GUIDANCE FOR AUTHORS

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

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Two copies of articles should be sent to the Editor, Organisation of African Unity/Interafrican Bureau for Animal Resources, P.O. Box 30786, Nairobi, Kenya.

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Introduction stating the purpose of the work.
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Results regular.
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BULLETIN

March 2003 Volume 51 No. 1

AFRICAN UNION
UNION AFRICAINE
# BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA

## CONTENTS

### ORIGINAL ARTICLES

| 1.  | The prevalence of udder and teat lesions in dairy cattle in Tanga, Tanzania.  
| 2.  | Study on the major diseases of chickens in Debre Zeit, Central Ethiopia.  
F. LOBAGO, D. NIGUSSIE, A. WOSSENE and H. ASHENAFI | 11 |
| 3.  | Chemical composition of Lablab Purpureus at different stages of growth and its use in feeding growing Tswana goats. A.A. AGANGA | 23 |
| 4.  | Influence of major genes controlling neck feather cover, body feather structure, and body size on chicken performance in the tropics  
S.H. MBAGA, A.M. KATULE and P. HORST | 31 |
| 5.  | The assessment of physiological fitness of donkeys on endurance tillage work in Ethiopia.  
T. ABAYNEH | 41 |
| 6.  | Feed efficiency, growth and eviscerated yield response of local turkey poultry to various levels of dietary energy.  
G.S. OJEWOLA, A.D. UDOKAINYANG, and V. OBASI | 49 |

### SHORT COMMUNICATIONS

| 7.  | Survey on Ixodid ticks in goats in Sokoto, Nigeria.  
A. AHMED, A. ADAMU H. MUHAMMED and B. AUWALU | 55 |
M.K. SAIMO, B. KASOZI, E.S. BIZIMENYERA, E.K. KYEWALABYE and G.W. LUBEGA | 59 |
R.S. SHIVAIRO | 62 |
J. K. GATHUMB N and T. A. NGATIA | 64 |
THE PREVALENCE OF UDDER AND TEAT LESIONS IN DAIRY CATTLE IN TANGA, TANZANIA.

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LA PREVALENCE DES LESIONS DE LA MAMELLE ET DU TRAYON CHEZ LE BETAIL LAITIER A TANGA EN TANZANIE

Résumé

Une étude transversale visant à connaître l'état du trayon et du quartier de la mamelle des vaches laitières a été menée dans la région de Tanga au nord de la Tanzanie pendant la période allant de janvier à avril 1999. Deux cents fermes furent choisies au hasard à partir d'une base d'échantillonnage de 3.001 fermes laitières durant la fin de l'année 1998. Parmi les 1.092 quartiers de mamelle et trayons examinés, la prévalence de la lésion physique ou les anomalies était de 4,94% pour les trayons et 4,71% pour les quartiers respectivement. Les lésions de trayon le plus souvent observées étaient les cicatrices, les ulcères et les verrues, tandis que le quartier dur ou ferme était le cas le plus souvent remarqué. Il n'y avait pas de nette différence entre F₁ et F₂ quant aux lésions constatées (P > 0,05) ; en revanche, on n'a trouvé aucune lésion chez F₃. Les résultats montrent qu'il y avait eu une mauvaise exploitation des troupeaux et les risques éventuels de lésions de la mamelle sont discutés.

Mots-clés : Petite exploitation, vaches laitières, lésions, quartiers, trayons, prévalence, Tanga, Tanzanie.

Summary

A cross-sectional study to investigate teat and individual dairy cow quarter health was carried out in Tanga region of northern Tanzania during the period January to April 1999. Two hundred farms were randomly selected from a sampling frame of 3001 smallholder dairy farms during the end of 1998. Of the 1092 udder quarters and teats investigated, the prevalence of physical lesion or defects were 4.94% for teats and 4.71% for quarters respectively. The common observed teat lesions were scars, ulcers and warts whereas presence of hard or firm quarter was more evident for the individual quarter screened. There was no clear difference between F₁ and F₂ on the lesion preferences (p > 0.05); however no lesions were found in F₃. The results suggest a poor management of the herds and the potential udder health risks are discussed.

Key words: Small holder, dairy cows, lesions, quarters, teats, prevalence, Tanga, Tanzania.

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Introduction

The reproductive system of cows consists of internal genital organs along with the mammary glands. Reproduction and production performance of cows is partly influenced by mammary gland health. The importance of mammary gland health is recognised from the significant role or loss or disease (mastitis) risk that can result if left unchecked. The losses are in form of productivity – reduced milk yield due to atrophied quarter or teat, discarded milk from infected quarters and possible potential human health risk due to consumption of pathogen-contaminated milk. Udder and teat lesions occur in all herds and arise from a variety of causes: bacterial and viral infection, insect bites like ticks, mechanical and chemical damage, trauma and fire burns. The lesions are important in dairy cows because they are painful and make milking difficult and predispose the animal to mastitis. Despite this importance, there is no available data about them in Tanga. A study was therefore undertaken to investigate, identify and quantify udder and teat lesions in an area of intensive dairy production in Tanga, northeastern, Tanzania.

Materials and methods

Study area and selection of study farms

The targeted group consisted of smallholder dairy farmers located within dairy production zones of Tanga region, practising zero-grazing and or semi-grazing system. Tanga milk shed area has both humid, coast to cool highlands weather and lies in northern eastern Tanzania. The region hosts 6% of national dairy herd. The study areas covered five out of the six districts (except Handeni) in the region. 200 out of 3001 farms registered with Tanga Dairy Development Programme (TDDP) farms were randomly selected in October 1998 (computer generated, Epi Info version 6.04). The type of cattle breeds kept include Zebu, Boran and Sahiwal. The level of exotic blood varied from first to three filial generation or F1, F2 and F3.

Questionnaire design, data collection and analysis

Individual cow questionnaire comprising cow bio-data, udder and teat lesions/defects were developed during the late 1998. The questionnaire was designed to comprise most closed ended question to ease data handling and analyses. One person collected most of the cow related data such as breed and filial generation on all selected farms on a single visit. Clinical examination of the bovine herd consisted of detailed visual inspection and systemic palpation of udder and teats. Teat ends were observed for alterations such as wounds, scars, vesicles, warts, patent orifice and ease of milking. Inspection of the udder included visual examination posteriorly to ascertain size and symmetry. Right and left hind or fore quarters were expressed relative to the examiner position. All individual udder quarters were observed for abnormal consistency like firmness, oedema, warmth and other physical defects. The investigations were carried out during the period of January to April 1999. Association between dependent (lesion or no lesion) and independent (HR, HF, FR, FH, F1, F2) variables were analysed by chi-square (Epi-info version 6.04b). Graphical results were developed using Excel software program (Microsoft Inc., USA).
The prevalence of udder and teat lesions in dairy cattle in Tanga, Tanzania

Fig 1. Frequency distribution of major identified HL, HR, FR & FL teat lesions/defects in Tanga (January - April 1999)^1

Proportion based on 273 each investigated individual teats

Fig. 2. Frequency distribution of major identified FL, FR, HR and HL udder (quarter) lesions/defects in Tanga (January - April 1999)^1

Proportion based on 273 each investigated individual quarters.
Fig. 3. Frequency distribution of major identified teat (T) and udder (U) lesions/defects by level of exotic blood (F1, F2) in Tanga (January - April 1999)\footnote{Proportion based on 137 and 130 reported to be F1 and F2 cows, respectively.}

**Results**

The common identified individual teat and udder (quarter) lesions or defects are shown in Figures 1-2. Of the 1092 quarters and teats examined, 52 (4.76\%) and 54 (4.94\%) respectively, were affected by lesions. Warts, scars and vesicles were the most common teat lesions identified, with both hind right (HR) and left (HL) teat recording a higher frequency than fore teats (FR & FL). However, there was no significance difference in distribution between quarters (p>0.05). Evidence of blind teats was recorded in all except fore right teats.

Of all the quarters investigated, evidence of firmness or hardness on palpation was single most common sign observed. However, higher frequencies were more evident in the fore (FR & FL) quarters (p>0.05).

Proportion of individual cow teat and udder quarter with lesion aggregated by level of exotic blood (F1, F2) is shown in Figure 3. Hard or firm quarters upon palpation were slightly more evident in F2 than in F1 (p>0.05). Teat with clear visible lesion (ulcers) and evidence of teat with warts were comparatively found in higher frequency in F1. No teat or udder (quarter) lesions were found in F3.

**Discussion**

The high evidence of hard/firm udder quarters and teats with lesions in both F1 and F2 was a reflection of the general number of these breeds in the herds. The proportion of F1 and F2 cows in the study were higher than F3.

The firm or hard quarters were those, which had dried up and lost their soft pliable consistency. The recorded prevalence of
the lesion (3.9 %) suggested an important problem of chronic mastitis. Ulcers, scars and warts were the most prevalent teat lesions. These lesions are quite common in cattle and in case of warts; incidences may be as high as 25 %. Ordinary warts cause little harm but often interfere with milking.

Open wound and blind teat had lowest prevalences (0.11 and 0.64 %) respectively. This suggests that injuries involving deep tissues of the teat were uncommon in these herds. Teat chaps or vesicles were the second less important lesion observed. The findings disagree with past observations. Bovine teats are known to be free of sebaceous gland and hence they are highly susceptible to desiccation and cracking. Because of their location, the teats are highly susceptible to cold and wet conditions and traumatic injuries while walking along vegetation. The resulting injuries allow bacteria to enter the gland where they may cause mastitis.

The hindquarters had more lesions than forequarters (p>0.05). These agree with another observation where ulcers and non-ulcers related teat lesions were studied. However there is no consensus in the few reports available and therefore more work need to be done.

In conclusion, this study shows that udder and teat lesions are important and could be a major contributing (risk) factor to mastitis and probably culling of dairy cows in this area.

Acknowledgements

We thank the Government of UK through DFID/NRRD Animal Health Research Programme for financing this work. Thanks to participating farmers and Project staff for cooperation and encouragement. Permission to publish this work from the Director of Livestock Development is gratefully acknowledged.

References


Received for publication on 3rd February, 2003.
STUDY ON THE MAJOR DISEASES OF CHICKENS IN DEBRE ZEIT, CENTRAL ETHIOPIA

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ETUDE SUR LES PRINCIPALES MALADIES DES POULETS A DEBRE ZEIT DANS LE CENTRE DE L'ETHIOPIE

Résumé

Une étude sur les principales maladies des poulets exotiques élevés en cages et avec une litière permanente a été menée de novembre 2001 à avril 2002 dans trois fermes commerciales avicoles privées sélectionnées à Debre Zeit dans le centre de l'Ethiopie. Dans vingt troupeaux, 260 poulets cliniquement malades ont fait l'objet d'une étude approfondie à l'aide de méthodes normalisées et treize différents syndromes et/ou maladies ont été observés. On a noté parmi les cas examinés : la coccidiose (28,85%), la salmonellose (15%), la colibacillose (11,54%), la maladie de Marek (9,23%), l'encephalomalacie (6,15%), la fatigue liée à la ponte en cage (4,23%), la carence en vitamine B₂ (3,85%), la péritonite (6,92%), le prolapus de l'anus (4,23%), l'arthrite (3,85%), le syndrome de foie gras (3,07%), le syndrome ascitique (1,92%) et l'aspergillose (1,15%).

Parmi ces maladies, le cas de mortalité la plus forte était due à la salmonellose (17,44%) suivie de la maladie de Marek (5,5%), de l'aspergillose (4,4%) et de la colibacillose (3,06%).

La présente étude a révélé, par ailleurs, que les conditions d'hygiène dans les fermes, l'alimentation, la lutte contre les maladies et les mesures préventives n'étaient pas satisfaisantes. Il est recommandé d'entreprendre une étude minutieuse pour concevoir et appliquer les mesures préventives, et mener la lutte contre les maladies.

Mots-clés : Poulet, Debre Zeit, Ethiopie, principales maladies.

Summary

A study on the major diseases of exotic chickens kept under deep litter and cage systems of management was conducted from November 2001 to April 2002 in three selected commercial private poultry farms in Debre Zeit, Central Ethiopia. Among twenty flocks, 260 clinically ill chickens were thoroughly studied following standard examination techniques and thirteen different diseases and/or syndromes were observed. Of these examined cases, coccidiosis (28.85%), salmonellosis (15%), colibacillosis (11.54%), Marek's disease (9.23%), encephalomalacia (6.15%), cage layer fatigue (4.23%), vitamin-B₂ deficiency (3.85%), yolk peritonitis (6.92%), anal prolapse (4.23%), arthritis (3.85%), fatty liver syndrome (3.07%), ascitic syndrome (1.92%) and aspergillosis (1.15%) were observed.

Of these disease conditions, the highest case mortality was accorded to salmonellosis (17.44%) followed by Marek's disease (5.5%), aspergillosis (4.4%) and colibacillosis (3.06%). Furthermore, this study disclosed that the existing farm hygienic conditions, nutrition, disease control and preventive measures are not satisfactory. A detailed study for the design and implementation of appropriate disease control and preventive measures is recommended.

Keywords: Chicken, Debre Zeit, Ethiopia, major diseases.
Introduction

A major challenge facing several nations of the world today, including Ethiopia, is the need to feed the ever-increasing populations. This fast growing human population coupled with malnutrition and the low income of the people strongly suggests the need for further establishment, expansion and promotion of poultry farming in Ethiopia.

The recent estimate of the Ethiopian chicken population is about 56.5 million\(^1\) of which more than 0.5 million are exotic breeds maintained in large and small-scale commercial farms using relatively advanced management system\(^2\). Some ten years back there were limited number of large commercial state poultry farms that keep exotic breeds. However, at present the existing commercial state poultry farms are privatized and a number of small-scale poultry farms are mushrooming especially in and around Debre Zeit and Addis Ababa. Besides, extension services designed to supply farmers with high-grade exotic breeds of poultry have been started for the rural people as part of the agricultural extension programs\(^3\). All these efforts are expected to have a positive impact in increasing the supply of animal protein in the country.

The success of the poultry farming is largely dependent on various determinants of which improved management, proper nutrition and effective disease prevention and control schemes are the major component\(^4\). Poultry diseases were cited as the most important constraints responsible for reducing both the number and productivity. It is apparent that as more exotic breeds are introduced and with the advent of intensification, new disease and management problems will become extremely important both in the commercial and backyard poultry productions\(^5\).

Different poultry diseases have been recorded in exotic birds in Ethiopia, the major causes of economic loss being Newcastle disease, coccidiosis, salmonellosis, chronic respiratory disease, (CRD) and nutritional deficiencies\(^6\). Proper identification of disease causing agents, predisposing management factors and establishing their relative importance is vital in the development of effective control strategy. In Ethiopia, however, very few studies have been made so far to investigate the various causes of poultry diseases; particularly the widespread epidemics with high mortality in intensive and semi-intensive poultry farms of the various parts of the country are not still properly identified. The present study was therefore designed with the prime objective of identifying the major diseases of exotic chickens and assessing associated predisposing factors in commercial poultry farms in Debre Zeit.

Materials and Methods

Study animals and their management

Three farms with twenty flocks of chickens under intensive management were selected. The farms were located in Debre Zeit and were designated as A, B and C based on the type of flock.

Farm A is one of the largest commercial layer farms in the country with ten flocks (5 replacement, 4 layer and 1 layer breeder). The farm has a total of seventeen houses for rearing and production. All layers in the production are kept in cages. The deep litter system is practiced in all rearing birds. Density varied from 11 to 16 chicken/m\(^2\). Brooding is done for 30 days and feed is given by automatic
feeders. The birds maintained at the farm are *Isa Brown*, *Bovans white* and *brown*, all imported from Holland.

Farm B is a large commercial broiler farm and the capacity is more than 400,000 broilers per annum using 12 poultry houses. Additionally, the farm was also used for rearing of broiler parent stock. Only five flocks were included in the study. The birds maintained in the farm were *Hubbard* imported from Israel.

Farm C has mixed type (layer and broiler) of production. It had five flocks (C1, C2, C3, C4, C5). These flocks included two broiler flocks (C2 and C3), one broiler breeder flock (C1), one layer flock (C5), and one layer replacement flock (C4). Bovans brown egg type and Hubbard of meat type chickens are maintained in the farm. Deep litter system is used for all flocks except for layers that are under cage system.

**Study Design**

Based on their age, the birds were conventionally grouped as chicks (1-60 days), pullets (61-140 days), layers (>140 days), starters (1-28 days), and finishers (>28 days). Sampling method was cross-sectional and purposive type.

A total of 260 chickens that were clinically ill and at risk, including different age groups and production types were transported to Faculty of Veterinary Medicine (FVM), Debre Zeit, for detailed laboratory and postmortem examination (Table 1). Disease diagnosis was achieved through the procedures involving case history, clinical, postmortem, histopathological and microbiological examinations.

A questionnaire was prepared to get detailed and relevant information on factors assumed to contribute to the occurrence of poultry diseases in different farms. The questionnaire focused on the history and experience of disease of poultry, disease prevention and control measures, management and hygienic condition of each farm.

**Pathological Examination**

The chickens were opened and examined following standard postmortem examination procedures. The observed gross pathological lesions were described and recorded; tissues from all organs showing gross pathological changes were sampled and fixed in 10% neutral buffered formalin. The samples were dehydrated in alcohol, cleared in xylene, embedded in paraffin, sectioned at 4-5μm thickness and stained with haematoxylin and eosin (Mayor’s Haematoxylin Stain). Samples taken from Aspergillosis suspected cases were further subjected to Periodic Acid Schiff (PAS) reaction.

**Microbiological examination**

Tissue samples were taken aseptically during the postmortem examination and either inoculated directly in the isolation medium or stored at 4°C until processed. The most commonly collected samples were cardiac blood and liver from chickens that died as a result of sepsis. Swab samples of exudates from the pericardial sac, air sacs and joints were also collected aseptically. The isolation and identification of the organisms was made using standard procedures.

**Parasitological examination**

The intestines were examined thoroughly for the presence of any visible parasitic infestation. When coccidiosis was suspected, mucosal scrapings were taken from the intestine and/or ceca and emulsified with saline solution and
examined under the microscope for the demonstration of *Eimeria* oocysts. Identification of the *Eimeria* species was made by the nature of gross lesions they induced, the site of infestation, demonstration of the oocysts and histopathological findings described.  

**Data analysis**

The data were analyzed using chi-square test and particular rates were calculated using the following formula:

**Age-specific mortality rate**

\[
\text{Age-specific mortality rate} = \frac{\text{No of deaths among animals in specified age group} \times 10^2}{\text{Average no of the specified group}}
\]

**Cause-specific mortality rate**

\[
\text{Cause-specific mortality rate} = \frac{\text{No of deaths from specific cause} \times 10^2}{\text{Average population at risk}}
\]

**Crude-mortality**

\[
\text{Crude-mortality} = \frac{\text{Total death in a time period} \times 10^2}{\text{Average population at risk in time period}}
\]

**Results**

Diseases of various origins including bacterial, viral, fungal, nutritional were encountered in chickens of the three farms of interest. Out of the 260 clinically examined and necropsied chickens, thirteen different diseases and/or syndromes were encountered. Among the diseases, the most important causes of mortality in the farms were salmonellosis (17.44%), Marek’s disease (5.51%), aspergillosis (4.4%) and colibacillosis (3.06%) (Table 2).

**Coccidiosis**

Out of the 260 chickens examined from the selected farms, 56 of them were kept under cage system and had no coccidiosis infection. Seventy five (36.76%) of 204 chickens reared under deep litter system, (36.76%) were positive for coccidiosis. Of the positive cases, 41(20.09%) showed clinical coccidiosis with characteristic signs

### Table 1. Description of the study chickens according to their age and type of production and management system

<table>
<thead>
<tr>
<th>Type of Chickens</th>
<th>Age (days)</th>
<th>Type of Production</th>
<th>Management System</th>
<th>Farm A</th>
<th>Farm B</th>
<th>Farm C</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicks</td>
<td>1-60</td>
<td>Egg Type</td>
<td>Deep Litter</td>
<td>46</td>
<td>7</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Pullets</td>
<td>61-140</td>
<td>Egg Type</td>
<td>Deep Litter</td>
<td>41</td>
<td>15</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Layers</td>
<td>&gt;140</td>
<td>Egg Type</td>
<td>Cage</td>
<td>43</td>
<td>13</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>Starters</td>
<td>1-28</td>
<td>Meat Type</td>
<td>Deep Litter</td>
<td>_</td>
<td>38</td>
<td>14</td>
<td>52</td>
</tr>
<tr>
<td>Finishers</td>
<td>&gt;28</td>
<td>Meat Type</td>
<td>Deep Litter</td>
<td>_</td>
<td>29</td>
<td>14</td>
<td>43</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>130</td>
<td>67</td>
<td>63</td>
<td>260</td>
</tr>
</tbody>
</table>
and lesions on the intestine and/or ceca, while 34(16.66%) were positive for subclinical coccidiosis which is characterized by the presence of oocysts without any clinical signs and gross lesions on the intestine and/or ceca (Table 3).

Statistical analysis indicated that there was significant difference (p<0.05) in the prevalence of coccidiosis between farm C and A, and farm C and B. However, there was no significant difference (p>0.05) in the prevalence of coccidiosis between farm A and B. Out of the 41 clinical coccidiosis cases observed 18, 6, and 17 cases were recorded in chicks, pullets and finisher types of chickens, respectively.

Table 2. Overall case-specific mortality rates for different diseases of poultry in Debre Zeit.

<table>
<thead>
<tr>
<th>Type of disease Condition</th>
<th>Average population at risk</th>
<th>Mortality absolute (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Farm A Farm B Farm C Total</td>
<td>Farm A Farm B Farm C Total</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>8000 1650 5500 15150 1506(18.82%)</td>
<td>328(19.93%) 809(14.71%) 643(17.44%)</td>
</tr>
<tr>
<td>Marek's Disease</td>
<td>6600 5400 12000 367(5.56%)</td>
<td>294(5.44%) 661(5.51%)</td>
</tr>
<tr>
<td>Aspergillosis</td>
<td>2000 - - 88(4.4%)</td>
<td>- 88(4.4%)</td>
</tr>
<tr>
<td>Collibacillosis</td>
<td>2000 5000 3500 10500 60(3.03%)</td>
<td>160(3.2%) 102(2.91%) 322(3.06%)</td>
</tr>
<tr>
<td>Cage-layer fatigue</td>
<td>18000 - 5612 23612 320(1.77%)</td>
<td>- 179(3.19%) 499(2.11%)</td>
</tr>
<tr>
<td>Coccidiosis</td>
<td>8000 9500 4000 21500 208(2.6%)</td>
<td>44(0.46%) 112(2.8%) 364(1.69%)</td>
</tr>
<tr>
<td>Encephalomalacia</td>
<td>3000 2000 2000 7000 40(1.33%)</td>
<td>43(2.15%) 30(1.50%) 113(1.61%)</td>
</tr>
<tr>
<td>Anal prolapse</td>
<td>18200 - 6500 24700 245(1.35%)</td>
<td>- 125(1.92%) 370(1.49%)</td>
</tr>
<tr>
<td>Fatty-liver Syndrome</td>
<td>10500 - - 10500 142(1.35%)</td>
<td>- 142(1.35%)</td>
</tr>
<tr>
<td>Yolk peritonitis</td>
<td>10350 - 6000 16350 140(1.35%)</td>
<td>- 70(1.65%) 210(1.28%)</td>
</tr>
<tr>
<td>Vitamin-B2 deficiency</td>
<td>2007 2095 4102 7(0.35%)</td>
<td>30(1.43%) 37(0.90%)</td>
</tr>
<tr>
<td>Arthritis</td>
<td>- 2400 - 2400 5(0.36%)</td>
<td>- 5(0.36%)</td>
</tr>
<tr>
<td>Ascitic Syndrome</td>
<td>- 7000 - 7000 5(0.0714%)</td>
<td>- 5(0.0714%)</td>
</tr>
</tbody>
</table>
A mortality rate of 4.76%, 0.052% and 2.5% in chicks, pullets and finisher broilers, respectively were recorded due to coccidiosis during the study period. Four pathogenic *Eimeria* species were encountered and identified. Coccidiosis due to *E. acervulina*, *E. necatrix*, *E. maxima*, and *E. tenella* were registered in 19, 8, 14 and 3 cases, respectively. Mixed infections were also encountered in 3 cases.

**Salmonellosis**

Based on the bacteriological examination of tissue samples; *Salmonella pullorum* was isolated in 16 cases and *Salmonella gallinarum* in 23 cases. The overall mortality caused by *Salmonella* in affected flocks was 17.44%, which is the highest mortality rate as compared to the other diseases (Table 2). Salmonellosis caused mortality rate of 23.55%, 16.24% and 17.11% on chicks, pullets and starter birds, respectively. Mortality was not, however, recorded in layer and finisher chickens. It caused mortality rates of 18.82%, 19.93% and 14.71% in farm A, B and C, respectively.

**Colibacillosis**

The overall prevalence of colibacillosis was 11.54%. Its prevalence was 6.15%, 22.38% and 11.11% on farms A, B and C, respectively. The overall mortality rate of the disease was 3.06% in the selected farms (Table 2). It caused mortality of 3.0%, 2.58% and 4.0% on chicks, starters and finisher birds, respectively. No case of colibacillosis was recorded in pullet and layer types of chickens.

**Marek's Disease**

A total of 24 (9.23%) cases of Marek's disease were recorded in pullets of farm A and C with mortality rate of 5.51%. The disease caused mortality rate of 6.04% and 4.85% on pullets from farms A and C, respectively (Table 2). In this study, both the acute (visceral) and chronic (classical) forms of Marek's disease with its typical clinical signs and gross and microscopic lesions were observed.

**Aspergillosis**

There were three (1.15%) cases of Aspergillosis from chicks of farm A and gave rise to mortality rate of 4.4% (Table 2).

<table>
<thead>
<tr>
<th>Study farms</th>
<th>Number of chickens examined</th>
<th>Number of positive cases</th>
<th>Type of infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Clinical</td>
</tr>
<tr>
<td>Farm A</td>
<td>87</td>
<td>29(33.33%)</td>
<td>15(17.24%)</td>
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<tr>
<td>Farm B</td>
<td>67</td>
<td>21(31.85%)</td>
<td>12(17.91%)</td>
</tr>
<tr>
<td>Farm C</td>
<td>50</td>
<td>25(50%)</td>
<td>14(28.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>204</td>
<td>75(36.76%)</td>
<td>41(20.09%)</td>
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</tbody>
</table>

Table 3. Prevalence of coccidiosis in chickens kept under deep litter management.
The clinical cases had involvement of the respiratory, visceral and the central nervous systems.

**Nutritional deficiencies**

Sixteen (6.15%) cases of encephalomalacia were encountered. These were 6 (4.61%), 5 (7.46%), and 5 (7.93%) cases from chicks of farm A, starter broilers of farm B, and farm C, respectively. During the course of the disease, 1.33% of chicks, 2.15% of starter broilers and 1.50% of starter birds from farms A, B and C, respectively died, with an average total mortality rate of 1.61% for the three farms (Table 2).

A total of 11 (4.23%) cases of layer cage fatigue, 7 (5.38%) and 4 (6.35%) cases from layers of farm A and C, respectively were diagnosed and it caused 2.1% mortality (Table 2).

Ten (3.58%) cases of vitamin B₂ deficiency were observed. Of these, 5 (3.84%) and 5 (7.46%) were chicks from farms A and B, respectively. The disease caused mortality rate of 0.35% on chicks and 1.43% on starter broilers with case-specific mortality rate of 0.90% (Table 2).

**Miscellaneous diseases**

A total of 51 (19.62%) cases of miscellaneous disease conditions were observed. Eighteen (6.92%) cases of Yolk peritonitis were diagnosed. Of these 12 (9.23%) and 6 (9.52%) cases were layers from farms A and C, respectively and caused mortality of 1.28% during the course of the disease (Table 2).

Eleven (4.23%) cases of anal prolapse were encountered. Out of these 8 (6.15%) and 3 (4.76%) cases were from layers of farm A and C, respectively and caused mortality of 1.49% (Table 2).

Ten (3.85%) cases of arthritis on finisher broilers of farm B were observed and caused mortality of (0.36%) (Table 2). The cases were characterized clinically by swollen footpads and enlarged hock joints with serous exudate. A specific etiologic agent was not isolated.

Eight (3.07%) cases of Fatty liver syndrome were observed in layers of farm A and 1.35% of the layers died (Table 2). The cases were characterized by marked weakness, depression and followed by death.

Five (1.92%) cases of ascitic syndromes were observed on finisher broilers of farm B. Ascitic syndrome caused deaths of 5(0.0714%) of the affected birds (Table 2). The cases were characterized by enlarged abdomen with dyspnea and depression.

**Observation on intensive poultry production system**

In the process of disease investigation in the selected poultry farms, information on predisposing factors that contributed to occurrence of poultry diseases in the farms were gathered. Management conditions such as keeping system and hygiene, nutrition, the poultry disease history and the existing disease prevention and control measures of each farms were all supposed to contribute to the introduction, spread and persistence of poultry diseases in the farms.

**Farm management and hygiene**

All farms lack proper isolation from the surrounding villages. Dogs and other wild animals enter the farms freely. Also there is no physical isolation between the different units. Dead birds are disposed in pits located within the farms. The three farms do not practice an all-in all-out system.
Multi-age groups are usually reared in the same farms. Different age groups and male and females were sometimes managed in the same house. Broiler, broiler breeder and layer flocks have been reared in farm C. Moreover, in all the studied farms, managers and supervisors frequently visit the farms and farm unit without changing boots and overalls between units. Overalls and boots are only supplied twice a year. The attendants frequently move from one site to the other without restrictions. Many of the workers have local chickens at their homes that are unvaccinated to major diseases like Newcastle disease and Marek’s disease.

Feeding

Poultry maintained on the farms were fed on mixed concentrated feed, containing mainly maize, oil seed meals, meat meal, bone meal, and various milling by-products. These mixed feeds, which were produced by feed processing mills, usually were not correctly formulated due to discontinuities in supplies and variations in composition of ingredients, shortage of amino acids, vitamins, minerals and premixes. The present study indicated that coccidiosis has high prevalence rate (36.76%) under deep litter management in the studied poultry farms. Similarly, a relatively higher prevalence of coccidiosis (50.8%) under deep litter system than the backyard rearing system (11%) and the cage system of management (1%) was reported in and around Debre Zeit. The relatively higher prevalence rate in chickens maintained under deep litter system may be attributed to the rearing system where by animals are brought together under conditions in which the infective dose can be high. Moreover, the deep litter, particularly under poor sanitation and prolonged use may favor for the sporulation of the oocysts.

Higher proportion of chickens showed clinical coccidiosis (20.09%) than subclinical (16.66%) coccidiosis. This may suggest the poor management practices in the selected farms. In deep litter poultry
houses, which offer optimal conditions of temperature and humidity for oocyst sporulation the risk of heavy infection is further increased\textsuperscript{14}. In addition stress factors, such as change of diet, concurrent diseases and absence of effective control programs of coccidiosis in the farms may also account for such higher proportion of clinical coccidiosis. The replacement flocks were raised under continuous feeding of a single anticoccidial drug and such practice may result in selection and survival of drug-resistant strains of coccidia\textsuperscript{15}. Some of these facts may contribute for the higher prevalence of clinical coccidiosis in farm C (28\%) than in farm A (17.24\%) and in farm B (17.91\%).

The pathogenic \textit{Eimeria} species responsible for clinical coccidiosis in the study farms were \textit{E. acervulina} (46.34\%), \textit{E. maxima} (34.14\%), \textit{E. necatrix} (19.51\%) and \textit{E. tenella} (7.31\%). Some other previous works indicated that \textit{E. acervulina} was the major species in farm A at Debre Zeit\textsuperscript{16} while \textit{E. tenella} and \textit{E. necatrix} were the predominant species in Debre Zeit State poultry farms\textsuperscript{2}.

The current high prevalence of \textit{E. acervulina} and \textit{E. maxima} as compared to the previous findings could be attributed to the fact that most of the anticoccidial drugs in general use were developed specifically to control the two highly pathogenic species (\textit{Eimeria tenella} and \textit{Eimeria necatrix})\textsuperscript{14}. As a result, the other species have assumed a greater prevalence.

\textbf{Salmonellosis}

In this study, salmonellosis caused the highest mortality (17.44\%) in affected flocks in the three selected farms. Almost 23.55\% of chicks, 16.24\% of pullets and 17.11\% of starter boilers died of the disease. Moreover, the confirmed clinical cases of salmonellosis were 39 (15.0\%) in the three selected farms.

Salmonellosis was reported as the major disease problem in commercial exotic chickens in Ethiopia by different authors. One of such reports indicated 5\% and 20\% incidence rate of salmonellosis in 1983/84 and from 1985 to 1988 in Debre Zeit and Addis Ababa poultry farms, respectively\textsuperscript{2}. A recent similar work pointed out salmonellosis to be a major cause of economic loss through mortality and drug expenditure in Debre Zeit commercial poultry farms\textsuperscript{17}. The present and past studies confirm that salmonellosis has been one of the major diseases in exotic chickens of commercial poultry farms at Debre Zeit.

The existence of such high clinical cases and mortality due to salmonellosis in the selected farms may be attributed to unsatisfactory disease preventive measurers and poor management conditions. The three farms do not practice practical testing and eradication programs for control of egg-borne diseases such as pullorum and typhoid diseases in breeder and/or multiplier stocks. Absence of such practice and lack of proper sanitary conditions in the hatchery may favor the maintenance of non pullorum-typhoid-free breeder and/or multiplier flocks in the farms.

Moreover, history of previous occurrence of salmonellosis, minimal distances and lack of physical separation between different units, poor disposal of dead birds, absence of an all-in all-out system, poor biosecurity measures and maintaining different type and multi-age group of birds created favorable conditions for the occurrence of outbreaks and persistence of the disease in the farms.

\textbf{Colibacillosis}

The prevalence and mortality rate of colibacillosis were 11.54\% and 3.06\%, respectively. Mortality in the three farms in
chicks, starter and finisher birds, was 3.0%, 2.58%, and 4.0% respectively. No clinical case of colibacillosis was recorded in pullets and layers, as infection of colibacillosis is more frequent in young than mature birds.\textsuperscript{18} The existence of colibacillosis in all study farms is obviously associated with a low standard of sanitation. Most outbreaks of colibacillosis occur in poultry raised under a low standard of sanitation.\textsuperscript{6}

**Marek's disease**

In the present study, Marek's disease had a prevalence rate of 9.23% and caused mortality of 5.51% in vaccinated pullet flocks. Such occurrence of Marek's disease in vaccinated flocks may be attributed to early exposure to the virus and/or improper vaccination. Immunity from vaccination is not fully developed for 1-2 weeks and it is crucial to minimize early exposure by careful sanitation and disinfecting.\textsuperscript{15} Genetic differences of chickens can aid both in resistance to Marek's disease as well as the response to vaccination.\textsuperscript{18} Marek's disease has also been shown to cause high mortality (46%) in intensively managed non-vaccinated exotic chickens in Debre Zeit.\textsuperscript{19} Such excessive losses may be attributed to breed susceptibility and virulent virus strains.

**Aspergillosis**

Aspergillosis (1.15%) was observed only in chicks and caused mortality rate of 4.4%. The disease is most frequently seen in chicks, usually during the first 3-4 weeks of age and may give rise to mortality up to 5%.\textsuperscript{18} A similar report indicated that less than 0.01% prevalence rate of aspergillosis in Debre Zeit.\textsuperscript{2}

**Nutritional deficiencies**

A total of 37 (14.23%) cases were affected by three different nutritional deficiencies, Encephalomalacia, Vitamin-\textsubscript{B\textsubscript{2}} deficiency and Cage layer fatigue. The first two were encountered in young birds while the third one diagnosed in adult layers. The deficiencies are usually seen in young birds that are raised in confinement and compelled to eat only what is offered to them.\textsuperscript{20}

The present study clearly indicated that exotic chickens kept under intensive management system were exposed to a wide range of diseases or disease syndromes. Moreover, the existing improper management conditions like poor hygiene, improper nutrition and lack of appropriate disease preventive and control programs contributed for the occurrence of most of the disease outbreaks.

Furthermore, lack of trained manpower, especially in the fields of poultry health and nutrition, absence of primary avian diagnostic laboratories and lack of research in poultry health in the country have further exacerbated the prevailing situation.

Therefore, appropriate hygienic measures, proper nutrition, better disease preventive and control programs should be implemented for effective disease control in the existing commercial poultry farms. Moreover, appropriately equipped avian disease diagnostic laboratories should be established for accurate and timely diagnosis of diseases of chickens and serious attention should be paid to research works in the area of poultry health.

**References**

51: 197.


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Received for publication on 7th January, 2003.
CHEMICAL COMPOSITION OF *LABLAB PUPUREUS* AT DIFFERENT STAGES OF GROWTH AND ITS USE IN FEEDING GROWING TSWANA GOATS

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COMPOSITION CHIMIQUE DE *LABLAB PUPUREUS* A DIVERS STADES DE CROISSANCE ET SON UTILISATION POUR L’ALIMENTATION DES CHEVRES TSWANA A LA CROISSANCE

Résumé

Cette étude a été menée à la ferme du Collège agricole de Gaborone au Botswana de novembre 2002 à mars 2003. Des échantillons de *Lablab purpureus* étaient coupés deux fois/semaine et analysés afin de déterminer la protéine brute (PB), la lignocellulose (L), la lignine au détergent acide (LDA), la digestibilité de la matière sèche (DMS), la matière sèche (MS), la teneur en eau et certains oligo – éléments.

Dans un essai d’alimentation, qui a duré 90 jours, 21 boucs non castrés âgés d’un an étaient répartis en trois groupes de sept chacun à l’aide d’un dispositif expérimental complètement randomisé. L’ivraie constituait 100% de la ration pour le groupe-témoin et 50% pour chacun des deux autres groupes. Les deux autres groupes étaient complémentés soit avec de la luzerne (*Medicago sativa*), soit avec du dolique lablab (*Lablab purpureus*). L’eau potable était disponible tous les jours, tandis que les restes de l’eau et des aliments servis étaient évalués et pesés chaque jour avant de donner une nouvelle ration. Entre-temps, on relevait les poids deux fois/semaine. Les données recueillies étaient soumises à l’analyse de la variance et le test à portée multiple de Duncan était utilisé pour relever les moyennes. Lors de l’essai d’alimentation, les consommations de matière sèche des chèvres étaient respectivement de 711,40 g ; 693,85 g et 702,69 g pour le groupe-témoin, les groupes complémentés avec de la luzerne et du dolique lablab, et il n’y avait donc pas de différence significative entre les groupes (P >0,05). Les gains pondéraux moyens/jour étaient très différents (P <0,05) : les chèvres complémentées avec de la luzerne gagnaient 110,79 ± 1,18 g/jour comparé à 97,78 ± 6,40 g pour celles servies de dolique lablab et à 66,66 ± 1,06g pour les chèvres nourries d’ivraie à 100%.


Summary

This study was carried out on the Botswana College of Agriculture (BCA) farm, Gaborone, Botswana from November 2002 to March 2003. *Lablab purpureus* samples were cut biweekly and analysed for crude protein (CP), Acid detergent fibre (ADF), Acid detergent lignin (ADL), dry matter digestibility (DMD), Dry matter (DM), moisture content and some macro and trace minerals.

In a feeding trial, that lasted for 90 days, twenty-one yearling intact male goats were divided into three groups of seven goats each, using a completely randomized design. Ryegrass constituted 100% of the ration for the control and 50% each for the other 2 groups. The other two groups were supplemented with either Lucerne hay (*Medicago sativa*) or lablab hay (*Lablab purpureus*). Clean water was provided daily while leftovers for water and feed provided were measured and weighed daily prior to providing new ration. Interim weights were taken biweekly. Data collected were subjected to analysis of variance, and Duncan Multiple Range Test was used to separate the means. In the feeding trial, dry matter intakes (g) of goats were 711.40, 693.85 and 702.69 for the control, Lucerne and lablab supplemented goats and were not significantly different between treatments (P>0.05). Average daily body weight gains were significantly different (P<0.05). Lucerne supplemented goats gained 110.79±1.58 g / day compared to 97.78±6.40 g for those on lablab and 66.66±1.06g for goats on 100% rye-grass.

Keywords: *Lablab purpureus*, nutrient composition, Tswana goats, feed intake, growth.

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Introduction

At present, in-depth knowledge of nutritional characteristics of Lablab legume at different stages of growth and maturity in Botswana is lacking. This legume has distinctive botanical fractions with different nutritional characteristics. In 1999, a study indicated that *Lablab purpureus*, one of the common species of this legume, contains an average of 46% Neutral detergent fiber (NDF), 41% Acid detergent fiber (ADF) and dry matter digestibility of 53%\(^1\). Tropical forages are low in protein and have high cell wall contents resulting in low digestibility. They reported that the crude protein in the whole plant had an average of 17.0% on dry matter basis\(^1\). The ADF, ADL, and NDF were reported to have averages of 38.6%, 7.1% and 43% respectively\(^1\). These factors affected the dry matter digestibility. Regardless of the method used (*in vitro* or *in vivo*) to determine digestibility or the species used, the dry matter digestibility are quite similar in most legumes and declines with maturity.

In Botswana, feeding of small ruminants by small-scale farmers is based on traditional communal grazing system where the animals depend on natural grazing\(^2\). Flocks are herded on natural pastures during the day and kraaled at night. However, farmers are increasingly becoming aware of the need to improve small stock production through improved management. Botswana has an estimated goat population of 2.2 million\(^9\). Supplementation of tropical grasses with legumes has been reported to result in increased DM intake\(^2\) - \(^4\). Herbaceous tropical forage legumes such as *Lablab purpureus* (*Lablab*), have great potential as protein supplements to low quality roughages\(^2\). Forage quality and overall potential are best measured in terms of animal productivity. Good results have been obtained with forages of herbaceous legumes as supplements for ruminants on low quality diets\(^5\) - \(^6\). Improved live weight gains have generally been reported with supplementation of basal grass diets with legumes, with or without increase in total DM intake\(^7\) - \(^8\). Positive responses obtained with the grass-legume diet were attributed to the ability of the legume to ameliorate N deficiency in grass and reduce NDF concentration in the total diet\(^9\).

Goats are efficient animals in the use of water. They have a low rate of water turnover per unit of body weight\(^10\). In the tropics goats are adapted to water shortages, they often have low water turnover rates and the ability to resist desiccation. The demand for water increases in the dry season, which is often the season at which ambient temperatures are highest. Most animals gain weight during rainy season, part of which is lost during the harsh period of dry season. Live weight loss during this period results from the fact that ruminants subsist principally on roughage diets which are generally deficient in nutrients such as nitrogen, sulphur, minerals and vitamins\(^11\). However, legume supplements may increase output. This work evaluated nutrient composition of *Lablab purpureus* at different stages of growth and also compared two forage legume supplements differing in quality (Lucerne and Lablab) with rye hay as a basal roughage in the diet of Tswana goats. Considerable variation in animal response\(^12\) when forage supplements are fed have been reported. This variation may partly be attributed to the ratio of grass basal diet to legume supplement as well as to the quality of the basal roughage and forage supplement in the total diet.
Materials and Methods

Study 1
This study was conducted at Botswana College of Agriculture (BCA) farm. Samples of *Lablab purpureus* were obtained from 50 days post germination until 106 days post germination using quadrats 10m by 10m. Sampling was done every two weeks. Four replicate samples were obtained each time weighing 500g each. Fresh forage weights were determined immediately after harvesting using an analytical balance then oven dried at 70°C for 72 hours after which the dried samples were weighed. The dried samples were then ground and stored in air tight plastic containers for chemical composition analysis. All the samples were analysed for the following: dry matter (DM), total minerals (ash), acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL), in vitro digestibility and Crude protein (CP). The NDF, ADF and ADL were determined using the procedures. Percentage nitrogen was determined using the Kjeldahl procedures. Crude protein was then determined by multiplying the percentage nitrogen with the factor 6.25. In vitro dry matter digestibility was done following the modified procedures.

Study 2
A feeding trial was conducted at BCA farm, for a duration of ninety (90) days using twenty-one (21) yearling Tswana male goats which were divided into three groups of seven goats each, in a completely randomized design. The goats were kept individually in 1.5m by 1.0m pens with dwarf walls, concrete floor under a common roof made of corrugated iron sheets. Goats were offered rye hay as basal diet and Lucerne or lablab as supplements, whereby they had adequate feed with allowance for

<table>
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<th>Days post germination</th>
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<th>ADL(%)</th>
<th>CP(%)</th>
<th>DMD (%)</th>
<th>Dry matter (%)</th>
<th>Total minerals (%)</th>
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additional 10% of the feed as (ort) leftovers.

Rye hay constituted 100% of the ration as basal diet for the control group and fifty percent each for the other two groups which were supplemented with Lucerne hay (Medicago sativa) or lablab hay (Lablab purpureus). Mineral blocks were given to each individual goat and water was readily available. Pens were cleaned before providing daily ration. Leftovers were removed and weighed on a platform electronic scale. Water left over was measured with a measuring cylinder. Goats were weighed at the beginning of the trial and at two weeks intervals till the end of the trial. Weighing was done with an Avery walk-in scale the morning before feeding. Data collected were analyzed using ANOVA procedure and Duncan’s Multiple Range Test was used to separate the means.

Results and Discussion

In this study, fibre increased with maturity in the Lablab evaluated, while ADL and ADF increased with maturity. Crude protein and digestibility declined with maturity. Lablab follows a familiar growth pattern since protein content decreases with maturity. The latter workers observed that Lablab has the potential to supply rumen degradable nitrogen in excess of ruminant animal’s requirements. Lablab leaves do not contain tannins, thus providing a rapidly fermentable source of protein with little bypass protein potential.

The DMD of lablab was 55.3% which is in agreement with the past findings that reported 50.1% - 68.1% for whole lablab plant. There was no significant increase or decrease in total mineral content with maturity. Calcium content in Lablab was the

<table>
<thead>
<tr>
<th>Days post germination</th>
<th>Ca (%)</th>
<th>P (%)</th>
<th>Mg(%)</th>
<th>Zn (ppm)</th>
<th>Mn (ppm)</th>
<th>Fe (ppm)</th>
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<td>300.0±</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>±0.15</td>
<td>0.04±</td>
<td>±0.06</td>
<td>±1.0</td>
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<td>12.5</td>
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<tr>
<td>102</td>
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<td>0.36</td>
<td>40.0±</td>
<td>130.0</td>
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<td>4.4</td>
</tr>
<tr>
<td></td>
<td>±0.2</td>
<td>0.05</td>
<td>±0.05</td>
<td>±3.5</td>
<td>±8.5</td>
<td>±10.0</td>
<td>±0.3</td>
</tr>
<tr>
<td>116</td>
<td>3.2</td>
<td>0.24±</td>
<td>0.54</td>
<td>35.5</td>
<td>135.0</td>
<td>350.0</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>±0.3</td>
<td>0.03</td>
<td>±0.08</td>
<td>±2.0</td>
<td>±5.5</td>
<td>±15.3</td>
<td>0.5</td>
</tr>
<tr>
<td>130</td>
<td>3.0</td>
<td>0.24</td>
<td>0.49±</td>
<td>35.0±4</td>
<td>132.5</td>
<td>325.0</td>
<td>4.5</td>
</tr>
<tr>
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<td>±0.02</td>
<td>±0.05</td>
<td>±5.0</td>
<td>±8.4</td>
<td>±10.5</td>
<td>±0.3</td>
</tr>
</tbody>
</table>
### Table 3: DM content (%) and chemical composition (%) of feeds fed to Tswana goats (on dry matter basis).

<table>
<thead>
<tr>
<th></th>
<th>Lucern</th>
<th>Lalab</th>
<th>Ryce grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>94.90</td>
<td>96.40</td>
<td>90.00</td>
</tr>
<tr>
<td>CP</td>
<td>16.0</td>
<td>14.2</td>
<td>7.01</td>
</tr>
<tr>
<td>ASH</td>
<td>10.20</td>
<td>14.82</td>
<td>10.47</td>
</tr>
<tr>
<td>DMD</td>
<td>64.25</td>
<td>55.30</td>
<td>48.50</td>
</tr>
<tr>
<td>ADF</td>
<td>48.90</td>
<td>41.25</td>
<td>45.05</td>
</tr>
<tr>
<td>NDF</td>
<td>56.60</td>
<td>52.70</td>
<td>60.83</td>
</tr>
<tr>
<td>ADL</td>
<td>7.80</td>
<td>7.70</td>
<td>8.15</td>
</tr>
</tbody>
</table>

### Table 4: Mineral composition of Lucerne, lablab and rye grass (on dry matter basis) fed to experimental goats.

<table>
<thead>
<tr>
<th>Feed</th>
<th>Mg (%)</th>
<th>Ca (%)</th>
<th>K (%)</th>
<th>Na (%)</th>
<th>P ppm</th>
<th>Cu ppm</th>
<th>Zn ppm</th>
<th>Mn ppm</th>
<th>Fe ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucerne</td>
<td>0.08</td>
<td>1.52</td>
<td>2.89</td>
<td>0.09</td>
<td>0.26</td>
<td>7.70</td>
<td>19.70</td>
<td>39.00</td>
<td>280.00</td>
</tr>
<tr>
<td>Lalab</td>
<td>0.30</td>
<td>211</td>
<td>3.00</td>
<td>0.05</td>
<td>0.29</td>
<td>7.00</td>
<td>42.00</td>
<td>37.00</td>
<td>490.00</td>
</tr>
<tr>
<td>Rye grass</td>
<td>0.42</td>
<td>1.21</td>
<td>2.29</td>
<td>0.15</td>
<td>0.12</td>
<td>5.00</td>
<td>57.00</td>
<td>98.00</td>
<td>770.00</td>
</tr>
</tbody>
</table>

### Table 5: Intake (on dry matter basis) and response of Tswana goats during the feeding trial

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control Ryce grass and lucerne</th>
<th>Treatment 1 Ryce grass and lablab</th>
<th>Treatment 2 Ryce grass</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial weight (kg)</td>
<td>15.68±0.35</td>
<td>15.64±1.10</td>
<td>158.87±0.56</td>
<td>NS</td>
</tr>
<tr>
<td>Final weight (kg)</td>
<td>21.69±0.37</td>
<td>25.61±1.02a</td>
<td>24.67±0.75a</td>
<td>*</td>
</tr>
<tr>
<td>Body weight gain (kg)</td>
<td>6.00±0.95c</td>
<td>9.97±0.14a</td>
<td>8.80±0.58b</td>
<td>*</td>
</tr>
<tr>
<td>Average body weight gain (g)</td>
<td>66.67±1.05c</td>
<td>110.80±1.58a</td>
<td>97.78±6.4b</td>
<td>*</td>
</tr>
<tr>
<td>Average daily dry matter intake (g)</td>
<td>711.40±7.72</td>
<td>693.85±7.99</td>
<td>702.69±7.54</td>
<td>NS</td>
</tr>
<tr>
<td>Average daily DM grass hay intake (g)</td>
<td>711.40±7.72a</td>
<td>346.93±5.68b</td>
<td>351.35±17.62b</td>
<td>*</td>
</tr>
<tr>
<td>Average daily legumes intake (g)</td>
<td>346.93±9.34</td>
<td>351.35±12.85</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Average daily water intake (ml)</td>
<td>1526.51±24.83</td>
<td>1593.51±74.65</td>
<td>1554.18±30.52</td>
<td>NS</td>
</tr>
<tr>
<td>Feed conversion DM/Gain (g/g)</td>
<td>10.67±0.74a</td>
<td>6.26±0.48c</td>
<td>7.19±0.50b</td>
<td>*</td>
</tr>
</tbody>
</table>

*Means in the same row bearing different superscripts are significantly different (P<0.05). NS, no significant difference. Values are mean ± Standard Error (SE).*
highest mineral concentration obtained while copper concentration was the lowest. One of the challenges of growing forage in the tropical environments is the effect of the environment on the nutritional characteristics of plants. They noted that high temperatures decrease the soluble carbohydrate content of plants, resulting in increased fibre content and decreased digestibility.

The average ADF of lablab hay was 41.25 %, NDF was 52.70 % and ADL was 7.70 %. Earlier NDF were found to be 43.0% and 42.0% in lablab hay. The ADF percentage of lablab hay was found to be 36.0% and ADL was 7.0% in past study. The crude protein of both lablab and grass were found to be 14.2% and 7.01% respectively on dry matter basis. The major elements evaluated (Table 4) were magnesium, potassium, sodium, phosphorus and calcium while the micro elements were iron, zinc, copper and manganese. These are nutritionally important mineral elements. Legumes are good sources of proteins as compared to rye grass. Protein deficiency results in poor overall production of the animal like low weight gain and low forage hay intake due to the inability to provide enough nitrogen to the rumen microbes for the breakdown of cellulose. Goats tolerate high levels of Ca:P ratio. Dry matter digestibility (DMD) is positively correlated to crude protein content and negatively correlated to Acid Detergent Lignin (ADL) and Neutral detergent fiber (NDF) utilized by Menz sheep fed oat hay with lablab, sesbania, tagasaste or wheat middlings. The low DMD observed in rye grass may be linked to low CP content.

Table 5 shows the body weight gains of Tswana goats supplemented on lucerne and they had higher average daily weight gains of 110.80g per day as compared to 97.78g for those goats supplemented on lablab and 66.78g for those fed on rye grass only. Goats fed lucerne were efficient in converting dry matter to gain thus required less DM per unit gain compared to those fed either lablab or rye grass only. Goats on lucerne needed 6.26g of feed to gain 1g whereas those on 100% rye grass needed 10.67g to gain 1g. Body weight gains of the experimental goats were significantly different between treatments. This was attributed to the difference in nutritive value of the feedstuffs. Goats fed 100% rye grass had a slightly higher feed intake than other groups, though feed intake was not significantly different between the treatments. Water intake is related to feed intake and feed intake is correlated with productivity. Average daily gain in Menz sheep fed Lablab supplement was almost double that of sheep fed solely the basal diet in a past study. Similar results were reported when sheep fed Lablab as a supplement to Zimbabwe scrub land herbage gained a total of 3.1 kg in two months while unsupplemented sheep gained only 1.0 kg. Lablab is an adequate source of much needed protein which can be used as a supplementary feed to low quality tropical grasses. Lablab purpureus with its ability to out-yield conventional crops, especially during the dry season, and its enhanced nutritive value, is a 'fodder crop of great significance for the tropics'. The results of this study showed that Lucerne supplemented Tswana goats performed best followed by Tswana goats supplemented on Lablab purpureus but the advantage of Lablab is the ease of production in Botswana under dryland farming while Lucerne can only be grown
under irrigation which is not readily available to resource-poor livestock farmers. Lablab supplementation of Tswana goats will improve their productivity.

Acknowledgement

The author is grateful for the assistance of Mr. L. Jacyna the BCA farm manager, Messrs L. Peter and T. Mahatelo for data collection and Mr. T. Thema the Senior Laboratory Technician for assistance in laboratory analyses.

References

INFLUENCE OF MAJOR GENES CONTROLLING NECK FEATHER COVER, BODY FEATHER STRUCTURE, AND BODY SIZE ON CHICKEN PERFORMANCE IN THE TROPICS

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2Department of Animal Production, Humboldt University, 1000 Berlin 33, Lentzeallee 75, Germany.

EFFETS DES PRINCIPAUX GÈNES POUR LA PLUME DU COU, LA STRUCTURE DE LA PLUME DU CORPS ET LA TAILLE SUR LA PERFORMANCE DES POULETS SOUS LES TROPIQUES

Résumé

Les effets des principaux gènes relatifs à la plume du cou, à la structure de la plume du corps et à la taille sur la performance des poulets ont été étudiés en utilisant des jeunes poules de souche allemande "Rhode Island Red" dont les gènes pour le cou nu, la plume bouclée et la taille naine avaient été évalués soit séparément, soit en combinaison. Il y avait huit différents génotypes en ce qui concerne les trois gènes précités. Le gène pour le nanisme a réduit le poids vif, le nombre d’œufs et le poids de l’œuf de 33%, 21% et 7% respectivement. Le gène pour le nanisme était aussi lié au retard de l’âge de la maturité sexuelle d’environ 9 jours. Le gène pour le cou nu avait un effet positif sur le poids vif et l’âge à la maturité sexuelle. Le gène pour la plume bouclée a énormément accru l’âge à la maturité sexuelle (P < 0,05). Les interactions entre les trois gènes étaient faibles et avaient tendance à fausser le système de classement des génotypes multi-loci. Il est conclu que l’allèle récessif pour le gène de nanisme et l’allèle dominant pour le gène de cou nu pourraient être utiles à l’amélioration de la performance des poulets dans les climats chauds. Il est recommandé de s’assurer de l’importance économique de ces gènes.

Mots-clés: Cou nu, plume bouclée, nanisme, tropique.

Summary

The effects of major genes at three loci controlling neck feather cover, feather structure, and body size on chicken performance were investigated using pullets of a German strain of Rhode Island Red in which genes for the naked-neck (Na), frizzling (F), and dwarf (dw) condition had been incorporated either singly or in combination. There were eight different genotypes with respect to the three loci. The gene for dwarfism depressed body weight, egg number, and egg weight by 33%, 21%, and 7% respectively. Dwarf gene was also associated with delay in age at sexual maturity of the birds by about 9 days. The naked-neck gene positively influenced body weight and age at sexual maturity. The frizzling gene increased age at sexual maturity significantly (p<0.05). The interactions between the three genes were weak and tended to blur the ranking pattern of the multi-locus genotypes. It is concluded that the recessive allele for the dwarf gene and the dominant allele for the naked-neck gene are potentially useful in increasing the performance of chickens in hot climates. It is recommended that the economic merits of these genes be ascertained.

Keywords: Naked-neck, frizzling, dwarf, tropics

*Corresponding Author: E-mail: mbagash@suanet.ac.tz
Introduction

In hot and humid climates poultry production is adversely affected by stress resulting from heat dissipation problems, poor management, particularly low levels of nutrition, and insufficient protection against diseases. Exceedingly high ambient temperatures (i.e. above 30°C) are known to have depressive effects on feed intake, growth rate, egg weight and egg production\(^1\),\(^2\),\(^3\). In order to attain and sustain high production levels, it is necessary that the producer take ameliorative measures against high day temperatures and humidity experienced in the tropics. This approach however, is often too expensive to be afforded by most farmers in the tropics. Therefore intervention through breeding and selection might provide a better solution to the problem.

Findings from a number of studies have indicated that some major genes might have profound effects on the thermoregulatory efficiency of birds. Such genes include the naked-neck (Na) gene, which controls the coverage of feathers in the neck region; the frizzling (F) gene, which causes body feather blades to curl outwardly, and the sex-linked Dwarf (dw) gene, which causes dwarfism in chickens\(^2\),\(^4\). It has been suggested that these variations in body feather cover, feather structure, and body size may affect sensible heat loss by birds\(^4\),\(^5\), and hence might sustain productivity of the birds even under relatively hot environmental conditions. For example, the (Na) gene has been shown to promote growth rate, viability, egg weight and female reproductive performance under high ambient temperatures\(^4\),\(^6\). Similarly, the frizzling (F) gene has demonstrated some advantageous effects on chicken performance, particularly when incorporated in heavy breeds of chickens\(^7\). However, for most of the literature cited, the observations were conducted under controlled laboratory conditions. In the tropics, seasonal and diurnal variation in weather patterns and conditions could play a moderating or complicating role. The present study was therefore undertaken to evaluate the effect of the three genes singly or in combination on performance of chickens under normal husbandry conditions in Tanzania.

Materials and Methods

The experimental stock for the study consisted of pullets from a German strain of the Rhode Island Red breed in which the genes for the naked neck (Na), frizzling (F), and dwarfism (dw) had been incorporated either singly or in combination. Altogether there were eight phenotypic groups (hereafter referred to as genotypes) in the experiment as described in Table 1.

The birds were brought and raised at Sokoine University of Agriculture, Morogoro, Tanzania when they were about 4 days old. The experimental site is located about 6°S, at an altitude of 500-600m above sea level, and is about 200km East of the Indian Ocean coast. Maximum temperatures range from 27.6° to 35°C and minimum temperatures range from 15.1° to 23°C during the rainy season. The relative humidity averages 60% and 44% during the rainy and dry season respectively. Average rainfall is about 800mm per year.

On arrival, all chicks were wing-banded and brooded intermingled by genetic groups for one week, after which they were separated by feather pattern and kept in deep litter pens. Dwarf birds could not be separated at this stage. By the ninth week of age, distinction between normal size and
dwarfs could be made based on the length of their shanks. At this stage further separation were made. During the periods, a conventional starter ration followed by growers mash were offered and standard procedures for deep litter rearing of egg type pullets were followed. At the age of 18 weeks, the pullets were transferred and housed individually in cages.

**Measurements and Records**

Daily records of ambient temperatures were taken at 2:00 pm, a time, which was considered to be the hottest part of the day.

Individual body weights of birds were recorded weekly beginning the 10th week to the 32nd week, and cumulative body weight gains were derived from the weekly live-weights measurements in the two periods. Cumulative feed intake per bird was calculated for the period between the 20th and 26th week of age.

Age at sexual maturity was measured as the age (in days) of a bird at the time when the first egg was laid. Subsequently, the number of eggs laid by each bird from the age at first egg to 32 weeks of age were recorded. Four eggs laid during each of the three weeks beginning the 30th week of age were picked, weighed, and their mean weight recorded for each bird.

Mortality was recorded beginning the 10th week up to the 32nd week of age. With respect to this attribute, the birds were scored 1 and 0 for “alive” and “dead”, respectively.

**Data analysis**

The data were analyzed using two statistical models, the first model sought to isolate the effects of the three individual loci, while the second model compared the eight

<table>
<thead>
<tr>
<th>Dominant alleles at locus</th>
<th>Na</th>
<th>F</th>
<th>Dw</th>
<th>Genotype</th>
<th>Phenotype</th>
<th>N1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>NanaffDw-</td>
<td>Normal</td>
<td>49</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>naaffdwdw</td>
<td>Dwarf</td>
<td>35</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<td>Frizzled &amp; Dwarf</td>
<td>21</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>nanaF_Dw-</td>
<td>Frizzled</td>
<td>64</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Na_ffdwdw</td>
<td>Naked-neck &amp; Dwarf</td>
<td>28</td>
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<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Na_ffDw-</td>
<td>Naked-neck</td>
<td>47</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Na_F_dwdw</td>
<td>Naked-neck, Frizzled &amp; Dwarf</td>
<td>27</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Na_F_Dw-</td>
<td>Naked-neck &amp; Frizzled</td>
<td>66</td>
</tr>
</tbody>
</table>

Total 337

1Sample size
genetic groups of birds used in the experiment. The first model was:

\[ Y_{ikj} = m + N_{ai} + F_i + Dw_k + (NaF)_{ij} + (NaDw)_{ik} + (FDw)_{jk} + (NaFDw)_{ijk} + E_{ijkl} \]

Where \( Y_{ikj} \) = record (or measurement) on each individual bird;

- \( m \) = overall mean common to all observations;
- \( N_{ai} \) = effect of the \( i^{th} \) allele at the locus;
- \( F_i \) = effect of the \( j^{th} \) allele at the frizzling locus;
- \( Dw_k \) = effect of the \( k^{th} \) allele at the dwarf locus;
- \( (NaF)_{ij} \), \( (NaDw)_{ik} \), \( (FDw)_{jk} \) and \( (NaFDw)_{ijk} \) are two and three loci interactions;
- \( E_{ijkl} \) = random effects peculiar to each observation.

The second model was:

\[ Y_{ij} = m + G_i + E_{ij} \]

where \( Y_{ij} \) = observation on the \( j^{th} \) bird from the \( i^{th} \) genetic group;

- \( m \) = general mean common to all birds in the experiment;
- \( G_i \) = effect of the \( i^{th} \) genetic group;
- \( E_{ij} \) = random effect peculiar to each observation.

Heterozygous naked-necks (Nana) are distinguished from homozygous naked-neck (NaNa) by having a small tuft of feathers at the base of the neck. Because of the small sample size, no distinction between Nana and NaNa were made during the analyses hence, the two genotypes were analyzed as a single genetic group.

Data were analyzed using the SAS General Linear Models (GLM) procedure for the case of body weight, food intake and egg production traits. The data on mortality were analyzed using the SAS frequency procedure, through which chi-square tests for independence between genotypes and mortality rates were made.

**Results**

**Single locus effects**

Table 2 shows the least square means for various traits with respect to the three loci. The results revealed that the difference in performance between Na- and nana birds as well as between F- and ff birds were not significantly different (P>0.05) in respect of egg production traits. However, naked-neck birds significantly (P<0.05) improved body weight and weight gain compared to their normal feathered counterparts. Consequently, higher body weight and faster gain associated with the Na - loci resulted into a significant (P<0.05) reduction in age at sexual maturity by about 5 days. The frizzling condition tended to delay the onset of sexual maturity, whereas the recessive sex-linked dwarf gene significantly (P<0.05) depressed all the traits considered in the study, except mortality rate.

**Multiple-loci effects**

The results for the joint effects of two or more loci on various traits investigated are shown in Tables 3 and 4. The sex-linked dwarf gene depressed live-weight and cumulative body weight gains. The smaller body size was also associated with significant (P<0.05) reduction in feed intake. Dwarf birds matured late and produced eggs that were about 3-5 grams lighter than those from their normal sized counterparts (Table 4). All dwarf genotypes regardless of gene combination had statistically similar levels of performance, which were significantly (P<0.05) lower than those of
### Table 2: Least squares means and standard errors for various traits summarized by loci.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Naked-neck</th>
<th>Frizzling</th>
<th>Dwarfism</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Na_</td>
<td>nana</td>
<td>F_</td>
</tr>
<tr>
<td>20th wks BWT (g) -</td>
<td>1165±12a</td>
<td>1113±17b</td>
<td>1130±17a</td>
</tr>
<tr>
<td>BWT gain (g)</td>
<td>1018±20a</td>
<td>992±19a</td>
<td>976±19b</td>
</tr>
<tr>
<td>Cum. feed intake (g)</td>
<td>4298±49a</td>
<td>4374±44a</td>
<td>4384±47a</td>
</tr>
<tr>
<td>Age at maturity (d)</td>
<td>171±1a</td>
<td>176±1b</td>
<td>175±1a</td>
</tr>
<tr>
<td>Egg No. (20-32 wk)</td>
<td>42±2a</td>
<td>40±2a</td>
<td>41±2a</td>
</tr>
<tr>
<td>Laying rate (%)</td>
<td>40±1a</td>
<td>41±1a</td>
<td>42±2a</td>
</tr>
<tr>
<td>Egg wt (g)</td>
<td>52±1a</td>
<td>52±1a</td>
<td>53±1a</td>
</tr>
<tr>
<td>Mortality rate (%)</td>
<td>20.4±3a</td>
<td>17.5±3a</td>
<td>18.6±3a</td>
</tr>
</tbody>
</table>

Least square means with no superscript letters in common within a trait and locus group are significantly different (p<0.05)

### Table 3: Least square means and standard errors for growth and food intake summarized by genotypic groups.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>20th wk</th>
<th>BWT (g)</th>
<th>BWT gain (g)</th>
<th>Food intake (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>nanaffdwdw</td>
<td>861±45b</td>
<td>773±52d</td>
<td>3850±122b</td>
<td></td>
</tr>
<tr>
<td>Na_fdwdw</td>
<td>921±35b</td>
<td>747±41d</td>
<td>3724±101b</td>
<td></td>
</tr>
<tr>
<td>nanaF_dwdw</td>
<td>866±46b</td>
<td>837±53d</td>
<td>3952±113b</td>
<td></td>
</tr>
<tr>
<td>Na_F_dwdw</td>
<td>920±42b</td>
<td>758±49d</td>
<td>3787±154b</td>
<td></td>
</tr>
<tr>
<td>nanaffDw-</td>
<td>1369±26a</td>
<td>1197±30bc</td>
<td>4993±90a</td>
<td></td>
</tr>
<tr>
<td>Na_ffDw-</td>
<td>1416±30a</td>
<td>1175±35c</td>
<td>5034±80a</td>
<td></td>
</tr>
<tr>
<td>nanaF_Dw-</td>
<td>1336±28a</td>
<td>1270±28ab</td>
<td>5144±66a</td>
<td></td>
</tr>
<tr>
<td>Na_F_Dw-</td>
<td>1400±23a</td>
<td>1282±27a</td>
<td>5080±66a</td>
<td></td>
</tr>
</tbody>
</table>

Least square means with no superscript letters in common within a column are significantly different (p<0.05).
normal (Dw) genotypes.

Among the normal sized birds, no significant difference was observed between frizzled, naked-neck and normal feathered birds in terms of body weight and feed intake. The difference between normal feathered (nanaffDw-) and naked-neck birds (Na-ffDw-) was, significant (P<0.05) for eggs number. However, interaction between the Na and F gene (Na-F-Dw-) was not significant for most of the traits studied. In general, incorporation of the F gene in normal sized Na- genotypes was associated with reductions in performance of the birds possessing the two genes. For some traits e.g. age at sexual maturity, egg weight and feed intake, no additional improvement over the Na-genotype was gained.

**Discussion**

The study reveals that on overall, the dominant naked-neck gene had a positive influence on body weights and growth rate. Concomitantly, increased growth rate resulted in reduction of age at sexual maturity by about 5 days. It can be speculated that lack of neck feathers might have promoted better body heat loss, thereby enabling the Na- birds to better cope with heat than their normal-necked counterpart. Results from similar studies have indicated that in addition to having a bare neck, the Na gene is associated with 40% reduction in feather cover around the body\cite{5,7}. This magnitude of reduction in body feather cover would profoundly enhance the sensible heat loss from the

**Table 4**: Least square means and standard errors for egg production and mortality attributes by genotypic groups

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Age at maturity</th>
<th>Eggs No. (20-32wks)</th>
<th>Laying rate (%)</th>
<th>Egg wt at (g)</th>
<th>Mortality(d) rate(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>nanaffDwdw</td>
<td>174±2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>36±3&lt;sup&gt;d&lt;/sup&gt;</td>
<td>37±3&lt;sup&gt;b&lt;/sup&gt;</td>
<td>49±1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Na_ffDwdw</td>
<td>173±3&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>22±4&lt;sup&gt;e&lt;/sup&gt;</td>
<td>27±3&lt;sup&gt;c&lt;/sup&gt;</td>
<td>50±1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>18.8&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>nanaF_dwdw</td>
<td>185±3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>37±4&lt;sup&gt;cd&lt;/sup&gt;</td>
<td>42±4&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>50±1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>23.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Na_F_dwdw</td>
<td>178±3&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>45±5&lt;sup&gt;cd&lt;/sup&gt;</td>
<td>44±5&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>50±1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>29.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>nanaffDw-</td>
<td>171±2&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>47±3&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>42±3&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>53±2&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>19.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Na_ffDw-</td>
<td>167±2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>59±3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>49±3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>54±1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>nanaF_Dw-</td>
<td>172±2&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>42±2&lt;sup&gt;cd&lt;/sup&gt;</td>
<td>42±2&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>55±2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>13.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Na_F_Dw-</td>
<td>167±2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>48±2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>41±2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>54±1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Least square means with no superscript letters in common within a column are significantly different (p<0.05)
body, which would in turn reduce heat stress. The fact that feed intake by the Na-birds did not differ significantly from that of normal necked-birds imply that the Na-birds were more efficient in feed utilization.

Despite the fact that Na gene positively influenced body weight and growth rate, the effect of the gene was not significant on egg production traits. These results are partly in contradiction with those of other workers\textsuperscript{4,9,10}, who observed higher egg weights and egg number from naked-neck birds compared to normal feathered birds. It can be speculated that under cage environment, maintenance energy requirement and hence heat production by birds was low due to reduced activity in the cage. Under this circumstance, therefore, the differences between the naked-neck and normal-feathered birds would be expected to diminish. Similar argument could be extended for the frizzled genotypes. Other studies have demonstrated a favorable effects of the dominant allele for frizzling on various production and reproduction traits\textsuperscript{9,15,18}.

In contrast, the sex-linked dwarf locus appeared to exert profound effects on all traits considered in the present study, except on mortality rate. The observed inferior performance of dwarf birds relative to their normal-sized counterparts suggests that the dwarf gene may have pleiotropic effects on these traits. It further suggests that these traits could have a common physiological pathway through which they are manifested. The occurrence of genes with depressive effects on body size and other traits has been documented in other species of farm animals, such as cattle\textsuperscript{12,13}.

It is interesting to note that although the recessive dwarf gene caused a 33% reduction in body weights of birds relative to their dominant counterparts, the concomitant reductions in egg laying rate (11.4%), egg size (7.4%), and delay in onset of egg production (5%) were relatively small. Dwarf birds have been documented to have lower maintenance nutrient requirements than their normal-sized counterparts\textsuperscript{14}. These aspects have to be weighed against the observed 25% reduction in food intake by dwarf birds. The mere 25% reduction in food intake by dwarf birds viz a viz the 40% reduction in body weight suggests that dwarf birds were rather inefficient with respect to food utilization. The delay in the onset of sexual maturity observed for dwarf birds in the present study compare well with reports from some studies\textsuperscript{15,16} but, at variance with the findings from other studies\textsuperscript{7,12}. The delay in the onset of sexual maturity of dwarf birds has been attributed to the delay in reaching the critical weight for initiation of sexual maturation\textsuperscript{15}.

In the present study salmonellosis was singled out to be the main cause of deaths. However, the difference in mortality rate between dwarfs (21.9%) and non-dwarf (17.5%) birds was not statistically significant. This suggests that the deaths occurred randomly and that the two genotypes at the dwarf loci were equally susceptible. In contrast, some studies\textsuperscript{5,19} reported higher mortality among normal sized (Dw-) birds compared to dwarf birds. However, caution should be taken when interpreting these results since immune responses among the different genotypes might vary depending on the disease causing agents. Likewise resistance to one pathogenic organism does not necessarily imply resistance to other pathogens.

The study reveals a lack of any consistent pattern in the phenotypic expression of multi-locus genotypes, save for the clear separation of birds with respect
to the dwarf locus. Interaction between Na and F. gene in both dwarf and normal sized birds seemed to offer some advantage in some traits. However, the general pattern was that incorporation of the F. gene in Na-genotypes either resulted in reduction in performance or did not result in appreciable improvement in performance of the Na-birds. For example, Na-F-Dw- birds matured earlier than the nana-F-Dw- birds, but the difference was not significant. The existence of such interactions, though weak, among the three loci would have the effect of blurring the ranking pattern of the multiloci genotypes.

In the present study the minimum and maximum mean diurnal temperatures, were 23 and 31°C. It is contended that under the fluctuating ambient temperatures, the depressive effects of high diurnal ambient temperatures would be offset by compensatory mechanisms during the cooler hours of the day. In fact such compensatory mechanisms have been reported. It appears that birds consumed more feed during the cooler part of the day or at night.

Conclusion

In view of the present study, the dominant allele for the naked-neck gene and to a lesser extent the recessive allele for dwarfism seem to have potential in development of high performing chicken stock in hot climates. Interaction between naked-neck and frizzled gene were generally weak and had less effect on bird's performance. The allele for dwarfism tended to depress all traits studied except mortality rate. It is recommended that more studies are still needed to ascertain the economic merits of these genes under tropical husbandry condition.

Acknowledgement

The authors wish to thank the Norwegian Agency for International Development (NORAD) for financial support to S.H.M and Technical University of Berlin for providing the experimental birds.

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Received for publication on 21st February, 2003.
THE ASSESSMENT OF PHYSIOLOGICAL FITNESS OF DONKEYS ON ENDURANCE TILLAGE WORK IN ETHIOPIA

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EVALUATION DES CAPACITES PHYSIOLOGIQUES DES ANES A LA RESISTANCE AUX TRAVAUX DE LABOUR EN ETHIOPIE

Résumé

Une étude a été conduite à la Faculté de médecine vétérinaire de l’Ethiopie en vue d’évaluer les capacités physiologiques des ânes pour les travaux de labour continu. Au total, 8 ânes de type abyssinien (âge moyen ± écart type de la moyenne : 8,6 ± 1,04 ans) avec un poids vif moyen de 122,6 kg (écart type = 11,9) étaient utilisés pour l’expérience. Des paires d’ânes, dressés auparavant pour le labour, labouraient pendant 3 jours consécutifs par semaine durant plusieurs semaines et la température rectale (TR), le rythme respiratoire (RR), la fréquence des pulsations (FP), la numération de globules rouges (GR) et l’hématocrite (H) étaient enregistrés avant et immédiatement après le labour. Les réactions physiques et comportementales étaient également notées. L’observation des réactions physiologiques a révélé que les ânes avaient d’énormes ajustements physiologiques après le labour comme le montraient les fortes augmentations des valeurs moyennes de TR, RR et FP (P < 0,01). Une augmentation beaucoup plus forte de TR des ânes a été constatée pendant le labour l’après-midi par rapport à la matinée. Les différences relatives à l’augmentation moyenne de TR n’étaient pas significatives pour ce qui concerne la condition physique (P > 0,05). Les valeurs FP (86,1 ± 7,5) relevées immédiatement après 3 minutes de labour et la note moyenne enregistrée (14,5) pour évaluer la fatigue révélaient que les ânes étaient presque mais pas complètement fatigués. Les échantillons de sang prélevés avant et immédiatement après le labour ont montré une forte augmentation de la numération de GR (P < 0,05) et des valeurs de l’hématocrite (P < 0,01). D’après les résultats de l’étude, les ânes soumis à un labour continu étaient stressés ou fatigués en un laps de temps relativement plus court.

Mots-clés: Capacités physiologiques, ânes, labour, Ethiopie.

Summary

A study was carried out at the Faculty of Veterinary Medicine, Ethiopia, to assess the physiological fitness of donkeys for sustained tillage work. A total of eight abyssinian type donkeys (mean age±SEM, 8.6±1.04 years) with mean body weight of 122.6 kg (SD=11.9) were used for the experiment. Donkey pairs, previously trained for tillage, were made to plough for 3 consecutive days per week for several weeks during which rectal temperature (RT), respiratory rate (RR), heart rate (HR), RBC count and packed cell volume (PCV) were recorded before and soon after work. Physical or behavioral responses were also recorded as observed.

Observation on physiological responses revealed that donkeys showed considerable physiological adjustments after work as evidenced by significant increases in mean values of RT, RR and HR (P<0.01). Significantly higher increase in RT of donkeys was observed during the afternoon working session as compared to morning session. Differences in mean increase in RT (MtRT) with respect to body condition were not significant (P>0.05). Both heart rate values (86.1±7.5) recorded after 3 minutes of work and the mean fatigue score (14.5) obtained showed that donkeys were nearly but not fully fatigued. Blood samples taken before and immediately after work revealed significant increase in RBC count (P<0.05) and hematocrit values (P<0.01). The findings of the study demonstrated that donkeys on continuous tillage work were stressed or fatigued within relatively shorter work.

Keywords: Physiological fitness, Donkeys, Tillage, Ethiopia.

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Introduction

The donkey is widely used as a means of transport. Smallholder farmers, transporters and women are increasingly using them for cultivation, transport and income generation. Donkey use ensures the survival of poor women and men in hostile environments and enables them to integrate into social and economic processes\(^\text{1}\). In addition to their popularity in the transport sector, donkeys are being preferred to cattle for tillage in parts of sub-Saharan Africa owing to their better comparative advantages to survive and perform during droughts under poor feed resources\(^\text{2}\). Thus, donkeys have a future potential for tillage in developing countries where drought is becoming a threat to susceptible animals such as cattle\(^\text{3}\). A recent study also indicated donkeys’ potential use for tillage as an appropriate and affordable technology for resource limited farmers in Ethiopia\(^\text{4}\). Tillage, however, is a work that requires a higher energy cost of walking and a higher level of sustained effort for a relatively longer duration than the works of cart pulling and pack transport for which the donkey is well popular\(^\text{5}\).

Physical responses or behavioral manifestations and physiological indices taken during and/or after work including rectal temperature (RT), pulse rate (PR) and respiratory rate (RR) has been used to develop fatigue scoring system in donkeys, bullocks, buffaloes, camels and elephants\(^\text{6-10}\). Heart rate recovery after a set exercise is also considered to be one of the most widely accepted ways of assessing fitness\(^\text{11}\). The fitter the animal the more rapidly heart rate returns to resting levels after exercise. Heart rate three minutes after exercise/work appear to be a good indicator of recovery rate in horses and donkeys\(^\text{12}\).

The ability of a work animal to increase the oxygen carrying capacity of its blood by increasing its red cell volume and hematocrit value has also been reported to be indicator of physiological capacity for sustained strenuous exercise\(^\text{13}\). Several works have been conducted on the effects of prolonged exercise in marathon athletes, horses on endurance riding and to some extent in cattle\(^\text{13}\). Earlier reports indicated that donkeys on continuous pack work (50 kgf/100 kg body weight) were more stressed than donkeys worked on the basis of work-rest cycle indicating their inferior capacity for endurance pack work\(^\text{14}\).

Despite the increasing use of donkeys for tillage work, so far there is no information available regarding their fitness for prolonged tillage work. Physiological fitness of donkeys for endurance tillage work need to be investigated to enable develop strategies for optimum and sustainable use of donkeys for tillage without adversely affecting the health state or putting undue stress to the animal. The objective of this study was to assess the physiological fitness of donkeys for sustained tillage work based on their physical, physiological and hematological responses.

Materials and Methods

Donkeys

A total of eight healthy, abyssinian type donkeys previously trained in tillage work aged 8.6±1.04 years with mean body weight of 122.6 kg (SD=11.9) were used for the experiment\(^\text{15}\). The animals were housed in an open shade with building on one side for protection against wind. The donkeys were dewormed before the experiment and were fed on grass hay free choice with a
daily supplementation of 1 kg concentrate mixture (49% wheat bran & 49% Barley and 2% salt) and water provided ad libitum. They were also allowed to graze during non-working hours and assessed for general soundness and health prior to each work session.

**Experimental plan**

Before the start of the experiment, body condition of donkeys was assessed using scoring technique developed by the International Donkey Protection Trust\(^{16}\). The donkeys were then assigned into two groups viz. body condition grade 4 and 3 which referred to 'Good' and 'average or moderate' body conditions respectively.

**Exercise protocol**

Donkey pairs, previously trained in tillage work, were made to plough for three consecutive days per week for a couple of weeks. Hitching and ploughing was made using a comfortable wooden double neck yoke and a lightweight traditional plough respectively\(^4\). Ploughing persisted until each pair or a member was unwilling to continue work due to exhaustion. Failure to maintain position or unevenness of stride was considered as indicator of exhaustion. An exercise schedule was followed so that each day two pairs of donkeys, one pair in the morning (8:00 IST) while the other in the afternoon (14:00 IST), were subjected to work. Mean maximum and minimum ambient temperatures during the experimental period were 25.6 and 9.6°C respectively while the mean daily relative humidity (RH) was 40.2%\(^{17}\).

**Observation on physical and physiological changes**

During each work session physical responses to work viz. leg in-coordination, frothing, excitement, sweating and tongue protrusion were recorded as observed. Rectal temperature (RT), heart rate (HR) and respiratory rate (RR) were also recorded before and immediately after each work session. RT was measured using a clinical thermometer while HR and RR were measured by using stethoscope. Heart rate values immediately 3 minutes after exercise were also measured and recorded\(^{12}\).

**Assessment of fatigue**

Based on the physical/behavioral and physiological responses to work, the extent of fatigue was determined using a fatigue scorecard developed for donkeys\(^6\). On the basis of the scorecard, the donkey is said to be fatigued when the total score reaches 16.

**Blood Sampling and Laboratory techniques**

Venous blood samples (10 ml) were collected into heparinized tubes before and immediately after exercise for determination of hematocrit (PCV) and red blood cell (RBC) counts. PCV and RBC count of the samples was determined within 30 minutes of collection employing standard hematological laboratory procedures\(^{18}\).

**Statistical Analysis**

Paired t-tests were used to compare RT, HR and RR values as well as PCV and RBC counts before and immediately after exercise. Differences in RT, HR and RR responses with respect to time of work session and body condition of donkeys were also analyzed using paired t-tests\(^{19}\).

**Results**

Post exercise mean values of RT, RR and HR of donkeys were found significantly higher (P<0.01) than the respective mean
pre-exercise values (Table 1). Percent changes in RT, RR and HR after work were 4, 92.6 and 92.3% respectively. Significant difference (P<0.01) was observed in post exercise mean values of RT with SD, 39.9±0.94 during the afternoon and morning sessions (38.2±0.39). Although not significant (P>0.05), the mean increase in RT (MIRT) (1.69±0.9) was higher in donkeys with good body condition than those with moderate condition (1.23±0.17). Mean value of heart rate recorded immediately after three minutes of work was 86.1±7.5 beats per minute (bpm) with wide variation in individual heart rate recovery rates ranging from 76 to 96 bpm.

Based on physical observation and physiological responses, donkeys in this experiment attained a mean fatigue score of 14.5 out of 16, which ranged from 12 – 16 with two donkeys observed being totally fatigued.

Analysis of blood samples taken before and immediately after work revealed significant increase in average RBC count (P<0.05) and hematocrit values (P<0.01) in response to work (Table 1). Mean increase in RBC count and PCV values ranged from 285 x 10^4 to 688 x 10^4 counts per microliter and 29.5 to 36.9% with mean percent changes being 33.5 and 8.5% respectively.

**Discussion**

The significant increase in RT, RR and HR values in response to work agrees with previous findings reported in donkeys, buffaloes and oxen\textsuperscript{14,20-22}. The rise in these physiological parameters after work was associated with the heat produced due to the marked increase in metabolic rate during work and due to the increased works of respiratory and cardiovascular functions to dissipate the extra heat produced\textsuperscript{13,14}. Temperature rise during work has also been described as physiologically essential to increase the rate of chemical processes,

| Table 1. Mean±SD: Physiological (RT,RR and HR) and Hematological (PCV and RBC count) parameters before and immediately after work in donkeys working at an average of 20 kg df/100 kg live wt. |
|---|---|---|
| **Variable** | **Time in relation to exercise** | **Before work (n=8)** | **After work (n=8)** |
| | | (0 hour) | (1.54 hours) |
| Rectal temperature (°C) | | 37.6±0.13 | 39.1±0.6** |
| Respiratory rate (bpm ♣) | | 40.5±3.6 | 78±17.5** |
| Heart rate (bpm †) | | 49.1±1.7 | 94.4±11.4** |
| Packed cell volume (PCV) (%) | | 31.6±1.9 | 34.3±2.3** |
| RBC count x 10^4 (counts per micro liter) | | 321.3±28.8 | 428.8±124.4* |

bpm † = beats per minute
bpm ♣ = breaths per minute

** Significantly different (P<0.01) from the corresponding pre-exercise value
* Significantly different (P<0.05) from the corresponding pre-exercise value
to change internal friction resistance in muscles and to enhance supply of oxygen to the working muscles\textsuperscript{23}. However, high core temperature may speed up the onset of fatigue\textsuperscript{24}.

Despite the lower draft force output (20 kg df/100 kg live wt.) and work duration of the donkeys (1.54 hrs.), percent changes in RT (4\%) and HR (92.3\%) recorded were higher than previous reports in donkeys on 4 hour pack work (50 kgf/100 kg live wt.)\textsuperscript{14}. This indicated that the donkeys in this experiment were more heat stressed. This difference may have been attributed to differences with respect to type and condition of work. The energy cost of animals working on waterlogged and/or muddy surfaces as in tillage work is estimated to be four times greater than those working on compact or firm surfaces\textsuperscript{6}. Thus, the muddy working condition of the current study may have resulted in higher overall metabolic rates and hence heat production as compared to donkeys on pack work. The hot and humid environmental condition during the experiment might also have contributed to the situation through its negative impact on the efficiency of evaporative cooling mechanisms that are considered to be the main route of heat dissipation in the tropics\textsuperscript{22,25}.

The considerable influence of ambient conditions on RT responses during and/or after work was in agreement with previous reports in donkeys and bullocks\textsuperscript{14,22}. The significantly higher increase in RT during the afternoon working session was attributed to the heat gained both from the increased metabolic rate during work and from radiant solar energy in the afternoon when environmental temperature was the highest. The absence of significant difference in mean increase in RT (MIRT) with respect to body condition of donkeys contradicted the findings in oxen where MIRT of good conditioned animals was significantly higher than those in moderate and poor conditions\textsuperscript{22}. The differences in body condition of the donkeys used in this study might have been in the amount of muscle tissues rather than in subcutaneous fat layer that was described earlier as a major factor responsible for increasing the resistance of heat flow from the body to the environment\textsuperscript{22}. Another possible reason may have been due to the small subcutaneous fat layer in good conditioned animals to significantly affect the rate of heat dissipation.

The mean heart rate (86.1±7.5 bpm) recorded immediately after three minutes of work was lower than the maximum HR value (90 bpm for draft forces over 15 kg df/100 kg live weight) reported previously for equines beyond which considered to be indicative of excessive fatigue\textsuperscript{12}. This indicates that donkeys in this trial were not excessively fatigued. The average fatigue score (14.5) obtained in this study also showed that donkeys were nearly but not fully fatigued. However, they were more fatigued as compared to earlier reports in donkeys on continuous pack work\textsuperscript{14}. This may be associated with the difference that exists between the two experiments in the type and condition of work described before.

The results for PCV and RBC counts revealed significant increase in response to endurance tillage work unlike previous works in donkeys on continuous pack work where no significant increase was noted\textsuperscript{14}. Several other reports in other species of draft animals including Holstein and Zebu cattle, buffaloes and sokoto red goats indicated rather a decrease in PCV values after exercise\textsuperscript{26-29}. Probable increase in
plasma volume as well as possible destruction and sequestration of RBC in the capillaries following peripheral vasodilatation due to exercise and heat stress respectively were indicated as possible causes for the phenomenon\textsuperscript{27,30}. The current finding was, however, in agreement with the findings in horses where as much as 50\% increase in red cell count was noted in response to exercise which was associated with an increase in aerobic metabolism by up to 36 times of the resting level\textsuperscript{13}. In this regard the increase in hematocrit (8.5\%) and RBC count (33.5\%) obtained in donkeys appears to be a compensatory physiological response to increase the oxygen carrying capacity of their blood which may probably indicate the donkey's potential for aerobic metabolism. Despite this phenomenon, donkeys in this study were not observed to sustain work comparable to or for longer duration as compared to horses and cattle indicating their lower capacity for endurance tillage work. This suggests that RBC and PCV responses did not appear to be associated with aerobic capacity as in the horse.

**Conclusion**

Assessment of fitness as indicated by fatigue score and physiological responses demonstrated that donkeys on continuous tillage work were stressed or fatigued within a relatively shorter duration and hence less fit to endurance tillage work compared to cattle and horses. The findings of the current study suggest that optimum and sustainable utilization of donkeys for tillage work within a day can best be done on the basis of work-rest cycle preferably early morning and late afternoon when the ambient temperature is lowest.

**Acknowledgements**

The author would like to thank the Research and Publication Office (RPO) of the Addis Ababa University for funding the study.

**References**


Received for publication on 28th January, 2003.
FEED EFFICIENCY, GROWTH AND WEIGHT OF SLAUGHTERED LOCAL TURKEY POULTS TO VARIOUS LEVELS OF DIETARY ENERGY

G.S. OJEWOLA*, A.D. UDOKAINYANG, and V. OBASI


EFFICIENCE ALIMENTAIRE, CROISSANCE ET POIDS DES DINDONNEAUX LOCAUX SOUMIS A DIVERS NIVEAUX DE DENSITE ENERGETIQUE DES ALIMENTS

Résumé

Une expérience a été conduite afin d’étudier l’effet de divers niveaux de densité énergétique des régimes alimentaires sur la performance et les caractéristiques de la carcasse des dindonneaux locaux dans un milieu tropical humide. Quatre-vingt–et-un dindonneaux locaux âgés de 4 semaines axéxués ont été servis au hasard de trois régimes alimentaires contenant différentes concentrations énergétiques (2.702 ; 2.806 ; 2.909 kcal). Les dindonneaux étaient répartis en trois groupes et chaque groupe était soumis trois fois à chaque régime selon un dispositif expérimental complètement randomisé. L’expérience a duré 10 semaines. Lors de l’essai d’alimentation, les dindonneaux servis de régime contenant 2.702 kcal avaient la plus forte consommation alimentaire et le gain pondéral/jour le plus élevé (P < 0,05) ; ce régime a également permis d’obtenir le meilleur rapport aliment consommé/gain pondéral. L’augmentation de la densité énergétique du régime, allant de 2.702 à 2.909 kcal, a réduit la consommation alimentaire et le gain de poids, et donné un faible rapport aliment consommé/gain pondéral. Les caractéristiques de la carcasse n’ont suivi aucune tendance particulière (P > 0,05). Selon le résultat de la présente étude, l’élevage des dindonneaux qui a recours à un régime contenant 25% PB et 2.702 kcal/kg EM semble être le système le plus approprié dans un milieu tropical.

Summary

A trial was conducted to investigate the effect of varying dietary energy densities on the performance and carcass characteristics of local turkey poults in a humid tropical environment. Eighty-one 4 week-old unsexed local turkey poults were allocated randomly to three diets varying in energy concentrations (2702; 2806; 2909 kcal) with three replicates per group per diet in a completely randomized design. The trial lasted 10 weeks. In the feeding trial, poults fed 2702 kcal gave the highest mean total feed intake and daily weight gain (P<0.05). The diet also gave the best feed -to- gain ratio. Increase in dietary energy density from 2702 to 2909 kcal depressed feed intake, weight gain and gave poor feed-to-gain ratio. The carcass characteristics followed no particular trend (P>0.05). The result indicates that raising turkey poults on a diet containing 25% CP and 2702 kcal/kg ME seems to be most adequate in a tropical environment.

Introduction

Turkey production in Nigeria has largely remained at the smallholder level due to various reasons, among which are, high cost of feeds, inconsistency in feeding programmes, lack of knowledge of the adequate levels of nutrient requirements, unavailability of turkey poults and a longer rearing period when compared with broiler chicken. Feed constitutes the largest single item in the cost of growing turkeys¹ and must be supplied in adequate quantity and quality for maximum performance at the least cost².

Turkey feeds are hardly produced or stocked by commercial feed millers in the country because of the dearth of information on their nutrient requirements. Some recommendations had been made³,⁴ but they are not precise, especially for our local breeds. The emphasis in recent times, is
rather shifting from the setting of minimum requirements to describing the continuous relationships between intake and animal performance. And since energy density in the diet is probably the most important factor affecting feed intake, the requirements of other nutrients, expressed as a percentage of the diet are usually related to the energy content of the diet. According to Forbes, the quantity of feed consumed by poultry is inversely related to the concentration of dietary energy. Furthermore, over-supply of energy is likely to be expensive and animals may respond to the excess by storing it as fat.

Growth performance and carcass yield are the result of many complex interactions. According to Aletor et al., changes in nitrogen balance and biochemical parameters, nutrition or dietary manipulation exert several influences on the development of carcass traits, organs and certain muscles in broilers. This trial was carried out to appraise the effects of varying energy concentrations on performance and carcass characteristics of local turkey poults in a warm humid tropical environment.

Materials and Methods

Composition of diets

A total of three isonitrogenous diets (25% crude protein) varying in caloric densities (2700, 2800 and 2900 kcal/kg) were formulated. Maize was the major energy source while full-fat soyabean meal and fish meal were the major protein sources. The diets were fortified with the synthetic amino acids lysine and methionine. The feed was presented to the birds in mash form. The dietary composition is presented in Table 1.

Experimental birds and their Management

One hundred day-old, unsexed poults of the local strain were procured and brooded for four weeks. The poults were fed a commercial broiler starter diet from day-old to four weeks of age before being subjected to the test diets. Eighty-one poults were randomly selected from the one hundred 4-week old unsexed poults. They were allocated randomly to the three diets with three replicate groups per diet in a completely randomized design (CRD). Each treatment group had 27 birds while the replicates had 9 poults each. Throughout the 10-weeks trial, feed and water were supplied ad libitum. Health management practices carried out included the administration of Newcastle disease vaccine (i/o); Infectious Bursal disease (Gumboro) vaccine; Newcastle disease vaccine (Lasota); antistress and coccidiostat.

Initial liveweights of the poults were taken. The difference in poults weight between week 4 and week 14 was recorded as weight gain. Feed intake for each group was recorded and feed-to-gain ratio was calculated. No mortality occurred during the trial.

Carcass evaluation

At 14 weeks of age, 3 birds (one per replicate) closest to the mean weight of birds in each treatment group were randomly selected, starved for 24 hours, weighed and slaughtered by severing the jugular vein. The birds were bled, dipped in water and defeathered. The head, neck, feet and viscera were separated from the carcass. The wings were removed by cutting anteriorly, severing at the humero-scapular joint, with a cut made close to the body line. The breast was removed intact.
by pulling anteriorly after making lateral cuts through the rib heads to the shoulder girdle. This is in accordance with the procedure of Scott et al. The thighs, drumsticks and backs were also dissected from each carcass and weighed separately.

**Sample and data analyses**

The dietary samples were analysed for proximate components using AOAC methods. All data collected were subjected to an analysis of variance (ANOVA) according to the procedures described by Steel and Torrie. The Multiple Range Test according to Duncan was employed to compare treatment means found to be statistically significant at a probability of 0.05.

**Results**

Table 1 presents the composition of diets while Table 2 and 3 summarize the performance and carcass characteristics data among treatments. The calculated percent crude protein values for diets 1, 2 and 3 were 25.07, 25.09 and 25.10

**Table 1: Percentage composition of the experimental diets fed to local turkey poults from 4-14 weeks of age**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Dietary Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow maize</td>
<td>1</td>
</tr>
<tr>
<td>Maize offal</td>
<td>2</td>
</tr>
<tr>
<td>Fullfat Soyabean meal</td>
<td>3</td>
</tr>
<tr>
<td>Palm Kernel Cake</td>
<td>1</td>
</tr>
<tr>
<td>Fish meal</td>
<td>2</td>
</tr>
<tr>
<td>Bone meal</td>
<td>3</td>
</tr>
<tr>
<td>Oyster Shell</td>
<td>1</td>
</tr>
<tr>
<td>Salt</td>
<td>2</td>
</tr>
<tr>
<td>Vitamin mineral Premix1</td>
<td>3</td>
</tr>
<tr>
<td>Methionine (DL)</td>
<td>1</td>
</tr>
<tr>
<td>Lysine</td>
<td>2</td>
</tr>
<tr>
<td>Total (%)</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dietary Treatment</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow maize</td>
<td>25.00</td>
<td>33.30</td>
<td>41.60</td>
</tr>
<tr>
<td>Maize offal</td>
<td>10.00</td>
<td>5.50</td>
<td>1.00</td>
</tr>
<tr>
<td>Fullfat Soyabean meal</td>
<td>30.00</td>
<td>31.50</td>
<td>33.00</td>
</tr>
<tr>
<td>Palm Kernel Cake</td>
<td>21.30</td>
<td>16.00</td>
<td>10.70</td>
</tr>
<tr>
<td>Fish meal</td>
<td>7.00</td>
<td>7.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Bone meal</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Oyster Shell</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Salt</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Vitamin mineral Premix1</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Methionine (DL)</td>
<td>0.10</td>
<td>0.10</td>
<td>1.10</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Total (%)</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Calculated analysis
Crude protein (%) 25.07 25.09 25.10
Metabolizable energy (kcal/kg) 2702 2806 2909
Determined analysis
Crude protein (%) 19.81 18.92 20.22
Gross Energy (kcal/kg) 3019.00 3247.00 3195.00

Vitamin mineral Premix1
Composition per 2.5 kg (Biomix premix): Vit. A, I.U. 4,000,000; Vit. D3 I.U. 800,000; Vit. E. mg. 10,000; Vit. K. mg 1,200; Vit. B2 mg 1500; Vit B mg 1,500; Niacin mg 10,000; Pantholic acid mg 3,500; Biotin mg 15; Vit. B12 mg 10; Folic acid, mg 200; cholin Chloride mg 120,000; Manganese mg. 60,000; Iron, mg. 15,000; Zinc.
### Table 2: Effect of feeding varying dietary energy concentration on growth performance of local turkey poults

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Diet 1</th>
<th>Diet 2</th>
<th>Diet 3</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean daily feed intake (g)</td>
<td>111.35</td>
<td>105.88</td>
<td>98.83</td>
<td>3.63</td>
</tr>
<tr>
<td>Mean total feed intake (g)</td>
<td>7794.50</td>
<td>7410.00</td>
<td>6917.80</td>
<td>281.02</td>
</tr>
<tr>
<td>Mean initial body weight (g)</td>
<td>178.50</td>
<td>181.47</td>
<td>181.47</td>
<td>0.99</td>
</tr>
<tr>
<td>Mean final body weight (g)</td>
<td>2792.60</td>
<td>2637.50</td>
<td>2456.20</td>
<td>97.21</td>
</tr>
<tr>
<td>Mean total weight gain (g)</td>
<td>2614.10</td>
<td>2456.10</td>
<td>2274.70</td>
<td>98.05</td>
</tr>
<tr>
<td>Mean daily weight gain (g)</td>
<td>37.34</td>
<td>37.09</td>
<td>32.50</td>
<td>1.57</td>
</tr>
<tr>
<td>Feed-to-gain ratio</td>
<td>2.72</td>
<td>3.02</td>
<td>3.04</td>
<td>0.10</td>
</tr>
</tbody>
</table>

### Table 3: Effect of feeding varying dietary energy concentration on the carcass characteristics of local turkey poults

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Diet 1</th>
<th>Diet 2</th>
<th>Diet 3</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liveweight (g)</td>
<td>2386.67</td>
<td>2263.30</td>
<td>2363.33</td>
<td>37.81</td>
</tr>
<tr>
<td>Dressed weight (g)</td>
<td>1503.33</td>
<td>1403.33</td>
<td>1540.00</td>
<td>40.84</td>
</tr>
<tr>
<td>Carcass yield (% of LW)**</td>
<td>63.08</td>
<td>62.26</td>
<td>65.20</td>
<td>0.88</td>
</tr>
<tr>
<td>Cut-parts (% of DW)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast (%)</td>
<td>28.14</td>
<td>27.12</td>
<td>29.20</td>
<td>0.60</td>
</tr>
<tr>
<td>Drumstick (%)</td>
<td>16.87</td>
<td>16.68</td>
<td>16.89</td>
<td>0.07</td>
</tr>
<tr>
<td>Thigh (%)</td>
<td>19.50</td>
<td>19.94</td>
<td>19.29</td>
<td>0.19</td>
</tr>
<tr>
<td>Back (%)</td>
<td>19.63</td>
<td>18.05</td>
<td>17.53</td>
<td>0.63</td>
</tr>
<tr>
<td>Wing (%)</td>
<td>17.01</td>
<td>18.28</td>
<td>17.10</td>
<td>0.40</td>
</tr>
</tbody>
</table>

* Live weight (LW)

** Dressed weight (DW)

### Table 4: Least square means and standard errors for egg production and mortality attributes by genotypic groups

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Age at maturity (d)</th>
<th>Eggs No (20-32 wks)</th>
<th>Laying rate (%)</th>
<th>Egg wt at (g)</th>
<th>Mortality rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>nanaffdwdw</td>
<td>174±2bc</td>
<td>36±3c</td>
<td>37±3b</td>
<td>49±1b</td>
<td>17.9a</td>
</tr>
<tr>
<td>Na_ffdwd</td>
<td>173±2bc</td>
<td>22±4a</td>
<td>27±3c</td>
<td>50±1b</td>
<td>18.8a</td>
</tr>
<tr>
<td>nanaF_dwdw</td>
<td>185±3a</td>
<td>37±4cd</td>
<td>42±4ab</td>
<td>50±1b</td>
<td>23.1a</td>
</tr>
<tr>
<td>Na_F_dwdw</td>
<td>178±3a</td>
<td>45±5bcd</td>
<td>44±5ab</td>
<td>50±1b</td>
<td>29.0a</td>
</tr>
<tr>
<td>nanaffDw-</td>
<td>171±2bc</td>
<td>47±3bc</td>
<td>42±3ab</td>
<td>53±2ab</td>
<td>19.3a</td>
</tr>
<tr>
<td>Na_ffDw-</td>
<td>167±2c</td>
<td>59±3a</td>
<td>49±3a</td>
<td>54±1a</td>
<td>20.8a</td>
</tr>
<tr>
<td>nanaF_Dw-</td>
<td>172±2bc</td>
<td>42±2cd</td>
<td>42±2ab</td>
<td>55±2a</td>
<td>13.8a</td>
</tr>
<tr>
<td>Nana_F_Dw-</td>
<td>167±2c</td>
<td>48±2b</td>
<td>41±2b</td>
<td>54±1a</td>
<td>17.1a</td>
</tr>
</tbody>
</table>

Least square means with no superscript letters in common within a column are significantly different (p<0.05)
respectively while the corresponding metabolizable energy (kcal/kg) were 2702, 2806 and 2908. The actual crude protein (%) and gross energy (kcal/kg) values, which differed from the calculated values were 19.81, 18.92 and 20.22% respectively for diets 1, 2 and 3 while the corresponding energy (kcal/kg) concentrations were 3019.00, 3247.00 and 3195.00. At metabolizable energy (ME) level of 2702 kcal/kg (diet 1), mean daily feed intake 111.35 g and mean daily weight gain 37.34 g were highest though not significantly (p>0.05) different from others. This diet also gave the best feed-to-gain ratio (2.72) which was also non-significantly different from others. It was also observed that increase in dietary energy density (from 2702 to 2909 kcal/kg ME) non-significantly depressed feed intake 6917 g, weight gain 32.50 g and gave poor feed-to-gain ratio 3.04. The performance of poults fed diet 1 was better than that of poults fed diets 2 and 3.

The carcass characteristics followed no particular trend and there were non-significant (p>0.05) differences among treatments. At 2386.67 g liveweight, the percent edible part was 63.08 (1503.33 g). At 2263.30 g live weight, the percent edible part was 62.26 (1403.33 g), while at 2363.33 g liveweight, percent edible part was 65.20 (1540.00 g).

Economic analysis (Table 4) revealed that cost/kg weight gain (N) was lower (N129.60) in poults fed diet 1 as against those fed diets 2 (N139.91) and 3 (N147.74). The results also indicated that poults fed diet 1 had a significantly (P < 0.05) higher gross margin (N1 072.86) than those fed diets 2 (N982.81) and 3 (N892.13).

**Discussion**

The differences observed between the calculated and the determined percent crude protein values of these diets could be attributed to the differences in the elemental composition, especially, by the relative amount of nutrients contained in each of the feed components used in compounding the rations. The varieties of ingredients and processing methods used in preparing each of the ingredients could have accounted for the disparity observed. It is also important to note that the calculated values were obtained based on established standards which do not hold in all environments.

The results obtained in this trial agree with those of Leeson and Summers\(^{12,13}\), who observed that lower energy diets resulted in slightly higher energy consumption, a situation often seen with other species. The data also suggested that lower energy diets are not as detrimental for the turkey as they seem to be with broiler chicken\(^{14}\) in that the turkey will increase its feed intake with the lower energy diets to maintain high energy intake. Broilers have a limited capacity to react in such a manner. Use of high energy diets will, however, result in reduced feed intake. According to Cunningham and Morison\(^{15}\), energy intake is maximised through use of low rather than high-energy diets. The result is a further confirmation dietary nutrient densities for poultry bare lower in the tropics than those recommended for temperate zones\(^{3,4}\). There is therefore, a need to establish nutrient requirements that will suit our tropical conditions and adequately take care of the differences in the nutrient composition of our feedstuffs and the types
of turkey strains in our environments. The quantity of feed consumed by the turkey poult s is inversely related to the concentration of dietary energy. This is in agreement with Forbes.

Dietary energy has been implicated as the primary factor that governs the conformation of chicken which in turn plays a major role in plucked weight determination. The values observed in this trial do not completely agree with the idea put forward by Hayes and Marison that plum appearance in birds is associated with a higher percentage of edible meat. It could be that, apart from energy density, age, sex, genetic composition, strains of birds etc. could contribute both to the conformation and meat-to-bone ratio of the turkey poult s. Therefore, more investigation is required to evaluate the role of these factors in carcass characteristics.

In conclusion, results from this trial suggest that supply of excessive dietary energy more than normal could be regarded as wastage as no increase in gain is associated with it. Therefore, feeding 25% crude protein and 2702 kcal/kg ME to growing local turkey poult s in a tropical environment seems adequate.

References


Received for publication on 1st August, 2002.
SHORT COMMUNICATION

SURVEY ON IXODID TICKS IN GOATS IN SOKOTO, NIGERIA

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¹National Veterinary Research Institute, Epidemiology Research Laboratory, P.O. Box 801, Sokoto.
²State veterinary Clinic, Aliyu Jodi Gate, Ministry of Agriculture and Natural Resources.
³Faculty of Veterinary Medicine Dept. of Surgery and Medicine, Usman Danfodio University, Sokoto.

Hard ticks (Ixodidae) can serve as vectors of important livestock diseases like anaplasmosis and heartwater¹. Thus, apart from their role as vectors and potential reservoirs of infectious diseases, heavy infestations by ticks also cause direct losses².

Nigeria has the largest livestock population in the West African sub-region with the national goat flock currently numbering about 34.5 million based on the 1991 livestock census³. Goat husbandry is widespread throughout the country. These goats are managed under traditional setting. They serve as sources of meat, cash when sold and are used for gift.

The inhabitants of Sokoto are mainly the descendants of the pastoral fulbe whose major socio-economic activities was the rearing of animals⁴. In recent years, they are also engaged in crop farming, trading, as well as government work.

Sokoto is the capital of Sokoto state and is located in the North western zone of the country. The climate is semi-arid with rainfall of about 29 inches and a long dry season lasting between October to June. Temperature ranges between 30.50⁰ C to 43.00⁰ C.

The study was carried out in Sokoto and 3 villages, all within radius of 20-25 km from Sokoto. The goats are kept under traditional system and their movement during the day is unrestricted. They also browse shrubs but in the night, they are confined.

During the sampling period, ticks were picked from the perianal region, interdigital space, the underbelly as well as the ears. Care was taken to remove the ticks intact using a pair of hand forceps so that the mouth parts are not destroyed in the process. The ticks were then placed in labelled bottles containing 70% alcohol for preservation and subsequently identified according to Hoogstraal⁵.

A total of 896 ticks were collected during this study conducted over a 5 months period. Of the 701 goats sampled, 324 goats were found to be infested with ticks, giving an infestation rate of 46.21% and a mean tick density of 2.76 ticks per goat. (Table 1).
Four tick species were identified with *R. evertsi* being the most abundant accounting for 61.05%, followed by *B. decoloratus* 18.97% and *A. variegatum* 16.63%. The least collected was *R. appendiculatus* which accounted for 3.35% (Table 2).

More adult ticks were collected than nymphs and larvae and accounted for 84.70% with male ticks predominating over female. More nymphal and larval stages of *R. evertsi* were picked than of other tick species. The females of *B. decoloratus* were more abundant than males and nymphs, (Table 3).

*R. evertsi* was the most abundant among the four tick species identified. The result agrees with the survey in which it constituted 67.08% of the collection from horses. In Botswana, this tick was also reported to be the most predominant in studies on goats. However, the result is not consistent with findings where it formed only 6.4% of the total ticks picked from the survey in Ethiopia. The high numbers of the immature stages of this tick compared to the other ticks is explained by the ability of both adult and immature stages to parasitize same host. The part played by *R. evertsi* in transmitting disease to goats is not clear but it has been implicated with transmission of equine babesiosis caused by *Babesia equi* in horses.

The ability of this tick to survive in open land and its perennial breeding habit have both been advanced as the reasons for its high incidence.

*Boophilus decoloratus* constituted 18.97% and was the second most abundant tick. This observation is not consistent with the report of an earlier study in which it formed a significant proportion of ticks collected. However, more females were collected than males which is in consonance with the observations in sheep in Nigeria. This may be attributed to the males being very small in size and therefore difficult to collect. The apparently low infestation with *B. decoloratus* compared to *R. evertsi* may be a result of the presence of other hosts like cattle which are the preferential hosts of this tick.

The infestation of goats by *A. variegatum* in the present study (16.63%) is lower than that of both *R. evertsi* and *B.

<table>
<thead>
<tr>
<th>Town/Village</th>
<th>No. of Goat sampled</th>
<th>No. Infested (%)</th>
<th>Total ticks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sokoto</td>
<td>118</td>
<td>48 (10.67)</td>
<td>136</td>
</tr>
<tr>
<td>Wammako</td>
<td>187</td>
<td>98 (52.40)</td>
<td>243</td>
</tr>
<tr>
<td>Bodinga</td>
<td>253</td>
<td>116 (45.84)</td>
<td>341</td>
</tr>
<tr>
<td>Achida</td>
<td>143</td>
<td>62 (43.35)</td>
<td>176</td>
</tr>
<tr>
<td>Total</td>
<td>701</td>
<td>324</td>
<td>896</td>
</tr>
<tr>
<td>Percent</td>
<td></td>
<td>46.21%</td>
<td>276</td>
</tr>
</tbody>
</table>
*decoloratus*. However, this is still significant since it is the vector of *Cowdria ruminantium*, the agent that causes heartwater in Nigeria. This tick has also been implicated as a likely vector of the causative agent of pulmonary norcardiosis in horse. The ability of the nymphal and larvae stage of this tick to feed on other birds feeding on the ground and small animals like hare might have accounted for their low number.

*R. appendiculatus* represented only 3.35% of the ticks collected. This is low compared to the other three ticks in this study. This could be because it is not a specific ectoparasite of goats. However, it can be highly significant where heavy infestations occur which could result in fatal

**Table 2:** Distribution of tick genera collected

<table>
<thead>
<tr>
<th>Tick</th>
<th>Sokoto</th>
<th>Wammako</th>
<th>Bondinga</th>
<th>Achida</th>
<th>Total</th>
<th>%Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. evertsi</td>
<td>94</td>
<td>143</td>
<td>162</td>
<td>148</td>
<td>547</td>
<td>61.05</td>
</tr>
<tr>
<td>A. variegatum</td>
<td>11</td>
<td>59</td>
<td>79</td>
<td>-</td>
<td>149</td>
<td>16.63</td>
</tr>
<tr>
<td>B. decoloratus</td>
<td>31</td>
<td>28</td>
<td>83</td>
<td>28</td>
<td>170</td>
<td>18.97</td>
</tr>
<tr>
<td>R. appendiculatus</td>
<td>-</td>
<td>13</td>
<td>17</td>
<td>-</td>
<td>30</td>
<td>3.35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>136</td>
<td>243</td>
<td>341</td>
<td>176</td>
<td>896</td>
<td>100</td>
</tr>
</tbody>
</table>

**Table 3:** Distribution of tick stages

<table>
<thead>
<tr>
<th>Adult</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Nymph(%)</th>
<th>Larvae</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. evertsi</td>
<td>254(46.44)</td>
<td>186(34.00)</td>
<td>78(14.26)</td>
<td>29(5.30)</td>
</tr>
<tr>
<td>A. variegatum</td>
<td>87(58.39)</td>
<td>42(28.19)</td>
<td>20(13.42)</td>
<td>-(-0.0)</td>
</tr>
<tr>
<td>B. decoloratus</td>
<td>62(36.47)</td>
<td>98(57.64)</td>
<td>10(5.89 )</td>
<td>-(-0.0)</td>
</tr>
<tr>
<td>R. appendiculatus</td>
<td>11(36.67)</td>
<td>19(63.33)</td>
<td>-(0.0)</td>
<td>-(0.0)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>414</td>
<td>345</td>
<td>108</td>
<td>29</td>
</tr>
</tbody>
</table>
toxaemia and loss of resistance to other infections. Severe damage to the hosts ears, tails and udders can also result.

Further investigation is required to determine the specific role of these Ixodid ticks in transmission of diseases to goats as well as the damage on the highly valuable skin which is good raw material to the leather industry. Appropriate tick control measures adaptable to the traditional husbandry practice in this area is also required.

Acknowledgement

The authors are grateful to our colleagues for their criticisms and suggestions on the manuscript. Also to Mal. Ruwa Umar and Mr. John Ogah for their invaluable assistance in the field and laboratory respectively.

References


Received for publication on 5th February, 2002.
SHORT COMMUNICATION

COMMON PARASITIC DISEASES OF LIVESTOCK IN PERI-URBAN KAMPALA:
A RETROSPECTIVE STUDY OF FAECAL SAMPLES SUBMITTED FROM 1995-
2000.

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and G.W. LUBEQA3.

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2District Veterinary Department, Kalangala.
3Department of Veterinary Parasitology and Microbiology, Makerere University, P.O.
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The faculty of Veterinary Medicine Makerere University, has been in operation
since 1971, and runs an Ambulatory Clinic (A.C.) service in peri-urban Kampala. An
area of about 200 sq. km. stretching at some points to about 20 kilometers to the
North of Kampala, was carved out of Kyandondo county and gazetted by the
government for Ambulatory Clinic. The roles of the A.C. are field training for
students, services to farmers, research opportunities for academic staff and to a
small extent income generation. Farmers
in this area keep a mixed range of local
cattle (Bos indicus), exotic cattle (Bos
taurus), goats, pigs and poultry on different
sized farm units. There are many women
groups and individuals who keep dairy cows
under the zero-grazing system. Kyandondo
County having a typical wet and humid
tropical climate has problems of parasitic
diseases of livestock.

The A.C. services were improved by
the United Nation Development Program
(UNDP)2, Food and Agriculture
Organization (FAO) and the German
Technical Services (GTZ), who in turns
provided funds for the purchase of 4-wheel
drive vehicles, drugs, laboratory ware and
reagents. Technical personnel were also
trained in animal health and artificial
insemination. Reporting centres were
created in the A.C. area, where farmers
would report sick animals or those on heat.
On daily basis, a team of clinicians and
clinical year students go out to attend to the
reported sick animals. Complicated cases
are transferred to the faculty and attended
by respective departments. Laboratory
samples are collected and submitted to the
clinical laboratory. The present paper
reports the analysis of faecal samples (for
helminth eggs and coccidial oocysts)

A restrospective analysis of 490 faecal
samples submitted by the A.C. was done.
Most samples came from cattle with a few
from goats and had been collected directly
from the recta of animals. The faecal
samples had been subjected both to the
egg floatation and the egg sedimentation
techniques3 and the parasitic eggs, larvae
or ova identified with the use of a
microscope. A parallel structured study

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carried on faecal samples from 231 cattle in one area of the A.C. was used to
determine the prevalence of fascioliasis in paddocked and zero-grazed exotic cattle,
and free range local cattle between 1996-1997.

Albendazole and levamisole for helminths and amprolium and
sulphadimidine for coccidia, were the drugs
most commonly used for treatments.

The parasite eggs and ova most
commonly identified were strongyles (37.3%), Paramphistomum (32.0%),
coccidia (14.0%), Fasciola (10%),
Strongyloides (4.3%), Moniezia (1.2%),
Toxocara (1.0%) and Ancylostoma (0.2%).
The worm burden was highest in the rainy
seasons, March - May and August -
September. The total faecal parasite
detection varied from year to year with
peaks in 1996, 1999 and 2000, (Table 1).

The structured study on fascioliasis showed
that the prevalence was 70.3% in
paddocked exotic cattle (3.14 epg), 58.3%
in free range local cows (1.08 epg) and
lowest in zero-grazed exotic cattle 13.4%
(0.45 epg), (Table 2).

Parasitic diseases of livestock included
a heterogeneous group caused by
rickettsiae, protozoa, helminths and
anthropod. Laboratory diagnosis based on
demonstration of parasites or eggs has to
supplement the clinical diagnosis by
clinicians before a choice of treatment is
made. But a mere presence of parasite is
not adequate evidence that it is an aetiologic
agent of a disease. The present paper
focuses on faecal samples submitted to
the laboratory and reports a wide range of
helminths and coccidia.

The helminths most commonly
diagonised were strongyles (Haemonchus,
Trichostrongylus and Nematodirus),
Paramphistomum and Fasciola, in
agreement with an earlier study.4
Fascioliasis was to be expected given that
the Kyadondo county being near Lake
Victoria has many swamps and marshy
places conducive to in habitation by snails
that are intermediate hosts of Fasciola. The
disease is therefore less common in
confined cattle such as those on zero-
grazing but a major problem in exotic
animals on paddocks. Paramphistomum
featured prominently in the diagnosis.
Paramphistomiasis is common in cattle in
some countries5 but has not been reported
much in Uganda. It could be playing a major
role that is not documented in helminthosis.
The worm burden is influenced by many
factors, such as climate, nutrition, pasture
management and immunity6. There were
peaks in 1996, 1999 and 2000, which could
not be explained based on the climate
except for the El nino. Ancylostoma
featured low as it is a parasite of dogs and
cats, which are not handled by the A.C. but
by the Small Animal Clinic, of the Faculty
of Veterinary Medicine, Makerere
University.

Drugs of choice were albendazole and
levamisole for helminths and amprolium
and sulphadimidine for coccidia. But the real
afficacies of these drugs under field
conditions need to assessed as resistance
to the drugs may have developed6. There
is also the need to devise further studies to
analyze the epidemiological dynamics of
helminths and put in place better equipment
to identify the helminths to the identify the
helminths to the species level. This can be
achieved through fecal culturing for
strongyle type eggs to identify infective
larvae (L3). This is crucial because helminths
are widely recognized as major constraint
to livestock production in the tropics7.
Table 1: The worm burden in peri-urban Kampala between 1995 and 2000.

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>13.5</td>
</tr>
<tr>
<td>1996</td>
<td>24</td>
</tr>
<tr>
<td>1997</td>
<td>9</td>
</tr>
<tr>
<td>1998</td>
<td>12</td>
</tr>
<tr>
<td>1999</td>
<td>15.5</td>
</tr>
<tr>
<td>2000</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 2: The worm burden in peri-urban Kampala by grazing system between 1995 and 2000.

<table>
<thead>
<tr>
<th>Grazing system category</th>
<th>Prevalence rate (%)</th>
<th>Average No. of eggs Per gramme (epg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddock exotic cattle</td>
<td>70.29</td>
<td>3.14</td>
</tr>
<tr>
<td>Free grazing local cattle</td>
<td>58.33</td>
<td>1.08</td>
</tr>
<tr>
<td>Zero-grazed exotic cattle</td>
<td>13.04</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Acknowledgements

The authors wish to thank Uganda Government for the grant that funded the study. Thanks also go to the clinicians in the Ambulatory Clinic, Faculty of Veterinary Medicine, Makerere University.

References


Received for publication on 5th February, 2002.
THE EMERGING SIGNIFICANCE OF COCCIDIOSIS IN GOATS IN ARID AND SEMI-ARID LANDS (ASAL) IN KENYA

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Kenya has an estimated total of 8 million goats\(^1\). Most of the goats are kept in districts categorised under ASAL, which constitute 80% of Kenya’s land mass\(^2\). Diseases, especially internal parasites such as parasitic worms are a well documented constraint to small ruminant production in the ASAL\(^3\). There is, however, very little information on the prevalence rates and economic importance of coccidiosis in goats in the ASAL districts\(^4\).

A cross-sectional survey was conducted in selected goat herds in 26 districts in five provinces of Kenya, namely Western, Nyanza, Rift Valley, Eastern and Coast representing the major goat-keeping regions in Kenya. The objective was to establish the geographic extent of coccidiosis in all the major agro-climatic zones, ranging from Kakamega district with an annual rainfall of above 1000mm. to Isiolo and Samburu which have annual rainfalls of less than 500mm.

Faecal samples (about 5gm) were obtained from adult goats in each herd. Using the standard McMaster method oocyst per gram (OPG) and strongyle eggs per gram (EPG) were estimated.

Table 1 depicts the survey data on the number of herds, districts and provinces sampled. The table also summarizes the mean values, ranges and prevalence rates for the coccidial ooepocyst counts and strongyle egg counts. Rift Valley province had 9 districts while Eastern province had 7 districts sampled. These two provinces have some of the most arid districts in Kenya which include Turkana, Baringo, West Pokot, Kitui, Makueni and Isiolo.

The mean OPG were just above 500 in four of the provinces. Nyanza had 1050 OPG. The OPG ranges varied a lot with some provinces recording high figures e.g. 35,000 in Siaya district of Nyanza and 33,700 in Turkana, Rift Valley. Eastern and Coast provinces recorded moderately high OPGs of 11,000 and 14,100 OPG respectively. The prevalence rates averaged above 50% in four of the provinces except Nyanza which had 46%, but not significantly lower than the rest.

The mean strongyle count in four provinces averaged above 600 EPG, Coast province had a much lower value of 269 EPG. The ranges indicated some very high counts in some herds such as 13,700 EPG and 11,100 EPG in Eastern and Rift Valley respectively. Rift Valley recorded higher prevalence rate (81.7%) than the rest, while the Coast province had the lowest prevalence of 39.7%. The low prevalence in the Coast seemed to corresponded to the low mean value of 269 EPG.

In an earlier study of production constraints in Baringo district of Rift Valley, Shivairo and Musalia (in press\(^3\)) established the emerging pressure due to diminishing communal grazing land and watering points.
Table 1: Sampling results by province

<table>
<thead>
<tr>
<th>Province</th>
<th>Western</th>
<th>Nyanza</th>
<th>Rift Valley</th>
<th>Eastern</th>
<th>Coast</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Districts</td>
<td>2</td>
<td>3</td>
<td>9</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>No. of Herds</td>
<td>7</td>
<td>8</td>
<td>24</td>
<td>22</td>
<td>16</td>
</tr>
<tr>
<td>No. of Goats</td>
<td>48</td>
<td>67</td>
<td>327</td>
<td>233</td>
<td>166</td>
</tr>
<tr>
<td>Mean OPG</td>
<td>586</td>
<td>1050</td>
<td>585</td>
<td>537</td>
<td>537</td>
</tr>
<tr>
<td>Range</td>
<td>0-5200</td>
<td>0-35000</td>
<td>0-33700</td>
<td>0-11000</td>
<td>0-14100</td>
</tr>
<tr>
<td>Prevalence rate</td>
<td>54.2</td>
<td>46.3</td>
<td>63.5</td>
<td>52.5</td>
<td>58.6</td>
</tr>
<tr>
<td>Mean EPG</td>
<td>614</td>
<td>609</td>
<td>698</td>
<td>554</td>
<td>269</td>
</tr>
<tr>
<td>Range</td>
<td>0-5200</td>
<td>0-3600</td>
<td>0-11100</td>
<td>0-13700</td>
<td>0-400</td>
</tr>
<tr>
<td>Prevalence rate</td>
<td>60.4</td>
<td>62.7</td>
<td>81.7</td>
<td>67.3</td>
<td>39.7</td>
</tr>
</tbody>
</table>

leading to increased risk of disease spread in the ASAL. Coccidiosis in goats falls in the category of diseases whose economic significance is likely to increase as a result of grazing and watering pressure. It was also established in the same study that in spite of the risks mentioned, 83% of stock owners regularly treated against helminthosis but coccidiosis was virtually unknown. Craig clearly points out the economic significance of coccidiosis in goats. Considering the high OPG in adult animals in some herds and the significantly high prevalence rates in all the regions sampled, coccidiosis is bound to be a significant economic problem, in a subclinical form, especially in young naive goats. Kanyari’s study recorded higher prevalence rates in goats than in sheep. The study showed that eight species of *Eimeria* were present in goats in Kenya, including some of those known to cause severe disease in the naive animals. It is therefore necessary for further research to be carried out to document the actual economic importance of coccidiosis in Kenya, and an appropriate control programme devised.

Acknowledgements

The author gratefully acknowledges the financial support, those participated in sample collection, laboratory analyses, especially Joseph Matofari.

References


Received for publication on 17th February, 2003.
SHORT COMMUNICATION

AN IMMUNOCHEMICAL SURVEY OF OCHRATOXIN A IN SWINE SERUM IN CENTRAL KENYA

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Ochratoxin A (OTA) is a nephrotoxic and nephrocarcinogenic mycotoxin produced by several species of Aspergillus and Penicillium particularly A. alutaceus and P. verrucosum. The toxin is known to cause mycotoxic porcine nephropathy in swine and is suspected to play a role in the etiology of "Balkan endemic nephropathy" in human beings. In experimental animals, the toxin induces nephropathy, disturbs coagulation, carbohydrate metabolism and exerts immunosuppressive, teratogenic, genotoxic and immunosuppressive effects.

Ochratoxin A has been reported to be naturally occurring in many foods and feeds all over the world. These include most cereal grains, green coffee beans, cocoa beans, wine juice, meat, pork kidneys and blood sausages. In Kenya, the occurrence of ochratoxin A has been reported in mixed chicken feed. Exposure of animals to ochratoxin A may be estimated by measurement of OTA levels in animal feeds or in animal serum. This study was designed to investigate exposure of slaughter swine to ochratoxin A by measuring toxin levels in blood serum by enzyme immunoassay.

Twenty eight (28) whole blood samples were randomly collected from a pig slaughterhouse in Kabete, Kiambu district in central Kenya. Seven samples were collected per week for 4 consecutive weeks. The samples were transported to the laboratory and serum separated by centrifugation. Extraction of ochratoxin A was by the method described by Martlbauer and Terplan 5. Briefly, 2.5 ml 1M HCl and 4ml dichloromethane was added to 2ml serum and the mixture stirred at full speed for 5 minutes on a magnetic stirrer. The mixture was then centrifuged at 1500g for 15 minutes and the lower dichloromethane layer recovered. The dichloromethane extract was mixed with 3ml of 0.13M NaHCO₃ solution and homogenised for 30 seconds on wrist action shaker. This was followed by centrifugation at 1500g for 15 minutes and recovery of the aqueous phase. The dichloromethane layer was mixed with a further 3ml of 0.13M NaHCO₃ solution, followed by homogenisation and centrifugation as above and the recovery of the aqueous phase. The two aqueous extracts were mixed and used for ELISA analysis.

The procedure for competitive enzyme immunoassay for the determination of ochratoxin A was as described previously. Briefly, immunoplates were coated with an anti-ochratoxin A antiserum solution in bicarbonate buffer (100 μl/ well) and incubated overnight at room temperature. The plates were washed three times with NaCl- Tween solution (8.5g NaCl and 250 μl Tween 20 per litre of water). Aliquots (50μl...
μl) of 7 ochratoxin A standard dilutions in 0.13M NaHCO₃, in the 500pg/ml to 0pg/ml concentration range were pipetted in quadruplicates. Sample extract solutions in 0.13M NaHCO₃ (50 μl) were added to wells without OA standards solutions. A solution of ochratoxin A-HRP conjugate in 0.13M NaHCO₃ containing 1% tween 20 was prepared and 50 μl portions added to all wells. The plates were incubated for 2 hours at room temperature, washed and 100 μl of enzyme substrate/chromogen solution containing tetramethylbenzidine added to each well. The enzyme-substrate reaction was stopped after 15 minutes by addition of 1 mol 1⁻¹ H₂SO₄ (100 μl) and absorbance read at 450. Absorbance values for standards were analysed with a competitive ELISA software⁶ which uses a cubic spline function to construct a standard curve and

Figure 1. Typical standard curve of enzyme immunoassay for determination of ochratoxin A. The Coefficients of variation (n=4) were between 0.5 and 8.0% and the absolute absorbances (B0) were 1.0 and 1.2 units.

<table>
<thead>
<tr>
<th>Week</th>
<th>Prevalence (%)</th>
<th>Range (pg/ml)</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23</td>
<td>22-27</td>
<td>24.0=1.5</td>
<td>2.6</td>
</tr>
<tr>
<td>2</td>
<td>41.7</td>
<td>20-204</td>
<td>83.6=32.0</td>
<td>71.5</td>
</tr>
<tr>
<td>3</td>
<td>91.7</td>
<td>19-2965</td>
<td>407.0=71.0</td>
<td>867.8</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>26-531</td>
<td>207.0=71.0</td>
<td>173.9</td>
</tr>
</tbody>
</table>

Table 1. Prevalence of ochratoxin A contamination in swine serum.
Student's t test (n = 4; 95% confidence interval) to calculate the 50% inhibition levels, the detection limit and the coefficients of variation within OA standard replicates. Analysis of variance (one-way, 95%) was used to investigate differences in OA in samples collected in different weeks.

The ELISA test employed in the analysis of OA in this study was rapid and sensitive. The test had a detection limit of 17.2 pg/ml and 50% inhibition values of 55.6 pg/ml. A typical competitive inhibition curve is shown in Fig. 1. Overall, 52.1% samples were positive for OA; 25% in week 1, 41.7% in week 2, 91.7% in week 3 and 50% in week 4 (Table 1). Although the mean OA levels varied markedly in serum sampled in different weeks, this variation was not statistically significant. This incidence of contamination is comparable to 36% level reported in serum of 1600 slaughter swine from Canada and 38.14% of 388 samples of porcine serum from Poland. However, the levels of OTA contamination in this study were comparatively lower. The mean of all positive samples was 258.5 ± 117.5 pg/ml and the range was between 19 pg/ml and 2965 pg/ml. In contrast, 24% of the porcine serum from Canada had levels exceeding 15 ng/ml and 38.4% of porcine serum from Poland had between 1 to 520 ng/ml. The very high sensitivity of the ELISA method used in this study was therefore responsible for the high incidence of OA contamination reported.

Breitholtz et al. estimated that ochratoxin A intake (ng/kg bw and day) as equal to plasma OTA concentration multiplied by 1.34. According to these estimates, the mean OTA intake in porcine sampled in this study may be approximated as 0.35 ng/kg bw per day. It may therefore be concluded that slaughter swine from central Kenya are exposed to low amounts of OTA in feed.

References


Received for publication on 14th February, 2003.
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RECOMMANDATIONS AUX AUTEURS

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 interafricain des Ressources animales, P.O. Box 30786, Nairobi, Kenya

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

Genres d'articles publiés dans le Bulletin
- des communications originales,
- des brèves communications,
- analyse des articles proposés 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 dépasser 200 mots. Son texte bref et concis comprendra les principaux résultats et la (les) conclusion(s) de l'étude.

L'introduction expose le but de la recherche.
Le matériel et les méthodes utilisés.
Les résultats présentés brièvement.
Un débat sur l'importance de l'article.
Remerciements éventuels.

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" (soulignée), 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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