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Results presented concisely.
Discussion of significance.
Acknowledgements.
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VACCINATION OF NIGERIAN INDIGENOUS CHICKENS, GUINEA FOWLS AND TURKEYS AGAINST NEWCASTLE DISEASE: AN ASSESSMENT OF HAEMAGGLUTINATION INHIBITION TITRES

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National Animal Production Research Institute
Ahmadu Bello University, Shika, Zaria
*Veterinary Teaching Hospital, A.B.U., Zaria

VACCINATION DES POULETS, DES PINTADES ET DES DINDONS LOCAUX DU NIGERIA CONTRE LA MALADIE DE NEWCASTLE: UNE EVALUATION DES TITRES DE L'INHIBITION DE L'HEMAGGLUTINATION

Résumé
Une enquête séroépidémiologique sur des titres de l'inhibition de l'hémagglutination (IH) contre la maladie de Newcastle (MN), obtenus des bandes de poulets, de pintades et de dindons locaux élevés en libre parcours à Giwa LGA dans l'Etat de Kaduna a été menée en vue d'évaluer les taux d'anticorps chez les bandes après les vaccinations contre la maladie de Newcastle. La présence d'anticorps chez les oiseaux vaccinés a été évaluée avec le test de l'inhibition de l'hémagglutination. Tous les poulets et les pintades vaccinés, sans tenir compte du type de vaccin utilisé, ont développé des anticorps IH au virus MN avec des titres qui variaient entre log₂ 3 et log₂ 11, alors que chez les dindons les titres étaient entre log₂ 0 et log₂ 4.

Tous les poulets et les pintades vaccinés, sans tenir compte de leur âge, étaient protégés lorsqu'ils étaient infectés avec une souche virulente sauvage de virus MN. En revanche, les dindons n'étaient pas protégés et 25% d'entre eux succombaient 4 à 6 jours après le traitement au vaccin MN - Komarov.

Summary
A seroepidemiological survey of Newcastle disease (ND) Haemagglutination Inhibition (HI) titres (antibodies) from flocks of indigenous chickens, guinea fowls and turkeys on free range in Giwa LGA, Kaduna State was carried out to evaluate the protective antibody levels in the flocks following Newcastle disease vaccinations. Presence of antibodies in vaccinated birds was evaluated by the Haemagglutination Inhibition test.

All the vaccinated chickens and guinea fowls irrespective of the type of vaccine treatment developed HI antibodies to ND virus with titres ranging from log₂ 3.0 log₂ 11.0 while the turkeys had log₂ 0.0 -log₂ 4.0.

All the vaccinated chickens and guinea fowls irrespective of age were protected when challenged with field virulent ND virus. The turkeys were however not protected and 25% died 4-6 days post NDV - Komarov treatment.

Introduction
Newcastle disease (ND) is an acute rapidly spreading viral disease of domestic poultry characterised by respiratory signs, nervous manifestations and diarrhoea. ND constitutes the most important epizootic disease in Nigeria causing serious economic threat to the local poultry and resulting in increased flock morbidity, mortality and loss of eggs.

Over 80% of the poultry population in Nigeria is on free range in almost every village and town backyards, and are traditionally uncaresed for and unvaccinated. These birds are highly susceptible to many diseases including ND. The need to vaccinate against ND, whose outbreaks usually wipe out whole village flocks has assumed greater importance among the free-ranging village flocks which
provide about 80% of poultry meat supply in Nigeria.

ND vaccines have been of considerable value in reducing losses from the disease in general, but the effectiveness of ND vaccinations in indigenous chickens, turkeys and guinea fowls have not been widely studied in the country. The efficacy of the locally available ND vaccines in the indigenous poultry were evaluated.

Materials and Methods

This study was carried out with free range flocks comprising 215 indigenous chickens, 98 guinea fowls and 40 turkeys that were allowed to scavenge within the neighbourhood and return to the residence of the owners every evening in Giwa LGA of Kaduna State.

Flocks were selected from each of the 10 villages in the study area totalling 25 flocks of chickens, 10 of guinea fowls and 5 of turkeys. The birds in the chicken flocks were subdivided into 3 groups based on ages i.e. chicks (1-9 weeks); Growers (10-19 weeks) and Adults (over 20 weeks). The guinea fowls and turkeys were however not divided into groups because they were all over 12 weeks of age.

Flock histories obtained included age, flock size, previous illness, types of medication and vaccination histories. Only healthy flocks with no vaccination history were included in the study. Five clinically healthy birds were randomly selected from each group and bled through the wing vein to obtain pre-vaccination HI titres.

Vaccines and Vaccinations

The Newcastle disease vaccines, NDV - Intraocular batch 21, NDV - LaSota batch 14 and NDV - Komarov batch 12, used in the study were obtained from the National Veterinary Research Institute (NVRI), Vom, Nigeria.

The initial vaccination of all the flocks except the control in each village was done at the end of 3 weeks pre-vaccination bleeding. NDV - intra-ocular was administered on Day 22 followed by NDV - LaSota on day 50 via drinking water and then NDV - Komarov on day 78 intramuscularly, according to the Manufacturer's Instructions.

Serum Samples: Five birds were randomly selected from each group and bled 3 weeks post each vaccination. Serum was extracted from the blood samples after 3 hours storage at 4°C by centrifugation at 2,000 rpm for 10 minutes. The sera were then frozen until tested.

Chicken red blood cells

Five millilitres of chicken blood was collected into 10 ml of Alsever's anticoagulant solution and gently mixed. The red blood cells (RBCs) were washed 3 times with phosphate buffered saline (PBS) pH 7.4 by centrifugation at 2000 rpm for 5 minutes each. The concentration was adjusted to 1% by preparing a 5% suspension as described by Allan, Lancaster and Toth.

Source of Antigen was NDV - Lasota batch 14 from NVRI.

Haemagglutination -Inhibition test (HI)

The titre of the antigen was determined by haemagglutination (HA) titration. The result obtained was used to calculate the test dilution necessary to give a solution (in PBS) containing 4 HA units.

The HI test method is based on procedures described by Allan and Gough and Allan et al using 0.05 ml as the unit volume. The titre range included in the test is from log2 2 to log2 11 for routine purposes.

Field Challenge

The vaccinated chickens and guinea fowls were allowed to scavenge in the neighbourhood with confirmed field cases of ND in the unvaccinated groups 3 weeks post the last vaccination. The turkeys were however not challenged because some had already developed clinical signs of ND 48 hours post NDV-K vaccination.
Results
The pre-vaccination HI titres in all groups ranged between $\log_{2} 0$ and $\log_{2} 6$, with geometric mean titre (GMT) 2.1 which is far below the protective levels (Table 1.)

<table>
<thead>
<tr>
<th>Group</th>
<th>Range $\log_{2}$ Titre</th>
<th>Gmt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicks +</td>
<td>0-3</td>
<td>2.3</td>
</tr>
<tr>
<td>Growers +</td>
<td>1-4</td>
<td>2.3</td>
</tr>
<tr>
<td>Adults +</td>
<td>1-3</td>
<td>2.1</td>
</tr>
<tr>
<td>Guinea Fowls</td>
<td>1-6</td>
<td>2.3</td>
</tr>
<tr>
<td>Turkeys</td>
<td>0-2</td>
<td></td>
</tr>
<tr>
<td>Mean average</td>
<td></td>
<td>2.2</td>
</tr>
</tbody>
</table>

* Geometric Mean Titre + Indigenous chickens

Table 2: HI (antibodies) titres 3-weeks post NDV i/o vaccination

<table>
<thead>
<tr>
<th>Group</th>
<th>Range $\log_{2}$ titre</th>
<th>Gmt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicks+</td>
<td>4-9</td>
<td>5.7</td>
</tr>
<tr>
<td>Growers+</td>
<td>5-10</td>
<td>6.0</td>
</tr>
<tr>
<td>Adults+</td>
<td>3-11</td>
<td>5.1</td>
</tr>
<tr>
<td>Guinea Fowls</td>
<td>4-8</td>
<td>5.3</td>
</tr>
<tr>
<td>Turkeys</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mean average</td>
<td></td>
<td>5.5</td>
</tr>
</tbody>
</table>

* Geometric Mean Titre + Indigenous chickens

while GMT was 7.9 which rather than protect killed some of them.

Table 3: HI (antibodies) titre 3-weeks post NDV-I vaccination

<table>
<thead>
<tr>
<th>Group</th>
<th>Range $\log_{2}$ titre</th>
<th>Gmt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicks +</td>
<td>3-8</td>
<td>4.4</td>
</tr>
<tr>
<td>Growers +</td>
<td>3-7</td>
<td>4.0</td>
</tr>
<tr>
<td>Adults +</td>
<td>3-7</td>
<td>4.0</td>
</tr>
<tr>
<td>Guinea Fowls</td>
<td>3-5</td>
<td>4.1</td>
</tr>
<tr>
<td>Turkeys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean average</td>
<td></td>
<td>4.1</td>
</tr>
</tbody>
</table>

* Geometric Mean Titre + Indigenous chickens

Table 4: HI (antibodies) titre 3-weeks post NDV-K vaccination

<table>
<thead>
<tr>
<th>Group</th>
<th>Range $\log_{2}$ titre</th>
<th>Gmt*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicks +</td>
<td>5-10</td>
<td>7.0</td>
</tr>
<tr>
<td>Growers +</td>
<td>5-11</td>
<td>8.0</td>
</tr>
<tr>
<td>Adults +</td>
<td>5-11</td>
<td>7.0</td>
</tr>
<tr>
<td>Guinea Fowls</td>
<td>5-9</td>
<td>7.2</td>
</tr>
<tr>
<td>Turkeys</td>
<td>5-11</td>
<td>7.9</td>
</tr>
<tr>
<td>Mean average</td>
<td></td>
<td>7.4</td>
</tr>
</tbody>
</table>

* Geometric Mean Titre + Indigenous chicken

All the vaccinated birds except turkeys irrespective of age and vaccine treatment survived field virulent challenge.

Discussion
The assessment of immunity to Newcastle disease in indigenous poultry by the use of HI titre measurement is one of the most practical methods at present available to assess the degree of resistance of a ND vaccinated flock to virulent field challenge. A titre greater than $\log_{2} 4$ is reported to protect against mortality from ND while that of $\log_{2} 7$ or above is required to protect against loss of eggs following ND challenge$^{5.13}$.

The pre-vaccination HI titre recorded for all groups ranged from $\log_{2} 0$ - $\log_{2} 6$ with a GMT of 2.1 which indicated high susceptibility in case of
an outbreak. The high HI titre recorded for all the vaccinated birds ranged from $\log_2 3 - \log_2 11$ except the turkeys that reacted only to NDV - K.

The general immune response in the 3 vaccinations was lowest in NDV - L with titres ranging from $\log_2 3$ to $\log_2 8$ and GMT 4.1 (Table 3). This could be anticipated as the volume of water containing the vaccine drank by each bird varied in addition to the effect of ingesta on the vaccine.

The immune response to NDV - K was highest in all groups irrespective of age. This agrees with the earlier findings (4). Although the HI titres obtained in response to NDV - i/o and NDV - L could be protective, it is however necessary to include NDV - K in the village poultry vaccination schedule if long lasting protection is desired. The failure of the turkeys to develop HI titres to earlier vaccines except the NDV - K might be that they were either immuno depressed at the time of vaccinations or the two vaccines were not strong enough to elicit an immune response in the turkeys. It however shows how virulent NDV - K strain was and might have probably accounted for the mortalities recorded.

The ability of the vaccinated chickens and guinea fowls to resist field virulent challenge shows the protective ability of the vaccines that are advocated to boost the productivity of indigenous poultry in the country.

Conclusion
The results of this study indicates that both indigenous chickens and guinea fowls irrespective of age can be adequately protected against ND. It also shows that previously unvaccinated chicken flocks of all ages in a village set-up can be successfully vaccinated against ND. The vaccination schedule should however be started with the milder NDV - i/o strain then followed by subsequent booster vaccinations of NDV - L and NDV - K

References
BODY TEMPERATURE, RESPIRATION AND HEART RATE IN THE RED SokOTO GOAT DURING THE HARMATTAN SEASON

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TEMPERATURE CORPORELLE, RYTHME RESPIRATOIRE ET FREQUENCE DES PULSATIONS CHEZ LES CHEVRES ROUSSES DE SOKOTO PENDANT LA SAISON DE L'HARMATTAN

Résumé

On a fait des expériences avec onze chèvres rousses de Sokoto en libre parcours afin de déterminer leur adaptabilité à la saison de l'hamattan, en notant les variations de leurs réactions à la température rectale (TR), au rythme respiratoire (RR) et à la fréquence des pulsations (FP). Les valeurs de TR, RR et FP étaient relevées tous les jours à 6H, 13H et 18H pendant deux semaines vers la fin de décembre et de janvier. Tous les paramètres physiologiques mesurés ont montré des variations diurnes distinctes comme décrit auparavant pour les races caprines sauvages et les chèvres naines de l'Afrique de l'ouest. Pendant toute la saison de l'hamattan, la moyenne de la chèvre rousse de Sokoto a augmenté de 38,3 ± 0,8°C à 6H à un maximum de 39,4 ± 0,04°C à 18H. Les valeurs globales les plus élevées pour RR: 37,53 ± 1,38 respirations/minute et pour FP: 116,78 ± 6,19 pulsations/minute étaient enregistrées à 13H, tandis que les valeurs les plus faibles : 32,07 ± 1,54 respirations/minute et 109,9 ± 6,35 pulsations/minute étaient obtenues à 6H. Pendant toute la saison de l'hamattan, il y avait une corrélation positive et négligeable entre TR et FP (r = 0,835, P < 0,05) et TR et RR (r = 0,820, P > 0,05). Le coefficient de corrélation entre FP et RR était positif et significatif (r = 0,999, P < 0,01). Une tendance générale à la baisse des valeurs de tous les paramètres physiologiques était observée chez les chèvres puisque la durée de la saison de l'hamattan a prolongé de décembre à janvier. Les résultats obtenus dans cette étude montrent que l'hamattan de décembre était légèrement plus stressant pour les chèvres que celui de janvier. La chèvre rousse de Sokoto s'est surtout adaptée aux conditions météorologiques stressantes pendant toute la saison de l'hamattan. On en a conclu que la chèvre rousse de Sokoto a apparemment un potentiel de reproduction dans la zone de savane guinéenne du nord du Nigeria.

Summary

Experiments were performed on eleven free-grazing Red Sokoto goats with the aim of determining their adaptability to the harmattan season by describing the fluctuations in their rectal temperature (RT), respiratory rate (RR) and heart rate (HR) responses. Measurements of RT, RR and HR were taken daily at 06:00, 13:00 and 18:00h for two weeks each in late December and January. All the physiological parameters measured showed distinct diurnal fluctuations as described previously for the temperate breeds of goats and the West African Dwarf goat. For the entire harmattan season, the mean RT of the Red Sokoto goat rose significantly (P < 0.001) from the minimum value of 38.30 ± 0.8°C at 06:00h to the maximum value of 39.40 ± 0.04°C at 18:00h. The highest overall values of both the RR, 37.53 ± 1.38 breaths per minute, and HR, 116.78 ± 6.19 beats per minute, were recorded at 13:00h, while the lowest values, 32.07 ± 1.54 breaths per minute and 109.90 ± 6.35 beats per minute, respectively, were obtained at 06:00h. Throughout the entire harmattan season, there was a positive but insignificant correlation between the RT and HR (r = 0.835, P > 0.05), and the RT and RR (r = 0.820, P > 0.05). The correlation coefficient between the HR and RR was positive and significant (r = 0.999, P < 0.001). A general trend of decrease in values of all the physiological parameters was observed in the goats as the duration of the harmattan season increased from December to January. The results obtained in this study indicated that the December harmattan was slightly more stressful to the goats than the January harmattan. The Red Sokoto goat has predominantly adapted to the stressful meteorological conditions prevailing during the entire harmattan season. It is concluded that the Red Sokoto goat is apparently a potential breeding stock in the Northern Guinea Savannah zone of Nigeria.

Key words: Rectal temperature, heart rate, respiration, haarmattan, goat
Introduction

Goats are the most predominant species of small ruminants reared in Nigeria. They number about 34.5 million\(^1\). They are reared all over the country by a large number of rural households, but their density is highest in the northern part of Nigeria. Goats in Nigeria, especially in the Northern Guinea Savannah zone, are reared predominantly under the traditional free range management system. They provide good source of meat and high quality skin used in leather industries, and income to the small-scale farmers\(^1,2\).

The Red Sokoto goat (Maradi) is the most numerous and widely distributed breed of goats in Nigeria. It is one of the few well-defined breeds, and is characterized by its uniformly dark-red coat colour, short and horizontal ears and horns in both sexes\(^2\). Some studies have been done on nutrition\(^3,4,5\), and reproduction of the goat in Nigeria\(^6,7\). There is urgent need to embark upon serious long-term systematic selective breeding of local breeds of goats to provide improved breeds most adapted to the local environmental conditions\(^8,9\).

Responses of the indigenous breeds of goats in Nigeria to the prevailing meteorological factors are not well elucidated. It is known though that these factors act upon the animals throughout the year, and thus may result into stress situations, which could have serious adverse effects on both productivity and health. The response of the Red Sokoto goat to the stressful harmattan could serve as a guide in the selection of goats, possessing those attributes which promote adaptability.

The rectal temperature (RT), heart or pulse rate (HR or PR) and respiratory rate (RR) are three important indicators of the physiological status of an animal, often used not only in diagnosis and prognosis of the health status, but also in the adaptability of domestic animals to various environmental conditions\(^10,11,12\).

The present study was, therefore, aimed at elucidating changes in RT, HR and RR responses of the Red Sokoto goat during the stressful harmattan season of the Northern Guinea Savannah zone of Nigeria. Such data on the Red Sokoto goat are currently not available in the literature.

Materials and Methods

(a) Site and Weather Conditions

The experiment was performed at the Livestock Farm of the College of Agriculture, Ahmadu Bello University, Samaru - Zaria (11° 10'N, 07° 38'E), located in the Northern Guinea Savannah zone of Nigeria. The measurements were taken for a total of four weeks, comprising two weeks each in the second-half of both December, 1995 and January, 1996. These two months constitute the peak of the harmattan season, starting from November to February, in Samaru Zaria, Nigeria\(^13\). Meteorological data for this locality were recorded.

<table>
<thead>
<tr>
<th>Month</th>
<th>Relative Humidity, %</th>
<th>Ambient Temperature, °C</th>
<th>Wind</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
<td>Mean</td>
</tr>
<tr>
<td>December</td>
<td>20.90±0.57</td>
<td>32.84±0.52</td>
<td>14.10±0.59</td>
<td>23.47±1.26</td>
</tr>
<tr>
<td>January</td>
<td>20.18±0.70</td>
<td>32.32±0.18</td>
<td>10.90±0.69</td>
<td>21.34±1.42</td>
</tr>
</tbody>
</table>

*Data collated from Institute for Agricultural Research, Meteorological Unit, Samaru, Nigeria.*
(b) Animals and Management

Eleven apparently healthy Red Sokoto goats, including both male and non-pregnant female animals of about 2-3 years old and weighing 21.41 ± 1.81 kg, served as subjects of the experiment. A pre-conditioning period of one week was allowed during which RR, HR and RT of the goats were measured to get the animals accustomed to the experimental procedure. The goats were not subjected to any special therapy prior to the commencement of the experiment. They were grazed during the day on a natural pasture of mainly Gamba grass (Andropogon gayanus) for approximately 8 h per day. The goats were not herded under shade trees at noon time. At night, they were penned in a well ventilated enclosure with a concrete floor. A feed supplement of rice bran mixed with guinea corn and guinea grass (Panicum maximum) hay was provided after grazing with clean water ad libitum. The 06:00h recordings were completed before the animals were given feeds or water. The feeds and water were withdrawn during the measurements at 13:00 and 18:00h.

(c) Experimental procedure

Measurements of RT, HR and RR were taken at 06:00; 13:00 and 18:00h daily throughout the entire four-week period. Each goat was caught easily for the measurements, which were completed within 5 min. The RR in each animal was determined by counting the number of respiratory flank movements over two 30-second periods, while the HR was taken with the aid of a stethoscope in the fourth left intercostal space, and the number of beats per minutes in each animal was recorded. The RT was recorded, as an indicator of body temperature, with the aid of a clinical thermometer, inserted about 10 cm into the rectum and kept as such for two minutes. The RR was estimated before the HR and RT measurements. The 13:00h measurements were taken after goats had grazed for about four hours, and rested in the shade for approximately one hour.

(d) Statistical Analysis

All data obtained were subjected to correlation analysis and Student's t-test. Data were expressed in mean ± standard error of the mean (X ± S.E.M). Values of P < 0.05 were considered significant.

Results

Meteorological data, including the mean ambient temperature (AT), relative humidity (RH), wind speed and sunshine during the experimental period, are shown in Table 1. The harmattan season had relatively low-temperature minima of 10.90°C ± 0.69 and 14.10 ± 0.59°C in January and December, respectively and high temperature maxima of 32.32 ± 0.18°C and 32.84 ± 0.52°C in January and December, respectively. The RH was very low both in December and January. The harmattan season was characterized by the cold, dry and dust-laden north-east wind, blowing from the Sahara desert.

It had a dessicating effect, and had no rains. Ambient night temperatures ranged between 9 to 14°C, while afternoon ambient temperatures were often above 28°C and sometimes were as high as 35°C (Table 1).

The difference between mean daily maximum and minimum body temperatures of the goats was 1.1°C during the harmattan season. The RT of the goats rose from the lowest value at 06:00h to the highest at 18:00h, both in December and January. At 06:00h recordings, goats were observed to shiver. The overall mean body temperature of the goats in December, 39.03 ± 0.22°C, was not significantly (P > 0.05) higher than that of January, 38.84 ± 0.21°C. The highest RR and HR values were recorded at 13:00h, while the lowest were obtained at 06:00h, both in December and January (Tables 2 and 3).

The mean RT in December was not significantly (P < 0.05) different from that of January. Although both the RR and HR in December were higher than the comparative
values in January, only the increase in HR was significant (P < 0.05). There was a positive correlation between the RT and the HR, and the RT and the RR both in December and January. Similarly, the correlation coefficient between the HR and RR was positive and significant (P < 0.001) both in December and January (Table 4).

As a whole, a general trend of decrease in the values of RT, HR and RR was observed in all the animals examined as the duration of the experiment increased. Thus, there was a negative correlation between weeks of the experiment and the RR (r = -0.093, P > 0.05), and especially the RT (r = -0.623, P < 0.05) and HR (-0.774, P < 0.05) values.

The relationship between the AT and HR during the entire four-week duration of the experiment was insignificant, but negative in December and positive in January. The correlation coefficient between AT and RR was negative and significant in December, but positive and insignificant in January. The correlation between RH and HR was positive and insignificant both in December and January. The relationship between RH and RR was positive and significant (P < 0.01) in December, but insignificant in January (Table IV).

Table 2: Monthly Rectal Temperature, Respiratory Rate and Heart Rate of the Red Sokoto Goat (X±S.E.M, n=11)

<table>
<thead>
<tr>
<th>Hour month</th>
<th>Rectal Temperature, ºC</th>
<th>Respiratory Rate, breaths/min.</th>
<th>Heart Rate, beats/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>0600</td>
<td>December 38.38 ± 0.90a</td>
<td>33.13 ± 3.29a</td>
<td>120.29 ± 4.40a</td>
</tr>
<tr>
<td></td>
<td>January 38.22 ± 0.13a</td>
<td>31.02 ±1.08b</td>
<td>99.50±3.15b</td>
</tr>
<tr>
<td>1300</td>
<td>December 39.25 ± 0.23a</td>
<td>37.81 ± 2.59b</td>
<td>126.69 ± 0.99c</td>
</tr>
<tr>
<td></td>
<td>January 38.97 ± 0.08a</td>
<td>37.26 ± 2.14b</td>
<td>106.87 ± 5.67d</td>
</tr>
<tr>
<td>1800</td>
<td>December 39.46 ± 0.02a</td>
<td>37.25 ± 0.32b</td>
<td>104.34 ± 2.47f</td>
</tr>
<tr>
<td></td>
<td>January 39.34 ± 0.06a</td>
<td>33.99 ± 2.22b</td>
<td>104.34 ± 2.47f</td>
</tr>
</tbody>
</table>

a,b,c,d,e,f - Data with different superscripts in the same column within the same hour are statistically different (P <0.001).

Table 3: Overall Rectal Temperature, Respiratory Rate and Heart Rate of the Red Sokoto Goat (X ± S.E.M., n = 11)

<table>
<thead>
<tr>
<th>Hour</th>
<th>Rectal Temperature, ºC</th>
<th>Respiratory Rate, breaths/min.</th>
<th>Heart Rate, beats/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>0600</td>
<td>38.30 ± 0.08a</td>
<td>32.07 ± 1.54a</td>
<td>109.90 ± 6.35a</td>
</tr>
<tr>
<td>1300</td>
<td>39.11 ± 0.13b</td>
<td>37.53 ± 1.36b</td>
<td>116.78 ± 6.19a</td>
</tr>
<tr>
<td>1800</td>
<td>39.40 ± 0.04c</td>
<td>35.62 ± 1.31a</td>
<td>114.54 ± 6.01a</td>
</tr>
<tr>
<td>Mean ± S.E.M.</td>
<td>38.94 ± 0.33</td>
<td>35.07 ± 1.60</td>
<td>113.74 ± 2.03</td>
</tr>
</tbody>
</table>

a,b,c = Data with different superscripts in the same column are statistically different (P < 0.05).
Table 4: Correlation (r) Coefficients between Ambient Temperature, Relative Humidity and Physiological Parameters of the Red Sokoto Goat

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rectal Temperature</th>
<th>Respiratory rate</th>
<th>Heart rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>December</td>
<td>January</td>
<td>December</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>-0.757*</td>
<td>-0.010NS</td>
<td>-0.773*</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>0.635NS</td>
<td>-0.161NS</td>
<td>0.810**</td>
</tr>
<tr>
<td>Rectal Temperature</td>
<td>0.957**</td>
<td>0.636NS</td>
<td>0.884NS</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>0.982***</td>
<td>0.979***</td>
<td></td>
</tr>
</tbody>
</table>

NS = No significant difference (P > 0.05)  
* = P < 0.05;  ** = P < 0.01;  *** = P < 0.001

**Discussion**

The results of the present study clearly indicated that the Red Sokoto goat is stable to the stressful thermal conditions prevailing during the harmattan season of the Northern Guinea Savannah zone of Nigeria. The breed showed a high physiological resistance to the harmattan stress as evidenced by the RT values obtained in the present study, which were within the normal physiological range for the goat as described by Belyakov et al.\textsuperscript{14} and Mazurkevich\textsuperscript{15}. The overall mean HR of 113.74 ± 2.03 beats per minutes, was 42.5% higher than the upper limit (80 beats per minute) of the normal HR range in the goat. This increase was apparently due to the effect of the stressful harmattan. Thus, the effect of the harmattan stress on the cardiovascular activity of the goats may be more pronounced than on any of the systems investigated. Similar increase in PR was obtained by Mittal and Ghosh\textsuperscript{10}, and Vihan and Sahni\textsuperscript{11} in the sheep under stressful climatic conditions.

All the parameters measured showed distinct diurnal fluctuations, with the minimum parameters recorded at 06:00h, while the maximum values were obtained in the afternoon for RR and HR, and at 18:00h for the RT. These findings are in agreement with the results of previous studies on the temperate breeds of goats\textsuperscript{16}, and the West African Dwarf goat in Southern Nigeria\textsuperscript{17}. Similar findings were also obtained on the Desert sheep in Sudan\textsuperscript{12}.

The mean 06:00 and 13:00h RT values obtained in the present study were analogous to the corresponding values obtained by Igono et al.\textsuperscript{13} on Savannah Brown goats during the harmattan seasons. The mean 06:00h RR value of 32.07 ± 1.54 breaths per minute obtained in this study was also significantly lower than that 13:00h. This is in agreement with the findings of Orji and Umesiobi\textsuperscript{18} on the West African Dwarf sheep in Southern Nigeria, and Ahmed and Abdellatif\textsuperscript{12} on the Desert sheep in Sudan. However, the 06:00 RR obtained in the present study was significantly lower than the value of 56 ± 1.4 breaths per minute obtained by Ahmed and Abdellatif\textsuperscript{12}, and 25.8% higher than that obtained by Orji and Umesiobi\textsuperscript{18}. Also the 13:00h RR value of 37.53 ± 1.38 breaths per minute, obtained in the present study, was 103% lower than the comparative value of 76.2 breaths per minute obtained by Orji and Umesiobi\textsuperscript{18} and about 200% lower than the value of 112 ± 5.4 breaths per minute obtained by Ahmed and Abdellatif\textsuperscript{12} on the Desert sheep.

The RR values obtained in this study ranged between the lowest value of 31.02 ± 1.08 breaths per minute to the highest value of 37.81 ± 2.59 breaths per minute. These values were greater than the normal values for the goat, ranging between 10 and 30 breaths per minute\textsuperscript{16,19}. The slight increase in RR in the Red Sokoto goat, recorded during the experimental period could be due to the effect of the stressful environmental conditions prevailing during the harmattan season. However, RR values obtained in this study were significantly lower than those obtained on the sheep in India, ranging between 42.75 - 122.68 breaths per minute, during the summer\textsuperscript{11}.  


In general, values of RT, HR and RR in December were higher than the comparative values in January. It thus appears that the compensatory mechanisms of the goat became more effective with increase in the duration of the harmattan season, and consequently the adverse effects of the harmattan stress on the animals were gradually reduced to the barest minimum. The results of the present study further confirm that the meteorological conditions play an important role in the variation of the physiological parameters of animals under stressful environments. It appears that the goats were in the alarm stage of the general adaptation syndrome, characterized by the mobilisation of body protective mechanisms, during the December harmattan. As the force of the body compensatory mechanisms increased, the stage of alarm was apparently changed to that of resistance or adaptation in January, in spite of the fact that the meteorological conditions were more severe in January than December.

The shivering observed at the 06:00 h recordings was an evidence that the AT fell below the thermoneutral zone of the goats, especially in December. This may probably be the reason why the correlation coefficients obtained between the AT and HR as well as RR were negative in December. On the other hand as the AT increased in January the values of RT, HR and RR were increased. Again, this indicated the effective adjustment of the physiological mechanisms of the goat to combat the stressful meteorological conditions of the harmattan.

As a whole, the results obtained in the present study strongly suggest that the Red Sokoto goat has adapted successfully to the stressful harmattan, and that it possesses effective physiological mechanisms capable of adjusting to the extreme daily fluctuations in meteorological conditions during the harmattan season. The Red Sokoto goat is thus a breed that shows relatively less rise in indices of physiological status during the peak of harmattan season of December - January. The results obtained strongly suggest, from the environmental physiology point of view, that the Red Sokoto goat is a potential breeding stock in the Northern Guinea Savanna zone of Nigeria.

References


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DICHROSTACHYS CINEREA AND ACACIA NILOTICA AS SUPPLEMENTS TO BUFFALO GRASS (BUCHLOE DACTYLOIDES) HAY FED TO TSWANA GOATS

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DICHROSTACHYS CINEREA ET ACACIA NILOTICA UTILISES COMME COMPLEMENTS AU FOIN DE L'HERBE AUX BISONS (BUCHLOE DACTYLOIDES) SERVIS AUX CHEVRES TSWANA

Résumé
Dans une expérience d'alimentation faite au Collège agricole de Gaborone au Botswana d'octobre 1997 à février 1998 pendant 120 jours, 24 boucs âgés d'un an étaient pesés et répartis au hasard en trois groupes de huit animaux chacun en utilisant un modèle complètement randomisé. Tous les animaux étaient nourris de foin d'herbe aux bisons (Buchloe dactyloides) comme aliment de base, tandis que la luzerne (medicago sativa) était servie au groupe témoin comme complément. Les deux autres groupes étaient nourris soit avec Acacia nilotica, soit avec Dichrostachys cinerea comme compléments. L'aliment de base constituait 60% de la ration tandis que le reste (40%) était composé de luzerne ou de plantes à brouter. L'eau était disponible tous les jours. Les restes d'aliments et d'eau étaient évalués chaque jour. La pesée des chèvres expérimentales était faite chaque quinzaine avant l'alimentation du matin. Les données recueillies faisaient l'objet d'une analyse de la variance.

La consommation moyenne journalière de matière sèche des chèvres services de luzerne comme complément était de 618,31 g, ce qui était nettement plus faible (P < 0,05) comparé aux 727,08 g de Dichrostachys cinerea servis aux chèvres comme compléments. Les chèvres nourries de foin de luzerne buvaient beaucoup plus d'eau (P < 0,05) 1485,44 ml que les chèvres qui recevaient Dichrostachys cinerea et Acacia nilotica, et buvaient 1275 ml et 1275,15 ml respectivement. Le gain pondéral moyen quotidien (71 g) était plus élevé chez les chèvres nourries de luzerne par rapport à celles servies de Dichrostachys cinerea et d'Acacia nilotica comme compléments (66 g et 63 g respectivement). Les chèvres nourries de plantes à brouter mangeaient les feuilles et les brindilles, et ne laissaient que les tiges.

Summary
In a feeding trial conducted at the Botswana College of Agriculture Content Farm Gaborone from October 1997 to February 1998, for 120 days, 24 yearling Tswana male goats were weighed and randomly divided into three groups of eight animals each using a completely randomised design. All the animals were fed buffalo grass hay (Buchloe dactyloides) as basal diet while Lucerne (medicago sativa) was fed to control group as supplement. The other two groups were fed either Acacia nilotica or Dichrostachys cinerea as supplements. The basal diet constituted 60% of the ration while the Lucerne or browses made up the remaining 40%. Water was provided daily. Both the water and feed left-overs were measured daily. Weighing of experimental goats was done every two weeks prior to morning feeding. Data collected were subjected to analysis of variance.

Average daily dry matter intake of goats on Lucerne as supplement was 618.31g which was significantly lower (P<0.05) than 727.08g of goats on Dichrostachys cinerea as supplements. Goats on Lucerne hay drank significantly (P<0.05) more water 1485.44 ml compared to 1275.00ml and 1275.15ml consumed by goats on Dichrostachys cinerea and Acacia nilotica respectively. The average daily body weight gain was higher for goats on Lucerne 71g compared to 66g and 63g for those on Dichrostachys cinerea and Acacia nilotica as supplements respectively. Goats fed on browses consumed the leaves and twigs leaving only the stalks.
Introduction

There are about one million eight hundred and thirty seven thousand seven hundred (1873700) goats in Botswana1 with over 98% on communal lands under extensive management. Goats thrive well in the semi - arid regions of Botswana due to their ability to feed on browsers, forbs and grasses. The mobile upper lip of the goat enables it to feed on a variety of browsers which provide proteins and minerals lacking in grasses. The mobile upper lip of the goat enables it to feed on a variety of browsers which provide proteins and minerals lacking in grasses during the dry season2. *Dichrostachys cinerea* and *Acacia nilotica* are widespread and common throughout Botswana rangelands and goats feed on these browsers. The use of browsers in semi-arid regions of Botswana in providing feed to ruminant livestock especially goats throughout the year is of utmost importance. Browse plants are less subject to seasonal variation than grasses because of their adaptation to arid environments by deep rooting habits. This study was undertaken to investigate the utilization of two commonly available browsers namely *Dichrostachys cinerea* and *Acacia nilotica* as supplements in the diet of Tswana goats.

Material and Methods

The experiment was conducted at the Botswana College of Agriculture Content farm, Gaborone from October 1997 to February 1998 for a period of 120 days. Twenty four Tswana yearling male goats were divided into three groups of eight animals in a completely randomised design. Buffalo grass hay (*Buchloe dactyloides*) constituted 60% of the ration as basal diet to all goats while the control group received Lucerne hay (*Medicago sativa*) as supplement. The other two groups were supplemented with *Dichrostachys cinerea* and *Acacia nilotica*. The browsers or Lucerne formed 40% of the ration offered to the goats daily on dry matter basis. Water was provided daily and the goats were individually penned under a common roof.

Cleaning of the pens and removal of left-overs of the previous day was done daily before placement of the days’ ration. Water and feed left-overs were measured daily while the goats were weighed every two weeks, before the morning feeding. The three groups investigated were:

- **Control:** Buffalo grass plus Lucerne
- **Treatment 1:** Buffalo grass plus *Dichrostachys cinerea*
- **Treatment 2:** Buffalo grass plus *Acacia nilotica*

All goats were provided with mineral block (a commercial block) *ad. libitum*.

A measuring cylinder was used to measure the volume of water given and left-overs while a platform electronic scale was used to measure the feed given and left-overs. An Avery walk-in scale was used to measure the weight of each goat every two weeks. Proximate analysis of feeds fed were done3. Data collected were subjected to analysis of variance4.

| Table 1: Dry Matter (DM) content (g/kg) and chemical composition (g/kg) of feeds fed to Experimental Goats+ |
|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|
| Buffalo grass | Lucerne | *Dichrostachys cinerea* | *Acacia nilotica* |
| Dry matter | 945.6 | 950.6 | 569.7 | 508.1 |
| Crude protein | 68.5 | 140.1 | 128.5 | 95.3 |
| Crude fibre | 281.3 | 298.7 | 208.6 | 213.2 |
| Ash | 11.9 | 69.3 | 61.6 | 54.8 |

+Goats on all diets were allowed free access to mineral block containing (in addition to NaCl): in g/kg Calcium 120.0, Phosphorus 60.0, Sulphur 25.0, Fluorine 0.4 and in mg/kg Iron 750.0, Manganese 600.0, Zinc 600.0, Copper 150.0, Iodine 7.5, Cobalt 1.5 and Selenium 1.5.
**Table 2:** Intake and response of Tswana goats during the experimental period

<table>
<thead>
<tr>
<th>Feed Types</th>
<th>Control</th>
<th>Trt 1</th>
<th>Trt 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Buffalo grass + Lucerne</td>
<td>Buffalo grass +</td>
<td>Buffalo grass + Acacia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dichrostachys cinerea</td>
<td>nilotica</td>
</tr>
<tr>
<td>Initial Liveweight (kg)</td>
<td>16.00 ± 1.13</td>
<td>15.63 ± 0.69</td>
<td>15.63 ± 0.53</td>
</tr>
<tr>
<td>Final Liveweight (kg)</td>
<td>24.50 ± 0.91</td>
<td>23.88 ± 0.58</td>
<td>23.13 ± 0.56</td>
</tr>
<tr>
<td>Average daily body weight gained (kg)</td>
<td>0.071 ± 0.004</td>
<td>0.066 ± 0.004</td>
<td>0.063 ± 0.002</td>
</tr>
<tr>
<td>Average daily DM dry matter intake (g)</td>
<td>618.31 ± 26.88^b</td>
<td>727.08 ± 13.46^a</td>
<td>661.24 ± 12.50^b</td>
</tr>
<tr>
<td>Average daily DM buffalo grass hay intake</td>
<td>26780 ± 25.15^b</td>
<td>448.22 ± 12.10^a</td>
<td>413.02 ± 11.23^a</td>
</tr>
<tr>
<td>Average daily DM legume or browse intake (g)</td>
<td>351.09 ± 3.71^*</td>
<td>281.60 ± 2.83^b</td>
<td>248.22 ± 2.60^o</td>
</tr>
<tr>
<td>DM/gain (g/g) (feed conversion)</td>
<td>8.70 ± 0.08^b</td>
<td>11.01 ± 0.06^a</td>
<td>10.49 ± 0.05^a</td>
</tr>
<tr>
<td>DM intake g/kg W^{0.75}</td>
<td>64.81 ± 1.23^b</td>
<td>77.59 ± 1.65^a</td>
<td>71.56 ± 1.77^a</td>
</tr>
<tr>
<td>Average daily water intake(ml)</td>
<td>1485.44 ± 30.62^a</td>
<td>1275.00 ± 32.90^b</td>
<td>1275.15 ± 36.25^b</td>
</tr>
</tbody>
</table>

+ SD= Standard deviation
* abc = Means in the same row not having common letters differ significantly (P<0.05)

**Result and Discussion**

The chemical composition of the goats diets are shown in table 1, which indicates that *Dichrostachys cinerea* and *Acacia nilotica* are good sources of protein. Also, they are rich sources of total minerals which are comparable to that of Lucerne. The goats fed *Dichrostachys cinerea* as supplements consumed more feed than the other two groups of goats (Table 2). The goats on the two browses consumed more Buffalo grass hay than those on Lucerne as supplement. The DM intake was higher for goats fed *Dichrostachys cinerea* as supplements when expressed either as a percentage of body weight or on the basis of metabolic body weight (W^{0.75}). Table 2 shows that browse intake as % of body weight is 1.42 for *Dichrostachys cinerea* and 1.28 for *Acacia nilotica* which falls within the range of optimum dietary levels (ODL) of 0.9 - 1.5% as percentage of liveweight suggested by Devendra. Feed conversion and average daily gain were best for goats fed on Lucerne as supplement. However, the difference in average daily gain was not statistically significant (P>0.05). Overall, feed conversion and growth rates were good for the three diets.

*Acacia nilotica* (scented thorn) is found in Tanzania, Zimbabwe, Swaziland, Botswana and South Africa. *Acacia nilotica* is widespread in Botswana except in the Kalahari. The leaves and pods are browsed by livestock, but the pods are said to be harmful if eaten in large amounts. The bark and pods contain tannin and have been used for tanning leather. *Dichrostachys cinerea* is equally widespread in Botswana and its heavily browsed by ruminant livestock. *D. cinerea* was fed as supplements to sheep in Ethiopia.

Results of this study show a significant difference in water intake (P < 0.05) between the three groups of goats. Water intake of the goats varied with types of feed, indicating that water in feed influenced the amount of drinking water required by goats. Goats in the control
group on Lucerne hay as supplementary feed drank a significantly (P < 0.05) higher quantity of water (1485.44 ml) compared to goats on the browses which contained more water (Table 1). Average daily water intake ml/kg$^{0.75}$ was significantly (P < 0.05) higher for goats fed Lucerne hay as supplement 155.70 compared to 136.07 and 138.00 for goats supplemented on Dichrostachys cinerea and Acacia nilotica respectively. Results of this study are in agreement to earlier findings on Tswana goats fed Acacia fleckii and Acacia tortilis as supplement$^{9}$. The browses used in this study were obtained from the range-lands surrounding the goat units without costs, that is cost of production of Tswana goats could be reduced by using these browse species as supplementary feeds. Further work is required to investigate other browse species that could enhance the nutritive value of locally available grasses for goat production.

Acknowledgements

The authors are very grateful to Botswana College of Agriculture (BCA) for allowing us to publish the material.

References


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FACTORS AFFECTING MILK BUTTERFAT CONTENT OF TWO INDIGENOUS KENYAN GOAT BREEDS

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LES FACTEURS AFFECTANT LA TENEUR EN MATIÈRE GRASSE DU LAIT DE DEUX RACES CAPRINES LOCALES DU KENYA

Résumé

La teneur en matière grasse du lait (MG%) est un composant important et un déterminant de la qualité du lait. MG% est influencé par des facteurs génétiques et non-génétiques. En caractérisant les races ovines, MG% est l'un des traits à étudier. La présente étude a été menée en vue d'examiner les facteurs qui affectent MG% de deux races caprines locales du Kenya: le chèvre de l'Afrique de l'est et le Galla. Il n'y a pas de différence significative entre les deux races quant à leur MG%, même si le Galla produit du lait ayant une MG% légèrement plus forte. Le lait du matin avait une MG% plus faible que celui du soir, tandis que les mères plus jeunes produisaient du lait avec une MG% plus forte que les mères plus âgées. MG% diminuait progressivement avec le stade de lactation. Ni l'âge, ni la race, ni le stade de lactation n'a influencé la MG%. Lorsqu'on rend compte de la MG% de ces races caprines locales, il est important et conseillé d'ajuster d'abord les effets de l'âge de la mère et du stade de lactation.

Summary

Milk butterfat content (BF%) is an important component and milk quality determinant. BF% is influenced by both genetic and non-genetic factors. While characterizing livestock breeds, BF% is one of the traits worth investigating. This study was conducted to investigate factors that affect BF% of two indigenous goat breeds in Kenya; the East African and Galla. The two breeds did not significantly differ in their BF%, although the Galla. The two breeds did not significantly differ in their BF%, although the Galla does produced milk with slightly higher BF%. Morning milk was lower in BF% than the evening milk, while younger does produced milk with higher BF% than the very old ones. BF% steadily declined with stage of lactation. Neither breed by age nor breed by stage of lactation influenced BF%. When reporting BF% for these local goat breeds, it is important and advisable to first adjust for both age of doe and stage of lactation effects.

Introduction

Milk composition is a very important determinant of its quality and therefore price per unit volume. Both macro and micro mineral contents are important for the nutritional value of this important food. Besides, components such as proteins, and butterfat are equally important especially when the milk is to be processed into cheese, butter and other dairy products. Many factors have been reported to influence goat milk composition, butterfat (BF%) included. Factors such as genotype, age and dietary type and constituents are important determinants of milk composition. Animal and physiological related factors such as parity and state of lactation are also important. The study whose results are reported and discussed here were generated from a major characterization study of indigenous Kenyan goat breeds (the East African and the Galla). This paper focuses on their comparative milk butterfat composition and factors that affect this trait.

Materials and Methods

In a characterization study of two indigenous Kenyan goat breeds, the East African and the Galla goats, every other doe kidding from each breed was milked and the milk butterfat content analyzed using the Gerba method. The experiment was conducted at Ol'imagogo farm of the National Animal Husbandry Research
Centre, Naivasha. The farm is situated on the lower slopes of the Central Rift Valley in Kenya. The goats were grazed between 8.00 hours and 16.00 hours for approximately 8 hours daily in a natural thorn bushland. A detailed description of the environment and the management is given elsewhere\textsuperscript{11-14}.

The goats were aged between 2 and 8 years and were milked in the morning or evening. The morning milk was analyzed for butterfat (BF) within the first 3 hours while the evening milk was kept overnight at 4°C and analyzed the following day using the Gerber method\textsuperscript{15}.

**Statistical Analysis**

Effect of breeds (B), age group (A), time of milking (T) and both linear and non-linear components of the stage of lactation as covariates were evaluated. Also fitted were 1st order interactions between B and A, B x T and A and T. These were evaluated using analysis of variance using least square maximum likelihood programme\textsuperscript{16}.

**Results and Discussion**

The analysis of variance results is presented in Table 1, while the least square means are presented in Table 2. The overall mean butterfat content (BF\%) estimate obtained in this study was 3.5 ± 0.16\%. This estimate is within the BF\% estimates of 5.04 and 2.5\% reported for a sample of Galla goats in Kenya, Sardinian goats in Italy and Serpentina goats in Portugal\textsuperscript{8,17,18}. Whereas the estimate obtained in this study was comparable to the 3.75\% and 3.45\% reported for Alpina goats in the USA and Yugoslavia respectively\textsuperscript{2,19}, it was however higher than the 2.5\% reported for Sardinian goats in Italy\textsuperscript{17}. On the other hand, estimates of between 4.54 and 4.6;5.39 and 6.8\%; 4.4 and 4.5\% as well as between 4.2 and 4.6\%; reported for Galla, Malawian, Italian Alpine, various Greek goats and Chilean goat breeds respectively were much higher\textsuperscript{8,9,10,20}. These differences could be due to breed effects and/or combinations of other environmental factors.

<table>
<thead>
<tr>
<th>Source</th>
<th>Df</th>
<th>Ms</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed (B)</td>
<td>1</td>
<td>0.21</td>
<td>0.07</td>
<td>0.79</td>
</tr>
<tr>
<td>Age group (A)</td>
<td>4</td>
<td>4.77</td>
<td>1.5</td>
<td>0.19</td>
</tr>
<tr>
<td>Time of milking (T)</td>
<td>1</td>
<td>13.29</td>
<td>4.26</td>
<td>0.04</td>
</tr>
<tr>
<td>B x T</td>
<td>4</td>
<td>0.83</td>
<td>0.27</td>
<td>0.89</td>
</tr>
<tr>
<td>B x T</td>
<td>4</td>
<td>1.43</td>
<td>0.45</td>
<td>0.50</td>
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<tr>
<td>Stage of lactation (LS)</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>13.17</td>
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<td>0.04</td>
</tr>
<tr>
<td>Quadratic</td>
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<td>0.53</td>
<td>0.17</td>
<td>0.68</td>
</tr>
<tr>
<td>Cubic</td>
<td>1</td>
<td>0.72</td>
<td>0.23</td>
<td>0.60</td>
</tr>
<tr>
<td>Residual</td>
<td>289</td>
<td>3.13</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Effects of breed and age**

Breed had no significant (P > 0.05) effect on BF. However, the BF\% content of Galla goat's milk was marginally higher by 0.08 percentage points than their East African counterparts. This translates to 2.3\% higher BF (Table 2). The estimates of BF\% obtained in this study for Galla does was nevertheless lower than 4.2–4.6\% reported from a small sample of mature Galla does from the same herd\textsuperscript{4}.

<table>
<thead>
<tr>
<th>Factor</th>
<th>N</th>
<th>Mean</th>
<th>SE</th>
<th>CV%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East African</td>
<td>180</td>
<td>3.47</td>
<td>0.20</td>
<td>-</td>
</tr>
<tr>
<td>Galla</td>
<td>128</td>
<td>3.56</td>
<td>0.22</td>
<td>-</td>
</tr>
<tr>
<td>Age groups:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>43</td>
<td>3.82</td>
<td>0.31</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
<td>3.71</td>
<td>0.41</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>62</td>
<td>3.43</td>
<td>0.31</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>106</td>
<td>3.42</td>
<td>0.23</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td>3.16</td>
<td>0.28</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>3.29</td>
<td>0.17</td>
<td>-</td>
</tr>
<tr>
<td>Time:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning</td>
<td>236</td>
<td>3.30</td>
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<td>-</td>
</tr>
<tr>
<td>Evening</td>
<td>72</td>
<td>3.72</td>
<td>0.25</td>
<td>-</td>
</tr>
<tr>
<td>Lactation stage:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>1</td>
<td>-0.02</td>
<td>0.12</td>
<td>-</td>
</tr>
<tr>
<td>Quadratic</td>
<td>1</td>
<td>0.0001</td>
<td>0.0004</td>
<td>-</td>
</tr>
<tr>
<td>Cubic</td>
<td>1</td>
<td>8.05 x 10^{4}</td>
<td>1.55 x 10^{6}</td>
<td>-</td>
</tr>
<tr>
<td>Overall</td>
<td>308</td>
<td>3.36</td>
<td>1.77</td>
<td>52.72</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Df</th>
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<th>F</th>
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<tr>
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<td></td>
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</tr>
<tr>
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</tr>
<tr>
<td>Residual</td>
<td>289</td>
<td>3.13</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
In the above study\(^4\), the Galla goats were however, fed on diets composed of different sources of proteins supplements. These results are within the range of estimates reported for blended goats in Tanzania\(^5\), but were much lower than those reported for different Malawian goat genotypes\(^6\). The fact that the Galla goat produces more milk and had longer lactation period than the East African goat\(^19,21\), means that the overall butterfat yield from Galla goats would be much higher. There was however a fairly high within breed variation in BF% as indicated by the high (52%) coefficients of variation (CV). Selection programmes could therefore yield substantial response in this trait among these breeds, given that relatively moderate to high heritability estimates that usually associated with this trait.

Younger does (aged less than 5 years) produced milk within significantly (P > 0.05) higher BF than the rest of older does. However, the lowest (3.16%) BF percent were recorded in mild produced by the very old (> 7 years of age) does (Table 2). The difference in BF% between the does aged over 4 years and under 7 years was not significant (P>0.05) and their mean BF% was approximately 3.42%. There was an apparent rise in BF with age, followed by a stable trend and then a final declining trend which is consistent with lactation curves in cattle and dairy goats\(^22\). This increasing BF% trend as parity increased contrasted highly with observations in studies that involved Chilean and Indian goats breeds respectively\(^6,9\). Whereas no significant change was observed in BF% as parity advanced in Chilean goats\(^8\), the opposite was observed in studies that involved various Indian and Malawian goat breeds\(^6,8\). Again, these differences could be due to breed differences as well as to many other environmental factors acting singly or interactively.

**Effect of time of milking**

Morning milk had significantly lower mean BF% than evening milk (3.30 ± 0.17 vs 3.72 ± 2.5). This was expected given that the volume of the morning milk was much more, than that produced in the evening and therefore less concentrated than the evening milk. The evening milk is associated with more active lactogenesis period than a period when the animal is actively moving about, grazing as well as ruminating. The hot temperatures associated with the tropical day time periods is further reduced feeding and higher body fluid loss through perspiration, BF% trends have been temperate dairy goat breeds fed on diets in which somatoropin (GH) was included\(^7\).

**Effect of lactation stage**

Butterfat content declined at an average linear rate of 0.02 ± 0.01% per day of lactation, the quadratic and cubic component of this lactation stage was negligible (P > 0.05) and therefore unimportant.

These results contrasts with observations made in studies involving Indian and Italian goat breeds respectively\(^6,10\) and is in agreement with reports from other studies\(^23\). This could be indicative of not only the diverse breed differences but also the differences in stages of lactation of the animals studied. For example, whereas the Indian and Italian studies were on dairy goat breeds, and also covered early lactation stages, this study was carried out on tropical meat goats breeds and covered a sizable component of or their entire lactation periods.

The significance of this finding is that BF% depends on the stage of lactation and therefore whenever goat milk sampling is carried out, a linear regression equation can be used to adjust for the difference in lactation stage to constant stage equivalent basis, thus enabling standardization for different samples across different stages of lactation for comparison purposes.

**Effect of interactions**

There were no significant (P > 0.05) breed by age as well as age by time interactions and both breeds responded similarly to age group and time of milking. The milk BF content of older animals milked in the morning were also equally consistently higher than those within the same age group but milked in the evening, because proportionately each category of does produced consistently low milk yield regardless of the time of the day when they were milked.
Conclusions
The results of this study showed that the milk BF content of Galla and East African Goats did not significantly differ, although the Galla produced milk with 2.3% higher BF%. Younger does produced milk that was significantly higher in BF than older ones. Likewise, morning milk had lowered BF% than evening milk. Milk produced by does that were in their last lactation stages was lower in BF%. Milk BF content declined linearly with the lactation stage. It is therefore important to appropriately correct for doe age, stage of lactation and time of milking when milk BF% contents comparisons are to be made between individual animals and/or herds for these goat breeds.

Acknowledgments
The study was partly supported by USAID’s Title XII SR-CRSP and the Kenya Government, Ministry of Agriculture and livestock and Development. Their support is highly acknowledged. The contributions of the support and technical staff of SR-CRSP< at the NAHRC-Naivasha’s Olmagogo station are highly appreciated too.

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20. G. Kattatzopoulos, 1993. A review of current research on goat milk in Greece Lait. 73: 5-6, 431-441 (Abstr.)
UREA TOXICITY ASSOCIATED WITH UREA-MOLASSES BLOCK FEEDING IN LAMBS IN THE CENTRAL HIGHLANDS OF ETHIOPIA

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TOXICITE DE L'UREE ASSOCIEE A L'ALIMENTATION AVEC DES BLOCS MELASSE/UREE CHEZ LES AGNEAUX DANS LE HAUT-PLATEAU CENTRAL DE L'ETHIOPIE

Résumé

L'article porte sur la toxicité accidentelle de l'urée chez les agneaux, associée à l'alimentation de groupe avec des blocs mélasse/urée (BMU). La méthode d'alimentation, la dose toxique approximative et les cas de toxicité sont décrits. Les signes cliniques, le traitement, les conséquences et les conclusions pathologiques macroscopiques sont discutés. Le risque lié à l'alimentation de groupe avec BMU et à d'autres compléments d'azote non-protéique est souligné et l'on propose aussi les moyens éventuels de prévenir le danger.

Summary

The paper reports on accidental urea toxicity in lambs associated with group feeding of urea-molasses block (UMB). The feeding method, the estimated toxic dose, and the incident of toxicity are described. The clinical signs, treatment, outcome, and gross pathological findings are discussed. The danger involved in group feeding of UMB and other non-protein nitrogen (NPN) supplements is stressed, and the possible ways of preventing toxicity are suggested.

Introduction

Ruminants utilise non-protein nitrogenous compounds as a protein source. Most of these preparations are in the form of urea1 and its use with molasses for better productivity has been documented2,3.

Urea poisoning occurs when sheep accidentally get access to large quantities of urea, or are fed large quantities when they are unaccustomed to it, or when feeds are improperly mixed4. Most of the reports on urea toxicity are based on experimental trials5,6 and give limited information on the natural poisoning in the field. Some accidental urea toxicity in ruminants have also been reported7,8, though they addressed poisoning with fertiliser urea. Consequently, information on urea toxicity associated with feeding of urea preparations like urea-molasses block is scarce. This report contributes some information on clinical and pathological changes of urea toxicity associated with feeding of urea-molasses block (UMB).

Materials and Methods

Incident area

The toxicity occurred at the International Livestock Research Institute (ILRI), Debre Berhan Research Station. The station is located in the central highlands of Ethiopia, about 120 km north east of Addis Ababa. The climate and vegetation coverage has been previously described9.

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2Current Address: Jimma College of Agriculture, P.O. Box 307, Jimma, Ethiopia
**Animals and incident**

The animals at risk consisted of 22 Horro and 56 Menz ram lambs under urea-molasses blocks nutritional treatment in a study designed to assess the capacity of fat deposition in the two breeds. The breeds have been described earlier. In addition to the UMB group, there were two other groups fed on cotton seed cake and Noug (Guizotia abyssinica) cake. Table 1 shows data on the animals in UMB group. Out of the 78 lambs on the UMB, 10 (1 Horro and 9 Menz) became intoxicated.

**Table 1: Basic Data on lambs under UMB Nutritional Treatment of Fat Deposition Study**

<table>
<thead>
<tr>
<th>Number (kg)</th>
<th>Horro</th>
<th>Menz</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live weight</td>
<td>9.4-20.2</td>
<td>7.4-19.8</td>
<td>7.4-20.2</td>
</tr>
<tr>
<td>Mean live weight (kg)</td>
<td>13.7 ± 0.9</td>
<td>12.3 ± 0.4</td>
<td>13.0 ± 0.6</td>
</tr>
<tr>
<td>Age range (months)</td>
<td>4-17</td>
<td>4-17</td>
<td>4-17</td>
</tr>
<tr>
<td>Average age (months)</td>
<td>6.2 ± 0.3</td>
<td>7.3 ± 0.4</td>
<td>7.1 ± 0.3</td>
</tr>
</tbody>
</table>

**Urea-Molasses Block and feeding**

The diet for all groups in the study before commencement of the experiment was 150 g head\(^{-1}\) day\(^{-1}\) concentrate (a mixture of wheat bran (66%), Noug cake (33%), and salt (1%)). The mixture contained 30-35% crude protein. Animals grazed on rotation basis to 5 paddocks of various sizes totalling 138 hectares. In addition, lambs had access to grass hay ad libitum at night. Water was also provided ad libitum, but mineral licks had never been provided.

The UMB consisted of sugar cane molasses, common salt, fertiliser grade urea (46% N), Di-ammonium phosphate fertiliser, cement (as binding material) and wheat bran at proportions of 42, 5, 10, 3, 15 and 25%, respectively. Table 2 shows the chemical and mineral composition of the UMB and grass hay. The UMB was prepared by cold process as follows: Initially, two parts of cement was mixed with one part water. The molasses and urea were put into a trough and stirred thoroughly until mixed. Then, salt, cement and Di-ammonium phosphate were added to the mixture and mixed. Thereafter, the mixture was added on wheat bran in small quantities at a time and was mixed thoroughly until the mixture was even and without lumps. Then, the complete multi-nutrient mixture was poured into a mould (plastic bucket of small size = 2.5 litres in capacity). The mix was left in the bucket for a day and the block was taken out by turning the bucket over and knocking the bottom and sides. This was left in open-air to dry for two weeks.

The blocks were chopped into pieces manually before feeding. On the first day of the adaptation period of the experiment, the 78 lambs were offered 5.8 kg of UMB on group basis by spreading the pieces on a trough (6 meters X 0.5 meters and 0.4 meter deep). One kg of UMB was removed when signs of toxicity were first observed to avoid further toxicity. Therefore, the group intake on the first day was 4.8 kg. On the second day, for fear of toxicity, the offer was reduced and there was no refusal, the group intake being 2.9 kg.

The proportion of Di-ammonium phosphate and urea were added to calculate the toxic dose\(^{1}\). This resulted in an equivalent of 13% (10% urea and 3% DAP) urea in the mixture. Therefore, assuming that the 4.8 kg of UMB was equally consumed, the consumption of UMB and urea head\(^{-1}\) on the first day was 61.5 and 8 g, respectively. For the second day, the total number of lambs being less by 7 (4 dead and 3 sick lambs), the consumption of UMB and urea head\(^{-1}\) was 40.9 and 5.3 g, respectively. Thus, the average intake of urea for day 1 and 2 was 0.62 and 0.41 g kg\(^{-1}\) body weight respectively, using the overall mean body weight of 13 kg.

**Clinical examinations and treatment**

Animals were closely observed after the first incident. Tag number and time at which clinical symptoms started and detailed clinical signs were recorded. Vinegar of table preparation was administered at a dose rate of 50-100 ml per head\(^{1}\). Table 3 and 4 show basic information about the incident and treatment, and the clinical signs observed.
Table 2: Chemical and mineral composition of the dietary Urea-Molasses Block (UMB) and grass hay offered

<table>
<thead>
<tr>
<th>Feed</th>
<th>Chemical Composition</th>
<th>Mineral Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DM ASH OM NCP (NX6.25) NDF ADF LIGNIN ADF ash IVDMD</td>
<td>Na K Ca Mg Fe Mn Cu Zn</td>
</tr>
<tr>
<td></td>
<td>% % % % % % % %</td>
<td>% Ppm % % ppm ppm</td>
</tr>
<tr>
<td>UMB Grass</td>
<td>88.54 34.56 65.44 6.24 39.00 11.25 4.65 1.14 2.63</td>
<td>75.46 1109.51 3.06 8.22 0.18 1926.10 114.20 16.67 65.86</td>
</tr>
<tr>
<td>Hay</td>
<td>90.05 7.87 92.13 0.93 5.81 62.32 32.97 4.62 2.98</td>
<td>59.52 55.86 1.31 0.69 0.21 107.61 174.97 4.93 27.93</td>
</tr>
</tbody>
</table>

DM = Dry matter  NDF = Neutral detergent fibre  Na = Sodium  Fe = Iron
ASH = Ash  ADF = Acid detergent fibre  K = Potassium  Mn = Manganese
OM = Organic matter  LIGNIN = Lignin  Ca = Calcium  Cu = Copper
N = Nitrogen  ADF ash = Acid detergent fibre ash  Mg = Magnesium  Zn = Zinc
CP = Crude protein  IVDMD = In vitro dry matter digestibility

Table 3: Information on Incident, Treatment, and Outcome of the Urea Poisoned Lambs from Urea-Molasses Block (UMB)

<table>
<thead>
<tr>
<th>Sheep ID</th>
<th>Breed</th>
<th>Age (months)</th>
<th>Live weight (kg)</th>
<th>Sickness Date</th>
<th>Time of UMB offer</th>
<th>Time of 1st clinical sign observed</th>
<th>Treatment with Vinegar</th>
<th>Time of Death</th>
<th>Course one* (min.)</th>
<th>Course two** (min.)</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6633</td>
<td>Menz</td>
<td>3.6</td>
<td>6.5</td>
<td>20-12-97</td>
<td>14:00</td>
<td>14:05</td>
<td>—</td>
<td>14:15</td>
<td>5</td>
<td>10</td>
<td>Death</td>
</tr>
<tr>
<td>M97141</td>
<td>Menz</td>
<td>4.8</td>
<td>12.0</td>
<td>20-12-97</td>
<td>14:00</td>
<td>14:15</td>
<td>—</td>
<td>14:30</td>
<td>15</td>
<td>15</td>
<td>Death</td>
</tr>
<tr>
<td>M97089</td>
<td>Menz</td>
<td>6.0</td>
<td>14.0</td>
<td>20-12-97</td>
<td>14:00</td>
<td>14:15</td>
<td>—</td>
<td>14:35</td>
<td>10</td>
<td>20</td>
<td>Death</td>
</tr>
<tr>
<td>M97041</td>
<td>Menz</td>
<td>6.0</td>
<td>7.0</td>
<td>20-12-97</td>
<td>14:00</td>
<td>14:30</td>
<td>50 ml</td>
<td>16:30</td>
<td>30</td>
<td>120</td>
<td>Death</td>
</tr>
<tr>
<td>M6208</td>
<td>Menz</td>
<td>16.8</td>
<td>17.0</td>
<td>20-12-97</td>
<td>14:00</td>
<td>14:40</td>
<td>100 ml</td>
<td>—</td>
<td>40</td>
<td>—</td>
<td>Recovery</td>
</tr>
<tr>
<td>M6381</td>
<td>Menz</td>
<td>10.8</td>
<td>12.0</td>
<td>20-12-97</td>
<td>14:00</td>
<td>14:45</td>
<td>100 ml</td>
<td>—</td>
<td>45</td>
<td>—</td>
<td>Recovery</td>
</tr>
<tr>
<td>M97150</td>
<td>Menz</td>
<td>4.8</td>
<td>8.0</td>
<td>22-12-97</td>
<td>11:00</td>
<td>16:00</td>
<td>100 ml</td>
<td>17:15</td>
<td>300</td>
<td>75</td>
<td>Death</td>
</tr>
<tr>
<td>H97092</td>
<td>Horro</td>
<td>6.0</td>
<td>8.0</td>
<td>22-12-97</td>
<td>11:00</td>
<td>16:20</td>
<td>100 ml</td>
<td>18:00</td>
<td>320</td>
<td>100</td>
<td>Death</td>
</tr>
<tr>
<td>M6399</td>
<td>Menz</td>
<td>10.8</td>
<td>13.0</td>
<td>22-12-97</td>
<td>11:00</td>
<td>16:40</td>
<td>100 ml</td>
<td>20:15</td>
<td>340</td>
<td>215</td>
<td>Death</td>
</tr>
<tr>
<td>M97140</td>
<td>Menz</td>
<td>4.8</td>
<td>13.0</td>
<td>22-12-97</td>
<td>11:00</td>
<td>15:25</td>
<td>100 ml</td>
<td>—</td>
<td>265</td>
<td>—</td>
<td>Recovery</td>
</tr>
</tbody>
</table>

* Course one = The period between the time of UMB offer and the time of the first clinical sign observed
** Course two = The period between the first clinical sign observed and the time of death
### Table 4: Clinical Signs Recorded from Urea Poisoned Sheep

<table>
<thead>
<tr>
<th>Sheep ID</th>
<th>Sickness date</th>
<th>Muscle tremor</th>
<th>Incoordination</th>
<th>Weakness</th>
<th>Dyspnoea</th>
<th>Bloat</th>
<th>Recumbency</th>
<th>Struggling</th>
<th>Frothy saliva</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6633</td>
<td>20-12-97</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>M97141</td>
<td>20-12-97</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>M97089</td>
<td>20-12-97</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>M97041</td>
<td>20-12-97</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>M6208</td>
<td>20-12-97</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>M6381</td>
<td>20-12-97</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>M97150</td>
<td>22-12-97</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>H97092</td>
<td>22-12-97</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>M6399</td>
<td>22-12-97</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
<td>+</td>
</tr>
<tr>
<td>M97140</td>
<td>22-12-97</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

### Table 5: Gross pathological lesions observed in sheep died from urea toxicity

<table>
<thead>
<tr>
<th>Sheep ID</th>
<th>Eye</th>
<th>Mouth</th>
<th>Abdomen</th>
<th>Rumen</th>
<th>Abomasum</th>
<th>Liver</th>
<th>Lung</th>
<th>Kidneys</th>
<th>Brain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Congestion of Conjunctiva</td>
<td>Frothy blood-sting discharge</td>
<td>Distention</td>
<td>Pilation of mucosa</td>
<td>Haemorrhage</td>
<td>Haemorrhage</td>
<td>Oedema</td>
<td>Haemorrhage</td>
<td>Degeneration</td>
</tr>
<tr>
<td>M6633</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>M97141</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>M97089</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>M97041</td>
<td>++</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
<td>–</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>M97150</td>
<td>++</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
<td>–</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>H97092</td>
<td>++</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>–</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>M6399</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
</tbody>
</table>

+= mild; ++ = moderate; +++= severe
1 ammonia odour upon opening the rumen
2 petechial haemorrhage
3 moderate level lung worm infestation of trachea and bronchi
Post mortem examination

Incidents of death were entered to individual post mortem collection forms. Post mortem examination was carried out on every dead sheep within 6 hours of death. Necropsy was conducted according to the method described\textsuperscript{12}.

Results

Clinical and post mortem findings

The clinical symptoms recorded were muscle tremor (100\%), incoordination (80\%), weakness (70\%), dyspnoea (70\%), bloat (100\%), recumbency (100\%), violent struggling (70\%), frothy saliva (70\%), and death (70\%) (Table 4). It was managed to treat 7 and save 3 (42.7\%) of the poisoned lambs.

The gross pathological lesions in the 7 dead animals were abdominal distention, frothy blood-titting discharge from mouth and nostrils, congestion of conjunctiva, haemorrhage in the abomasum, liver, and kidneys, pilation of ruminal mucosa, severe pulmonary oedema, and degeneration of brain tissue. The degree of the severity of the lesions was recorded from mild to severe (Table 5). Upon opening the rumen there was ammonia odour in all carcasses.

Discussion

Different levels of lethal toxic doses of urea have been reported in sheep, including 2 g kg\textsuperscript{-1} \textsuperscript{13}, 1.1-1.5 g kg\textsuperscript{-1} \textsuperscript{11} and 0.8 g kg\textsuperscript{-1} \textsuperscript{14}. Therefore, the calculated urea doses in our case (0.62 g kg\textsuperscript{-1} and 0.41 g kg\textsuperscript{-1}) are lower than the other reports. However, the group feeding obviously allowed some of the lambs to consume more than their share. The average weight of the poisoned lambs was 11.1 kg which is lower than the average of the group. Therefore, the calculated 8 g urea head\textsuperscript{-1} had allowed a dose of more than 0.72 g kg\textsuperscript{-1} of urea. These facts strongly suggest that the group feeding had led to toxicity of lambs at a lower dose than mostly reported. Therefore, the danger of offering even a low level of urea preparation in group feeding should not be overlooked. Furthermore, the weight data indicates that a greater number of lambs could have been poisoned. This was probably abated by the protein diet the animals had been fed before the experiment and/or the molasses in UMB. The role of molasses and other digestible carbohydrate feeds\textsuperscript{15,16} and prior protein supplementation\textsuperscript{5,15} in minimising the toxicity of ingested urea has been documented.

The time of onset of clinical signs is in agreement with other report\textsuperscript{1} who indicated as early as 10 minutes. The onset on the first day was much quicker than the next. This could be due to the higher intake of urea on the first day. Clinical onset started with nervous signs especially tremor in all of the lambs, which could be due to the rapid uptake of ammonia by the brain\textsuperscript{6}.

The clinical signs observed in this incident are generally in agreement with other reports\textsuperscript{1,7,8}. However, unlike the other report\textsuperscript{8}, there was no bleeding from orifices. Despite the treatment by vinegar in the other report\textsuperscript{7}, there was 100\% mortality. The differences might have arisen from the role of molasses in reducing the severity of toxicity unlike the consumption of pure urea in both reports. One important observation was that the 3 survivors had not shown signs of dyspnoea and oral frothy discharge. This may suggest that death in urea toxicity is primarily from respiratory embarrassment. Moreover, struggling was not seen in these 3 lambs indicating the poor prognosis associated with this sign. The 2 survivors from day 1 had a late onset. The prolonged course of sickness in the treated but dead lambs might have arisen from the treatment intervention.

The post mortem findings were in agreement with other reports\textsuperscript{1,7,8}. However, it was not possible to compare the severity of the lesions because of the lack of such information in the other reports.

The treatment measures taken to save the lambs were immediate removal of the UMB and administration of vinegar. It was believed that the treatment with vinegar had helped in saving the 3 lambs in view of the death of the untreated ones.

This observation reveals that little live weight differences can make noticeable changes in urea toxicity. In addition, offering the chopping
of UMB during the adaptation period may lead to consumption of toxic dose of urea in molasses. Therefore, it is suggested that little weight difference in group feeding should not be overlooked, and the offer of UMB during the adaptation period should be in a block form for animals to lick rather than in chopping.

References


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ROLE DU VIRUS DE LA FIEVRE DE LA VALLEE DU RIFT DANS LES AVORTEMENTS DES PETITS RUMINANTS AU BURKINA FASO

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THE ROLE OF THE RIFT VALLEY FEVER VIRUS IN AGENT OF ABORTION IN SMALL RUMINANTS IN BURKINA FASO

Summary

A study on the role of the Rift Valley Fever (RVF) virus in Small Ruminants was conducted on Sheep and Goats following a number of abortions recorded in the four northern provinces in Burkina Faso in 1992 and 1993.

1174 serum samples collected from sheep and goats, post abortion, were used for the study. The Elisa Test was used for the detection of specific class G and gammaglobulins; a seroneutralization test was also conducted.

The Elisa test made it possible to detect a positive rate of 2.98% and 0.0%, respectively for class G & M, whereas the seroneutralization test revealed a positive rate of 1.28%.

On the basis of these rates, there is reason to believe that there was a post epizootic infection.

The low incidence of class G gammaglobulins and the absence of those of class M show that there is a low incidence of RVF virus in the northern region of Burkina Faso during the time of the study.

Résumé


Au total, 1174 sérum prélèvés sur des brebis et des chèvres ayant avorté ont fait l’objet de l’étude.

Les sérum ont été éprouvés à un test ELISA pour la mise en évidence des immunoglobulines spécifiques de classe G et M, et à un test de séronéutralisation.

Le test ELISA a permis de détecter des taux globaux de positivité de 2,98% et 0,0% respectivement pour les immunoglobulines de classe G et M, alors que le test de séronéutralisation a révélé un taux global de positivité de 1,28%. Tous ces taux sont témoins d’une infection post-épizootique.

La faible prévalence des immunoglobulines de classe G et l’absence de celles de la classe M reflètent une circulation à bas bruit du virus de la FVR dans la zone Nord du Burkina Faso pendant la période de l’étude.

Introduction

Le Nord du Burkina Faso est une zone d’élevage par excellence. Il compte 57% de l’effectif bovin estimé à 4,850.000 têtes, 31% de caprins et 22,1% de l’effectif ovin estimé à 6,250.000 têtes(1). L’élevage représente 8,2% du produit intérieur brut (PIB).

La situation générale de l’élevage dans cette partie du Burkina Faso (zone sahélienne) connaît beaucoup de difficultés tant du point de vue de l’alimentation que de la santé. Les petits ruminants en particulier sont sujets à diverses pathologies de nature infectieuse, parasitaire et nutritionnelle.

Des enquêtes réalisées auprès des services vétérinaires ont permis de révéler dans certaines parties du pays l’existence de taux élevées d’avortement et de mortalité des jeunes dont
les causes réelles ne sont pas encore identifiées. Devant l'ampleur de ce problème compromettant sérieusement le développement de l'élevage de petits ruminants à sa racine, nous avons entrepris d'évaluer le rôle du virus de la FVR dans cette pathologie particulière des petits ruminants. Trois laboratoires de la sous-région ouest-africaine ont été impliqués dans la réalisation des examens et analyses: le Laboratoire National d'Elevage de Ouagadougou au Burkina Faso, le Laboratoire National de l'Elevage et de Recherches Vétérinaires de Dakar et l'Institut Pasteur de Dakar au Sénégal.

Matériels et Méthodes

I. Zone d'étude et choix des sites
La zone Nord retenue pour l'étude couvre une superficie de 49.161 km² et comprend les provinces du Yatenga, du Soum, du Seno et de l'Oudalan (Figure 1). C'est une zone sahélienne située entre le 14è et le 15è parallèle. Elle est caractérisée par une pluviométrie moyenne annuelle décroissante allant de 350mm à 550mm (2). La végétation est composée de prairies et de graminées annuelles sur sables éoliens (2). Les ressources en eau de cette région consistent essentiellement en de nombreuses mares.

Figure 1: Zone d'étude
II. Les prélèvements et leur traitement
Au total, 1174 séroms dont 468 d’ovins et 706 de caprins ont été recolltés. Le sang est prélevé au tube vacutainer par ponction veineuse. Le temps séparant l’avortement de la prise de sang est de 6 mois au maximum. Après la coagulation du sang, les séroms sont décantés, centrifugés à 3000 tours par minute pendant 10 minutes et conservés dans une glacière à +4°C pendant quatre heures en moyenne correspondant au temps nécessaire à leur acheminement au laboratoire puis conservés à -20°C jusqu’à la réalisation des tests.

III. Les méthodes de laboratoire
a) Le test ELISA
Les séroms ont été éprouvés au test ELISA (3) pour la mise en évidence des IgG et IgM en faisant appel à un antigène viral inactif (virus de la FVR souche Ar B 38661 issue d’Aedes alzei collectés à Kédougou au Sénégal en Novembre 1983) et à un antigène témoin. Les séroms ont été dilués à 1/100 et des séroms de contrôle positifs et négatifs sont utilisés pour valider chaque réaction.

La valeur seuil de positivité est déterminée par la moyenne des différences de densités optiques obtenues avec l’antigène spécifique et l’antigène témoin, lue pour cette population augmentée de trois écart-types. Les séroms exprimant une différence de densité optique supérieure à cette valeur sont considérés comme positifs.

b) Le test de séronéutralisation
Le test utilisé est le test de séronéutralisation à virus constant et sérum variable sur culture de cellule de lignée Vero. Le virus utilisé est la souche vaccinale Smithburn.

IV. Analyses statistiques
Les comparaisons statistiques ont été effectuées en réalisant le test de Chi-carré (X²) par l’utilisation du logiciel SAS (4). Le seuil de probabilité α considéré est de 5%.

Résultats

I. Les résultats d’ensemble
Le Tableau 1 présente les résultats d’ensemble en fonction de l’espèce animale. Les taux globaux de positivité au test ELISA sont nuls pour les immunoglobulines de classe M, de 2,98% pour celles de classe G et de 1,28% au test de séronéutralisation.

II. Résultats selon l’espèce
Le Tableau 1 montre qu’il n’y a pas de différence significative entre les ovins et les caprins aux deux tests.

III. Résultats selon les zones de prélèvements
Le Tableau 2 montre qu’il n’y a pas de différence significative entre les zones de prélèvement de même qu’entre les espèces dans ces zones.

### Tableau 1: Résultats d’ensemble

<table>
<thead>
<tr>
<th>Espèce</th>
<th>Nombre</th>
<th>Résultats</th>
<th>Test de séronéutralisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Test Elisa</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IgG</td>
<td>IgM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>457</td>
</tr>
<tr>
<td>Ovin</td>
<td>468</td>
<td>(2,35)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Caprin</td>
<td>706</td>
<td>24</td>
<td>682</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3,39)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1174</td>
<td>35</td>
<td>1139</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2,98)</td>
<td></td>
</tr>
</tbody>
</table>

1 (): Les chiffres entre parenthèses correspondent au pourcentage calculé sur les effectifs spécifiques.
2C= séroms contaminés
### Tableau 2: Résultats en fonction des zones de prélèvement

<table>
<thead>
<tr>
<th>Espèce</th>
<th>Province</th>
<th>Nombre</th>
<th>Résultats</th>
<th>Test de Séronéutralisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>IgG+</td>
<td>IgM+</td>
</tr>
<tr>
<td>Ovin</td>
<td>Oudalan</td>
<td>107</td>
<td>2 (1,86)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Soum</td>
<td>36</td>
<td>2 (5,55)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Seno</td>
<td>170</td>
<td>2 (1,18)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Yatenga</td>
<td>155</td>
<td>5 (3,22)</td>
<td>0</td>
</tr>
<tr>
<td>Caprin</td>
<td>Oudalan</td>
<td>296</td>
<td>3 (1,01)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Soum</td>
<td>154</td>
<td>8 (5,19)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Seno</td>
<td>175</td>
<td>10 (5,71)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Yatenga</td>
<td>81</td>
<td>3 (3,70)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1174</td>
<td>35 (2,98)</td>
<td>0</td>
</tr>
</tbody>
</table>

1 () : Les chiffres entre parenthèses correspondent au pourcentage calculé sur les effectifs spécifiques.  
2 c = sérum contaminé

### Tableau 3: Résultats selon l’âge et l’espèce

<table>
<thead>
<tr>
<th>Espèce</th>
<th>Age</th>
<th>Classe I ≤ 6 mois</th>
<th>Classe II 7 mois à 2 ans</th>
<th>Classe III &gt;2 ans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nbre</td>
<td>IgG</td>
<td>IgM</td>
<td>Ser</td>
</tr>
<tr>
<td>Ovin</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Caprin</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1 Ser = test de séronéutralisation;  
2 () = pourcentage calculé sur l’effectif correspondant de la classe.

### IV. Résultats selon l’âge

Les animaux ont été répartis en trois classes d’âge en tenant compte de la dentition. La classe d’âge I regroupe les animaux âgés de 6 mois, la classe d’âge II ceux de 7 mois à 2 ans et la classe d’âge III les animaux de plus de 2 ans (Tableau 3).

Chez les ovins, il existe une différence significative entre les animaux de la classe d’âge II et ceux de la classe d’âge III (X²=4,702; ddl=1; P=2,85%). Chez les caprins, la comparaison entre la classe I et la classe II montre une différence significative (X²=5,692; ddl=1; P=1,63%). Toutes les autres comparaisons ne montrent aucune différence significative au seuil de probabilité de 5%.
Tableau 4: Résultats selon le test

<table>
<thead>
<tr>
<th>Espèce</th>
<th>Nombre</th>
<th>Méthode</th>
<th>Test de séroneutralisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Test ELISA</td>
<td>IgG+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ovins</td>
<td>468</td>
<td>11(2,35)¹</td>
<td>0</td>
</tr>
<tr>
<td>Caprins</td>
<td>706</td>
<td>24(3,39)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1174</td>
<td>35(2,98)</td>
<td>0</td>
</tr>
</tbody>
</table>

¹ (): Les chiffres entre parenthèses correspondent au pourcentage calculé sur les effectifs spécifiques.

V. Résultats selon la méthode

Le test ELISA pour la mise en évidence des immunoglobulines de classe M s’est révélé négatif pour tous les sérum. Chez les ovins et les caprins, respectivement 2,35% et 3,98% des sérum sont positifs pour les immunoglobulines de type G. Au test de séroneutralisation, 1,28% des sérum sont positifs aussi bien chez les ovins que chez les caprins (Tableau 4). Il y a une différence significative entre les tests ELISA et de séroneutralisation ($X^2=0.6; \text{ddl}=1; P=0.99\%)$.

Discussion


La faible prévalence en anticorps de type IgG et l’absence de ceux de type IgM montrent une activité très faible de la FVR et signifie une circulation à bas bruit dans la zone d’étude. Cette zone serait dans une période post-épizootique après la flambée de 1987 (6).

L’absence totale d’anticorps de type IgM et la présence de ceux de type IgG avec une variation de leur prévalence d’une région à l’autre, d’un site à l’autre, et chez toutes les espèces confirmeraient l’hypothèse d’une infection ancienne. Dans notre étude, aucune différence significative n’a été observée entre les provinces concernées par les prélèvements. Les 4 provinces étudiées: l’Oudalan, le Séno, le Soum et le Yatenga sont des provinces voisines avec des ishyoyètes de pluies proches.

Cependant, nous ne pouvons pas refuter la possibilité qu’au sein de cette même zone climatique, on observe une liaison entre l’incidence de cette arbovirose et la pluviométrie. Toutefois la pluviométrie n’est pas le seul paramètre pour évaluer le risque d’épizootie de la FVR.

Au Sénégal, Thiongane et collaborateurs (7) montrent une baisse de l’infection par le virus après l’épizootie de 1987; cette baisse n’a pas la même ampleur partout.

La prévalence en anticorps de type IgG varie légèrement d’une espèce à l’autre (3,39% chez les caprins contre 2,35% chez les ovins). L’analyse statistique montre que la différence n’est pas significative ($X^2=1,07; \text{ddl}=1; P=30,14\%)$. En 1990 NDeye (8) à partir de 206 sérum d’ovins et 125 de caprins montre des variations de 17,5 ± 2,64% chez les ovins contre 22,4% ± 3,72% chez les caprins. L’analyse statistique de ces variations entre les ovins et les caprins montre que celles-ci ne sont pas significatives.
Chez les ovin, il existe une différence significative entre les animaux âgés de 7 mois à 2 ans et ceux âgés de plus de 2 ans, tandis que chez les caprins, la différence est significative entre les animaux de moins de 6 mois et ceux de 7 mois à 2 ans. La comparaison des classes d'âge permet un contrôle de la cohérence des résultats: il est logique de trouver moins d'IgG chez les jeunes que chez les animaux adultes. N'Deye (8) en 1990 trouve que le taux d'infection chez les ovins est significativement plus élevé chez les adultes (27,76%) que chez les jeunes (9,36%). La même constatation est faite chez les caprins avec des taux plus élevés chez les adultes (22,72%) que chez les jeunes (3,22%). Thiongane (7) en 1990 trouve chez les adultes un pourcentage d'infection plus élevé que chez les jeunes, les animaux positifs chez les petits ruminants étant âgés de plus de 3 ans.

Il faut enfin signaler que des deux tests sérologiques utilisés, celui de l'ELISA a permis de détecter significativement plus de cas positifs que le test de séroneutralisation.

**Conclusion**

La présente étude a mis en évidence l'existence d'anticorps de type IgG avec une prévalence faible, chez les ovins et les caprins dans la zone Nord du Burkina Faso pendant la période de 1992 à 1993. Le faible taux de positivité (2,9%) révèle une circulation à bas bruit du virus de la FVR, tandis que les résultats négatifs aux IgM écartent l'éventualité du caractère épidémique de la maladie pendant la période considérée de l'étude.

Les observations faites au cours de la présente étude, concernant les relations entre l'incidence de la FVR et les avortements sont concordantes. Elles confirment l'absence de poussées épidémiques au moment de l'étude. Ces résultats rendent plus complexes l'étude des causes des avortements chez les petits ruminants au Burkina Faso. De nombreux facteurs, infectieux et non-infectieux, pourraient être à la base de ce problème sérieux de l'élevage des petits ruminants.

**Références**


*Reçu pour publication le 30 juillet 1996*
DOMINANTES PATHOLOGIQUES DE LA REPRODUCTION DANS LES ELEVAGES DE PETITS RUMINANTS DU CENTRE-EST, DE L'EST ET DU CENTRE DU BURKINA FASO

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MAIN PATHOLOGICAL PROBLEMS ENCOUNTERED IN SMALL RUMINANT BREEDING IN THE EASTERN-CENTRAL, EASTERN AND CENTRAL REGIONS OF BURKINA FASO

Summary
Epidemiological study was carried out in the livestock breeding villages of Central, Eastern-Central and Eastern regions of Burkina Faso in order to focus attention on the diagnosis of causes of epizootic abortions and neonatal mortality in sheep and goats as reported by farmers. Suspected diseases were: Brucellosis, Rift Valley Fever (RVF), Chlamydiosis, Colibacillosis Campylobacteriosis, Listeriosis, Salmonellosis and Pasteurellosis. Serum samples, fecal and other organs as well as stomach content were collected from the farm concerned and slaughter houses receiving the animals from the regions for laboratory examination.

A total of 2115 samples were collected of which 1010 sera were tested for Brucellosis. 994 were subject to the ELISA test using the immuncapture of IgG and IgM specific to RVF. 151 organs and stomach content were used for bacterial cultures. A total positive rate, obtained from all the species, was 0.09% to Brucellosis, thus excluding Brucellosis from the main pathological diseases causing abortion in the cases studied. Similarly, a positive rate of 0.4% was observed for the IgG, and an absence of IgM, which also excludes RVF.

The bacterial cultures revealed the following germs in sheep: Escherichia coli, Proteus sp., Listeria sp., Salmonella sp., Klebsiella sp., Enterobacter sp. and Citrobacter sp.; only E. coli was detected in the goats.

Bacterial etiology in those abortions established a positive rate of 35%, especially in goats.

Résumé

Au total, 2115 prélèvements ont été effectués, dont 1010 sérums ont été testés pour la brucellose, 954 ont subi le test ELISA par immuncapture des IgG et IgM spécifiques à la FVR, 151 organes et contenu stomacal foetaux ont servi pour les cultures bactériennes. Toutes espèces confondues, nous avons obtenu un taux de positivité de 0,09% à la brucellose, ce qui exempte cette pathologie d’un rôle déterminant dans les avortements observés. De même, un taux de positivité de 0,4% a été noté pour les IgG, et une absence d’IgM, ce qui permet d’écarter la FVR. Les cultures bactériennes ont révélé chez les ovins les germes suivants: Escherichia coli, Proteus sp., Listeria sp., Salmonella sp., Klebsiella sp., Enterobacter sp. et Citrobacter sp.; chez les caprins, seul E. coli a été mis en évidence.

L’étiologie bactérienne de ces avortements est établie par 35 % de positivité globale obtenus, notamment chez les caprins.

Mots clés : Avortements - Mortalités des jeunes petits ruminants - Burkina Faso

Remerciements : Nous sommes profondément reconnaissants à l’ensemble des membres des deux équipes de recherches de l’INERA et du LNE pour l’appui financier, logistique et humain mis en commun afin de mener à bien cette étude dont le paysan attend tant les résultats.
Introduction

L'élevage au Burkina Faso est confronté à de multiples difficultés et sa situation continue de se détériorer aussi bien sur le plan santé que sur le plan production.

Cette situation est encore plus préoccupante au niveau des petits ruminants pour lesquels aucune mesure de prophylaxie systématique de masse n'est instituée par les services techniques d'encadrement.

Dans l'ensemble de la pathologie infectieuse, parasitaire et nutritionnelle des petits ruminants, les avortements et la mortalité des jeunes constituent une entité dont l'importance par la fréquence, les pertes directes mais également celles insidieuses ainsi que l'incidence hygiénique n'est plus à démontrer.

Face aux nombreux avortements et aux mortalités notamment néonatales enregistrés ces dernières années, nous avons entrepris une étude sur "l'étiologie des avortements des petits ruminants en élevage villageois".

Matériel et Méthodes

1. Zone d'étude - choix des sites

L'étude a été réalisée au Burkina Faso, pays sahélien situé entre les 14e et 15e parallèles.


Ces enquêtes épizootiologiques et cliniques ont permis dans un premier temps de s'orienter vers les entités pathologiques ci-après: brucellose, FVR, chlamydiose, listériose, campylobactériose, salmonellose et pasteurellose.

2. Les prélèvements et leur traitement

1010 prélèvements de sérum ont été effectués par ponction à la veine jugulaire pour le sérodiagnostic de la brucellose; 954 sérums ont été prélevés pour la sérologie de la Fièvre de la Vallée du Rift (FVR); 151 foetus et annexes toutes espèces confondues ont été récupérés à l’abattoir frigorifique de Ouagadougou, pour subir des cultures bactériennes.

3. Les méthodes de laboratoire

Les sérums ont été éprouvés aux anticorps de type IgG et IgM vis-à-vis de la FVR par le test ELISA (Akakpo et al., 1982; Gonzalez et al., 1992) ainsi qu’au test d’agglutination rapide à l’épreuve tamponnée au Rose Bengale (Bessin, 1982) pour le sérodiagnostic de la brucellose.

Après autopsie des foetus et examens anatomopathologiques des organes, des isolements et des cultures de germes bactériens sur milieux usuels et sélectifs ont été réalisés.

Tableau 1: Répartition géographique des prélèvements dans la zone d’étude

<table>
<thead>
<tr>
<th>Province</th>
<th>Sérodiagnostic de la brucellose</th>
<th>Sérodiagnostic de la FVR</th>
<th>Cultures bactériennes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bazèga</td>
<td>77</td>
<td>–</td>
<td>35</td>
</tr>
<tr>
<td>Gnangna</td>
<td>96</td>
<td>221</td>
<td>–</td>
</tr>
<tr>
<td>Gourma</td>
<td>150</td>
<td>167</td>
<td>–</td>
</tr>
<tr>
<td>Kadiogo</td>
<td>190</td>
<td>105</td>
<td>53</td>
</tr>
<tr>
<td>Oubritenga</td>
<td>69</td>
<td>114</td>
<td>24</td>
</tr>
<tr>
<td>Sanmatenga</td>
<td>–</td>
<td>–</td>
<td>23</td>
</tr>
<tr>
<td>Kouritenga</td>
<td>62</td>
<td>–</td>
<td>16</td>
</tr>
<tr>
<td>Tapoa</td>
<td>204</td>
<td>192</td>
<td>–</td>
</tr>
<tr>
<td>Zoundwéogo</td>
<td>164</td>
<td>155</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>1012</td>
<td>954</td>
<td>151</td>
</tr>
</tbody>
</table>

Résultats - Discussions

Nous présentons successivement les résultats des examens sérologiques puis des cultures bactériennes, tout en analysant l’étiologie selon l’espèce affectée, la zone géographique et les résultats d’ensemble.
1. Les résultats sérologiques selon l'espèce et la province

1.1. Sérologie de la FVR

Chez l'espèce ovine, deux provinces se sont révélées positives: ce sont la province de la Gnagna avec 1,2 % de taux de positivité et l'Oubritenga avec une positivité de 1,7% (Tableau 2).

Chez les caprins, seule la province de la Tapoa montre une positivité de 0,7 %.

Au total, toutes espèces confondues nous relevons une positivité de 0,4 % dans la province de la Gnagna, 1,7% dans la province de l'Oubritenga et 0,5% dans la province de la Tapoa à la FVR.

### Tableau 2: Résultats de la FVR selon l'espèce et la province

<table>
<thead>
<tr>
<th>Province</th>
<th>Ovins</th>
<th>Caprins</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nb.</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Gnagna</td>
<td>82</td>
<td>81</td>
<td>1</td>
</tr>
<tr>
<td>Gourma</td>
<td>106</td>
<td>106</td>
<td>0</td>
</tr>
<tr>
<td>Kadiogo</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oubritenga</td>
<td>114</td>
<td>112</td>
<td>2</td>
</tr>
<tr>
<td>Tapoa</td>
<td>53</td>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>Zoundwéogo</td>
<td>101</td>
<td>101</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>456</td>
<td>453</td>
<td>3</td>
</tr>
</tbody>
</table>

1.2. Sérologie de la brucellose

Sur l'ensemble de la zone étudiée, seul le Gourma présente 1,2% de positivité à la brucellose, cela ne concernant que les ovins. Pour les caprins, elle est nulle dans toute la zone. (Tableau 3).

2. Les résultats des cultures bactériennes chez les foetus

Les cultures ont porté sur divers organes tels que le cœur, le foie, la rate, le contenu stomacal des foetus; les résultats figurent dans le Tableau 4.

### Tableau 3: Résultats de la brucellose selon l'espèce et la province

<table>
<thead>
<tr>
<th>Province</th>
<th>Ovins</th>
<th>Caprins</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nb.</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Bazéga</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gnagna</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gourma</td>
<td>80</td>
<td>79</td>
<td>1</td>
</tr>
<tr>
<td>Kadiogo</td>
<td>110</td>
<td>110</td>
<td>0</td>
</tr>
<tr>
<td>Kouritenga</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oubritenga</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tapoa</td>
<td>87</td>
<td>87</td>
<td>0</td>
</tr>
<tr>
<td>Zoundwéogo</td>
<td>59</td>
<td>59</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>336</td>
<td>335</td>
<td>1</td>
</tr>
</tbody>
</table>
Tableau 4: Résultats des cultures bactériennes selon l’espèce et la province.

<table>
<thead>
<tr>
<th>Province</th>
<th>Espèce</th>
<th>Nombre</th>
<th>Germes isolés</th>
<th>Total isolés</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Prot</td>
<td>E. Coli</td>
</tr>
<tr>
<td>Bazèga</td>
<td>Ovin</td>
<td>15</td>
<td>0</td>
<td>1(6,6)</td>
</tr>
<tr>
<td></td>
<td>Caprin</td>
<td>20</td>
<td>0</td>
<td>3(15)</td>
</tr>
<tr>
<td>Kadiogo</td>
<td>Ovin</td>
<td>43</td>
<td>0</td>
<td>21(48,8)</td>
</tr>
<tr>
<td></td>
<td>Caprin</td>
<td>10</td>
<td>0</td>
<td>5(50)</td>
</tr>
<tr>
<td>Kouritenga</td>
<td>Ovin</td>
<td>13</td>
<td>0</td>
<td>3(23)</td>
</tr>
<tr>
<td></td>
<td>Caprin</td>
<td>3</td>
<td>0</td>
<td>2(66,6)</td>
</tr>
<tr>
<td>Oubritenga</td>
<td>Ovin</td>
<td>18</td>
<td>0</td>
<td>7(38,8)</td>
</tr>
<tr>
<td></td>
<td>Caprin</td>
<td>6</td>
<td>0</td>
<td>0(0,0)</td>
</tr>
<tr>
<td>Sanmatenga</td>
<td>Ovin</td>
<td>18</td>
<td>1(5,5)</td>
<td>0(0,0)</td>
</tr>
<tr>
<td></td>
<td>Caprin</td>
<td>5</td>
<td>0</td>
<td>1(20)</td>
</tr>
</tbody>
</table>

| Total    | 151    | 1      | 43    | 3      | 2      | 4      | 1      | 1      | 56    | 37   |

% Global: 0,6 28,5 2,0 1,3 2,6 0,6 0,6 37,0

(*) = Pourcentage

2.1 Infections bactériennes chez les ovin
* Dans la province du Bazèga, il a été isolé et identifié les germes suivants: E. coli, Listeria sp., Salmonella sp., Klebsiella sp. et Citrobacter sp. avec des taux de prévalence respectivement de 6,6%, 13,3%, 13,3%, 26,6% et 6,6%; soit un taux de positivité globale ovine de 66,6% pour la province.
* Dans le Kadiogo, nous notons une prévalence de 48,8% à E. coli.
* La province du Kouritenga montre un taux de positivité de 23% à E. coli et 15,4% aux Enterobacter.
* Dans l’Oubritenga, le taux est de 38,8% pour E. coli et 5,5% pour Listeria sp.
* Dans le Sanmatenga, la positivité au germe Proteus atteint 5,5%.

2.2. Infections bactériennes chez les caprins
Dans les provinces du Bazèga, du Kadiogo, du Kouritenga et du Sanmatenga, toutes les cultures ont mis en évidence E. coli, à des taux de positivité compris entre 15% et 66,6% (Tableau 4).

3. Résultats d’ensemble
Sur 954 sérum éprouvés, la prévalence de 0,4% aux anticorps de type IgG vis-à-vis de la FVR et l’absence des anticorps de type IgM excluent à priori toute corrélation entre les avortements et la FVR chez les petits ruminants dans les régions prospectées (Zeller et al., 1992).

Avec un taux de prévalence de 0,09% à partir des 1010 sérum éprouvés, il ne semble pas non plus possible d’incriminer la brucellose dans les phénomènes abortifs observés chez ces petits ruminants.

Enfin, le taux de positivité de 37,08% obtenu à partir d’ensemencement d’organes de 151 foetus et l’isolement de différents germes bactériens montrent l’étiologie bactérienne de ces problèmes observés chez les petits ruminants dans cette région.

La fréquence de certains germes permet
d’entrevoir leur rôle déterminant dans la manifestation de cette entité pathologique. Il s’agit notamment pour l’espèce caprine de *Escherichia coli* qui est pratiquement le seul germe mis en évidence, et à des pourcentages de positivité importants (15 à 66%).

Au niveau des ovins, la gamme des agents pathogènes est relativement plus large, couvrant par ordre d’importance décroissant: *E. coli*, *Klebsiella sp.*, *Enterobacter sp.*, *Citrobacter sp.*, *Listeria sp.*, *Salmonella sp*.

Sur le plan géographique, bien que la Ganga et l’Oubritenga soient seules à révéler la FVR, le faible taux de positivité et la nature des anticorps trouvés (Ig) indiquent une infection ancienne où le virus circule à bas bruit. Sans que cette situation ne soit alarmante, elle mérite qu’une attention particulière soit accordée aux résultats obtenus (Akakpo *et al.*, 1989; Chartier et Chartier, 1988).

Le Gourma est la seule province dans la zone d’étude à révéler un cas de brucellose. Les provinces du centre (Kadiogo, Bazèga, Oubritenga et Kouritenga) semblent être les plus atteintes par les germes bactériens, bien qu’en réalité aucune n’est totalement indemne.

Nous pensons que cela tient à l’insuffisance des actions sanitaires de prophylaxie au niveau des petits ruminants. En effet, il n’existe pratiquement pas de campagne régulière de vaccination des moutons et des chèvres par les services vétérinaires.

Par ailleurs, les éleveurs non plus ne prennent pratiquement pas de mesures spécifiques de soins et d’hygiène pour les femelles reproductrices, qui divagent avec le reste du troupeau.

**Conclusion**

Cette étude sur l’étiologie des multiples avortements et les mortalités de jeunes ovins et caprins au Burkina Faso a permis de suspecter fortement des causes bactériennes diverses. Il nous paraît indispensable à ce stade, de faire observer que les mesures préconisées ci-après devront nécessairement être accompagnées d’un programme nutritionnel adéquat pour cette catégorie d’animaux (femelles gestantes, jeunes sevrés ou non), et d’un mode d’élevage plus attentionné qu’actuellement vis-à-vis de ces espèces. Le plan de prophylaxie que nous recommandons pour la zone d’étude concernée est le suivant:

1. une hygiène rigoureuse et la désinfection des bergeries chèvreries trois (3) fois au minimum dans l’année (saison sèche froide, saison sèche chaude, hivernage).
2. Pose d’ovules gynécologiques chez les femelles dès l’apparition des chaleurs et pendant le 1er tiers de la gestation.
3. Administration d’antibiotiques dès l’observation de phénomène abortif dans le troupeau à toutes les femelles gestantes.
4. Antibiothérapie aux agneaux et chevreaux souffrants dans le premier mois de naissance.
5. Vaccination systématique des adultes contre la pasteurellose et la peste des petits ruminants.

**Bibliographie**


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SHORT COMMUNICATION

PREVALENCE OF HELMINTHIASIS IN WILD AND DOMESTIC PIGEONS FROM THE NORTH-EAST ZONE OF NIGERIA

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In the modern world, birds play an important economic role, as many are raised for meat and eggs, and provide ornaments. These birds include the domestic fowl (Gallus gallus), turkey (Meleagris gallopava), guinea fowl (Numida meleagris) and the domestic pigeon (Columba l. domestica). Pigeons are found in all types of communities, with some species, particularly Columba g. guinea, living in close proximity to human habitats.

In Nigeria, investigations on the parasites of pigeons have been sadly neglected, when compared to the enormous body of information available on the parasites of other vertebrates. Several cestodes and nematodes have been isolated and identified as gastrointestinal helminth parasites of chicken¹,²,³ and guinea fowl⁴.

This survey was aimed at isolation and identification of helminth parasites of the pigeon, as well as the determination of their prevalence and intensity of infestation, in order to provide preliminary information on the role of pigeons as possible alternative or reservoir hosts of some helminth parasites of chicken.

Altogether 30 pigeons, consisting of 24 Columba l. domestica, 4 Columba g. guinea and 2 Streptopelia d. shelleyi were obtained from Maiduguri metropolis and Numan in Borno and Adamawa states respectively, during the dry season between the months of February and May. They were examined for helminth parasite infestation. Pigeons obtained live were killed anaesthetically in chloroform. Dissection and autopsy procedures used were adopted from those described by others¹,⁵,⁷ Helminths isolated were examined in lactophenol under the microscope. They were fixed in hot formalin.

The procedures used for staining and clearing cestodes are as described by Fabiyi¹. Finally, the cestodes were mounted on slides in Canada balsam and identified under the microscope, using identification keys drawn up by Soulsby⁶. Cestodes that we could not identify were identified at the Commonwealth Institute of Parasitology, London.

Twenty (66.7%) out of the 30 pigeons examined were infested with helminth parasites, mainly cestodes. These belong to 4 genera, the majority of which were davyneids. Prominent among these davyneids was Raillietina. The speces of Raillietina recovered include R. joyeuxi, R. columbiella and R. cesticillus. Other cestodes recovered included Cotugnia cuneata, Retinometra serrata and an unidentified one. All the cestodes were collected exclusively from the small intestines and were mainly restricted to the duodenal loop and the ileum, while the detached matured proglottids were recovered from the rectal region.

Percentage prevalence and intensity of infection of all species of cestodes recovered are presented in Table 1. Raillietina spp were dominantly encountered, occurring in 16 (80.0%) of all the birds examined, with R. columbiella prominent among them, and whose infection cut across all the species of pigeons examined. With the exception of the unidentified cestode, which was found strictly in C. l. domestica, all other cestodes occurred in both C. l. domestica and C. g. guinea. The study revealed single infection (one species of cestode/host) as the highest and occurred in 9 birds (30%), followed by double infections in 8 (26.7%), while multiple infection (3 or more species of cestode/host) was found in 3 birds (10%). Each of the cestodes
Table 1: Percentage prevalence and intensity of infection with Cestode parasited in the three species of pigeons examined from Maiduguri and Numan.

<table>
<thead>
<tr>
<th>Parasite recovered</th>
<th>Columba domestica</th>
<th>Columba g. guinea</th>
<th>Streptopelia d. shelleyi</th>
<th>Overall prevalence by parasite</th>
<th>Parrot/ Load infected bird (Range)</th>
<th>Mean No. of parasite/ infected bird ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. columbiella</td>
<td>8 (33.3)</td>
<td>3 (75.0)</td>
<td>2 (100.0)</td>
<td>13 (43.3)</td>
<td>1 - 15</td>
<td>5.5 ± 4.8</td>
</tr>
<tr>
<td>R. joyeuxi</td>
<td>9 (37.5)</td>
<td>3 (75.0)</td>
<td>0 (0.0)</td>
<td>12 (40.0)</td>
<td>2 - 26</td>
<td>6.9 ± 6.8</td>
</tr>
<tr>
<td>R. cesticillus</td>
<td>3 (12.5)</td>
<td>1 (25.0)</td>
<td>0 (0.0)</td>
<td>4 (13.3)</td>
<td>1 - 6</td>
<td>2.6 ± 2.2</td>
</tr>
<tr>
<td>C. cuneata</td>
<td>3 (12.5)</td>
<td>1 (25.0)</td>
<td>0 (0.0)</td>
<td>4 (13.3)</td>
<td>1 - 6</td>
<td>2.3 ± 1.5</td>
</tr>
<tr>
<td>R. serrata</td>
<td>1 (4.2)</td>
<td>1 (25.0)</td>
<td>0 (0.0)</td>
<td>2 (6.7)</td>
<td>5 - 6</td>
<td>5.5 ± 6.7</td>
</tr>
<tr>
<td>Unidentified cestode</td>
<td>2 (8.3)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (6.7)</td>
<td>3 - 5</td>
<td>4.0 ± 1.4</td>
</tr>
<tr>
<td>Overall prevalence in birds</td>
<td>15 (62.5)</td>
<td>3 (75.0)</td>
<td>2 (100)</td>
<td>20 (66.67)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

had a very low range of infestation, the highest limit being 26 parasites. Double or multiple infections often resulted into a high parasite load, with the highest recorded intensity of 51 parasites per infected bird.

Parasites of pigeons were not included in the check list of helminth parasites that was compiled and published from the northern region of Nigeria(6). As far as we are aware, there is no available literature on the helminth parasites of pigeons from the northern part of Nigeria. This survey may therefore be the first of its kind in this region. The survey revealed that cestodes are the major cause of helminthiasis in pigeons. The overall infection rate of 60% recorded can be explained from the point of view of the altitude. Rates of infection with helminth parasites in birds have been found to decrease with altitude, with only 9% infection at 1400 - 1800m above sea level7. Maiduguri and Numan fall within altitude 400 - 600m above sea level.

The diet of birds has been known to a greater extent to determine the composition of their parasitic fauna. Pigeons feed on grains of all kinds. They also feed on fruits, slugs, maggots and insects. All these foods may carry infective stages of these parasites, thereby serving as intermediate hosts. Ants belonging to the orders Pheidole and Tetramorium were reported to serve as intermediate hosts in the transmission of Rainlietina spp.9.

The unfavourable climatic conditions that characterised the survey, might have brought about the low population of intermediate invertebrate hosts and negatively affected the viability of oncospheres of these cestodes, resulting into the low infection rates and worm loads in the birds examined. It is interesting to note that inspite of common feeding grounds, the species of nematodes and protozoans detected in chicken12 were totally absent from the pigeons examined. This difference might have arisen from the food searching ability of chicken, which more often obtain food by scratching below the surface soil where most infective stages of these nematodes are hidden.

All the cestodes were obtained exceptionally from the small intestine, and being restricted to the duodenal loop and the ileum. Such site preference has been explained10, as being
greatly determined by the degree of saline and glucose concentration and other metabolic requirements optimum to the parasite species.

Infection with the parasites encountered, in rare cases caused pathological changes in the gastrointestinal tract and heart. These changes were acute catarrhal inflammation, thickening of the gastrointestinal tract and congestion of the ileum. Among the cestodes recovered, R. joyeuxi had the highest pathogenicity. The penetration of this cestode into the villi caused haemorrhagic enteritis in a few birds, characterised by slightly reddish colour of chyme in the ileum. Formation of nodules were common features at the sites of attachment.

R. cesticillus encountered in this survey had earlier been reported in chicken in the Vom area of what is now the Plateau state and Maiduguri, Borno state. Cotugnia spp. have been found in domestic birds in the neighbouring Chad Republic. Due to some similarities in the species of cestodes recovered in this survey and those encountered in chicken in the northern region of Nigeria and the neighbouring Chad Republic, it has become imperative to conclude that pigeons may possibly serve as reservoir hosts and major distributors of cestode parasites of poultry, particularly chicken, within and across political boundaries.

The studies need to cover all seasons (rainy and dry) and possibly a parallel survey in other domestic birds such as chicken especially in localities where pigeons are found with the other birds.

Acknowledgements

We wish to extend our profound gratitude to the staff of the commonwealth Institute for Parasitology, for their role in identifying some of the cestodes; To Dr. E. N. Gadzama we owe special thanks for her expert suggestion and criticisms. Finally, we thank the Gongola State Government for the provision of funds to execute this project.

References


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The domestic chicken has been known to have paired ceca, each cecum being made up of base, a body and an apex. An adult, male, local chicken used to demonstrate the digestive viscera of chicken in a practical class presented a single right cecum. No trace of the left cecum was grossly seen. The chicken was purchased by the Department of Veterinary Anatomy from a local market (Orba Market).

The unilateral right cecum (Fig. 1), presented three parts; proximal; middle and distal parts. The dimensions were taken using a meter rule and Vanier Calipers. The proximal part of the cecum had a length of 3.5cm and a diameter of 6.6mm. This part looked more like the cranial continuation of the rectum. The ileum had a narrower diameter, 4.5mm and looked more like a side line. The rectum had a diameter of 5.9mm. The distal part of the proximal part of the cecum ended blindly and was not directly continuous with the middle part of the cecum. The middle part of the cecum joined the proximal part by a narrow neck 8mm proximal to the blind distal end of the proximal part.

The middle part of the cecum has a length of 3.7cm and a diameter of 3.9mm. It was the narrowest part. Its distal portion looked slightly enlarged but a sharp constriction separated it from the distal part of the cecum. The distal part of the cecum had a length of 7.3cm and a diameter of 8.2mm in its widest portion. It presented the distal rounded blunt apex of the cecum.

One single cecum presented by this domestic chicken 18 unusual. This is a case of congenital absence of the left cecum in the domestic chicken.
The proximal, middle and distal parts presented by this single right cecum may appear to correspond respectively to the base, body and apex of a normal chicken cecum but the features are different. The proximal part of this single right cecum presenting a blind end is unusual and the narrow neck by which the middle part joined the proximal part is unusual. In a normal case the base of the cecum is directly continuous with the body.

The narrow middle part separated by a sharp constriction from the distal part is not seen as such in the normal chicken cecum. The distal part of the cecum does not present a well defined (pointed) apex. It rather has a rounded blunt end.

The fact that this chicken with a single cecum lived to adult life is evidence that although the domestic chicken normally has paired ceca, a single cecum is compatible with life.

References

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SHORT COMMUNICATION

DISEASE STATUS OF GUINEA FOWLS IN ZAMBIA: RESULTS OF A PRELIMINARY SURVEY

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Introduction

There is a growing appreciation of the importance of keeping domesticated guinea fowls (Numida meleagris) by many traditional households in Zambia. Two species of guinea fowls i.e. Numida meleagris (helmeted guinea fowls) and Guttera pucherani (crested guinea fowls) are common in Zambia1,2.

The knowledge on disease status in guinea fowls is limited especially in Zambia3. This preliminary survey was embarked upon to investigate the prevalence of four major diseases of economic importance in a population of guinea fowls kept under semi-intensive management with no history of routine vaccination against any of the selected diseases. The diseases include: Mycoplasmosis, Newcastle disease (NCD), Infectious Bursal Disease (IBD) and Salmonellosis.

Blood samples were collected through the wing vein from a population of 72 apparently healthy guinea fowls and serum separated by centrifugation at 3000 rpm for 5 minutes. Serodiagnosis for antibodies against Salmonella pullorum, Mycoplasma gallisepticum and Mycoplasma synoviae were carried out using Rapid Agglutination Test (RAT) according to the methods described in the Technical Manual for Diagnosis of animal diseases4. Diagnosis for NCD and IBD was by Haemagglutination Inhibition Test (HIT) and Agar Gel Precipitation reaction tests respectively.

None of the 72 birds were positive for NCD and IBD antigens. This implies that the birds had no recent contact with the pathogens causing the two diseases. The birds are therefore, vulnerable to attack by these pathogens5. Newcastle disease is one of the most significant factor limiting village chicken production in Zambia6,7 and the local strains of the virus have been known to be extremely virulent8. The negative reaction for the IBD antigens was not surprising because the disease has never been reported in Guinea fowls in Zambia but was documented in Nigeria9.

Most of the birds (56.9%) tested positive for Mycoplasma synoviae while about 39% had antibodies against Mycoplasma gallisepticum antigens. This implies that the majority of the birds had been exposed to the pathogen Mycoplasma synoviae at one time or another while 39% of the guinea fowls must have had contact with Mycoplasma gallisepticum. This could be a true reflection of the actual situation since the birds according to our investigations have never been vaccinated against these organisms.

This survey also reveals that about 21% of the birds demonstrated antibodies for both species of Mycoplasma while 8.3% reacted positive to Mycoplasma synoviae, Mycoplasma gallisepticum and Salmonella pullorum infections. In the absence of vaccination, seropositivity can be taken as indicative of a history of infection10. The seropositivity demonstrated in this study could therefore, imply that the birds were exposed to the pathogens. With less than half of the birds showing antibodies against Mycoplasma gallisepticum antigens, it could be inferred that a large proportion remains susceptible to its infection. The majority (56.9%) of the guinea fowls appeared to have antibodies against
Mycoplasma synoviae. This suggests that they are not very prone to attack by this bacteria because their immunity status is relatively high. The birds which tested positive might have recovered from the bacterial infection or not. Though the birds were apparently healthy at the time of sample collection, it could be that they were carriers.

References

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SHORT COMMUNICATION

EFFECT OF ANTHELMINTIC TREATMENT ON LIVEWEIGHT GAINS IN SHEEP IN A HELMINTH ENDEMIC AREA OF CENTRAL KENYA


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Fasciolosis is an important helminth disease of domestic ruminants in Kenya, causing significant morbidity with grave economic losses. It is generally accepted that acute infection with Fasciola spp. can cause severe clinical disease and high mortality in grazing sheep. However, of even greater overall economic importance are the less dramatic but insidious, long term and deleterious effects of the chronic wasting condition, which generally remains undetected and hence may significantly reduce production without the producer’s knowledge. Assessment of the economic cost of chronic infections remains difficult because of multiple factors that can occur in the management system. Fasciolosis has also been linked to reduced conception and pregnancy rates, and delayed onset of puberty in sheep.

The present study was conducted to compare the production advantages over an untreated control group (live weight gains) afforded by treatment with either an anthelmintic that is effective solely against gastrointestinal (GI) helminths or an anthelmintic that is effective against both liver flukes and GI helminths.

The study was conducted in Lari Division in Kiambu District, in the central Kenyan highlands and situated to the north-west of Nairobi. The area lies at an altitude of 1800 m above sea level and two distinct rainy seasons occur annually. The long rains cover mid-March to May while the short rains occur from mid-October to December. Annual average rainfall ranges between 1300 and 2500 mm.

The experimental farm had an acreage of about 50 ha and mixed farming was practiced; livestock enterprise being mainly for wool and milk production. The over 150 sheep on the farm consisted mainly of Corriedale, Merino and Romney Marsh crosses and had access to permanent natural pastures, which they grazed according to the availability of herbage. The animals were allowed to graze for 7 hrs day, and were housed at night. They had free access to water and minerals.

The experiment was conducted from 13 March to 23 October 1997, starting at the onset of the long rains. Forty five 5 to 6 month old lambs were identified by eartags, weighed and randomly allocated on the basis of their weight into 3 groups of 15 animals. There was a similar ratio of males to females in each of the groups. Group I was the unmedicated control, while Groups II and III were treated with fenbendazole (FBZ) (Panacur, Hoechst, Munich, Germany, 10 mg kg-1 body weight) and albendazole (ABZ) (Valbazen, SmithKline, 10 mg kg-1 body weight, respectively. The two drugs were administered orally using separate calibrated syringes and animals in a given group received a constant dose based on the heaviest animal in the group. A second treatment with the respective anthelmintics was undertaken on 23 July, 1997. Weight gains were assessed by weighing each lamb monthly.

A preliminary faecal examination revealed nematode and liver fluke infections in over 90% and 60% respectively of the flock. The levels of parasite infection were monitored at 14-day intervals and quantitative estimate of nematode egg output in faeces was done by the modified
McMaster technique\textsuperscript{10}. Counts were expressed as the number of eggs per gram of faeces (epg). Larval cultures were made on pooled faecal samples (50-100 g) collected before each treatment and at the termination of the study. Presence of liver fluke eggs in faeces was demonstrated by sedimentation as described by Hansen and Perry\textsuperscript{11}. As faecal egg counts were not considered to be a good indicator of the parasite burdens\textsuperscript{12}, individual faecal samples were recorded as either positive or negative with actual counts of epg for Fasciola spp. not determined. Complete necropsies were performed to ascertain the cause of death for each animal that died.

Student's t-test was used for data analysis and differences with P < 0.05 were considered significant\textsuperscript{13}.

There were no significant differences (P > 0.05) in mean faecal egg counts (epg) between the 3 groups of lambs at the start of the study, as initial mean epg counts ranged from 780 to 813. However, there was a marked reduction (100\%) in epg in groups II and III after each treatment. Thereafter, epg counts rose gradually and were indistinguishable from those of the control (Group I) lambs at the termination of the study.

The pooled coproculture from each group for positive epg identified H. contortus as the predominant nematode with an occurrence rate of 75.3\% in the flock. The occurrence rate of Trichostrongylus spp. was 16.8\% and of Oesophagostomum spp. 7.9\%.

There were no deaths in the ABZ treated group, while in August and September, 2 lambs in the FBZ treated group and 5 in the control group died due to helminthosis, mainly fasciolosis. Grossly, livers were enlarged and in many cases covered with red-brown fibrous capsules. Gall bladders were distended and filled with thick bile. Bile ducts were dilated and contained liver flukes. Some livers showed a mottled appearance with scattered white foci. In each case adult flukes were recovered (mean of 19, range of 15-39) from each liver. Other post-mortem lesions were oedema, anaemia and emaciation. The nematodes H. contortus, T. colubriformis and O. columbianum, and the cestodes Stilesia hepatica and Moniezia expansa were recovered at necropsy of most cases (Table 1).

The mean monthly body weights are shown in Fig. 1. A significant difference (P < 0.05) was observed in mean monthly weights between both the ABZ and FBZ treated groups and the control group from the third month (May) onwards and, between ABZ and FBZ treated groups only in the months of September and October. At the end of the experiment, ABZ treated lambs had a mean weight gain advantage of 2.6 kg over FBZ treated lambs (P < 0.05) and 6.4 kg (P < 0.05) over the control (Group I) lambs (Table 2).

Figure 1: Mean liveweight of treated and control lambs. Group I the untreated control, Group II treated twice with fenbendazole (FBZ) and Group III treated twice with albendazole (ABZ).
Table 1: Species composition and abundance of helminth parasites recovered from Group I and Group II necropsied lambs

<table>
<thead>
<tr>
<th>Parasites</th>
<th>Group I (controls)</th>
<th>Group II (FBZ treated)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2</td>
<td>3  4</td>
</tr>
<tr>
<td>H. contortus</td>
<td>293 559</td>
<td>428 647</td>
</tr>
<tr>
<td>T. colubriformis</td>
<td>40 120</td>
<td>167 187</td>
</tr>
<tr>
<td>O. columbianum</td>
<td>22 13</td>
<td>6 31</td>
</tr>
<tr>
<td>F. gigantica</td>
<td>18 26</td>
<td>17 25</td>
</tr>
<tr>
<td>S. hepatica</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>M. expansa</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

+ = Positive for S. hepatica or M. expansa, - = Negative for S. hepatica or M. expansa

Table 2: Mean weight gains of control (Group I) and treated (Group II and III) lambs

<table>
<thead>
<tr>
<th>Groups</th>
<th>Number of animals</th>
<th>Mean initial weight (kg)</th>
<th>Mean final weight (kg)</th>
<th>Mean gain (kg)</th>
<th>Mean daily gain (g day⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>10</td>
<td>23.2.8±3.5</td>
<td>28.6±2.7</td>
<td>5.4±1.6</td>
<td>21.8±4.3</td>
</tr>
<tr>
<td>II</td>
<td>13</td>
<td>23.5±2.9</td>
<td>32.7±2.1</td>
<td>9.2±1.3</td>
<td>30.0±3.7</td>
</tr>
<tr>
<td>III</td>
<td>15</td>
<td>22.9±3.6</td>
<td>34.7±2.5</td>
<td>11.8±1.8</td>
<td>38.4±5.8</td>
</tr>
</tbody>
</table>

*Significantly different from groups I and II (P<0.05).

This study demonstrated that grazing sheep in the liver fluke endemic area resulted in significant mortality of lambs not treated for the flukes. The assessment of the cause of death was based on evidence of liver damage, presence of liver flukes in the bile ducts and the absence of any other demonstrable cause. When only GI helminths were removed in the FBZ treated group, the lambs gained less weight than those treated with ABZ, probably due to the chronic liver fluke infections. However, both treatment groups demonstrated significantly reduced lamb mortality rates and increased growth when compared to the control group. Other helminths particularly H. contortus may have contributed to the poor health of this group. Earlier studies have shown that the fluke/nematode disease complex is the result of the additive effects of flukes and nematodes accumulated independently and not the result of a synergism between the parasites\textsuperscript{14,15}.

The present results show that liver fluke infection in sheep is of economic significance in the central highlands of Kenya. For maximal benefit, strategic treatment with a broad spectrum anthelmintic, which has efficacy against liver flukes, before (March) and after the long rains (July) should therefore be used to prevent production losses caused by fasciolosis that may be superimposed upon existing GI helminth infections\textsuperscript{8,16}. Other methods of control, for example biological control of fluke intermediate host\textsuperscript{17} and GI nematodes merit further consideration.
Acknowledgement

This study was financially supported by the Livestock Helminth Research Project under the auspices of the Danish International Development Agency (DANIDA).

References


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Helminths in livestock are a major cause of production losses in the livestock industry. This is mainly so in the traditional (small holder) sector where helminth problems are not well known and hence anthelmintic regimes are almost non existent. This entails that a more vigorous campaign should be carried out to educate the traditional farmers on the importance of helminth control in livestock. As a first step in, the investigation and control of helminth infections, it is important to establish what helminth species are present in an area. This knowledge will be helpful among others, in knowing which of these helminths are of economic importance, how to intervene in control measures, what control measures to implement and the type of anthelmintic to use. In Zambia, very little is known about the types of helminths that are present in the various groups of domestic animals. This then poses a big challenge to both the veterinarian and the animal owners on how to control helminth problems in these animals. It was hence thought that the first step was to put together this report to act as a base reference point when dealing with helminth problems in domestic animals in Zambia.

Records in the Parasitology Laboratory of the School of Veterinary Medicine at the University of Zambia were analysed. The period covered in these records was between 1986 and 1998. Data was also collected from research work done by various scientists. The genera/species identified so far in Zambia are listed in groups with respect to the animal host (Tables 1-6).

Table 1: Helminths identified in Cattle in Zambia

<table>
<thead>
<tr>
<th>Nematodes</th>
<th>Trematodes</th>
<th>Cestodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oesophagostomum</td>
<td>Fasciola gigantica</td>
<td>Moniezia benedeni</td>
</tr>
<tr>
<td>Thelazia</td>
<td>Paramphistomum</td>
<td>M. expansa</td>
</tr>
<tr>
<td>Trichostrongylus axei</td>
<td>Schistosoma bovis</td>
<td>Hydacid cyst</td>
</tr>
<tr>
<td>Cooperia oncophora</td>
<td>S. leiperi</td>
<td>Cysticercus bovis</td>
</tr>
<tr>
<td>C. pectinata</td>
<td>S. margrebowiei</td>
<td></td>
</tr>
<tr>
<td>C. punctata</td>
<td>S matthei</td>
<td></td>
</tr>
<tr>
<td>Strongyloides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bunostomum phlebotomum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemonchus spp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toxocara vitulorum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichuris discolor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setaria labiopapillosa</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Phiri, D., B.V.M., M.V.M., Lecturer, Department of Paraclinical Studies.
Ziela, M., B.V.M. Research fellow, Department of Clinical Studies.
Chota A. Dip. Agric. (Animal Science Major), Technician, Department of Paraclinical Studies.
Table 2: Helminth genera identified in Goats in Zambia

<table>
<thead>
<tr>
<th>Nematodes</th>
<th>Trematodes</th>
<th>Cestodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongyloides papillosus</td>
<td>Stilesia hepatica</td>
<td>Adults</td>
</tr>
<tr>
<td>Haemonchus contortus</td>
<td></td>
<td>larval stages</td>
</tr>
<tr>
<td>T. colubriformis</td>
<td>Thysaniezia giardi</td>
<td></td>
</tr>
<tr>
<td>O. columbianum</td>
<td>Moniezia expansa</td>
<td></td>
</tr>
<tr>
<td>Skrjabinema ovis</td>
<td>Cysticercus tenuicollis</td>
<td></td>
</tr>
</tbody>
</table>

* Trichostrongylus
† Oesophagostomum

Table 3: Helminths identified in Sheep in Zambia

<table>
<thead>
<tr>
<th>Nematodes</th>
<th>Trematodes</th>
<th>Cestodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemonchus contortus</td>
<td>Paramphistomum</td>
<td>Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td>larval stages</td>
</tr>
<tr>
<td>Trichuris ovis</td>
<td></td>
<td>Moniezia benedeni</td>
</tr>
<tr>
<td>Cooperia pectinata</td>
<td></td>
<td>Cysticercus tenuicollis</td>
</tr>
<tr>
<td>C. punctata</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O. columbianum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichuris discolor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. globulosa</td>
<td>A. centripunctata</td>
<td></td>
</tr>
<tr>
<td>T. skrjabini</td>
<td>Stilesia hepatica</td>
<td></td>
</tr>
</tbody>
</table>

*Oesophagotomum
† Aviellina

Table 4: Helminths identified in Pigs in Zambia

<table>
<thead>
<tr>
<th>Nematodes</th>
<th>Trematodes</th>
<th>Cestodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascaris suum</td>
<td></td>
<td>Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td>larval stages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cysticercus cellulosae</td>
</tr>
</tbody>
</table>
Table 5: Helminths identified in Dogs in Zambia

<table>
<thead>
<tr>
<th>Nematodes</th>
<th>Trematodes</th>
<th>Cestodes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td>larval stages</td>
</tr>
<tr>
<td>Toxocara canis</td>
<td></td>
<td>Dipylidium caninum</td>
</tr>
<tr>
<td>Spirocerca lupi</td>
<td></td>
<td>Taenia hydatigena</td>
</tr>
<tr>
<td>Ancylostoma caninum</td>
<td></td>
<td>Mesocestoides lineatus</td>
</tr>
<tr>
<td>A. braziliense</td>
<td></td>
<td>Echinococcus granulosus</td>
</tr>
</tbody>
</table>

Table 6: Helminths identified in Poultry in Zambia

<table>
<thead>
<tr>
<th>Nematodes</th>
<th>Trematodes</th>
<th>Cestodes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td>larval stages</td>
</tr>
<tr>
<td>Ascaridia galli</td>
<td></td>
<td>Raillietina cesttcillus</td>
</tr>
<tr>
<td>Heterakis gallinarum</td>
<td></td>
<td>R. echinobothrida</td>
</tr>
<tr>
<td>Tetrameris americana</td>
<td></td>
<td>R. tetragona</td>
</tr>
<tr>
<td>Gongylonema ingluvicola</td>
<td></td>
<td>Davainea proglottina</td>
</tr>
<tr>
<td>Cheilospirura hamulosa</td>
<td></td>
<td>Hymenolepis carioca</td>
</tr>
<tr>
<td>Capillaria spp</td>
<td></td>
<td>Amoehotaenia sphenoid</td>
</tr>
<tr>
<td>Subulura brumpti</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the tables it would appear that there is still more work to be done in formulating a data bank of helminths in Zambia. Most of the tabulated data was collected from areas around the capital city and may not necessarily mean they are the only helminth species in Zambia.

Very little work has been done in pigs and the two helminth species identified may not be the only ones that exist. In poultry, it must be mentioned that the cestode list is not exhaustive because Shamul Islam reported only these ones and it is possible other species have emerged or were missed in that work. This is evident in the extra species of nematodes reported by Ziela (Unpublished data).

All in all, the results may be used as a stepping stone to future research of helminth problems in Zambia. A number of the helminths identified such as Haemonchus, Fasciola, Schistosoma are very pathogenic and hence the specific areas where these are found need to be identified. Losses due to the most pathogenic helminths in the various species need to be quantified and feasible control methods formulated.

Acknowledgement

We are deeply indebted to the staff of the Department of Paraclinical Studies, School of Veterinary Medicine, University of Zambia, who kept the records that enabled this information to be retrieved. Due thanks are also extended to all the workers who carried out several works in Zambia on helminths.
References


Received for publication on 5th March, 1998
SHORT COMMUNICATION

HELMINTH INFECTION LEVELS IN GOATS IN A SEMI ARID AREA OF KENYA

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A survey was undertaken in a semi-arid area to study gastrointestinal helminth infections in goats on seven small scale farms after a single anthelmintic treatment. These farms had no history of previous anthelmintic use. Twenty goats from each farm were ear-tagged for identification. They were faecal sampled at the end of May 1996 and treated with 10% Albendazole at the manufacturer's recommended dosage. They were then sampled after 14 days (June 1996), then after six months (January 1997) and after 11 months (May 1997). The faecal egg counts (Eggs Per Gram of faeces -EPG) varied with individual goats and farms at the beginning of the survey. The rate of acquisition of the infective larvae also varied with the farms and individual goats. Some goats were negative at the beginning and even during subsequent samplings. The highest EPG recorded was 5000 at the beginning while at the end (after 11 months) it was 2200. The main helminths infecting the goats were Haemonchus contortus (45%), Cooperia curvicollis (30%), Oesophagostomum spp. (20%) and Trichostrongylus spp. (5%). The results showed that goats in this area are infected with gastrointestinal helminths at various levels. More work needs to be done to assess the impact of helminths on goat production and viable control in this area to be identified.

There are about 8 million goats in Kenya 1. Most of these goats are kept by subsistence farmers in the arid and semi-arid areas where they serve various purposes like subsistence and as farmers' "banks". They are also used for various cultural purposes. Helminthosis has been identified as a major constraint to productivity in goats 2,3. The widespread occurrence of infection at sub-clinical levels with hemithns, the associated loss in production, the cost of anthelmintics and death of infected animals are some of the major concerns4.

Goats are particularly suited for the arid and semi-arid areas as they are able to walk for long distances in search of pastures and water. They can graze and also browse. They feed on dry pods, barks and high twigs and hence are less vulnerable to nutritional stress during prolonged dry periods5,6.

This study was undertaken to provide information on the faecal egg counts and the rate at which goats acquire infective larva on seven farms in Gachoka division of Mbeere District. The area lies in the arid and semi-arid area (Ecozone 4) and receives a mean annual rainfall of 750mm. The pattern is bimodal with the short rains in October- December and the long rains in March - May. The study was carried out between May 1996 and May 1997.

Seven farmers with more than 30 goats were identified with the assistance of the agricultural extension officer. These were the farmers who had no history of anthelmintic use in goats. Twenty goats of various ages were ear-tagged from each farm for identification and monitored over the study period. All the goats on these farms were treated with 10% Albendazole at the manufacturer's recommended dosage at the end of May 1996. The ear-tagged goats were faecal sampled before treatment, 14 days, 6 months and 11
months post treatment. Individual faecal samples were collected into labelled faecal polytubes and transported to the laboratory where they were analysed by the Modified MacMaster technique using Sodium Chloride as the flotation fluid. Pooled faecal samples were cultured at 27°C for 14 days and the resultant infective larvae recovered and identified by the Baermann technique.

<table>
<thead>
<tr>
<th>Farm</th>
<th>May 1996 (0 - 1700)</th>
<th>June 1996a (200 - 500)</th>
<th>January 1997 (0 - 1000)</th>
<th>May 1997 (0 - 1400)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm 1</td>
<td>470</td>
<td>325</td>
<td>480</td>
<td>520</td>
</tr>
<tr>
<td>Farm 2</td>
<td>240</td>
<td>260</td>
<td>520</td>
<td>640</td>
</tr>
<tr>
<td>Farm 3</td>
<td>250 (0 - 500)</td>
<td>225 (0 - 500)</td>
<td>640 (0 - 1100)</td>
<td></td>
</tr>
<tr>
<td>Farm 4</td>
<td>270 (0 - 500)</td>
<td>320 (0 - 600)</td>
<td>620 (0 - 1100)</td>
<td></td>
</tr>
<tr>
<td>Farm 5</td>
<td>1380 (0 - 5000)</td>
<td>160 (0 - 600)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm 6</td>
<td>540 (0 - 1700)</td>
<td>275 (0 - 1100)</td>
<td>180 (0 - 800)</td>
<td></td>
</tr>
<tr>
<td>Farm 7</td>
<td>280 (0 - 1000)</td>
<td>270 (0 - 500)</td>
<td>361 (0 - 1200)</td>
<td></td>
</tr>
</tbody>
</table>

*14 days post treatment with 10% Albendazole.

All the goats were shedding nematode eggs. The infection varied from farm to farm. The mean faecal counts (EPG's) are shown on Table 1. Most goats had EPG's below 1000. After the anthelmintic treatment, 14 days post treatment EPG's were reduced to zero in the goats on all the farms. In all the farms the mean EPG's did not reach the pre-treatment individual levels or the farm mean levels. Five types of nematodes were identified from the coprocultures. Haemonchus contortus was the main nematode identified (45%). All the goats were shedding Eimeria oocysts at low levels.

These results showed that goats in this area are infected with gastrointestinal helminths at various levels. Gastrointestinal helminthisis in the semi-arid and arid areas has been earlier reported. The main helminth species infecting the goats was Haemonchus contortus which has been associated with hypobiosis in the semi-arid areas. This may account for the low EPG levels encountered in this study over the period after treatment.

Goats are important assets in this area and attempts to improve their productivity and boost their economic contribution should be encouraged.

Acknowledgements

This study was funded by DANIDA through ENRECA - RRHP and the University of Nairobi. The technical assistance of Mr Otieno and Ms V.M. Gichohi is appreciated.

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1. FAO 1995 Production year book

Received for publication on 8th March, 1998.
SHORT COMMUNICATION

RELATIONSHIP BETWEEN FAECAL EGG COUNTS AND TOTAL WORM BURDEN IN TRADITIONAL CATTLE OF THE SOUTHERN PROVINCE OF ZAMBIA

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2Department of Biological Sciences, School of Natural Sciences, University of Zambia, P. O. Box 32379, Lusaka.

Faecal egg count is the most used method in the diagnosis of most helminthosis. Despite the fact that faecal egg count is frequently used as a cheap and easily performed technique, the assumption that there is a relationship between the number of eggs per gram of faeces and the total number of worms has been questioned because counts are influenced by many factors including varying fecundity of species of parasites, ingesta volume, age of worms and host resistance1. No correlation has been reported to exist between the number of worms at necropsy and the number of eggs per gram of faeces2,3,4. Acquisition of immunity also affects the relationship in that egg production by female worms is depressed and low egg counts may be recorded even though significant numbers of adult worms are present in the host5. Ploeger6 reports that faecal egg counts determined early in the first grazing season, do have the ability to point at potentially dangerous levels of exposure during the second half of the first grazing season. A negative relationship develops after the first grazing season probably due to the acquisition of immunity. Bisset7 also found a significant relationship between the natural worm burdens of calves aged less than one year and the faecal egg counts and also the explanation would be the development of resistance in older animals. It has been observed, therefore, that the egg counts are related to the worm burden in young animals especially those that are in their first grazing period. This relationship slowly fades away as the animals gain immunity against the worms6,7,8. In older animals however, it has been suggested that faecal egg counts can be used to indicate the extent and intensity of parasites in the flock and may act as an indicator of the level of pasture contamination1,9,10.

The study animals were traditional cattle mostly of the Tonga breed from the Southern Province of Zambia. These animals were brought for slaughter at Turn Pike slaughter slab from different places of the Southern Province of Zambia. The reasons for their slaughter were varied, including old age and income. Five animals were selected at random and from these, the gastrointestinal tracts from the abomasum to the rectum were collected. The junctions between the abomasum and the small intestine and between the small and large intestine were ligated immediately after removal from the animal using jute twine to avoid the mixing of the contents.

The sexes of the animals sampled were noted and efforts were made to determine the age and source of the animal. The age, however, proved hard to determine because some animals belonged to people who were middlemen and had very little information on the age of the animals they were selling. They, however, were able to supply the information about the source of the animals.

All the tracts were processed on the same day of collection and the gastrointestinal contents preserved in 10% formaline. All faecal egg counts were done using the modified McMaster technique utilizing fully saturated sodium chloride solution. The post mortem differential worm counts in the different organs
were done as described by Hansen and Perry\textsuperscript{11}. A total of 70 animals were examined between February and October of 1997. Of the 70 animals examined all were found to contain varying numbers of helminths. Only two of these animals were found to have a faecal egg count of zero. The nematodes identified were Haemonchus spp., Cooperia spp., Oesophagostomum radiatum, Bunostomum phlebotomum and Trichostrongylus axei.

The scatter graph (Figure 1) and the regression line (Figure 2) between the total worm counts and faecal egg counts showed a positive correlation. There was a strong statistical positive correlation \((r = 0.7564, p<0.05)\) between these two variables.

**Figure 1**: Scatter graph for total adult worm counts compared with faecal egg counts in traditional cattle of Southern Province of Zambia

![Graph 1](image1)

**Figure 2**: Regression line and 95% CI of total adult worm counts compared with faecal egg counts on traditional cattle of Southern Province of Zambia

![Graph 2](image2)

Analysis of the data was done using Microsoft C-Stat\textsuperscript{®}, a computer application for Windows 95\textsuperscript{®}. The graphs were produced from Microsoft Excel\textsuperscript{®} for Windows 95\textsuperscript{®}.

The results show that aggregated faecal egg counts can reliably indicate levels of infection by gastrointestinal nematodes in the study area. From the knowledge that different species of worms have varying egg laying capacities\textsuperscript{12}, the correlation between the faecal egg counts and worm burdens, for individual species, should therefore be treated with caution. The correlation demonstrated faecal egg counts and worm counts for Haemonchus and Cooperia could indicate that positive correlation for individual species exists if their intensities are high. Some authors have previously questioned the use of faecal egg counts to estimate total worm burden\textsuperscript{3,4,13}, because of the different egg laying capacities of different species\textsuperscript{12} and also the external influence of the environment\textsuperscript{13,14,15}. For example, Haemonchus may produce between 5000 - 15000 eggs per female daily whilst Trichostrongylus will produce 100 - 200 eggs per female daily\textsuperscript{11}. The results will therefore have to be analyzed with the results of a differential larval count to see which species of worms are likely to have contributed the majority of the eggs.

Previous studies have shown that faecal egg counts can be used as an estimator of the total worm burden in the first grazing season in young animals\textsuperscript{5,7,8}. This means that as the animals grow older, the usefulness of faecal egg counts diminishes. However, in the present study, older animals of at least two years were used and a significant strong positive correlation \((r = 0.7564, p<0.05)\) was observed between faecal egg counts and total worm burdens. The reasons for this trend can not be easily forthcoming, but one explanation may be that the data for all the animals were pooled together before the analysis was done. Roberts and Swan\textsuperscript{16} caution against the use of faecal egg counts to predict individual animal's parasite burden, but state that the technique provides information with a satisfactory degree of precision, and aid rational decision-making in
the diagnosis and control of worms in flocks and herds. Faecal egg counts could be used to estimate worm burdens in large groups of animals. The results in the present study confirm the aforesaid.

Acknowledgments

Special thanks to the Nowergian University Fund (NUFU) for funding the entire research. We also would like to thank the technical staff of the University of Zambia namely Messers Chota Amos, Phiri Philip and Masuku Maxwell for their contribution. Special gratitude to the Management of TumPike Cooperative Society for allowing us to carry out the research at their premises.

References

3. Duwel, D., (1 990), Mitteilungen der Österreichischen Gesellschaft fur Tropenmedizin und Parazitologie, 12,69.

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Culicoides (Diptera: Ceratopogonidae) are small biting flies which have a dark and light patterned wings due to pigmentation in the wing membranes\(^1\). The females are obligatory blood suckers as a blood meal is required for the maturation of the ovaries. Many species of Culicoides have been recorded from southern Africa but Botswana has remained unsampled for biting midges\(^2\).

We report on the abundance and species composition of Culicoides collected in a light trap placed inside a pig sty at Sebele, Gaborone, Botswana. This is the first report on the collection and identification of Culicoides associated with pigs in Botswana.

This study was conducted at the Botswana College of Agriculture teaching farm, Sebele, near Gaborone a (grid reference of 24°33.\(^\prime\)E and 25°57\(^\prime\)S) at an altitude of 994m. Most of the rain falls in summer from November to March and averages 500mm annually (Botswana Meteorological Services). A total or 80 pigs of the Large White breed consisting of 10 adults, 50 weaners and 20 piglets were housed in a concrete floored building with half open side walls to permit adequate ventilation.

A single 220 volt 8w ultra-violet down draught suction light insect trap was suspended from the rafters of the pig sty. Culicoides were collected as previously described\(^2\) into water with 0.5% “Savlon” antiseptic solution. The trap was run from 1800 to 0730h. Culicoides were identified into different species by comparing the wing patterns as previously described\(^2\). Female Culicoides were differentiated from males which had a tapering abdomen and bushy antennae. Prevailing weather conditions on trapping nights were recorded.

Culicoides were collected on seven consecutive nights from 1 April to 7 April 1998. During the collection period the weather was very stable with a mean daily maximum and minimum temperatures of 33 and 17.8°C respectively and no rainfall was recorded (Table 1).

<table>
<thead>
<tr>
<th>Day</th>
<th>Number of Culicoides</th>
<th>Maxi. Temp. (°C)</th>
<th>Mini. Temp. (°C)</th>
<th>Rain (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>247</td>
<td>30.7</td>
<td>18.5</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>92</td>
<td>32.9</td>
<td>21.5</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>353</td>
<td>33.3</td>
<td>18.5</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>352</td>
<td>31.5</td>
<td>17.5</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>413</td>
<td>33.5</td>
<td>16.4</td>
<td>0.0</td>
</tr>
<tr>
<td>6</td>
<td>139</td>
<td>33.5</td>
<td>15.5</td>
<td>0.0</td>
</tr>
<tr>
<td>7</td>
<td>79</td>
<td>35.0</td>
<td>17.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>1675</td>
<td>231.6</td>
<td>124.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Mean</td>
<td>239.28</td>
<td>33.08</td>
<td>17.84</td>
<td>0.0</td>
</tr>
</tbody>
</table>
In total, 1675 Culicoides were collected with a mean daily catch of 240 biting midges (Table 1). Five Culicoides species were identified and C. imicola was the most abundant at 89.7% of the total catch (Table 2). C. schultzei group and C. similis were collected in very low numbers. Generally there were more female Culicoides than males with a mean average of 96.5% and 3.5% respectively (Table 3).

<table>
<thead>
<tr>
<th>Species</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>imicola</td>
<td>1502</td>
</tr>
<tr>
<td>leucostictus</td>
<td>91</td>
</tr>
<tr>
<td>engubandei</td>
<td>41</td>
</tr>
<tr>
<td>schultzei group</td>
<td>20</td>
</tr>
<tr>
<td>similis</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>1675</td>
</tr>
</tbody>
</table>

Table 2: Species of Culicoides identified.

<table>
<thead>
<tr>
<th>Species</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>imicola</td>
<td>1462</td>
<td>40</td>
</tr>
<tr>
<td>leucostictus</td>
<td>82</td>
<td>10</td>
</tr>
<tr>
<td>engubandei</td>
<td>46</td>
<td>5</td>
</tr>
<tr>
<td>schultzei group</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>similis</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1617</td>
<td>58</td>
</tr>
</tbody>
</table>

Table 3: Gender of Culicoides in light traps

A mean daily catch of 240 midges may be regarded as low and could be attributed of the absence of irrigated lawns or other sources of stationary water. Culicoides have previously been isolated from various classes of livestock including pigs from Zimbabwe and from South Africa. Since these insects are blood suckers they irritate the animals they feed on and when they occur in high numbers may result in loss of condition. They may also cause blood-loss anaemia apart from acting as vectors of haemoproteozoa, filaria and viruses.

C. imicola was the most abundant species collected. Although it is mainly associated with cattle, sheep and horses it is also the most common Culicoides in tropical Africa. Blood meal analysis of the collected Culicoides would provide the host preference.

In conclusion, a total of 1675 Culicoides were collected in an ultra-violet light trap hang from the rafters of a house containing 80 pigs with a mean daily catch of 240 biting midges. Culicoides imicola was the most abundant species collected and constituted about 90% of the total Culicoides caught. Female Culicoides were 96.5% of the total catch.

Acknowledgments

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Reference


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Objet
Le Bulletin de la Santé et de la Production animales en Afrique contient des articles de recherches originales traitant d'activités en matière de santé et de production animales visant à assurer le développement de l'industrie animale et une meilleure utilisation des ressources du bétail en Afrique. Le Bulletin est un périodique trimestriel.

Présentation des articles
Deux exemplaires des articles doivent être adressés à Monsieur le Rédacteur en Chef, Bulletin de la Santé et de la Production Animales en Afrique, Organisation de l'Unité Africaine/Bureau interafrique des Ressources animales, P.O. Box 30786, Nairobi, Kenya.
Un article ne peut être soumis pour publication que s'il n'a pas encore été proposé ailleurs ; il fera l'objet de quelques modifications par le Comité de Rédaction.

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

Format des articles
Les manuscrits doivent respecter les conditions suivantes :
Le titre doit être concis et ne pas dépasser plus de 15 mots, il est suivi du (des) nom(s) de l'auteur (ou des auteurs) et des établissements où le travail a été effectué, ainsi que de l'adresse pour les correspondances si elle n'est pas la même.
Le résumé ne doit pas excéder 200 mots. Son texte bref et concis comprendra les principaux résultats et les (les) conclusion(s) de l'étude.
L'introduction expose le but de la recherche.
Le matériel et les méthodes utilisés.
Les résultats présentés brièvement.
Un débat sur l'importance de l'article.
Remerciements éventuels.

Bibliographie : les références bibliographiques doivent être numérotées dans l'ordre, telles qu'elles apparaissent dans le texte. L'identification des références dans le texte se fera à l'aide de numéros (entre parenthèses) et non pas par les noms des auteurs.
La bibliographie doit respecter la présentation suivante :
1. Journal
Le nom de l'auteur (ou des auteurs) suivi des initiales du ou des prénoms, l'année de parution (entre parenthèses), l'abréviation du titre du périodique suivant la World List of Scientific Periodicals (souligné), le numéro de la première page. Le titre de l'article ne doit pas être inclus.
2. Revue
Le nom de l'auteur (ou des auteurs) suivi des initiales du ou des prénoms, l'année de parution (entre parenthèses), le titre exact (souligné), la ville où elle a été publiée, les éditeurs, le numéro de la première page.
3. Rapport annuel
Le nom du pays, l'année faisant l'objet du rapport, puis le nom du service ou de l'organisation, le numéro de la première page.
Si le même auteur est cité plus d'une fois, ses publications seront indiquées dans l'ordre chronologique dans la liste bibliographique et s'il y a plus d'une publication, les lettres "a, b, c," seront ajoutées aussi bien dans la liste bibliographique que dans le texte.

Illustrations
Les tableaux et les titres doivent être en nombre aussi réduit que possible. Un tableau d'une trop grande dimension est difficile à lire même s'il peut être reproduit. Les tableaux et les figures doivent être numérotés dans l'ordre, respectivement Tableau 1, etc., ou Fig. 1 etc. et joints à la fin du texte. Les références aux tableaux et aux figures dans le texte doivent être numérotées et non pas indiquées "tableau ci-dessous" ou "figure ci-dessous". Les illustrations en couleurs ne sont reproduites qu'aux frais de l'auteur (ou des auteurs).

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