensitivity and Its Relevance to Chronic Streptothricosis Lesions in the Cattle of West Africa


AUTHOR'S SUMMARY: Guinea-pigs were sensitized to CDNB and infected with D. congolensis at the site of a subsequent application of this chemical. The bacterium was recovered from the skin over a longer period of time in sensitized individuals than in non-sensitized controls. Animals rendered tolerant to the chemical gave lower yields of bacteria than sensitized animals. However, the lesions produced at the site of infection did not become chronic. The growth of D. congolensis at a contact hypersensitivity site may possibly simulate infection in skin following and arthropod bite and be relevant to the pathogenesis of chronic streptothricosis lesions in the cattle of West Africa.

IBAR/1984  M. P. DOUTRE & P. PERREAU
30  Pasteurella and Mycoplasma arginini Carriers in Goats in Senegal


AUTHORS' SUMMARY: A study of Pasteurella and Mycoplasma arginini carriers among healthy goats, slaughtered in Dakar, is carried out according to a procedure already experimented in sheep. Three strains of M. arginini, 21 of P. multocida and 24 of P. haemolytica are isolated. M. Arginini shows a low prevalence in goats; on the contrary P. haemolytica is demonstrated more often in goats than in sheep. In Senegal, pneumonia develops in goats consequently to a primary attack of pseudo pest of small ruminants; in sheep, a poor physiological state constitutes the usual predisposing stress.

IBAR/1984  J. DOMENECH, M. J. CORBEL, E. L. THOMAS & Ph. LUCET
31  Cattle Brucellosis in Central Africa. Identification and Typing of Strains isolated in Chad and Cameroun


AUTHORS' SUMMARY: This last paper of the series on cattle brucellosis in Central Africa gives the results obtained after the identification and the biotyping of the strains isolated in Cameroon and Chad.

Though most of the strains isolated were identified as being Brucella abortus biotype 3 (67 p. 100), the homogeneity recorded by other research-workers was not confirmed: 3 p. 100 of the strains were Brucella melitensis biotype 1, 1 p. 100 Brucella abortus biotype 2, 15 p. 100, Brucella abortus biotype 6 and 14 p. 100, Brucella abortus intermediate biotype 3/6.

The examination of a more varied range of pathological samples should enable us to clarify this point since, up to now, most of the samples consisted of samples taken from knee hygromas which is a widespread lesion easy to diagnose in African herds. The biochemical characteristics of the samples fit quite well with the standards defined for the Brucella species. Particularly, the oxydase test was positive for 94 p. 100 of the strains.

Although the oxydative metabolic tests have been carried out on few strains, the pattern of the oxydative metabolism of those strains is close to that of Brucella abortus. However, the use of some substrates makes some strains of Central Africa closer to the usual metabolic pattern of Brucella suis.

IBAR/1983  F.G. GLEGG, S. N.
32  CHIEJINA, A. L. DUNCAN R. N. KAY & C. WRAY
Outbreaks of Salmonella newport Infection in Dairy Herds and Their Relationship to Management and Contamination of the Environment


AUTHORS' SUMMARY: Two outbreaks of Salmonella newport infection in dairy herds are described which were characterised by haemorrhagic enteritis. The history of the outbreaks, the extent of the losses, clinical and laboratory findings and treatment are described. The first herd
consisted of 193 cattle, of which seven died, three aborted and another 84 required treatment. Salmonellosis persisted over 14 months throughout the summer on a paddock grazing system and continued during the following winter when the herd was loose-housed. The relationship of the commencement of clinical disease to dietary changes and to the time of calving is described, as are the problems in controlling the disease. The second herd consisted of 98 milking cows and a few beef animals. One cow died and two aborted; altogether 18 were clinically affected. The epidemiology of the disease and the geographical relationship between the two farms is described. Extensive contamination of streams occurred and one cow died on a neighboring third farm. In contact humans were found to be excreting the organism. The public health significance of the outbreak is discussed because bulk milk samples were contaminated with salmonellae for 10 months and local streams were polluted with human sewage.

IBAR/1984    CARLOS H. ROMERO, 35
              GERALDO B. CRUZ &
              CHERYL A. ROWE

Transmission of Bovine Leukaemia Virus in Milk


AUTHORS’ SUMMARY: Nineteen calves born to dams free of bovine leukaemia virus (BLV) did not possess maternally derived precipitating antibody to BLV in their sera after the ingestion of colostrum. Eight of these calves remained serologically negative after being fed milk from BLV-free cows while three (27.3%) of 11 similar calves that had been fed milk from BLV-infected cows developed antibody. Forty-four of 47 calves born to BLV-infected dams acquired maternal antibody to BLV after ingesting colostrum. Two (8.7%) of the 23 calves fed milk from BLV-free cows developed antibody to BLV probably as a result of transplacental or colostrum infection whereas four (16.7%) of the 24 calves fed milk from BLV-infected cows developed antibody. It is concluded that milk transmission of BLV is responsible in part for the high rates of infection encountered in our dairy herds and that calves lacking specific maternal antibody are more susceptible to BLV infection through the ingestion of milk than are calves with maternal antibody.

IBAR/1984    H. W. REID, D. BUXTON, I. POW & J. FINLAYSON

Transmission of louping-ill virus in goat milk

The vet. Record, 1984, 114 (7) 163.

AUTHORS’ SUMMARY: The course of louping-ill virus infection was examined in lactating goats. Seven goats were inoculated subcutaneously and titres of virus in blood and milk were monitored. All goats became viraemic with maximum titres of between $10^{16}$ and $10^{4.0}$ plaque forming units (pfu)/0.2 ml. Virus was also detected in the milk of all goats at maximum titres of between $10^{0.8}$ and $10^{6.7}$ pfu/0.2 ml. Only one of these goats exhibited clinical signs which were transient. In contrast, five of the 13 kids sucking these goats became infected and all showed marked clinical signs and one died and two were killed in extremis. It is considered that goats do not represent an efficient maintenance host for louping-ill virus but the excretion of virus in milk could represent a public health hazard.
AUTHORS' SUMMARY: The temporal development of antibody in four groups of pigs with different Aujeszyk's disease virus isolates was examined. The enzyme-linked immunosorbent assay detected antibody by five to six days after infection and the antibody-dependent cell-mediated cytotoxicity assay detected antibody seven to nine days after infection. Neutralising antibody was first detected nine to 10 days after infection, whereas assays measuring complement mediated antibody lysis did not detect antibody until 10 days after infection. These results are discussed in terms of their importance to the diagnosis and recovery from Aujeszyk's disease.

IBAR/1983 H. BIELEFELDT OHMNN
37 Pathogenesis of Bovine Viral Diarrhoea-mucosal Disease: Distribution and Significance of BVDV Antigen in Diseased Calves.


AUTHOR'S SUMMARY: The distribution of bovine viral diarrhoea virus (BVDV) antigen in tissues of animals with acute and chronic bovine viral diarrhoea-mucosal disease (BVD-MD) was examined using improved indirect immunofluorescence and indirect immunoperoxidase staining methods on cryostat and paraffin wax tissue sections. In lymphoid tissues the antigen was principally located in cells belonging to the mononuclear phagocyte system and in other cells with antigen-retaining capacity. The distribution of the infected cells within a particular organ varied with the clinical stage. In the non-lymphoid organs the antigen was detected in cells of the mononuclear phagocyte system as well as in epithelial cells. An apparent time lag between initial antigen-detection and progression of pathological manifestations was noticed in the intestinal mucosa and in the keratinised epithelia of the upper digestive system and in the skin. Only limited involvement of blood vessels was observed in the tissues investigated. In the light of the mononuclear phagocyte system being an apparent common denominator for all the different tissues involved in the morphological alterations which characterise BVD-MD, a possible pathogenesis of BVDV-MD is discussed.

IBAR/1984 R. MANICKAM, S. DHAR & R. P. SINGH
39 Protection of Cattle Against Theileria annulata Infection Using Corynebacterium parvum


AUTHORS' SUMMARY: An investigation was conducted to determine if depriving goat kids of colostrum and rearing them away from the herd would prevent transmission of caprine retrovirus infection. Twenty-four newborn goat kids were deprived of colostrum and reared on cow's milk away from their dams from an endemically infected goat herd. Twenty-three colostrum-deprived kids had no evidence of retrovirus infection at birth. One kid had sucked briefly and obtained some colostrum resulting in passive transfer of antibody but it did not develop evidence of infection. Nineteen showed no serological evidence of infection over the 370 days of the study. One colostrum-deprived, segregated goat was subsequently found to be infected and developed arthritis-synovitis. Three had doubtful positive response in one or 2 serological tests during the period but no evidence of infection in leucocyte co-cultures.

Cells centrifuged from colostrum of infected goats were co-cultivated with foetal goat synovial membrane cultures. Caprine retrovirus was isolated from cells in the colostrum from the 3 goats examined.

IBAR/1984 T. ELLIS, W. ROBINSON AND G. WILCOX
38 Effect of Colostrum Depri-
calves of group D. All the calves of groups A and B withstood the challenge whereas all the calves of groups C and D died of theileriosis. Complement fixing antibodies were detected in calves of groups B and C. There was a significant decrease in calves of groups A and B. No significant changes were seen in other cell types. The results of this study demonstrated that T. parvim alone may be used an immunostimulant for producing non-specific resistance against T. annulata.

IBAR/1984  J.P. POIVLEY, E. CAMUS & E. LANDAIS
40 Trypanosomiasis Infection Survey in Village Cattle Herds in the North of Ivory Coast.


AUTHORS' SUMMARY: 3040 head of N'Dama, Baoule, zebu and crossbred (Zebu x taurine) cattle from 194 herds distributed in sedentary villages of the North of Ivory Coast were sampled for blood examination. This survey led to the study of the degrees of trypanosomiasis infection and hematocrit value according to the various variation factors whose importance is discussed. The degree of infection of each animal depends on the season, the genetical type, the age and sex.

The hematocrit value varies with the degree of infection and the age and less noticeably with their genotype.

At the herd level, the infection rates are greatly influenced by the genetical types under consideration.

The trypanosomiasis resistance of taurine cattle is confirmed and the results show that this resistance is essentially an ability of the diseased animals to limit the level of their parasitemia.

IBAR/1984  G. UILENBERG
41 New Acquisitions Concerning the Vector Role of the Tick Amblyomma (Ixodidae)


AUTHOR'S SUMMARY: The West African tick Amblyomma astridion is a transtadal vector of the protozoan parasites Theileria mutans and Theileria velifera. Larvae of this tick, infected with the rickettsia Cowdria ruminantium, were able in one experiment to carry the infection through the nymphal stage and transmit it as adults. The East African tick A. cohaerens has been shown to be an efficient vector of cowdriosis, transtadal transmission from larva to nymph, from larva through nymph to adult, and from nymph adult all having been achieved. The American tick A. cajennense transmitted cowdriosis in one experiment only, from larva to nymph; this appears to be a poor vector. Experiments proving that the ticks A. lepidum and A. hebraeum are vectors of T. velifera are described; they had so far been published only by a short mention of the results.

IBAR/1984  L. PETRIE
42 Maximising the absorption of colostral immunoglobulins in the newborn dairy calf

The vet. Record, 1984, 114 (7) 157

AUTHOR'S SUMMARY: Various systems of early post natal management of the newborn calf were examined to determine which would consistently achieve high serum concentrations of maternally derived immunoglobulins, and to examine the factors which might influence this transfer. Early assisted sucking of colostrum to satiation produced consistently high serum concentrations of absorbed immunoglobulins with a mean of 27.17 ± 8.92 zinc sulphate turbidity (ZST) units for 100 calves. No significant increase in the serum concentrations of absorbed immunoglobulins occurred when calves, which had been assisted to suck immediately after birth, were permitted to remain with their dams and encouraged to suck again at 12 hours (29.20 ± 9.40 ZST units). Despite early assisted suckling, a small proportion of calves may remain hypogamma-globulinaemic because of the low concentration of immunoglobulins in their dams' colostrum; leakage of colostrum from the under before calving was the major cause of these low immunoglobulin concentrations. A highly significant correlation was demonstrated between the colostral immunoglobulin concentrations and the passively acquired serum immunoglobulin concentrations of the calves. With this intensive system of early assisted sucking the breed of the calf did not significantly influence the absorption of colostral immunoglobulins.
the oestrous cycle were delayed by 1 – 2 days. Maximal levels with 89. 7 + 9.2 (mean + s.e.m.) ng progesterone / 100 mg backfat were recorded on Day 15 of the oestrous cycle. It was estimated that, on this day, a total amount of about 36 mg progesterone is stored in the adipose tissue, which is approximately 200 times that present in total blood and corresponds to the daily production of the corpora lutea of the sow on Day 11.

Initial half-life of progesterone in backfat after ovariectomy was estimated to be about 34h compared to an initial half-life of plasma progesterone of about 120 min. The exact calculation of half-lives was, however, confounded by an obvious effect of anaesthesia or surgery on progesterone levels. Changes in backfat or plasma progesterone concentrations were not affected by the fat-to-lean ratio of the gilt.

Fat progesterone levels determined in 44 additional pregnant and non-pregnant sows 17 or days after mating indicated that reliable diagnosis of non-pregnant sows was possible on Day 20.

It is concluded that the endocrinology of the oestrous cycle in pigs is related to the enormous storage of progesterone in the fat.


AUTHORS’ SUMMARY: A herd of 73 dairy cows was observed at pasture and during parlour milking for three weeks during the breeding season. Thirty-nine cows were seen in oestrus, which occurred either naturally or following prostaglandin induction. Readiness to enter the parlour restless and elimination in the parlour were not found to be significantly affected by oestrus. However, cows in oestrus were more likely to be two or more batches away from their normally preferred parlour entry batch, and were more often early than late. Much more reliably indicative of oestrus, however, were large fluctuations in milk yield. Many cows showed a suppression at oestrus onset, with a rebound enhancement at the next milking. If a cow produced less than 75 per cent of its usual yield, there was a 30 per cent chance that it was in oestrus, and the rare occasions on which it gave 25 per cent more milk than normal only occurred during oestrus. Of seven cows induced but giving no behavioural indication of oestrus, six showed fluctuations in
yield of this magnitude during the two days in which oestrus was expected.

The action of corticosteroids persisted at least 2 weeks longer than that of chloramphenicol. This difference is discussed for its clinical relevance.

AUTHORS' SUMMARY: Fifty-one strains of Haemophilus pleuropneumoniae were tested for susceptibility to 27 antimicrobial agents using agar disc diffusion, broth-tube dilution and microdilution methods. There was generally good agreement between the interpretation of the disc diffusion inhibition zones and the actual minimal inhibitory concentrations obtained with the dilution methods. The agreement between the results obtained with the broth-tube dilution method and the microdilution method was very good. Three strains were resistant to penicillin, ampicillin, carbenicillin, methicillin and tetracycline. One of those was also resistant to chloramphenicol. Forty strains were resistant to streptomycin, 23 strains were resistant to novobiocin and seven were resistant to triple sulfa. It is thus necessary to consider resistance development against antimicrobial agents chosen for the treatment of pleuropneumonia in pigs caused by Haemophilus pleuropneumoniae.

AUTHORS' SUMMARY: The efficiency of a new benzimidazole anthelmintic, triclabendazole, was tested against cumulative infections with Fasciola hepatica aged 1 to 12 weeks in sheep and compared with that of rafoxanide. At 10 mg/kg, triclabendazole was 99% effective in eliminating both immature and adult flukes. At a lower dose rate of 5 mg/kg, triclabendazole was highly effective against adults and significantly reduced the number of early immature flukes with an 87% overall
reduction of fluke burden. Rafoxanide at 7.5 mg/kg showed high efficiency against adult fluke, but its effect on immatures was not significant, and overall efficiency was 64%.

IBAR/1984  R.W. LACEY  50
Does the Use of Chloramphenicol in Animals Jeopardize the Treatment of Human Infections?
The vet. Record, 1984, 114 (1) : 6

AUTHOR'S SUMMARY: It has been suggested that the therapeutic use of oral chloramphenicol in animals is liable to select resistance to antibiotics and that the resistance may jeopardise the treatment of infections in man. At present this risk appears minimal; resistance to chloramphenicol in animal bacteria may well be selected by the increasing use of semisynthetic penicillins because of linkage between genes coding for production of β-lactamase and resistance to chloramphenicol. Among salmonellae, the strains causing enteric fever have no animal reservoir and the few food poisoning incidents in man that require therapy can be treated with antibacterial agents such as trimethoprim. Chloramphenicol is not now the antibiotic of choice for any human infection except perhaps a few caused by Haemophilus influenzae. Resistance to antibiotics in ‘human’ culture has largely been selected by the use of antibiotics in human medicine. Control of salmonellosis is essentially a public health, not a therapeutic, problem.

IBAR/1984  Y. AMEGEE  51
Sturdy Caused by Bryoscarpus in Small Ruminants in South Togo

AUTHOR'S SUMMARY: The author describes a new case of food poisoning recorded in sheep and goats of south Togo and caused by Bryoscarpus coccineus which is a widespread shrub of West Africa.

The main symptoms are sturdy, dizziness, frantic aimless running. The shoots of this shrub are especially poisonous.

The animals recover spontaneously provided they are taken to other pastures where this tree does not grow but the convalescence is always long because of the pronounced loss of weight of the diseased animals.

IBAR/1984  W.F. ROBINSON AND T. M. ELLIS  52
The Pathological Features of an Interstitial Pneumonia of Goats.

AUTHORS' SUMMARY: An interstitial pneumonia in goats which predominantly affects the caudal lung lobes is described. It is characterized microscopically by hypertrophy of type 2 pneumocytes, the presence of an abundant oesinophilic, PAS-positive material within alveolar spaces, and a diffuse and focal lymphoid infiltration of alveolar septa. The material present within alveolar spaces is considered to be composed of surfactant and fibrin. Although the aetiology is not known the gross and microscopic appearance suggests that a retro-virus may be involved.

Tsetse and Trypanosomiasis Survey of Southern Darfur Province, Sudan

AUTHORS' SUMMARY: During a survey of Southern Darfur Province, Sudan, blood samples from over 4,000 migratory cattle were analysed to determine levels of anaemia and trypanosome parasitaemia byuffy coat examination of microhaematocrit centrifuged samples. Levels of trypanosomal infections in the herds correlated with their risk of exposure to tsetse being significantly lower at increasing distance from tsetse foci. Trypanosoma vivax infections predominated in all herds, more so with increasing distance from tsetse foci. Packed cell volume values could not be used to assist in trypanosome diagnosis at either individual or herd levels and the lack of correlation between anaemia and parasitaemia is suggested as evidence of a degree of trypanosomal tolerance in the Western *Baggara* cattle. Drug use and problems of drug resistance are discussed. Bovine trypanosomiasis is largely under control at present but requires continued surveillance (particularly of drug use) to prevent future problems as tsetse/cattle interactions increase.
ANDREAS SCHÖNEFELD
Field Trial in the Control of *Glossina morsitans submorsitans* by Screens Impregnated with Deltamethrin


**AUTHOR'S SUMMARY:** In the course of the field training “l'Ecole de lutte anti-tsetse” in Bobo-Dioulasso, an experiment was carried out for the first time to test the effectiveness of screens impregnated with insecticide against *G.m. submorsitans*; it took place in a region of West Upper-Volta reserved for livestock breeding.

500 screens impregnated with 100 mg deltamethrin each were positioned 200 m apart in an area of 13.5 km². During the three months of the experiment, the reduction in the tsetse fly population in the test area was significantly greater than that observed under natural conditions.

However, further investigation seems necessary, in particular to specify the optimal distribution of screens, esp. in relation to different types of savannah, also to confirm the choice and formulation of insecticide, and finally to assess the overall cost-effectiveness of the method.
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